NASA/TM–2013-218014

Simple Benchmark Specifications for Space Radiation Protection

Robert C. Singleterry, Jr.
Langley Research Center, Hampton, Virginia

Sukesh K. Aghara
University of Massachusetts, Lowell, Massachusetts

June 2013

NASA STI Program . . . in Profile

Since its founding, NASA has been dedicated to the advancement of aeronautics and space science. The NASA scientific and technical information (STI) program plays a key part in helping NASA maintain this important role.

The NASA STI program operates under the auspices of the Agency Chief Information Officer. It collects, organizes, provides for archiving, and disseminates NASA's STI. The NASA STI program provides access to the NASA Aeronautics and Space Database and its public interface, the NASA Technical Report Server, thus providing one of the largest collections of aeronautical and space science STI in the world. Results are published in both non-NASA channels and by NASA in the NASA STI Report Series, which includes the following report types:

- TECHNICAL PUBLICATION. Reports of completed research or a major significant phase of research that present the results of NASA Programs and include extensive data or theoretical analysis. Includes compilations of significant scientific and technical data and information deemed to be of continuing reference value. NASA counterpart of peer-reviewed formal professional papers, but having less stringent limitations on manuscript length and extent of graphic presentations.

- TECHNICAL MEMORANDUM. Scientific and technical findings that are preliminary or of specialized interest, e.g., quick release reports, working papers, and bibliographies that contain minimal annotation. Does not contain extensive analysis.

- CONTRACTOR REPORT. Scientific and technical findings by NASA-sponsored contractors and grantees.

- CONFERENCE PUBLICATION. Collected papers from scientific and technical conferences, symposia, seminars, or other meetings sponsored or co-sponsored by NASA.

- SPECIAL PUBLICATION. Scientific, technical, or historical information from NASA programs, projects, and missions, often concerned with subjects having substantial public interest.

- TECHNICAL TRANSLATION. English-language translations of foreign scientific and technical material pertinent to NASA's mission.

Specialized services also include organizing and publishing research results, distributing specialized research announcements and feeds, providing information desk and personal search support, and enabling data exchange services.

For more information about the NASA STI program, see the following:

- Access the NASA STI program home page at *http://www.sti.nasa.gov*

- E-mail your question to help@sti.nasa.gov

- Fax your question to the NASA STI Information Desk at 443-757-5803

- Phone the NASA STI Information Desk at 443-757-5802

- Write to:
  STI Information Desk
  NASA Center for AeroSpace Information
  7115 Standard Drive
  Hanover, MD 21076-1320

NASA/TM–2013-218014

Simple Benchmarck Specifications for Space Radiation Protection

Robert C. Singleterry, Jr.
Langley Research Center, Hampton, Virginia

Sukesh K. Aghara
University of Massachusetts, Lowell, Massachusetts

National Aeronautics and
Space Administration

Langley Research Center
Hampton, Virginia 23681-2199

June 2013

Available from:

NASA Center for AeroSpace Information
7115 Standard Drive
Hanover, MD 21076-1320
443-757-5802

Contents

List of Tables

1 Introduction and Background

Computational benchmarks are needed by NASA to help verify the algorithms and models used to transport important particle space radiation through spacecraft materials to humans and electronics. Benchmarks will also help to reduce the uncertainty amongst all algorithms by allowing comprehensive comparisons, in a common format, for a greater understanding of space radiation modeling. This enhances the entire community by understanding the needs of each algorithm and code and the many options allowed. Ultimately, the ability of each algorithm and code will be explored for use in solving space radiation scenarios to allow designers and engineers to produce spacecraft that meet mission requirements and that are safe for its occupants. Therefore, this document contains descriptions of various computational benchmarks as a first step towards complex benchmarks that can be used to help minimize mass for space vehicles in the near future. The appendix contains descriptions of the sources and human phantoms needed to analyze space radiation protection problems, plus the OLTARIS (On-Line Tool for the Assessment of Radiation in Space)[1] transport and response functions developed at the NASA Langley Research Center.

This document describes benchmark specifications for space related benchmarks. Each individual benchmark is described in full for each scenario to ensure that the proper data and models are used. Therefore, this document provides model explanation, results description, and a checklist for performing the benchmarks described. In order to provide a mechanism for a comprehensive comparison of benchmark results amongst benchmark teams, it is imperative that all output items described in this document be provided by the performing organization's benchmark team and be self contained.

These benchmarks start with straightforward models and progress to complex models. It is not intended for all benchmarks to be completed by one benchmark team; however, these benchmarks will show the capability of the various codes to help solve problems needed by the space radiation community. Each benchmark will be described in detail and models provided in either CAD (Computer Aided Design) format, combinatorial geometry format, or if available, both. Tables are included in this document that describe the boundary conditions and can either be used as is or can be supplied in computer readable format. While this document will not provide the detailed computer input decks, data, and models, the necessary input information can be obtained from this document and in computer readable format by contacting the authors. This document is meant to be a guideline and checklist for the team to perform the benchmarks; however all outputs described for a benchmark shall be provided by the team or an alternate output fully described shall be provided.

The benchmark team will write a report about their work which will include results for each benchmark in a separate section and each section labeled with the section names and numbers of this document. Any deviation from the models outlined here must be noted and explained in detail with any results. The report will be delivered to the authors when available by the team and shall be published in an appropriate reporting outlet. All cross section data must be described and either noted or included in the results. All codes used will be noted if available through RSICC[2] or some other code repository available to NASA, or provided to the authors if not easily available. All results will be tabular and plotted unless noted below. It is mandatory for the results report format to enable others, especially NASA, to regenerate the results.

This document contains seven sections and four appendices. The seven sections describe the major situations to be benchmarked:

1. Introduction and background, Section 1
2. Aluminum slab to simulate a spacecraft structure, Section 2.
3. Aluminum slab to simulate a spacecraft structure (thin and thick) and a polyethylene slab to simulate radiation shielding, Section 3.
4. Generic spacecraft object in free space with a target point inside, Section 4.
5. Generic spacecraft object in free space with a detailed human phantom inside, Section 5.
6. Generic spacecraft object on the moon with a target point inside, Section 6.
7. Generic spacecraft object on the moon with a detailed human phantom inside, Section 7.

The four appendices describe the necessary information needed to perform the benchmarks and extra information about how NASA currently performs its spacecraft analyses for result comparison. These appendices are:

1. Human phantom descriptions for CAM (Computer Anatomical Male)[3], CAF (Computer Anatomical Female)[4, 5], MAX (Male Adult voXel phantom)[6], and FAX (Female Adult voXel phantom)[7], Appendix A.

2. Source descriptions as used in OLTARIS for free space Galactic Cosmic Rays (GCR), Solar Proton Events (SPE), and Low Earth Orbit (LEO), Appendix B.

3. Description of the transport algorithms used in OLTARIS, Appendix C.

4. Description of the response functions used in OLTARIS, Appendix D.

The information in this document is sufficient for the benchmarks to be performed by the team with any deterministic or stochastic based solution algorithm. While details like mesh spacing (usually less than 50% of the shortest mean free path in a deterministic code) or convergence criterion (usually the standard deviation less than 10% everywhere, but other checks are necessary also) are not specified, these details shall be reported in the benchmark results. In total, the benchmark results shall contain enough information to understand and reproduce the results.

These benchmarks mandate that various results shall be reported. While these results are specific for NASA, as long as the results are described in the benchmark report, other similar results can be substituted. The desired results are:

1. Dose and dose rate (D), or the amount of energy deposited by particles in a set amount of material - Gy or Gy/time. This item is also the Total Ionizing Dose (TID) as used in electronic protection terminology. Rates apply to any environment source except the SPE.

2. Dose equivalent and dose equivalent rate (H), or the damage caused in tissue by the dose deposited in a set amount of material - Sv or Sv/time. Rates apply to any environment except the SPE. ICRP-60[8] quality factors based on LET (Linear Energy Transfer) are preferred, but alternatives are sufficient as long as the quality factors or weight factors are enumerated in the results.

3. Differential flux mapped to the LET domain - LET: $\frac{\text{keV}}{\mu\text{m}}$, differential flux: $\frac{\text{particles}}{\text{cm}^2-\frac{\text{keV}}{\mu\text{m}}-\text{day}}$, and differential fluence: $\frac{\text{particles}}{\text{cm}^2-\frac{\text{keV}}{\mu\text{m}}}$.

4. Whole body effective dose equivalent or whole body effective dose equivalent rate (H_T), or a weighted sum of the average organ dose equivalents in the human body - Sv or Sv/time. Rates apply to any environment except the SPE. This algorithm and weights are enumerated in NCRP-132[9].

The energy domain flux and fluence should also be reported. The units of differential flux and fluence are:

differential flux: $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$ and

differential fluence: $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}}$,

with the energy domain units as $\frac{\text{MeV}}{\text{A}}$.

1.1 Author Contact Information

For the data mentioned in this document, please contact Robert Singleterry at the NASA Langley Research Center, MS 188E, Hampton, VA 23681, by email at robert.c.singleterry@nasa.gov, and by phone (757) 864-1437.

2 Aluminum Slab

The material of choice to date by NASA spacecraft designers is aluminum. While the number of alloys has exploded, the relatively small quantities of alloying elements will not change the results of a radiation analysis by a drastic amount. Therefore, pure aluminum will be used for this benchmark. A slab analysis illuminates the material interactions and cross sections of a solution algorithm - the physics in a code. Therefore, a slab of this material will be infinite in extent in the y-z plane and only have thickness in the $+x$ direction. Table 2.1 shows the depths that will be used to produce response function versus depth tables for each benchmark. A vacuum will be used on each side of the slab. If the transport method only uses a forward marching technique, then a single slab can be used with edit points at the values in Table 2.1. If the transport method also tracks particles in the $-x$ direction, then ten separate slabs are to be analyzed: one slab at each depth listed.

Table 2.1: Aluminum Depths used to Produce Response Function versus Depth Tables ($\rho_{\mathrm{Al}} = 2.7 \frac{\mathrm{g}}{\mathrm{cm}^3}$)

#	Depth ($\frac{\mathrm{g}}{\mathrm{cm}^2}$)	Depth (cm)
0	0.0	0.000000
1	0.1	0.037037
2	0.3	0.111111
3	0.75	0.277778
4	1.0	0.370370
5	3.0	1.11111
6	7.5	2.77778
7	10.0	3.70370
8	30.0	11.1111
9	75.0	27.7778
10	100.0	37.0370

The results for each benchmark in this section will be dose or dose rate in aluminum and silicon and dose equivalent or dose equivalent rate in tissue versus depth for all depths; therefore, for each depth, there will be three values determined. Also available with the results will be a select set of the flux versus energy and flux mapped to LET in aluminum versus LET in aluminum plots. All of the raw data along with all input decks and output files will be included with the final results.

The sub-sections below are enumerated as a checklist, repetitive to be complete, and self-contained.

2.1 Proton Mono-energetic, Pencil Beam Source

The simplest charged particle is a proton. The simplest proton source is a mono-energetic, mono-directional beam of particles. Therefore, this source will be a 200 MeV proton source at a point on the slab perpendicular to the y-z face of the slab at $x, y, z = 0$.

2.2 Proton Mono-energetic, Mono-directional Source

The next simplest proton source is a mono-energetic and mono-directional source. Therefore, this source will be a 200 MeV proton source evenly distributed on and perpendicular to the entire y-z face of the slab at $x = 0$.

2.3 Proton Mono-energetic, Isotropic Source

The next simplest proton source is a mono-energetic source distributed in direction. Therefore, this source will be a 200 MeV proton source evenly distributed on and isotropic in direction to the entire y-z face of the slab at $x = 0$.

2.4 ^{56}Fe Mono-energetic, Pencil Beam Source

The most relevant, heavy charged particle for space analysis is ^{56}Fe, since it has the most binding energy per nucleon of any nucleus. The simplest ^{56}Fe source is a mono-energetic, mono-directional beam of particles. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source at a point on the slab perpendicular to the y-z face of the slab at $x, y, z = 0$.

2.5 ^{56}Fe Mono-energetic, Mono-directional Source

The next simplest ^{56}Fe source is a mono-energetic and mono-directional source. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source evenly distributed on and perpendicular to the entire y-z face of the slab at $x = 0$.

2.6 ^{56}Fe Mono-energetic, Isotropic Source

The next simplest ^{56}Fe source is a mono-energetic source distributed in direction. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source evenly distributed on and isotropic in direction to the entire y-z face of the slab at $x = 0$.

2.7 Free Space Solar Proton Event Mono-directional Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time, as seen in a SPE, in a single direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is evenly distributed on and perpendicular to the entire y-z face of the slab at $x = 0$.

2.8 Free Space Solar Proton Event Isotropic Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time, as seen in a SPE, distributed in direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is evenly distributed on and isotropic in direction to the entire y-z face of the slab at $x = 0$.

2.9 Free Space Galactic Cosmic Ray Mono-directional Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and in a single direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is evenly distributed on and perpendicular to the entire y-z face of the slab at $x = 0$.

2.10 Free Space Galactic Cosmic Ray Isotropic Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and distributed in direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is evenly distributed on and isotropic in direction to the entire y-z face of the slab at $x = 0$.

2.11 Low Earth Orbit Mono-directional Distributed Source

A more complex source is the LEO distributed source and in a single direction. There are three different components to this source. The first component is the trapped particles in the earth's magnetic field. It mainly consists of protons and electrons. The second component is the GCR penetrating through the magnetic field to the altitude and inclination of interest. The third component is a neutron albedo source emanating from the interactions of the first two sources in the atmosphere. Table B.3.1 defines the neutron albedo distribution. Tables B.3.2 through B.3.29 define the GCR distribution. Tables B.3.30 and B.3.31 define the proton and electron trapped components. This source is evenly distributed on and perpendicular to the entire y-z face of the slab at $x = 0$.

2.12 Low Earth Orbit Isotropic Distributed Source

A more complex source is the LEO distributed source and distributed in direction. There are three different components to this source. The first component is the trapped particles in the earth's magnetic field. It mainly consists of protons and electrons. The second component is the GCR penetrating through the magnetic field to the altitude and inclination of interest. The third component is a neutron albedo source emanating from the interactions of the first two sources in the atmosphere. Table B.3.1 defines the neutron albedo distribution. Tables B.3.2 through B.3.29 define the GCR distribution. Tables B.3.30 and B.3.31 define the proton and electron trapped components. This source is evenly distributed on and isotropic in direction to the entire y-z face of the slab at $x = 0$.

3 Aluminum and Polyethylene Slab

The shielding material of choice to date by NASA spacecraft radiation protection analysts is polyethylene. While polyethylene has many properties not compatible with space flight, it has a high hydrogen content. Hydrogen has been shown to be the most effective space radiation shielding material available[10]. Therefore, polyethylene will be used as the surrogate for shielding materials needed by humans and electronics. Again, aluminum will be used for the spacecraft structure as defined previously. A slab analysis illuminates the material interactions and cross sections of a solution algorithm - the physics in a code. Therefore, a slab of these materials will be infinite in extent in the y-z plane and only have thickness in the $+x$ direction. Table 3.1 shows the depths that will be used to produce the response function versus depth tables for each benchmark. A vacuum will be used on each side of the slab. If the transport method only uses a forward marching technique, then two slabs can be used with edit points at the values in Table 3.1. If the transport method also tracks particles in the $-x$ direction, then nineteen separate slabs are to be analyzed: one slab at each depth combination. Polyethylene shall be modeled as CH_2. Note that table items 0 and 11 in Table 3.1 should match outputs from table items 3 and 8 in Table 2.1.

The results for each benchmark in this section will be dose or dose rate in aluminum, polyethylene, and silicon and dose equivalent or dose equivalent rate in tissue versus depth for all depths; therefore, for each depth, there will be four values determined. Also available with the results will be a select set of the flux versus energy and flux mapped to LET in tissue versus LET in tissue plots. All of the raw data along with all input decks and output files will be included with the final results.

3.1 Proton Mono-energetic, Pencil Beam Source

The simplest charged particle is a proton. The simplest proton source is a mono-energetic, mono-directional beam of particles. Therefore, this source will be a 200 MeV proton source at a point on the slab perpendicular to the y-z face of the slab at $x, y, z = 0$.

3.2 Proton Mono-energetic, Mono-directional Source

The next simplest proton source is a mono-energetic and mono-directional source. Therefore, this source will be a 200 MeV proton source evenly distributed and perpendicular on the entire y-z face of the slab at $x = 0$.

3.3 Proton Mono-energetic, Isotropic Source

The next simplest proton source is a mono-energetic source distributed in direction. Therefore, this source will be a 200 MeV proton source evenly distributed and isotropic in direction on the entire y-z face of the slab at $x = 0$.

3.4 ^{56}Fe Mono-energetic, Pencil Beam Source

The most relevant, heavy charged particle for space analysis is ^{56}Fe, since it has the most binding energy per nucleon of any nucleus. The simplest ^{56}Fe source is a mono-energetic, mono-directional beam of particles. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source at a point on the slab perpendicular to the y-z face of the slab at $x, y, z = 0$.

Table 3.1: Aluminum/Polyethylene Depths used to Produce Response Function versus Depth Tables ($\rho_{\text{Al}} = 2.7\frac{\text{g}}{\text{cm}^3}$ and $\rho_{\text{poly}} = 0.92\frac{\text{g}}{\text{cm}^3}$)

#	Al Depth ($\frac{\text{g}}{\text{cm}^2}$)	Al Depth (cm)	Poly Depth ($\frac{\text{g}}{\text{cm}^2}$)	Poly Depth (cm)
0	0.75	0.27778	0.0	0.0
1	0.75	0.27778	0.1	0.108696
2	0.75	0.27778	0.3	0.326090
3	0.75	0.27778	0.75	0.815217
4	0.75	0.27778	1.0	1.08696
5	0.75	0.27778	3.0	3.26090
6	0.75	0.27778	7.5	8.15217
7	0.75	0.27778	10.0	10.8696
8	0.75	0.27778	30.0	32.6090
9	0.75	0.27778	75.0	81.5217
10	0.75	0.27778	100.0	108.696
11	30.0	11.1111	0.0	0.0
12	30.0	11.1111	0.1	0.108696
13	30.0	11.1111	0.3	0.326090
14	30.0	11.1111	0.75	0.815217
15	30.0	11.1111	1.0	1.08696
16	30.0	11.1111	3.0	3.26090
17	30.0	11.1111	7.5	8.15217
18	30.0	11.1111	10.0	10.8696
19	30.0	11.1111	30.0	32.6090
20	30.0	11.1111	75.0	81.5217
21	30.0	11.1111	100.0	108.696

3.5 ^{56}Fe Mono-energetic, Mono-directional Source

The next simplest ^{56}Fe source is a mono-energetic and mono-directional source. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source evenly distributed and perpendicular on the entire y-z face of the slab at $x = 0$.

3.6 ^{56}Fe Mono-energetic, Isotropic Source

The next simplest ^{56}Fe source is a mono-energetic source evenly distributed in direction. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source evenly distributed and isotropic in direction on the entire y-z face of the slab at $x = 0$.

3.7 Free Space Solar Proton Event Mono-directional Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time, as seen in a SPE, in a single direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is evenly distributed and perpendicular on the entire y-z face of the slab at $x = 0$.

3.8 Free Space Solar Proton Event Isotropic Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time, as seen in a SPE, distributed in direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is evenly distributed and isotropic on the entire y-z face of the slab at $x = 0$.

3.9 Free Space Galactic Cosmic Ray Mono-directional Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and in a single direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is evenly distributed and perpendicular on the entire y-z face of the slab at $x = 0$.

3.10 Free Space Galactic Cosmic Ray Isotropic Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and distributed in direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is evenly distributed and isotropic on the entire y-z face of the slab at $x = 0$.

3.11 Low Earth Orbit Mono-directional Distributed Source

A more complex source is the LEO distributed source and in a single direction. There are three different components to this source. The first component is the trapped particles in the earth's magnetic field. It mainly consists of protons and electrons. The second component is the GCR penetrating through the magnetic field to the altitude and inclination of interest. The third component is a neutron albedo source emanating from the interactions of the first two sources in the atmosphere. Table B.3.1 defines the neutron albedo distribution. Tables B.3.2 through B.3.29 define the GCR distribution. Tables B.3.30 and B.3.31 define the proton and electron trapped components. This source is evenly distributed and perpendicular on the entire y-z face of the slab at $x = 0$.

3.12 Low Earth Orbit Isotropic Distributed Source

A more complex source is the LEO distributed source and distributed in direction. There are three different components to this source. The first component is the trapped particles in the earth's magnetic field. It mainly consists of protons and electrons. The second component is the GCR penetrating through the magnetic field to the altitude and inclination of interest. The third component is a neutron albedo source emanating from the interactions of the first two sources in the atmosphere. Table B.3.1 defines the neutron albedo distribution. Tables B.3.2 through B.3.29 define the GCR distribution. Tables B.3.30 and B.3.31 define the proton and electron trapped components. This source is evenly distributed and isotropic on the entire y-z face of the slab at $x = 0$.

4 Typical Spacecraft Geometry in Free Space

Slabs are a good surrogate for materials interaction and cross section comparisons - the physics in a code, but a complex spacecraft model requires that a solution algorithm use all parts of its programming to find solutions - the engineering in a code. The set of benchmarks described here will test the engineering usefulness of a solution algorithm by analyzing a complex and fully three dimensional space vehicle in free space.

The full specification of the spacecraft cannot be given in this document, but the spacecraft geometry and materials will be provided by the authors upon request. The format of the spacecraft specification will be threefold:

1. a low level: faceted CAD specification in .OBJ format,
2. a defined point of interest within the space vehicle where the analysis will occur,
3. a thickness distribution: material thickness specification with 1002 rays, at the above mentioned point of interest.

Any deviation from or manipulation of these models during solution must be reported.

The results for each benchmark in this section will be dose or dose rate in aluminum and silicon and dose equivalent or dose equivalent rate in tissue at the analysis point of interest inside the spacecraft. Also available with the results will be a select set of the flux versus energy and flux mapped to LET in tissue

versus LET in tissue plots at that point. All of the raw data along with all input decks and output files will be included with the final results.

4.1 Proton Mono-energetic, Mono-directional Source

The simplest charged particle is a proton. The simplest proton source is a mono-energetic and mono-directional source. Therefore, this source will be a 200 MeV proton source at the spacecraft surface and directed toward the point of interest inside the spacecraft.

4.2 Proton Mono-energetic, Isotropic Source

The next simplest proton source is a mono-energetic source distributed in direction. Therefore, this source will be a 200 MeV proton source evenly distributed on and isotropic in direction to the spacecraft surface.

4.3 ^{56}Fe Mono-energetic, Mono-directional Source

The most relevant, heavy charged particle for space analysis is ^{56}Fe, since it has the most binding energy per nucleon of any nucleus. The simplest ^{56}Fe source is a mono-energetic and mono-directional source. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source at the spacecraft surface and directed toward the point of interest inside the spacecraft.

4.4 ^{56}Fe Mono-energetic, Isotropic Source

The next simplest ^{56}Fe source is a mono-energetic source distributed in direction. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source evenly distributed on and isotropic in direction to the spacecraft surface.

4.5 Free Space Solar Proton Event Mono-directional Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time, as seen in a SPE, in a single direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is at the spacecraft surface and directed toward the point of interest inside the spacecraft.

4.6 Free Space Solar Proton Event Isotropic Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time, as seen in a SPE, distributed in direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is evenly distributed on and isotropic in direction to the spacecraft surface.

4.7 Free Space Galactic Cosmic Ray Mono-directional Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and in a single direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is at the spacecraft surface and directed toward the point of interest inside the spacecraft.

4.8 Free Space Galactic Cosmic Ray Isotropic Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and distributed in direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is evenly distributed on and isotropic in direction to the spacecraft surface.

4.9 Low Earth Orbit Mono-directional Distributed Source

A more complex source is the LEO distributed source and in a single direction. There are three different components to this source. The first component is the trapped particles in the earth's magnetic field. It mainly consists of protons and electrons. The second component is the GCR penetrating through the magnetic field to the altitude and inclination of interest. The third component is a neutron albedo source emanating from the interactions of the first two sources in the atmosphere. Table B.3.1 defines the neutron albedo distribution. Tables B.3.2 through B.3.29 define the GCR distribution. Tables B.3.30 and B.3.31 define the proton and electron trapped components. This source is at the spacecraft surface and directed toward the point of interest inside the spacecraft.

4.10 Low Earth Orbit Isotropic Distributed Source

A more complex source is the LEO distributed source and distributed in direction. There are three different components to this source. The first component is the trapped particles in the earth's magnetic field. It mainly consists of protons and electrons. The second component is the GCR penetrating through the magnetic field to the altitude and inclination of interest. The third component is a neutron albedo source emanating from the interactions of the first two sources in the atmosphere. Table B.3.1 defines the neutron albedo distribution. Tables B.3.2 through B.3.29 define the GCR distribution. Tables B.3.30 and B.3.31 define the proton and electron trapped components. This source is evenly distributed on and isotropic in direction to the spacecraft surface.

5 Typical Spacecraft Geometry in Free Space with Human Phantoms

Slabs are a good surrogate for materials interaction and cross section comparisons - the physics in a code, but a complex spacecraft model requires that a solution algorithm use all parts of its programming to find solutions - the engineering in a code. The set of benchmarks described here will test the engineering usefulness of a solution algorithm by analyzing a complex and fully three dimensional space vehicle in free space with a human phantom.

The full specification of the spacecraft cannot be given in this document, but the spacecraft geometry and materials will be provided by the authors upon request. The format of the spacecraft specification will be fourfold:

1. a low level: faceted CAD specification in .OBJ format,
2. a defined point of interest within the space vehicle and human phantom where the analysis will occur,
3. a thickness distribution: material thickness specification with 1002 rays, at the above mentioned point of interest.
4. point and thickness distributions for relevant organs: a set of point and thickness distributions that cover the relevant organs. The thickness distributions will use 1002 rays, and the points and organs are phantom dependent.

Any deviation from or manipulation of these models during solution must be reported. The human phantom specification will be provided separately by request from the authors and must be integrated by the benchmark team into their overall model. This integration must be fully described by the team but the human phantom must contain the same point of interest used in Section 4 and be at the phantom's point of interest.

The results for each benchmark in this section will be a whole body effective dose equivalent and organ averaged dose equivalent for the human phantom and relevant organs. Also included will be the dose or dose rate in aluminum and silicon, and dose equivalent or dose equivalent rate in tissue at the point of interest inside the phantom. Also available with the results will be a select set of the flux versus energy and flux mapped to LET in tissue versus LET in tissue plots at that point. All of the raw data along with all input decks and output files will be included with the final results.

5.1 Proton Mono-energetic, Mono-directional Source

The simplest charged particle is a proton. The simplest proton source is a mono-energetic and mono-directional source. Therefore, this source will be a 200 MeV proton source at the spacecraft surface and directed toward the point of interest inside the spacecraft and phantom.

5.2 Proton Mono-energetic, Isotropic Source

The next simplest proton source is a mono-energetic source distributed in direction. Therefore, this source will be a 200 MeV proton source evenly distributed on and isotropic in direction to the spacecraft surface.

5.3 ^{56}Fe Mono-energetic, Mono-directional Source

The most relevant, heavy charged particle for space analysis is ^{56}Fe, since it has the most binding energy per nucleon of any nucleus. The simplest ^{56}Fe source is a mono-energetic and mono-directional source. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source at the spacecraft surface and directed toward the point of interest inside the spacecraft and phantom.

5.4 ^{56}Fe Mono-energetic, Isotropic Source

The next simplest ^{56}Fe source is a mono-energetic source distributed in direction. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source evenly distributed on and isotropic in direction to the spacecraft surface.

5.5 Free Space Solar Proton Event Mono-directional Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time, as seen in a SPE, in a single direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is at the spacecraft surface and directed toward the point of interest inside the spacecraft and phantom.

5.6 Free Space Solar Proton Event Isotropic Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time, as seen in a SPE, distributed in direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is evenly distributed on and isotropic in direction to the spacecraft surface.

5.7 Free Space Galactic Cosmic Ray Mono-directional Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and in a single direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is at the spacecraft surface and directed toward the point of interest inside the spacecraft and phantom.

5.8 Free Space Galactic Cosmic Ray Isotropic Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and distributed in direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is evenly distributed on and isotropic in direction to the spacecraft surface.

5.9 Low Earth Orbit Mono-directional Distributed Source

A more complex source is the LEO distributed source and in a single direction. There are three different components to this source. The first component is the trapped particles in the earth's magnetic field. It mainly consists of protons and electrons. The second component is the GCR penetrating through the magnetic field to the altitude and inclination of interest. The third component is a neutron albedo source

emanating from the interactions of the first two sources in the atmosphere. Table B.3.1 defines the neutron albedo distribution. Tables B.3.2 through B.3.29 define the GCR distribution. Tables B.3.30 and B.3.31 define the proton and electron trapped components. This source is at the spacecraft surface and directed toward the point of interest inside the spacecraft and phantom.

5.10 Low Earth Orbit Isotropic Distributed Source

A more complex source is the LEO distributed source and distributed in direction. There are three different components to this source. The first component is the trapped particles in the earth's magnetic field. It mainly consists of protons and electrons. The second component is the GCR penetrating through the magnetic field to the altitude and inclination of interest. The third component is a neutron albedo source emanating from the interactions of the first two sources in the atmosphere. Table B.3.1 defines the neutron albedo distribution. Tables B.3.2 through B.3.29 define the GCR distribution. Tables B.3.30 and B.3.31 define the proton and electron trapped components. This source is evenly distributed on and isotropic in direction to the spacecraft surface.

6 Typical Spacecraft Geometry on the Moon

Slabs are a good surrogate for materials interaction and cross section comparisons - the physics in a code, but a complex spacecraft model sitting on a planetary surface, like the moon, requires that a solution algorithm use all parts of its programming to find solutions - the engineering in a code. The set of benchmarks described here will test the engineering usefulness of a solution algorithm by analyzing a complex and fully three dimensional space vehicle sitting on a planetary surface.

The full specification of the spacecraft cannot be given in this document, but the spacecraft geometry and materials will be provided by the authors when requested. The format of the spacecraft specification will be threefold:

1. a low level: faceted CAD specification in .OBJ format,
2. a defined point of interest within the space vehicle where the analysis will occur,
3. a thickness distribution: material thickness specification with 1002 rays, at the above mentioned point of interest.

Any deviation from or manipulation of these models during solution must be reported. The lunar surface will be infinite in depth, flat, and infinite in extent. The lunar regolith specification[11] is based on the Apollo 17 (A17) highest iron composition and is shown in Table 6.1.

The results for each benchmark in this section will be dose or dose rate in aluminum and silicon and dose equivalent or dose equivalent rate in tissue at the point of interest inside the spacecraft. Also available with the results will be a select set of the flux versus energy and flux mapped to LET in tissue versus LET in tissue plots at that point. All of the raw data along with all input decks and output files will be included with the final results.

6.1 Proton Mono-energetic, Mono-directional Source

The simplest charged particle is a proton. The simplest proton source is a mono-energetic and mono-directional source. Therefore, this source will be a 200 MeV proton source at the spacecraft surface and directed toward the point of interest inside the spacecraft.

6.2 Proton Mono-energetic, Isotropic Source

The next simplest proton source is a mono-energetic source distributed in direction. Therefore, this source will be a 200 MeV proton source evenly distributed on and isotropic in direction to the spacecraft surface.

Table 6.1: Elemental Composition and Atom Density of Lunar Regolith ($\rho_{\text{regolith}} = 1.60 \frac{\text{g}}{\text{cm}^3}$)

#	Material	A	Z	Atom Density ($\frac{\text{atoms}}{\text{g}}$)	Atom Density ($\frac{\text{atoms}}{\text{cm}^3}$)
1	Silicon	28	14	4.02E+21	6.43E+21
2	Oxygen	16	8	1.56E+22	2.50E+22
3	Titanium	48	22	7.25E+20	1.16E+21
4	Aluminum	27	13	1.29E+21	2.06E+21
5	Chromium	52	24	3.66E+19	5.86E+19
6	Iron	56	26	1.49E+21	2.38E+21
7	Manganese	55	25	2.04E+19	3.26E+19
8	Magnesium	24	12	1.44E+21	2.30E+21
9	Calcium	40	20	1.15E+21	1.84E+21
10	Sodium	23	11	7.41E+19	1.19E+20
11	Potassium	40	19	9.82E+18	1.57E+19
12	Phosphorus	31	15	5.96E+18	9.54E+18
13	Sulfur	32	16	2.27E+19	3.63E+19

6.3 ^{56}Fe Mono-energetic, Mono-directional Source

The most relevant, heavy charged particle for space analysis is ^{56}Fe, since it has the most binding energy per nucleon of any nucleus. The simplest ^{56}Fe source is a mono-energetic and mono-directional source. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source at the spacecraft surface and directed toward the point of interest inside the spacecraft.

6.4 ^{56}Fe Mono-energetic, Isotropic Source

The next simplest ^{56}Fe source is a mono-energetic source distributed in direction. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source evenly distributed on and isotropic in direction to the spacecraft surface.

6.5 Free Space Solar Proton Event Mono-directional Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time, as seen in a SPE, in a single direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is at the spacecraft surface and directed toward the point of interest inside the spacecraft.

6.6 Free Space Solar Proton Event Isotropic Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time as seen in a SPE, distributed in direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is evenly distributed on and isotropic in direction to the spacecraft surface.

6.7 Free Space Galactic Cosmic Ray Mono-directional Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and in a single direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is at the spacecraft surface and directed toward the point of interest inside the spacecraft.

6.8 Free Space Galactic Cosmic Ray Isotropic Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and distributed in direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is evenly distributed on and isotropic in direction to the spacecraft surface.

7 Typical Spacecraft Geometry on the Moon with a Human Phantom

Slabs are a good surrogate for materials interaction and cross section comparisons - the physics in a code, but a complex spacecraft model sitting on a planetary surface, like the moon, requires that a solution algorithm use all parts of its programming to find solutions - the engineering in a code. The set of benchmarks described here will test the engineering usefulness of a solution algorithm by analyzing a complex and fully three dimensional space vehicle sitting on a planetary surface with a human phantom.

The full specification of the spacecraft cannot be given in this document, but the spacecraft geometry and materials will be provided by the authors upon request. The format of the spacecraft specification will be fourfold:

1. a low level: faceted CAD specification in .OBJ format,
2. a defined point of interest within the space vehicle and human phantom where the analysis will occur,
3. a thickness distribution: material thickness specification with 1002 rays, at the above mentioned point of interest.
4. point and thickness distributions for relevant organs: a set of point and thickness distributions that cover the relevant organs. The thickness distributions will use 1002 rays, and the points and organs are phantom dependent.

Any deviation from or manipulation of these models during solution must be reported. The lunar surface will be infinite in depth, flat, and infinite in extent. The lunar regolith specification is shown in Table 6.1. The human specification will also be provided separately and must be integrated by the benchmark team. This integration must be fully described by the team but the human phantom must contain the same point of interest used in Section 5 and be at the phantom's point of interest.

The results for each benchmark in this section will be a whole body effective dose equivalent and organ averaged dose equivalent for the human phantom. Also included will be the dose or dose rate in aluminum and silicon, and dose equivalent or dose equivalent rate in tissue at the point of interest inside the phantom. Also available with the results will be a select set of the flux versus energy and flux mapped to LET in tissue versus LET in tissue plots at that point. All of the raw data along with all input decks and output files will be included with the final results.

7.1 Proton Mono-energetic, Mono-directional Source

The simplest charged particle is a proton. The simplest proton source is a mono-energetic and mono-directional source. Therefore, this source will be a 200 MeV proton source at the spacecraft surface and directed toward the point of interest inside the spacecraft and phantom.

7.2 Proton Mono-energetic, Isotropic Source

The next simplest source is a mono-energetic source distributed in direction. Therefore, this source will be a 200 MeV proton source evenly distributed on and isotropic in direction to the spacecraft surface.

7.3 ^{56}Fe Mono-energetic, Mono-directional Source

The most relevant, heavy charged particle for space analysis is ^{56}Fe, since it has the most binding energy per nucleon of any nucleus. The simplest ^{56}Fe source is a mono-energetic and mono-directional source. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source at the spacecraft surface and directed toward the point of interest inside the spacecraft and phantom.

7.4 ^{56}Fe Mono-energetic, Isotropic Source

The next simplest ^{56}Fe source is a mono-energetic source distributed in direction. Therefore, this source will be a 1 GeV per nucleon (56.0 GeV total) ^{56}Fe source evenly distributed on and isotropic in direction to the spacecraft surface.

7.5 Free Space Solar Proton Event Mono-directional Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time, as seen in a SPE, in a single direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is at the spacecraft surface and directed toward the point of interest inside the spacecraft and phantom.

7.6 Free Space Solar Proton Event Isotropic Distributed Source

The next step in source distributions is a simple proton energy distribution integrated over time, as seen in a SPE, distributed in direction. Table B.1.1 defines the actual energy versus fluence values needed to describe the event. This source is evenly distributed on and isotropic in direction to the spacecraft surface.

7.7 Free Space Galactic Cosmic Ray Mono-directional Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and in a single direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is at the spacecraft surface and directed toward the point of interest inside the spacecraft and phantom.

7.8 Free Space Galactic Cosmic Ray Isotropic Distributed Source

A more complex source distribution is the GCR distribution that contains 28 different particles and distributed in direction. Tables B.2.1 through B.2.28 defines the actual energy and species domain flux distributions for the GCR. This source is evenly distributed on and isotropic in direction to the spacecraft surface.

8 Remarks

While this is not a complete set of benchmarks that would be needed to evaluate a potential algorithm's and code's usefulness to the space radiation community, it is the basic set that must be performed to ensure confidence in the results obtained by the community. It is imperative that each benchmark team's report be complete and self contained only pointing to RSICC or other code repositories for codes and data. This complete report allows a comprehensive comparison of all codes benchmarked on the same basis. The main requirement for the team's report format is the ability for a reader to reproduce the benchmarks with the codes and data without help from the team.

While other benchmarks, such as response function maps inside the entire space vehicle, will be defined in the future, there are other types of codes necessary for the functions that are to be performed in the space radiation community. These other codes range from particle track structure codes needed to understand the details of the electron and gamma fields at the cell level, adjoint codes needed once a space vehicle is built to enable fast and accurate evaluation for training and operations, to perturbation codes needed to enable fast analysis of a design for small changes. Better interfaces to CAD based geometry are needed to speed up

analysis turn around times after a change is made. All of these items will need benchmarks. Therefore, this is an ongoing process, and this paper outlines the first set of benchmark specifications.

A Human Phantoms of Interest to NASA: CAM, CAF, MAX, and FAX

Various human phantoms are available to work with in a space radiation environment. The first non-CAD based phantom of interest to NASA in the 70's and 80's was CAM and CAF. Their organs and other parts are made of quadratic surfaces enclosing regions. These phantoms had a computer code, CAMERA, that could resize their parts.

More modern phantoms are available. The NASA Langley Research Center has chosen the 2005 version of MAX and FAX to work with currently. These phantoms are voxelized CT scans (X-ray Computed Tomography) of deceased volunteers. The voxels were then segmented (each voxel being assigned a tissue type).

Currently, the authors can supply all human phantoms in thickness distribution with material composition formats to match the spacecraft's ray trace as used by OLTARIS. CAM and CAF can also be supplied in combinatorial geometry for codes like MCNP; however, CAF is currently sized like CAM unlike the thickness distributions. MAX and FAX can be supplied in voxel format and also can be input into combinatorial geometry formats like MCNP. The resulting input decks however are huge: about 650 MB and take about 30 minutes to read into MCNP. They can also need large amounts of memory per core to execute in MCNP and therefore care must be used to execute these models.

B Sources

The three major sources need to be discussed in detail for a better understanding of what they provide. The three are: Solar Proton Event (SPE), Galactic Cosmic Rays (GCR), and Low Earth Orbit (LEO). These sources are standard NASA sources used in OLTARIS and other analyses for past, current, and future spacecraft. They are offered here in 100 energy point tables and can be supplied by the authors in Fortran readable and MCNP SDEF formats.

B.1 Free Space Solar Proton Event Distributed Source used in OLTARIS

The physics behind SPEs are complex and not fully understood; however, an engineering understanding of SPEs is sufficient to perform these benchmarks. While SPEs are like Earthquakes in that the maximum size SPE is unknown, SPE frequency is not well understood, and the character of any particular SPE can't be determined *a priori*, historical SPEs can be used to generate a design basis. This is the approach used by NASA. Table B.1.1 defines the fluence versus energy relationship of the SPE used for this benchmark.

Table B.1.1: Energy per Proton Fluence Data for the Solar Proton Event Source

Energy $\frac{\text{MeV}}{\text{A}}$	Fluence $\frac{\text{proton}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Fluence $\frac{\text{proton}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Fluence $\frac{\text{proton}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}}$
1.000000E-02	9.240700E+08	1.338088E-02	9.239600E+08	1.790479E-02	9.238000E+08
2.390681E-02	9.235900E+08	3.183221E-02	9.233100E+08	4.210285E-02	9.229500E+08
5.510735E-02	9.225000E+08	7.111503E-02	9.219400E+08	9.027458E-02	9.212800E+08
1.124807E-01	9.205100E+08	1.375337E-01	9.196400E+08	1.657185E-01	9.186600E+08
1.968371E-01	9.175800E+08	2.302813E-01	9.164200E+08	2.675015E-01	9.151400E+08
3.081838E-01	9.137300E+08	3.525475E-01	9.122100E+08	4.010248E-01	9.105400E+08
4.541620E-01	9.087100E+08	5.125794E-01	9.067100E+08	5.769560E-01	9.045100E+08
6.480289E-01	9.020900E+08	7.263492E-01	8.994300E+08	8.129234E-01	8.964900E+08
9.085720E-01	8.932600E+08	1.014071E+00	8.897200E+08	1.129672E+00	8.858400E+08
1.258328E+00	8.815500E+08	1.399567E+00	8.768700E+08	1.556046E+00	8.717000E+08
1.728746E+00	8.660400E+08	1.919146E+00	8.598400E+08	2.129073E+00	8.530600E+08
2.361070E+00	8.456200E+08	2.617216E+00	8.374900E+08	2.899599E+00	8.286100E+08
3.210916E+00	8.189300E+08	3.554511E+00	8.083800E+08	3.933012E+00	7.969200E+08
4.350185E+00	7.844700E+08	4.810052E+00	7.709800E+08	5.316827E+00	7.563700E+08
5.875216E+00	7.406000E+08	6.490437E+00	7.236100E+08	7.167928E+00	7.053400E+08
7.914280E+00	6.857500E+08	8.736185E+00	6.648100E+08	9.641356E+00	6.424900E+08
1.063789E+01	6.187700E+08	1.173515E+01	5.936800E+08	1.294341E+01	5.672200E+08
1.427364E+01	5.394500E+08	1.573864E+01	5.104300E+08	1.735183E+01	4.802900E+08
1.912722E+01	4.491600E+08	2.108195E+01	4.172200E+08	2.323460E+01	3.846700E+08
2.560620E+01	3.517400E+08	2.821697E+01	3.187400E+08	3.109330E+01	2.859600E+08
3.426162E+01	2.537300E+08	3.775280E+01	2.224100E+08	4.160081E+01	1.923500E+08
4.584282E+01	1.639000E+08	5.051828E+01	1.373900E+08	5.567888E+01	1.130800E+08
6.136987E+01	9.122500E+07	6.765432E+01	7.196500E+07	7.459531E+01	5.538200E+07
8.226303E+01	4.146700E+07	9.074045E+01	3.011400E+07	1.001212E+02	2.113700E+07
1.105347E+02	1.426800E+07	1.220314E+02	9.246200E+06	1.348146E+02	5.707800E+06
1.489691E+02	3.345800E+06	1.648166E+02	1.839800E+06	1.823669E+02	9.487600E+05
2.018336E+02	4.551200E+05	2.239260E+02	1.977300E+05	2.484365E+02	7.841100E+04
2.756300E+02	2.810100E+04	3.060040E+02	8.931700E+03	3.407294E+02	2.409000E+03
3.793953E+02	5.599700E+02	4.231804E+02	1.073000E+02	4.728099E+02	1.649100E+01
5.290970E+02	1.971400E+00	5.930393E+02	1.765500E-01	6.664974E+02	1.104100E-02
7.505074E+02	4.636600E-04	8.471435E+02	1.209200E-05	9.587661E+02	1.791300E-07
1.090824E+03	1.227300E-09	1.243621E+03	3.844400E-12	1.417821E+03	5.369700E-15
1.624766E+03	2.179900E-18	1.869156E+03	2.154100E-22	2.158058E+03	3.968300E-27
2.500000E+03	9.878500E-33	–	–	–	–

B.2 Free Space Galactic Cosmic Ray Distributed Source used in OLTARIS

The exact origin of the GCR is unknown at this time; however, they are from outside the solar system and the Sun's magnetic field does modulate the intensity of the GCR fields inside the solar system. This modulation is monitored by observing the Sun Spot Number (SSN), which is an indication of the turbulence and intensity of the Sun's magnetic field. A more turbulent and intense magnetic field or the higher the SSN, the fewer the GCR particles that can enter the solar system. The SSN also has a period of approximately 11 years. Two caveats exist:

1. between 11 year cycles, it is unknown how long the quiet period will last, and

2. the peak of the cycle and how many Sun Spots there will be at that peak are unknown until the peak has passed.

While there seems to be a lot of missing information, from historical cycles, this information is enough to be used for the engineering purpose of spacecraft design and operations. At this moment, NASA has no requirement for a design basis for GCR; however, the benchmark source is defined in Tables B.2.1 through B.2.28 by isotope and energy.

Table B.2.1: Energy per Nucleon versus ^{1}H Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	4.144000E-03	1.408122E-02	6.136400E-03	1.982806E-02	9.068900E-03
2.780981E-02	1.331700E-02	3.875467E-02	1.937500E-02	5.332453E-02	2.774000E-02
7.201205E-02	3.882900E-02	9.504214E-02	5.290200E-02	1.222573E-01	6.996200E-02
1.535488E-01	9.001900E-02	1.887641E-01	1.130300E-01	2.276714E-01	1.388800E-01
2.714374E-01	1.684000E-01	3.199159E-01	2.015400E-01	3.737161E-01	2.387700E-01
4.336543E-01	2.807200E-01	5.006712E-01	3.281100E-01	5.754554E-01	3.815100E-01
6.594890E-01	4.420700E-01	7.538421E-01	5.106600E-01	8.598675E-01	5.883700E-01
9.791078E-01	6.764400E-01	1.111958E+00	7.753000E-01	1.262183E+00	8.878800E-01
1.430260E+00	1.014700E+00	1.619384E+00	1.158400E+00	1.831895E+00	1.320900E+00
2.070313E+00	1.504500E+00	2.337882E+00	1.712100E+00	2.638686E+00	1.947100E+00
2.976327E+00	2.212900E+00	3.354537E+00	2.513000E+00	3.779000E+00	2.852500E+00
4.255003E+00	3.236400E+00	4.788643E+00	3.670600E+00	5.386816E+00	4.162000E+00
6.057149E+00	4.718000E+00	6.808107E+00	5.347400E+00	7.649509E+00	6.060400E+00
8.591997E+00	6.868400E+00	9.647560E+00	7.784300E+00	1.082961E+01	8.823300E+00
1.215322E+01	1.000300E+01	1.363491E+01	1.134100E+01	1.529532E+01	1.286400E+01
1.715376E+01	1.459300E+01	1.923466E+01	1.656000E+01	2.156430E+01	1.879500E+01
2.417442E+01	2.133800E+01	2.709740E+01	2.422500E+01	3.037216E+01	2.750400E+01
3.404070E+01	3.122000E+01	3.815234E+01	3.541800E+01	4.276254E+01	4.015500E+01
4.793135E+01	4.547400E+01	5.373154E+01	5.140600E+01	6.023854E+01	5.799900E+01
6.755091E+01	6.527000E+01	7.576738E+01	7.320800E+01	8.500710E+01	8.176000E+01
9.540710E+01	9.090900E+01	1.071423E+02	1.005400E+02	1.203541E+02	1.104600E+02
1.352905E+02	1.205500E+02	1.521613E+02	1.305400E+02	1.713748E+02	1.402000E+02
1.930143E+02	1.490800E+02	2.178676E+02	1.570800E+02	2.461532E+02	1.637000E+02
2.781110E+02	1.686000E+02	3.147252E+02	1.715800E+02	3.571010E+02	1.724100E+02
4.053476E+02	1.709200E+02	4.617689E+02	1.669900E+02	5.268134E+02	1.607200E+02
6.024618E+02	1.522200E+02	6.913280E+02	1.416900E+02	7.956862E+02	1.295100E+02
9.191872E+02	1.160600E+02	1.067888E+03	1.016800E+02	1.245753E+03	8.707100E+01
1.453242E+03	7.315600E+01	1.709641E+03	5.966800E+01	2.016451E+03	4.752600E+01
2.396919E+03	3.665800E+01	2.863224E+03	2.746200E+01	3.444241E+03	1.989400E+01
4.156085E+03	1.402400E+01	5.040332E+03	9.589300E+00	6.133931E+03	6.381000E+00
7.488086E+03	4.140500E+00	9.166967E+03	2.624500E+00	1.126486E+04	1.623500E+00
1.386132E+04	9.870500E-01	1.709441E+04	5.896700E-01	2.112206E+04	3.468800E-01
2.615197E+04	2.011500E-01	3.243614E+04	1.152100E-01	4.023251E+04	6.555400E-02
5.000000E+04	3.690700E-02	–	–	–	–

Table B.2.2: Energy per Nucleon versus ^{4}He Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	1.636400E-03	1.408122E-02	2.376500E-03	1.982806E-02	3.448600E-03
2.780981E-02	4.978800E-03	3.875467E-02	7.132300E-03	5.332453E-02	1.007000E-02
7.201205E-02	1.392500E-02	9.504214E-02	1.877400E-02	1.222573E-01	2.460900E-02
1.535488E-01	3.142800E-02	1.887641E-01	3.921200E-02	2.276714E-01	4.792100E-02
2.714374E-01	5.783100E-02	3.199159E-01	6.892400E-02	3.737161E-01	8.135500E-02
4.336543E-01	9.533000E-02	5.006712E-01	1.110900E-01	5.754554E-01	1.288200E-01
6.594890E-01	1.489000E-01	7.538421E-01	1.716100E-01	8.598675E-01	1.973200E-01
9.791078E-01	2.264400E-01	1.111958E+00	2.591100E-01	1.262183E+00	2.962900E-01
1.430260E+00	3.381600E-01	1.619384E+00	3.855900E-01	1.831895E+00	4.392600E-01
2.070313E+00	4.999100E-01	2.337882E+00	5.684800E-01	2.638686E+00	6.461600E-01
2.976327E+00	7.340600E-01	3.354537E+00	8.333800E-01	3.779000E+00	9.458200E-01
4.255003E+00	1.073100E+00	4.788643E+00	1.217200E+00	5.386816E+00	1.380400E+00
6.057149E+00	1.565300E+00	6.808107E+00	1.774700E+00	7.649509E+00	2.012000E+00
8.591997E+00	2.281000E+00	9.647560E+00	2.585900E+00	1.082961E+01	2.931300E+00
1.215322E+01	3.322500E+00	1.363491E+01	3.765200E+00	1.529532E+01	4.266300E+00
1.715376E+01	4.831300E+00	1.923466E+01	5.468300E+00	2.156430E+01	6.183800E+00
2.417442E+01	6.985300E+00	2.709740E+01	7.877100E+00	3.037216E+01	8.867400E+00
3.404070E+01	9.958200E+00	3.815234E+01	1.114800E+01	4.276254E+01	1.244000E+01
4.793135E+01	1.382600E+01	5.373154E+01	1.529200E+01	6.023854E+01	1.682800E+01
6.755091E+01	1.841200E+01	7.576738E+01	2.001500E+01	8.500710E+01	2.160200E+01
9.540710E+01	2.314400E+01	1.071423E+02	2.459800E+01	1.203541E+02	2.591300E+01
1.352905E+02	2.705800E+01	1.521613E+02	2.798400E+01	1.713748E+02	2.865800E+01
1.930143E+02	2.903700E+01	2.178676E+02	2.910700E+01	2.461532E+02	2.884300E+01
2.781110E+02	2.825100E+01	3.147252E+02	2.733300E+01	3.571010E+02	2.609700E+01
4.053476E+02	2.459600E+01	4.617689E+02	2.283600E+01	5.268134E+02	2.089400E+01
6.024618E+02	1.881600E+01	6.913280E+02	1.665100E+01	7.956862E+02	1.447100E+01
9.191872E+02	1.233100E+01	1.067888E+03	1.026500E+01	1.245753E+03	8.352100E+00
1.453242E+03	6.677100E+00	1.709641E+03	5.175900E+00	2.016451E+03	3.921200E+00
2.396919E+03	2.875300E+00	2.863224E+03	2.048800E+00	3.444241E+03	1.412000E+00
4.156085E+03	9.484900E-01	5.040332E+03	6.187400E-01	6.133931E+03	3.935200E-01
7.488086E+03	2.445400E-01	9.166967E+03	1.487500E-01	1.126486E+04	8.846100E-02
1.386132E+04	5.182000E-02	1.709441E+04	2.988200E-02	2.112206E+04	1.699600E-02
2.615197E+04	9.543500E-03	3.243614E+04	5.300000E-03	4.023251E+04	2.927800E-03
5.000000E+04	1.601800E-03	–	–	–	–

Table B.2.3: Energy per Nucleon versus ^{7}Li Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	5.360400E-06	1.408122E-02	7.792100E-06	1.982806E-02	1.131500E-05
2.780981E-02	1.634300E-05	3.875467E-02	2.341700E-05	5.332453E-02	3.306400E-05
7.201205E-02	4.571100E-05	9.504214E-02	6.160700E-05	1.222573E-01	8.072100E-05
1.535488E-01	1.030400E-04	1.887641E-01	1.284800E-04	2.276714E-01	1.569300E-04
2.714374E-01	1.892700E-04	3.199159E-01	2.254400E-04	3.737161E-01	2.659300E-04
4.336543E-01	3.114000E-04	5.006712E-01	3.626400E-04	5.754554E-01	4.202300E-04
6.594890E-01	4.853800E-04	7.538421E-01	5.590200E-04	8.598675E-01	6.422800E-04
9.791078E-01	7.364800E-04	1.111958E+00	8.420500E-04	1.262183E+00	9.620800E-04
1.430260E+00	1.097100E-03	1.619384E+00	1.249900E-03	1.831895E+00	1.422500E-03
2.070313E+00	1.617300E-03	2.337882E+00	1.837300E-03	2.638686E+00	2.086100E-03
2.976327E+00	2.367100E-03	3.354537E+00	2.684000E-03	3.779000E+00	3.042200E-03
4.255003E+00	3.446700E-03	4.788643E+00	3.903600E-03	5.386816E+00	4.419800E-03
6.057149E+00	5.003000E-03	6.808107E+00	5.661700E-03	7.649509E+00	6.405900E-03
8.591997E+00	7.246800E-03	9.647560E+00	8.196600E-03	1.082961E+01	9.269100E-03
1.215322E+01	1.047900E-02	1.363491E+01	1.184400E-02	1.529532E+01	1.338300E-02
1.715376E+01	1.511400E-02	1.923466E+01	1.705800E-02	2.156430E+01	1.923800E-02
2.417442E+01	2.167400E-02	2.709740E+01	2.438400E-02	3.037216E+01	2.739300E-02
3.404070E+01	3.071400E-02	3.815234E+01	3.435100E-02	4.276254E+01	3.832200E-02
4.793135E+01	4.261600E-02	5.373154E+01	4.721000E-02	6.023854E+01	5.209300E-02
6.755091E+01	5.722000E-02	7.576738E+01	6.253000E-02	8.500710E+01	6.793500E-02
9.540710E+01	7.337200E-02	1.071423E+02	7.872500E-02	1.203541E+02	8.383800E-02
1.352905E+02	8.861800E-02	1.521613E+02	9.289500E-02	1.713748E+02	9.653800E-02
1.930143E+02	9.934000E-02	2.178676E+02	1.012300E-01	2.461532E+02	1.020400E-01
2.781110E+02	1.016700E-01	3.147252E+02	1.000500E-01	3.571010E+02	9.716200E-02
4.053476E+02	9.305800E-02	4.617689E+02	8.771500E-02	5.268134E+02	8.134000E-02
6.024618E+02	7.410300E-02	6.913280E+02	6.618000E-02	7.956862E+02	5.787300E-02
9.191872E+02	4.944800E-02	1.067888E+03	4.111200E-02	1.245753E+03	3.325900E-02
1.453242E+03	2.631500E-02	1.709641E+03	2.007800E-02	2.016451E+03	1.489400E-02
2.396919E+03	1.062900E-02	2.863224E+03	7.329200E-03	3.444241E+03	4.859100E-03
4.156085E+03	3.124400E-03	5.040332E+03	1.941300E-03	6.133931E+03	1.171000E-03
7.488086E+03	6.877400E-04	9.166967E+03	3.941400E-04	1.126486E+04	2.201900E-04
1.386132E+04	1.209400E-04	1.709441E+04	6.526600E-05	2.112206E+04	3.468900E-05
2.615197E+04	1.817700E-05	3.243614E+04	9.409500E-06	4.023251E+04	4.843200E-06
5.000000E+04	2.466400E-06	–	–	–	–

Table B.2.4: Energy per Nucleon versus ^{9}Be Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	1.815700E-06	1.408122E-02	2.654000E-06	1.982806E-02	3.873000E-06
2.780981E-02	5.618400E-06	3.875467E-02	8.080800E-06	5.332453E-02	1.144600E-05
7.201205E-02	1.586400E-05	9.504214E-02	2.142200E-05	1.222573E-01	2.811000E-05
1.535488E-01	3.592000E-05	1.887641E-01	4.482600E-05	2.276714E-01	5.478100E-05
2.714374E-01	6.609300E-05	3.199159E-01	7.873800E-05	3.737161E-01	9.288600E-05
4.336543E-01	1.087700E-04	5.006712E-01	1.266500E-04	5.754554E-01	1.467300E-04
6.594890E-01	1.694300E-04	7.538421E-01	1.950500E-04	8.598675E-01	2.240100E-04
9.791078E-01	2.567300E-04	1.111958E+00	2.933500E-04	1.262183E+00	3.349500E-04
1.430260E+00	3.816800E-04	1.619384E+00	4.344800E-04	1.831895E+00	4.940600E-04
2.070313E+00	5.611700E-04	2.337882E+00	6.368100E-04	2.638686E+00	7.221900E-04
2.976327E+00	8.184500E-04	3.354537E+00	9.267400E-04	3.779000E+00	1.048800E-03
4.255003E+00	1.186300E-03	4.788643E+00	1.341300E-03	5.386816E+00	1.515700E-03
6.057149E+00	1.712300E-03	6.808107E+00	1.933500E-03	7.649509E+00	2.182700E-03
8.591997E+00	2.463400E-03	9.647560E+00	2.779400E-03	1.082961E+01	3.135200E-03
1.215322E+01	3.535600E-03	1.363491E+01	3.986100E-03	1.529532E+01	4.493500E-03
1.715376E+01	5.063600E-03	1.923466E+01	5.704400E-03	2.156430E+01	6.423900E-03
2.417442E+01	7.231300E-03	2.709740E+01	8.135200E-03	3.037216E+01	9.146700E-03
3.404070E+01	1.027600E-02	3.815234E+01	1.153200E-02	4.276254E+01	1.292800E-02
4.793135E+01	1.447200E-02	5.373154E+01	1.617200E-02	6.023854E+01	1.803900E-02
6.755091E+01	2.007600E-02	7.576738E+01	2.228500E-02	8.500710E+01	2.465700E-02
9.540710E+01	2.719100E-02	1.071423E+02	2.987100E-02	1.203541E+02	3.265500E-02
1.352905E+02	3.552600E-02	1.521613E+02	3.842500E-02	1.713748E+02	4.130500E-02
1.930143E+02	4.404300E-02	2.178676E+02	4.661800E-02	2.461532E+02	4.888100E-02
2.781110E+02	5.070600E-02	3.147252E+02	5.198900E-02	3.571010E+02	5.264800E-02
4.053476E+02	5.255600E-02	4.617689E+02	5.163000E-02	5.268134E+02	4.982400E-02
6.024618E+02	4.716400E-02	6.913280E+02	4.367600E-02	7.956862E+02	3.949000E-02
9.191872E+02	3.476800E-02	1.067888E+03	2.967600E-02	1.245753E+03	2.453000E-02
1.453242E+03	1.972000E-02	1.709641E+03	1.521000E-02	2.016451E+03	1.133800E-02
2.396919E+03	8.083500E-03	2.863224E+03	5.534700E-03	3.444241E+03	3.621300E-03
4.156085E+03	2.285400E-03	5.040332E+03	1.386400E-03	6.133931E+03	8.128400E-04
7.488086E+03	4.622000E-04	9.166967E+03	2.556200E-04	1.126486E+04	1.374000E-04
1.386132E+04	7.245000E-05	1.709441E+04	3.746700E-05	2.112206E+04	1.905400E-05
2.615197E+04	9.539800E-06	3.243614E+04	4.713500E-06	4.023251E+04	2.314300E-06
5.000000E+04	1.123300E-06	–	–	–	–

Table B.2.5: Energy per Nucleon versus ^{11}B Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	9.696900E-06	1.408122E-02	1.412300E-05	1.982806E-02	2.054600E-05
2.780981E-02	2.972600E-05	3.875467E-02	4.265700E-05	5.332453E-02	6.030800E-05
7.201205E-02	8.347200E-05	9.504214E-02	1.126100E-04	1.222573E-01	1.476600E-04
1.535488E-01	1.886000E-04	1.887641E-01	2.353100E-04	2.276714E-01	2.875400E-04
2.714374E-01	3.469200E-04	3.199159E-01	4.133500E-04	3.737161E-01	4.877200E-04
4.336543E-01	5.712600E-04	5.006712E-01	6.653900E-04	5.754554E-01	7.711900E-04
6.594890E-01	8.908900E-04	7.538421E-01	1.026200E-03	8.598675E-01	1.179100E-03
9.791078E-01	1.352200E-03	1.111958E+00	1.546100E-03	1.262183E+00	1.766500E-03
1.430260E+00	2.014500E-03	1.619384E+00	2.295000E-03	1.831895E+00	2.612000E-03
2.070313E+00	2.969600E-03	2.337882E+00	3.373200E-03	2.638686E+00	3.829700E-03
2.976327E+00	4.345300E-03	3.354537E+00	4.926500E-03	3.779000E+00	5.583100E-03
4.255003E+00	6.324500E-03	4.788643E+00	7.161700E-03	5.386816E+00	8.107300E-03
6.057149E+00	9.175100E-03	6.808107E+00	1.038100E-02	7.649509E+00	1.174300E-02
8.591997E+00	1.328200E-02	9.647560E+00	1.501900E-02	1.082961E+01	1.698200E-02
1.215322E+01	1.919600E-02	1.363491E+01	2.169500E-02	1.529532E+01	2.451400E-02
1.715376E+01	2.768700E-02	1.923466E+01	3.125500E-02	2.156430E+01	3.526100E-02
2.417442E+01	3.975000E-02	2.709740E+01	4.475500E-02	3.037216E+01	5.033100E-02
3.404070E+01	5.650700E-02	3.815234E+01	6.330500E-02	4.276254E+01	7.076500E-02
4.793135E+01	7.888300E-02	5.373154E+01	8.763300E-02	6.023854E+01	9.700500E-02
6.755091E+01	1.069400E-01	7.576738E+01	1.173400E-01	8.500710E+01	1.280500E-01
9.540710E+01	1.389700E-01	1.071423E+02	1.498900E-01	1.203541E+02	1.605100E-01
1.352905E+02	1.706700E-01	1.521613E+02	1.800100E-01	1.713748E+02	1.882800E-01
1.930143E+02	1.950300E-01	2.178676E+02	2.001000E-01	2.461532E+02	2.031000E-01
2.781110E+02	2.037600E-01	3.147252E+02	2.019000E-01	3.571010E+02	1.974200E-01
4.053476E+02	1.903400E-01	4.617689E+02	1.805900E-01	5.268134E+02	1.685100E-01
6.024618E+02	1.544200E-01	6.913280E+02	1.386600E-01	7.956862E+02	1.218600E-01
9.191872E+02	1.045700E-01	1.067888E+03	8.726500E-02	1.245753E+03	7.080300E-02
1.453242E+03	5.613100E-02	1.709641E+03	4.287400E-02	2.016451E+03	3.180700E-02
2.396919E+03	2.267800E-02	2.863224E+03	1.560500E-02	3.444241E+03	1.031300E-02
4.156085E+03	6.602900E-03	5.040332E+03	4.080700E-03	6.133931E+03	2.446100E-03
7.488086E+03	1.426300E-03	9.166967E+03	8.109300E-04	1.126486E+04	4.491000E-04
1.386132E+04	2.443900E-04	1.709441E+04	1.306000E-04	2.112206E+04	6.870800E-05
2.615197E+04	3.562100E-05	3.243614E+04	1.823800E-05	4.023251E+04	9.282900E-06
5.000000E+04	4.673400E-06	–	–	–	–

Table B.2.6: Energy per Nucleon versus ^{12}C Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	4.400900E-05	1.408122E-02	6.390500E-05	1.982806E-02	9.272100E-05
2.780981E-02	1.338500E-04	3.875467E-02	1.917200E-04	5.332453E-02	2.706800E-04
7.201205E-02	3.742600E-04	9.504214E-02	5.045500E-04	1.222573E-01	6.613600E-04
1.535488E-01	8.445800E-04	1.887641E-01	1.053700E-03	2.276714E-01	1.287800E-03
2.714374E-01	1.554100E-03	3.199159E-01	1.852200E-03	3.737161E-01	2.186200E-03
4.336543E-01	2.561800E-03	5.006712E-01	2.985300E-03	5.754554E-01	3.461800E-03
6.594890E-01	4.001400E-03	7.538421E-01	4.611900E-03	8.598675E-01	5.302900E-03
9.791078E-01	6.085500E-03	1.111958E+00	6.963500E-03	1.262183E+00	7.962900E-03
1.430260E+00	9.088400E-03	1.619384E+00	1.036300E-02	1.831895E+00	1.180600E-02
2.070313E+00	1.343700E-02	2.337882E+00	1.528000E-02	2.638686E+00	1.736900E-02
2.976327E+00	1.973200E-02	3.354537E+00	2.240300E-02	3.779000E+00	2.542700E-02
4.255003E+00	2.885000E-02	4.788643E+00	3.272600E-02	5.386816E+00	3.711600E-02
6.057149E+00	4.208900E-02	6.808107E+00	4.772300E-02	7.649509E+00	5.410900E-02
8.591997E+00	6.134700E-02	9.647560E+00	6.955200E-02	1.082961E+01	7.884900E-02
1.215322E+01	8.937800E-02	1.363491E+01	1.013000E-01	1.529532E+01	1.147900E-01
1.715376E+01	1.300000E-01	1.923466E+01	1.471500E-01	2.156430E+01	1.664100E-01
2.417442E+01	1.879800E-01	2.709740E+01	2.119800E-01	3.037216E+01	2.386300E-01
3.404070E+01	2.679700E-01	3.815234E+01	2.999600E-01	4.276254E+01	3.346900E-01
4.793135E+01	3.719100E-01	5.373154E+01	4.112400E-01	6.023854E+01	4.524200E-01
6.755091E+01	4.948500E-01	7.576738E+01	5.377300E-01	8.500710E+01	5.801200E-01
9.540710E+01	6.212500E-01	1.071423E+02	6.599700E-01	1.203541E+02	6.949200E-01
1.352905E+02	7.252700E-01	1.521613E+02	7.497400E-01	1.713748E+02	7.674600E-01
1.930143E+02	7.773300E-01	2.178676E+02	7.789600E-01	2.461532E+02	7.717700E-01
2.781110E+02	7.558800E-01	3.147252E+02	7.314000E-01	3.571010E+02	6.985600E-01
4.053476E+02	6.587800E-01	4.617689E+02	6.121500E-01	5.268134E+02	5.607700E-01
6.024618E+02	5.058200E-01	6.913280E+02	4.485400E-01	7.956862E+02	3.908200E-01
9.191872E+02	3.340500E-01	1.067888E+03	2.791500E-01	1.245753E+03	2.281700E-01
1.453242E+03	1.833600E-01	1.709641E+03	1.430000E-01	2.016451E+03	1.090900E-01
2.396919E+03	8.062800E-02	2.863224E+03	5.796300E-02	3.444241E+03	4.034600E-02
4.156085E+03	2.739500E-02	5.040332E+03	1.808000E-02	6.133931E+03	1.164300E-02
7.488086E+03	7.331100E-03	9.166967E+03	4.521100E-03	1.126486E+04	2.727800E-03
1.386132E+04	1.621800E-03	1.709441E+04	9.496100E-04	2.112206E+04	5.486400E-04
2.615197E+04	3.130400E-04	3.243614E+04	1.767000E-04	4.023251E+04	9.923100E-05
5.000000E+04	5.520200E-05	–	–	–	–

Table B.2.7: Energy per Nucleon versus ^{14}N Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	9.954600E-06	1.408122E-02	1.449100E-05	1.982806E-02	2.107200E-05
2.780981E-02	3.047700E-05	3.875467E-02	4.373000E-05	5.332453E-02	6.182400E-05
7.201205E-02	8.557800E-05	9.504214E-02	1.154700E-04	1.222573E-01	1.514500E-04
1.535488E-01	1.934900E-04	1.887641E-01	2.414900E-04	2.276714E-01	2.951800E-04
2.714374E-01	3.562600E-04	3.199159E-01	4.246200E-04	3.737161E-01	5.012000E-04
4.336543E-01	5.872600E-04	5.006712E-01	6.842800E-04	5.754554E-01	7.933900E-04
6.594890E-01	9.169100E-04	7.538421E-01	1.056600E-03	8.598675E-01	1.214600E-03
9.791078E-01	1.393500E-03	1.111958E+00	1.594000E-03	1.262183E+00	1.822200E-03
1.430260E+00	2.078900E-03	1.619384E+00	2.369600E-03	1.831895E+00	2.698300E-03
2.070313E+00	3.069400E-03	2.337882E+00	3.488700E-03	2.638686E+00	3.963200E-03
2.976327E+00	4.499700E-03	3.354537E+00	5.105100E-03	3.779000E+00	5.789800E-03
4.255003E+00	6.563900E-03	4.788643E+00	7.439200E-03	5.386816E+00	8.429100E-03
6.057149E+00	9.548700E-03	6.808107E+00	1.081500E-02	7.649509E+00	1.224800E-02
8.591997E+00	1.386900E-02	9.647560E+00	1.570400E-02	1.082961E+01	1.778000E-02
1.215322E+01	2.012700E-02	1.363491E+01	2.278000E-02	1.529532E+01	2.577900E-02
1.715376E+01	2.916000E-02	1.923466E+01	3.297000E-02	2.156430E+01	3.725200E-02
2.417442E+01	4.205300E-02	2.709740E+01	4.740800E-02	3.037216E+01	5.337200E-02
3.404070E+01	5.997200E-02	3.815234E+01	6.721600E-02	4.276254E+01	7.514200E-02
4.793135E+01	8.372400E-02	5.373154E+01	9.291200E-02	6.023854E+01	1.026800E-01
6.755091E+01	1.129200E-01	7.576738E+01	1.235000E-01	8.500710E+01	1.342400E-01
9.540710E+01	1.449800E-01	1.071423E+02	1.554800E-01	1.203541E+02	1.654200E-01
1.352905E+02	1.745900E-01	1.521613E+02	1.826700E-01	1.713748E+02	1.893800E-01
1.930143E+02	1.943500E-01	2.178676E+02	1.974500E-01	2.461532E+02	1.983800E-01
2.781110E+02	1.970100E-01	3.147252E+02	1.932600E-01	3.571010E+02	1.871000E-01
4.053476E+02	1.787100E-01	4.617689E+02	1.680900E-01	5.268134E+02	1.556700E-01
6.024618E+02	1.417600E-01	6.913280E+02	1.267100E-01	7.956862E+02	1.110600E-01
9.191872E+02	9.527500E-02	1.067888E+03	7.969300E-02	1.245753E+03	6.500700E-02
1.453242E+03	5.197000E-02	1.709641E+03	4.017800E-02	2.016451E+03	3.027300E-02
2.396919E+03	2.201100E-02	2.863224E+03	1.550500E-02	3.444241E+03	1.053200E-02
4.156085E+03	6.953600E-03	5.040332E+03	4.446700E-03	6.133931E+03	2.766000E-03
7.488086E+03	1.677700E-03	9.166967E+03	9.943700E-04	1.126486E+04	5.752600E-04
1.386132E+04	3.274300E-04	1.709441E+04	1.832700E-04	2.112206E+04	1.010900E-04
2.615197E+04	5.500400E-05	3.243614E+04	2.958000E-05	4.023251E+04	1.581900E-05
5.000000E+04	8.373300E-06	–	–	–	–

Table B.2.8: Energy per Nucleon versus ^{16}O Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	4.477100E-05	1.408122E-02	6.495400E-05	1.982806E-02	9.416700E-05
2.780981E-02	1.358400E-04	3.875467E-02	1.944600E-04	5.332453E-02	2.744000E-04
7.201205E-02	3.792600E-04	9.504214E-02	5.111400E-04	1.222573E-01	6.698500E-04
1.535488E-01	8.552800E-04	1.887641E-01	1.067000E-03	2.276714E-01	1.303900E-03
2.714374E-01	1.573400E-03	3.199159E-01	1.875200E-03	3.737161E-01	2.213400E-03
4.336543E-01	2.593600E-03	5.006712E-01	3.022500E-03	5.754554E-01	3.505100E-03
6.594890E-01	4.051800E-03	7.538421E-01	4.670300E-03	8.598675E-01	5.370500E-03
9.791078E-01	6.163800E-03	1.111958E+00	7.053800E-03	1.262183E+00	8.067200E-03
1.430260E+00	9.208700E-03	1.619384E+00	1.050200E-02	1.831895E+00	1.196600E-02
2.070313E+00	1.362100E-02	2.337882E+00	1.549300E-02	2.638686E+00	1.761400E-02
2.976327E+00	2.001500E-02	3.354537E+00	2.273000E-02	3.779000E+00	2.580500E-02
4.255003E+00	2.928800E-02	4.788643E+00	3.323300E-02	5.386816E+00	3.770400E-02
6.057149E+00	4.277200E-02	6.808107E+00	4.851600E-02	7.649509E+00	5.503100E-02
8.591997E+00	6.242000E-02	9.647560E+00	7.080000E-02	1.082961E+01	8.030200E-02
1.215322E+01	9.106800E-02	1.363491E+01	1.032600E-01	1.529532E+01	1.170700E-01
1.715376E+01	1.326400E-01	1.923466E+01	1.501900E-01	2.156430E+01	1.699100E-01
2.417442E+01	1.919700E-01	2.709740E+01	2.165000E-01	3.037216E+01	2.437000E-01
3.404070E+01	2.736000E-01	3.815234E+01	3.061100E-01	4.276254E+01	3.413100E-01
4.793135E+01	3.788900E-01	5.373154E+01	4.184100E-01	6.023854E+01	4.595700E-01
6.755091E+01	5.017000E-01	7.576738E+01	5.439300E-01	8.500710E+01	5.852700E-01
9.540710E+01	6.249100E-01	1.071423E+02	6.616700E-01	1.203541E+02	6.942200E-01
1.352905E+02	7.217300E-01	1.521613E+02	7.430100E-01	1.713748E+02	7.572400E-01
1.930143E+02	7.635300E-01	2.178676E+02	7.615300E-01	2.461532E+02	7.509000E-01
2.781110E+02	7.319300E-01	3.147252E+02	7.048900E-01	3.571010E+02	6.700800E-01
4.053476E+02	6.290900E-01	4.617689E+02	5.820600E-01	5.268134E+02	5.311100E-01
6.024618E+02	4.773600E-01	6.913280E+02	4.220000E-01	7.956862E+02	3.667800E-01
9.191872E+02	3.129300E-01	1.067888E+03	2.612200E-01	1.245753E+03	2.134800E-01
1.453242E+03	1.716800E-01	1.709641E+03	1.341400E-01	2.016451E+03	1.026200E-01
2.396919E+03	7.615200E-02	2.863224E+03	5.502900E-02	3.444241E+03	3.854800E-02
4.156085E+03	2.636800E-02	5.040332E+03	1.755000E-02	6.133931E+03	1.140700E-02
7.488086E+03	7.255200E-03	9.166967E+03	4.522800E-03	1.126486E+04	2.760100E-03
1.386132E+04	1.660600E-03	1.709441E+04	9.843300E-04	2.112206E+04	5.759400E-04
2.615197E+04	3.329000E-04	3.243614E+04	1.904100E-04	4.023251E+04	1.083700E-04
5.000000E+04	6.110700E-05	–	–	–	–

Table B.2.9: Energy per Nucleon versus ^{19}F Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	5.088100E-07	1.408122E-02	7.417700E-07	1.982806E-02	1.080000E-06
2.780981E-02	1.563800E-06	3.875467E-02	2.245700E-06	5.332453E-02	3.176900E-06
7.201205E-02	4.399400E-06	9.504214E-02	5.937500E-06	1.222573E-01	7.788600E-06
1.535488E-01	9.950800E-06	1.887641E-01	1.241800E-05	2.276714E-01	1.517700E-05
2.714374E-01	1.831400E-05	3.199159E-01	2.182300E-05	3.737161E-01	2.575300E-05
4.336543E-01	3.016600E-05	5.006712E-01	3.513900E-05	5.754554E-01	4.072800E-05
6.594890E-01	4.705200E-05	7.538421E-01	5.419800E-05	8.598675E-01	6.227800E-05
9.791078E-01	7.141800E-05	1.111958E+00	8.165900E-05	1.262183E+00	9.330100E-05
1.430260E+00	1.064000E-04	1.619384E+00	1.212100E-04	1.831895E+00	1.379400E-04
2.070313E+00	1.568200E-04	2.337882E+00	1.781200E-04	2.638686E+00	2.022100E-04
2.976327E+00	2.294000E-04	3.354537E+00	2.600600E-04	3.779000E+00	2.946900E-04
4.255003E+00	3.337800E-04	4.788643E+00	3.779100E-04	5.386816E+00	4.277400E-04
6.057149E+00	4.839900E-04	6.808107E+00	5.475100E-04	7.649509E+00	6.192400E-04
8.591997E+00	7.002400E-04	9.647560E+00	7.917000E-04	1.082961E+01	8.949700E-04
1.215322E+01	1.011500E-03	1.363491E+01	1.143000E-03	1.529532E+01	1.291300E-03
1.715376E+01	1.458300E-03	1.923466E+01	1.646200E-03	2.156430E+01	1.857200E-03
2.417442E+01	2.093800E-03	2.709740E+01	2.357900E-03	3.037216E+01	2.652500E-03
3.404070E+01	2.979400E-03	3.815234E+01	3.339900E-03	4.276254E+01	3.736600E-03
4.793135E+01	4.169500E-03	5.373154E+01	4.637800E-03	6.023854E+01	5.141600E-03
6.755091E+01	5.678400E-03	7.576738E+01	6.243400E-03	8.500710E+01	6.829800E-03
9.540710E+01	7.432500E-03	1.071423E+02	8.041600E-03	1.203541E+02	8.641600E-03
1.352905E+02	9.224000E-03	1.521613E+02	9.771000E-03	1.713748E+02	1.026900E-02
1.930143E+02	1.069200E-02	2.178676E+02	1.103400E-02	2.461532E+02	1.127100E-02
2.781110E+02	1.138500E-02	3.147252E+02	1.136700E-02	3.571010E+02	1.120700E-02
4.053476E+02	1.090300E-02	4.617689E+02	1.044700E-02	5.268134E+02	9.853800E-03
6.024618E+02	9.136800E-03	6.913280E+02	8.311400E-03	7.956862E+02	7.408100E-03
9.191872E+02	6.456700E-03	1.067888E+03	5.481600E-03	1.245753E+03	4.532000E-03
1.453242E+03	3.665400E-03	1.709641E+03	2.862800E-03	2.016451E+03	2.175300E-03
2.396919E+03	1.592300E-03	2.863224E+03	1.127400E-03	3.444241E+03	7.683900E-04
4.156085E+03	5.083100E-04	5.040332E+03	3.252600E-04	6.133931E+03	2.022200E-04
7.488086E+03	1.225000E-04	9.166967E+03	7.245900E-05	1.126486E+04	4.181400E-05
1.386132E+04	2.373300E-05	1.709441E+04	1.324300E-05	2.112206E+04	7.281000E-06
2.615197E+04	3.948400E-06	3.243614E+04	2.116100E-06	4.023251E+04	1.127800E-06
5.000000E+04	5.949100E-07	–	–	–	–

Table B.2.10: Energy per Nucleon versus ^{20}Ne Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	6.165900E-06	1.408122E-02	8.956800E-06	1.982806E-02	1.300000E-05
2.780981E-02	1.877100E-05	3.875467E-02	2.689400E-05	5.332453E-02	3.797600E-05
7.201205E-02	5.251500E-05	9.504214E-02	7.080400E-05	1.222573E-01	9.281200E-05
1.535488E-01	1.185300E-04	1.887641E-01	1.478800E-04	2.276714E-01	1.807200E-04
2.714374E-01	2.180900E-04	3.199159E-01	2.599100E-04	3.737161E-01	3.067700E-04
4.336543E-01	3.594500E-04	5.006712E-01	4.188500E-04	5.754554E-01	4.856700E-04
6.594890E-01	5.613300E-04	7.538421E-01	6.469200E-04	8.598675E-01	7.437900E-04
9.791078E-01	8.534800E-04	1.111958E+00	9.765200E-04	1.262183E+00	1.116600E-03
1.430260E+00	1.274200E-03	1.619384E+00	1.452800E-03	1.831895E+00	1.654900E-03
2.070313E+00	1.883200E-03	2.337882E+00	2.141200E-03	2.638686E+00	2.433500E-03
2.976327E+00	2.764200E-03	3.354537E+00	3.137800E-03	3.779000E+00	3.560700E-03
4.255003E+00	4.039200E-03	4.788643E+00	4.580900E-03	5.386816E+00	5.194100E-03
6.057149E+00	5.888500E-03	6.808107E+00	6.674900E-03	7.649509E+00	7.565900E-03
8.591997E+00	8.575300E-03	9.647560E+00	9.718900E-03	1.082961E+01	1.101400E-02
1.215322E+01	1.248100E-02	1.363491E+01	1.414000E-02	1.529532E+01	1.601700E-02
1.715376E+01	1.813200E-02	1.923466E+01	2.051700E-02	2.156430E+01	2.319500E-02
2.417442E+01	2.619400E-02	2.709740E+01	2.953200E-02	3.037216E+01	3.323900E-02
3.404070E+01	3.732300E-02	3.815234E+01	4.178100E-02	4.276254E+01	4.662600E-02
4.793135E+01	5.182900E-02	5.373154E+01	5.734000E-02	6.023854E+01	6.312700E-02
6.755091E+01	6.911000E-02	7.576738E+01	7.518500E-02	8.500710E+01	8.122100E-02
9.540710E+01	8.711800E-02	1.071423E+02	9.271600E-02	1.203541E+02	9.782400E-02
1.352905E+02	1.023300E-01	1.521613E+02	1.060400E-01	1.713748E+02	1.088300E-01
1.930143E+02	1.105400E-01	2.178676E+02	1.111000E-01	2.461532E+02	1.104100E-01
2.781110E+02	1.084700E-01	3.147252E+02	1.052900E-01	3.571010E+02	1.008800E-01
4.053476E+02	9.543400E-02	4.617689E+02	8.895100E-02	5.268134E+02	8.172000E-02
6.024618E+02	7.391200E-02	6.913280E+02	6.570400E-02	7.956862E+02	5.737200E-02
9.191872E+02	4.912800E-02	1.067888E+03	4.111200E-02	1.245753E+03	3.363500E-02
1.453242E+03	2.704000E-02	1.709641E+03	2.108600E-02	2.016451E+03	1.607300E-02
2.396919E+03	1.186400E-02	2.863224E+03	8.511900E-03	3.444241E+03	5.909400E-03
4.156085E+03	3.999900E-03	5.040332E+03	2.630200E-03	6.133931E+03	1.686800E-03
7.488086E+03	1.057300E-03	9.166967E+03	6.489100E-04	1.126486E+04	3.895100E-04
1.386132E+04	2.303500E-04	1.709441E+04	1.341300E-04	2.112206E+04	7.705900E-05
2.615197E+04	4.371300E-05	3.243614E+04	2.452900E-05	4.023251E+04	1.369300E-05
5.000000E+04	7.571600E-06	–	–	–	–

Table B.2.11: Energy per Nucleon versus ^{23}Na Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	1.036800E-06	1.408122E-02	1.509100E-06	1.982806E-02	2.194000E-06
2.780981E-02	3.172600E-06	3.875467E-02	4.551000E-06	5.332453E-02	6.432500E-06
7.201205E-02	8.901600E-06	9.504214E-02	1.200800E-05	1.222573E-01	1.574500E-05
1.535488E-01	2.011100E-05	1.887641E-01	2.509300E-05	2.276714E-01	3.066600E-05
2.714374E-01	3.700400E-05	3.199159E-01	4.409400E-05	3.737161E-01	5.203600E-05
4.336543E-01	6.095900E-05	5.006712E-01	7.101600E-05	5.754554E-01	8.232300E-05
6.594890E-01	9.512000E-05	7.538421E-01	1.095900E-04	8.598675E-01	1.259500E-04
9.791078E-01	1.444700E-04	1.111958E+00	1.652300E-04	1.262183E+00	1.888400E-04
1.430260E+00	2.154100E-04	1.619384E+00	2.454700E-04	1.831895E+00	2.794600E-04
2.070313E+00	3.178300E-04	2.337882E+00	3.611500E-04	2.638686E+00	4.101700E-04
2.976327E+00	4.655800E-04	3.354537E+00	5.280800E-04	3.779000E+00	5.987300E-04
4.255003E+00	6.785800E-04	4.788643E+00	7.688100E-04	5.386816E+00	8.708100E-04
6.057149E+00	9.861001E-04	6.808107E+00	1.116400E-03	7.649509E+00	1.263800E-03
8.591997E+00	1.430400E-03	9.647560E+00	1.618800E-03	1.082961E+01	1.831800E-03
1.215322E+01	2.072500E-03	1.363491E+01	2.344200E-03	1.529532E+01	2.651200E-03
1.715376E+01	2.996800E-03	1.923466E+01	3.386000E-03	2.156430E+01	3.822900E-03
2.417442E+01	4.312400E-03	2.709740E+01	4.858000E-03	3.037216E+01	5.465300E-03
3.404070E+01	6.136900E-03	3.815234E+01	6.874200E-03	4.276254E+01	7.680900E-03
4.793135E+01	8.555100E-03	5.373154E+01	9.492100E-03	6.023854E+01	1.049000E-02
6.755091E+01	1.153900E-02	7.576738E+01	1.262600E-02	8.500710E+01	1.373400E-02
9.540710E+01	1.485000E-02	1.071423E+02	1.594800E-02	1.203541E+02	1.699800E-02
1.352905E+02	1.798100E-02	1.521613E+02	1.886100E-02	1.713748E+02	1.961200E-02
1.930143E+02	2.019500E-02	2.178676E+02	2.059500E-02	2.461532E+02	2.077800E-02
2.781110E+02	2.072700E-02	3.147252E+02	2.043100E-02	3.571010E+02	1.988200E-02
4.053476E+02	1.909600E-02	4.617689E+02	1.806600E-02	5.268134E+02	1.683200E-02
6.024618E+02	1.542500E-02	6.913280E+02	1.387800E-02	7.956862E+02	1.224600E-02
9.191872E+02	1.057900E-02	1.067888E+03	8.912700E-03	1.245753E+03	7.324100E-03
1.453242E+03	5.898400E-03	1.709641E+03	4.595300E-03	2.016451E+03	3.489700E-03
2.396919E+03	2.558100E-03	2.863224E+03	1.817300E-03	3.444241E+03	1.245400E-03
4.156085E+03	8.298600E-04	5.040332E+03	5.358000E-04	6.133931E+03	3.366300E-04
7.488086E+03	2.063200E-04	9.166967E+03	1.236100E-04	1.126486E+04	7.232100E-05
1.386132E+04	4.164500E-05	1.709441E+04	2.359000E-05	2.112206E+04	1.317300E-05
2.615197E+04	7.258500E-06	3.243614E+04	3.954200E-06	4.023251E+04	2.142400E-06
5.000000E+04	1.149200E-06	–	–	–	–

Table B.2.12: Energy per Nucleon versus ^{24}Mg Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	8.758300E-06	1.408122E-02	1.270800E-05	1.982806E-02	1.842500E-05
2.780981E-02	2.657900E-05	3.875467E-02	3.805100E-05	5.332453E-02	5.369500E-05
7.201205E-02	7.421300E-05	9.504214E-02	1.000200E-04	1.222573E-01	1.310700E-04
1.535488E-01	1.673400E-04	1.887641E-01	2.087500E-04	2.276714E-01	2.550800E-04
2.714374E-01	3.078000E-04	3.199159E-01	3.668200E-04	3.737161E-01	4.329500E-04
4.336543E-01	5.073000E-04	5.006712E-01	5.911500E-04	5.754554E-01	6.855000E-04
6.594890E-01	7.923500E-04	7.538421E-01	9.132500E-04	8.598675E-01	1.050100E-03
9.791078E-01	1.205100E-03	1.111958E+00	1.379000E-03	1.262183E+00	1.577000E-03
1.430260E+00	1.800000E-03	1.619384E+00	2.052700E-03	1.831895E+00	2.338600E-03
2.070313E+00	2.661800E-03	2.337882E+00	3.027200E-03	2.638686E+00	3.441400E-03
2.976327E+00	3.910200E-03	3.354537E+00	4.439900E-03	3.779000E+00	5.040000E-03
4.255003E+00	5.719400E-03	4.788643E+00	6.488900E-03	5.386816E+00	7.360800E-03
6.057149E+00	8.348600E-03	6.808107E+00	9.468200E-03	7.649509E+00	1.073700E-02
8.591997E+00	1.217700E-02	9.647560E+00	1.380800E-02	1.082961E+01	1.565800E-02
1.215322E+01	1.775300E-02	1.363491E+01	2.012400E-02	1.529532E+01	2.280800E-02
1.715376E+01	2.583400E-02	1.923466E+01	2.924500E-02	2.156430E+01	3.307400E-02
2.417442E+01	3.736000E-02	2.709740E+01	4.212200E-02	3.037216E+01	4.740200E-02
3.404070E+01	5.320700E-02	3.815234E+01	5.952200E-02	4.276254E+01	6.636000E-02
4.793135E+01	7.366600E-02	5.373154E+01	8.135800E-02	6.023854E+01	8.937900E-02
6.755091E+01	9.760000E-02	7.576738E+01	1.058600E-01	8.500710E+01	1.139700E-01
9.540710E+01	1.217700E-01	1.071423E+02	1.290400E-01	1.203541E+02	1.355200E-01
1.352905E+02	1.410400E-01	1.521613E+02	1.453800E-01	1.713748E+02	1.483600E-01
1.930143E+02	1.498000E-01	2.178676E+02	1.496400E-01	2.461532E+02	1.477900E-01
2.781110E+02	1.442900E-01	3.147252E+02	1.391900E-01	3.571010E+02	1.325400E-01
4.053476E+02	1.246400E-01	4.617689E+02	1.155100E-01	5.268134E+02	1.055600E-01
6.024618E+02	9.501800E-02	6.913280E+02	8.410800E-02	7.956862E+02	7.318200E-02
9.191872E+02	6.249500E-02	1.067888E+03	5.220200E-02	1.245753E+03	4.267700E-02
1.453242E+03	3.432300E-02	1.709641E+03	2.680900E-02	2.016451E+03	2.049600E-02
2.396919E+03	1.519400E-02	2.863224E+03	1.096400E-02	3.444241E+03	7.666500E-03
4.156085E+03	5.233000E-03	5.040332E+03	3.474500E-03	6.133931E+03	2.252300E-03
7.488086E+03	1.428300E-03	9.166967E+03	8.876300E-04	1.126486E+04	5.399200E-04
1.386132E+04	3.237400E-04	1.709441E+04	1.912300E-04	2.112206E+04	1.114900E-04
2.615197E+04	6.420900E-05	3.243614E+04	3.659100E-05	4.023251E+04	2.074800E-05
5.000000E+04	1.165500E-05	–	–	–	–

Table B.2.13: Energy per Nucleon versus ^{27}Al Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	1.181100E-06	1.408122E-02	1.717200E-06	1.982806E-02	2.494200E-06
2.780981E-02	3.603700E-06	3.875467E-02	5.165800E-06	5.332453E-02	7.297200E-06
7.201205E-02	1.009400E-05	9.504214E-02	1.361100E-05	1.222573E-01	1.784400E-05
1.535488E-01	2.278800E-05	1.887641E-01	2.843100E-05	2.276714E-01	3.474200E-05
2.714374E-01	4.192200E-05	3.199159E-01	4.995500E-05	3.737161E-01	5.895400E-05
4.336543E-01	6.906800E-05	5.006712E-01	8.046800E-05	5.754554E-01	9.328900E-05
6.594890E-01	1.078000E-04	7.538421E-01	1.242100E-04	8.598675E-01	1.427800E-04
9.791078E-01	1.638000E-04	1.111958E+00	1.873700E-04	1.262183E+00	2.141800E-04
1.430260E+00	2.443600E-04	1.619384E+00	2.785300E-04	1.831895E+00	3.171600E-04
2.070313E+00	3.607900E-04	2.337882E+00	4.100900E-04	2.638686E+00	4.658900E-04
2.976327E+00	5.289900E-04	3.354537E+00	6.002100E-04	3.779000E+00	6.807700E-04
4.255003E+00	7.718700E-04	4.788643E+00	8.748900E-04	5.386816E+00	9.914200E-04
6.057149E+00	1.123300E-03	6.808107E+00	1.272400E-03	7.649509E+00	1.441200E-03
8.591997E+00	1.632200E-03	9.647560E+00	1.848300E-03	1.082961E+01	2.092900E-03
1.215322E+01	2.369400E-03	1.363491E+01	2.681900E-03	1.529532E+01	3.035100E-03
1.715376E+01	3.432900E-03	1.923466E+01	3.880900E-03	2.156430E+01	4.383800E-03
2.417442E+01	4.947000E-03	2.709740E+01	5.574000E-03	3.037216E+01	6.271000E-03
3.404070E+01	7.040100E-03	3.815234E+01	7.881700E-03	4.276254E+01	8.799400E-03
4.793135E+01	9.789100E-03	5.373154E+01	1.084400E-02	6.023854E+01	1.195800E-02
6.755091E+01	1.312100E-02	7.576738E+01	1.431500E-02	8.500710E+01	1.551700E-02
9.540710E+01	1.671000E-02	1.071423E+02	1.786600E-02	1.203541E+02	1.894900E-02
1.352905E+02	1.993700E-02	1.521613E+02	2.079300E-02	1.713748E+02	2.149100E-02
1.930143E+02	2.199100E-02	2.178676E+02	2.228100E-02	2.461532E+02	2.233100E-02
2.781110E+02	2.213100E-02	3.147252E+02	2.167600E-02	3.571010E+02	2.096300E-02
4.053476E+02	2.001800E-02	4.617689E+02	1.883700E-02	5.268134E+02	1.747000E-02
6.024618E+02	1.594900E-02	6.913280E+02	1.430900E-02	7.956862E+02	1.260600E-02
9.191872E+02	1.088700E-02	1.067888E+03	9.184200E-03	1.245753E+03	7.570500E-03
1.453242E+03	6.126700E-03	1.709641E+03	4.807000E-03	2.016451E+03	3.683800E-03
2.396919E+03	2.731700E-03	2.863224E+03	1.967700E-03	3.444241E+03	1.370600E-03
4.156085E+03	9.301500E-04	5.040332E+03	6.129500E-04	6.133931E+03	3.937600E-04
7.488086E+03	2.471500E-04	9.166967E+03	1.518500E-04	1.126486E+04	9.123900E-05
1.386132E+04	5.400300E-05	1.709441E+04	3.147100E-05	2.112206E+04	1.809400E-05
2.615197E+04	1.027200E-05	3.243614E+04	5.768400E-06	4.023251E+04	3.222700E-06
5.000000E+04	1.783400E-06	–	–	–	–

Table B.2.14: Energy per Nucleon versus ^{28}Si Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	6.345400E-06	1.408122E-02	9.209100E-06	1.982806E-02	1.335500E-05
2.780981E-02	1.927100E-05	3.875467E-02	2.759400E-05	5.332453E-02	3.894600E-05
7.201205E-02	5.383700E-05	9.504214E-02	7.256700E-05	1.222573E-01	9.510600E-05
1.535488E-01	1.214400E-04	1.887641E-01	1.515100E-04	2.276714E-01	1.851500E-04
2.714374E-01	2.234300E-04	3.199159E-01	2.662800E-04	3.737161E-01	3.143100E-04
4.336543E-01	3.683100E-04	5.006712E-01	4.292100E-04	5.754554E-01	4.977300E-04
6.594890E-01	5.753300E-04	7.538421E-01	6.631400E-04	8.598675E-01	7.625400E-04
9.791078E-01	8.751400E-04	1.111958E+00	1.001500E-03	1.262183E+00	1.145300E-03
1.430260E+00	1.307300E-03	1.619384E+00	1.490800E-03	1.831895E+00	1.698500E-03
2.070313E+00	1.933200E-03	2.337882E+00	2.198700E-03	2.638686E+00	2.499600E-03
2.976327E+00	2.840100E-03	3.354537E+00	3.225000E-03	3.779000E+00	3.660900E-03
4.255003E+00	4.154400E-03	4.788643E+00	4.713500E-03	5.386816E+00	5.346900E-03
6.057149E+00	6.064600E-03	6.808107E+00	6.878000E-03	7.649509E+00	7.800300E-03
8.591997E+00	8.846000E-03	9.647560E+00	1.003200E-02	1.082961E+01	1.137600E-02
1.215322E+01	1.289900E-02	1.363491E+01	1.462300E-02	1.529532E+01	1.657500E-02
1.715376E+01	1.877600E-02	1.923466E+01	2.125800E-02	2.156430E+01	2.404500E-02
2.417442E+01	2.716600E-02	2.709740E+01	3.063600E-02	3.037216E+01	3.448500E-02
3.404070E+01	3.871900E-02	3.815234E+01	4.332900E-02	4.276254E+01	4.832300E-02
4.793135E+01	5.366500E-02	5.373154E+01	5.929400E-02	6.023854E+01	6.516900E-02
6.755091E+01	7.119700E-02	7.576738E+01	7.726300E-02	8.500710E+01	8.322500E-02
9.540710E+01	8.897200E-02	1.071423E+02	9.433800E-02	1.203541E+02	9.913200E-02
1.352905E+02	1.032400E-01	1.521613E+02	1.064800E-01	1.713748E+02	1.087400E-01
1.930143E+02	1.098800E-01	2.178676E+02	1.098500E-01	2.461532E+02	1.085900E-01
2.781110E+02	1.061200E-01	3.147252E+02	1.024800E-01	3.571010E+02	9.770100E-02
4.053476E+02	9.200000E-02	4.617689E+02	8.539200E-02	5.268134E+02	7.817200E-02
6.024618E+02	7.050100E-02	6.913280E+02	6.254700E-02	7.956862E+02	5.456200E-02
9.191872E+02	4.673000E-02	1.067888E+03	3.916500E-02	1.245753E+03	3.214100E-02
1.453242E+03	2.595700E-02	1.709641E+03	2.037200E-02	2.016451E+03	1.565700E-02
2.396919E+03	1.167600E-02	2.863224E+03	8.480000E-03	3.444241E+03	5.972300E-03
4.156085E+03	4.107900E-03	5.040332E+03	2.750000E-03	6.133931E+03	1.798200E-03
7.488086E+03	1.150800E-03	9.166967E+03	7.220000E-04	1.126486E+04	4.435300E-04
1.386132E+04	2.686500E-04	1.709441E+04	1.603500E-04	2.112206E+04	9.448300E-05
2.615197E+04	5.500500E-05	3.243614E+04	3.169200E-05	4.023251E+04	1.816900E-05
5.000000E+04	1.032200E-05	–	–	–	–

Table B.2.15: Energy per Nucleon versus ^{29}P Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	1.196400E-07	1.408122E-02	1.747300E-07	1.982806E-02	2.548300E-07
2.780981E-02	3.695000E-07	3.875467E-02	5.312800E-07	5.332453E-02	7.523900E-07
7.201205E-02	1.042800E-06	9.504214E-02	1.408400E-06	1.222573E-01	1.848500E-06
1.535488E-01	2.362700E-06	1.887641E-01	2.949400E-06	2.276714E-01	3.605600E-06
2.714374E-01	4.351700E-06	3.199159E-01	5.186200E-06	3.737161E-01	6.120500E-06
4.336543E-01	7.169900E-06	5.006712E-01	8.352000E-06	5.754554E-01	9.680500E-06
6.594890E-01	1.118300E-05	7.538421E-01	1.288100E-05	8.598675E-01	1.480000E-05
9.791078E-01	1.697100E-05	1.111958E+00	1.940200E-05	1.262183E+00	2.216500E-05
1.430260E+00	2.527200E-05	1.619384E+00	2.878500E-05	1.831895E+00	3.275200E-05
2.070313E+00	3.722600E-05	2.337882E+00	4.227200E-05	2.638686E+00	4.797500E-05
2.976327E+00	5.441100E-05	3.354537E+00	6.166100E-05	3.779000E+00	6.984400E-05
4.255003E+00	7.907700E-05	4.788643E+00	8.949200E-05	5.386816E+00	1.012400E-04
6.057149E+00	1.145000E-04	6.808107E+00	1.294500E-04	7.649509E+00	1.463300E-04
8.591997E+00	1.653600E-04	9.647560E+00	1.868500E-04	1.082961E+01	2.110800E-04
1.215322E+01	2.384100E-04	1.363491E+01	2.692200E-04	1.529532E+01	3.039700E-04
1.715376E+01	3.430900E-04	1.923466E+01	3.871100E-04	2.156430E+01	4.365700E-04
2.417442E+01	4.920800E-04	2.709740E+01	5.541600E-04	3.037216E+01	6.235500E-04
3.404070E+01	7.007800E-04	3.815234E+01	7.863300E-04	4.276254E+01	8.808900E-04
4.793135E+01	9.847600E-04	5.373154E+01	1.098000E-03	6.023854E+01	1.220900E-03
6.755091E+01	1.353200E-03	7.576738E+01	1.494300E-03	8.500710E+01	1.642900E-03
9.540710E+01	1.798300E-03	1.071423E+02	1.958400E-03	1.203541E+02	2.120100E-03
1.352905E+02	2.281500E-03	1.521613E+02	2.438400E-03	1.713748E+02	2.587700E-03
1.930143E+02	2.722600E-03	2.178676E+02	2.841500E-03	2.461532E+02	2.937200E-03
2.781110E+02	3.004300E-03	3.147252E+02	3.038800E-03	3.571010E+02	3.037600E-03
4.053476E+02	2.997100E-03	4.617689E+02	2.914600E-03	5.268134E+02	2.790700E-03
6.024618E+02	2.627900E-03	6.913280E+02	2.428500E-03	7.956862E+02	2.199600E-03
9.191872E+02	1.948600E-03	1.067888E+03	1.682200E-03	1.245753E+03	1.414400E-03
1.453242E+03	1.163000E-03	1.709641E+03	9.239900E-04	2.016451E+03	7.141000E-04
2.396919E+03	5.319000E-04	2.863224E+03	3.832600E-04	3.444241E+03	2.659600E-04
4.156085E+03	1.791500E-04	5.040332E+03	1.167700E-04	6.133931E+03	7.396400E-05
7.488086E+03	4.566100E-05	9.166967E+03	2.753400E-05	1.126486E+04	1.620500E-05
1.386132E+04	9.382400E-06	1.709441E+04	5.342200E-06	2.112206E+04	2.998000E-06
2.615197E+04	1.660000E-06	3.243614E+04	9.086100E-07	4.023251E+04	4.946000E-07
5.000000E+04	2.665600E-07	–	–	–	–

Table B.2.16: Energy per Nucleon versus ^{32}S Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	9.285600E-07	1.408122E-02	1.351200E-06	1.982806E-02	1.964300E-06
2.780981E-02	2.840400E-06	3.875467E-02	4.074500E-06	5.332453E-02	5.759400E-06
7.201205E-02	7.971000E-06	9.504214E-02	1.075400E-05	1.222573E-01	1.410400E-05
1.535488E-01	1.801800E-05	1.887641E-01	2.248600E-05	2.276714E-01	2.748500E-05
2.714374E-01	3.317200E-05	3.199159E-01	3.953600E-05	3.737161E-01	4.666600E-05
4.336543E-01	5.468000E-05	5.006712E-01	6.371500E-05	5.754554E-01	7.387600E-05
6.594890E-01	8.537800E-05	7.538421E-01	9.838600E-05	8.598675E-01	1.131000E-04
9.791078E-01	1.297700E-04	1.111958E+00	1.484500E-04	1.262183E+00	1.697000E-04
1.430260E+00	1.936300E-04	1.619384E+00	2.207100E-04	1.831895E+00	2.513400E-04
2.070313E+00	2.859300E-04	2.337882E+00	3.250100E-04	2.638686E+00	3.692400E-04
2.976327E+00	4.192600E-04	3.354537E+00	4.757100E-04	3.779000E+00	5.395800E-04
4.255003E+00	6.117900E-04	4.788643E+00	6.934500E-04	5.386816E+00	7.858200E-04
6.057149E+00	8.903200E-04	6.808107E+00	1.008500E-03	7.649509E+00	1.142400E-03
8.591997E+00	1.293800E-03	9.647560E+00	1.465200E-03	1.082961E+01	1.659200E-03
1.215322E+01	1.878500E-03	1.363491E+01	2.126600E-03	1.529532E+01	2.407000E-03
1.715376E+01	2.723100E-03	1.923466E+01	3.079300E-03	2.156430E+01	3.479700E-03
2.417442E+01	3.928500E-03	2.709740E+01	4.428800E-03	3.037216E+01	4.985900E-03
3.404070E+01	5.601700E-03	3.815234E+01	6.277100E-03	4.276254E+01	7.015100E-03
4.793135E+01	7.813200E-03	5.373154E+01	8.666000E-03	6.023854E+01	9.570600E-03
6.755091E+01	1.051700E-02	7.576738E+01	1.149300E-02	8.500710E+01	1.248000E-02
9.540710E+01	1.346600E-02	1.071423E+02	1.442600E-02	1.203541E+02	1.533200E-02
1.352905E+02	1.616700E-02	1.521613E+02	1.689900E-02	1.713748E+02	1.750700E-02
1.930143E+02	1.795900E-02	2.178676E+02	1.824200E-02	2.461532E+02	1.833200E-02
2.781110E+02	1.821900E-02	3.147252E+02	1.789700E-02	3.571010E+02	1.736400E-02
4.053476E+02	1.663600E-02	4.617689E+02	1.571100E-02	5.268134E+02	1.462800E-02
6.024618E+02	1.341000E-02	6.913280E+02	1.208600E-02	7.956862E+02	1.070100E-02
9.191872E+02	9.292000E-03	1.067888E+03	7.886700E-03	1.245753E+03	6.544500E-03
1.453242E+03	5.334100E-03	1.709641E+03	4.218600E-03	2.016451E+03	3.260700E-03
2.396919E+03	2.440900E-03	2.863224E+03	1.776200E-03	3.444241E+03	1.251000E-03
4.156085E+03	8.589600E-04	5.040332E+03	5.731000E-04	6.133931E+03	3.729700E-04
7.488086E+03	2.372800E-04	9.166967E+03	1.478300E-04	1.126486E+04	9.011200E-05
1.386132E+04	5.412600E-05	1.709441E+04	3.201900E-05	2.112206E+04	1.869200E-05
2.615197E+04	1.077700E-05	3.243614E+04	6.147900E-06	4.023251E+04	3.489300E-06
5.000000E+04	1.962000E-06	–	–	–	–

Table B.2.17: Energy per Nucleon versus ^{35}Cl Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	1.162800E-07	1.408122E-02	1.699000E-07	1.982806E-02	2.478600E-07
2.780981E-02	3.595000E-07	3.875467E-02	5.170200E-07	5.332453E-02	7.323300E-07
7.201205E-02	1.015200E-06	9.504214E-02	1.371200E-06	1.222573E-01	1.799700E-06
1.535488E-01	2.300300E-06	1.887641E-01	2.871600E-06	2.276714E-01	3.510400E-06
2.714374E-01	4.236700E-06	3.199159E-01	5.048900E-06	3.737161E-01	5.958200E-06
4.336543E-01	6.979300E-06	5.006712E-01	8.129600E-06	5.754554E-01	9.422000E-06
6.594890E-01	1.088400E-05	7.538421E-01	1.253500E-05	8.598675E-01	1.440100E-05
9.791078E-01	1.651200E-05	1.111958E+00	1.887500E-05	1.262183E+00	2.156100E-05
1.430260E+00	2.458000E-05	1.619384E+00	2.799400E-05	1.831895E+00	3.184800E-05
2.070313E+00	3.619300E-05	2.337882E+00	4.109300E-05	2.638686E+00	4.662900E-05
2.976327E+00	5.287600E-05	3.354537E+00	5.991000E-05	3.779000E+00	6.784800E-05
4.255003E+00	7.680000E-05	4.788643E+00	8.689500E-05	5.386816E+00	9.828100E-05
6.057149E+00	1.111200E-04	6.808107E+00	1.256000E-04	7.649509E+00	1.419300E-04
8.591997E+00	1.603400E-04	9.647560E+00	1.811100E-04	1.082961E+01	2.045300E-04
1.215322E+01	2.309200E-04	1.363491E+01	2.606700E-04	1.529532E+01	2.942200E-04
1.715376E+01	3.319500E-04	1.923466E+01	3.744200E-04	2.156430E+01	4.221200E-04
2.417442E+01	4.756700E-04	2.709740E+01	5.355800E-04	3.037216E+01	6.025600E-04
3.404070E+01	6.771800E-04	3.815234E+01	7.599300E-04	4.276254E+01	8.515500E-04
4.793135E+01	9.523800E-04	5.373154E+01	1.062600E-03	6.023854E+01	1.182600E-03
6.755091E+01	1.312300E-03	7.576738E+01	1.451100E-03	8.500710E+01	1.598100E-03
9.540710E+01	1.752800E-03	1.071423E+02	1.913300E-03	1.203541E+02	2.076600E-03
1.352905E+02	2.241100E-03	1.521613E+02	2.402800E-03	1.713748E+02	2.558700E-03
1.930143E+02	2.701700E-03	2.178676E+02	2.830500E-03	2.461532E+02	2.937400E-03
2.781110E+02	3.016300E-03	3.147252E+02	3.063000E-03	3.571010E+02	3.073800E-03
4.053476E+02	3.044100E-03	4.617689E+02	2.970700E-03	5.268134E+02	2.853500E-03
6.024618E+02	2.694300E-03	6.913280E+02	2.495400E-03	7.956862E+02	2.263700E-03
9.191872E+02	2.007000E-03	1.067888E+03	1.732400E-03	1.245753E+03	1.455000E-03
1.453242E+03	1.193800E-03	1.709641E+03	9.453000E-04	2.016451E+03	7.272500E-04
2.396919E+03	5.385200E-04	2.863224E+03	3.852400E-04	3.444241E+03	2.650600E-04
4.156085E+03	1.768100E-04	5.040332E+03	1.139900E-04	6.133931E+03	7.135300E-05
7.488086E+03	4.349000E-05	9.166967E+03	2.587300E-05	1.126486E+04	1.501200E-05
1.386132E+04	8.564200E-06	1.709441E+04	4.802600E-06	2.112206E+04	2.653400E-06
2.615197E+04	1.445900E-06	3.243614E+04	7.786500E-07	4.023251E+04	4.169600E-07
5.000000E+04	2.210000E-07	–	–	–	–

Table B.2.18: Energy per Nucleon versus ^{38}Ar Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	3.220600E-07	1.408122E-02	4.689400E-07	1.982806E-02	6.819900E-07
2.780981E-02	9.863900E-07	3.875467E-02	1.415100E-06	5.332453E-02	2.000100E-06
7.201205E-02	2.767700E-06	9.504214E-02	3.732900E-06	1.222573E-01	4.893900E-06
1.535488E-01	6.249700E-06	1.887641E-01	7.796200E-06	2.276714E-01	9.525300E-06
2.714374E-01	1.149100E-05	3.199159E-01	1.368900E-05	3.737161E-01	1.615100E-05
4.336543E-01	1.891500E-05	5.006712E-01	2.202900E-05	5.754554E-01	2.552900E-05
6.594890E-01	2.948900E-05	7.538421E-01	3.396300E-05	8.598675E-01	3.902200E-05
9.791078E-01	4.474500E-05	1.111958E+00	5.115700E-05	1.262183E+00	5.844600E-05
1.430260E+00	6.664400E-05	1.619384E+00	7.591800E-05	1.831895E+00	8.639600E-05
2.070313E+00	9.821600E-05	2.337882E+00	1.115600E-04	2.638686E+00	1.266400E-04
2.976327E+00	1.436700E-04	3.354537E+00	1.628800E-04	3.779000E+00	1.845700E-04
4.255003E+00	2.090600E-04	4.788643E+00	2.367000E-04	5.386816E+00	2.679200E-04
6.057149E+00	3.031700E-04	6.808107E+00	3.429700E-04	7.649509E+00	3.879200E-04
8.591997E+00	4.386800E-04	9.647560E+00	4.960000E-04	1.082961E+01	5.607000E-04
1.215322E+01	6.336900E-04	1.363491E+01	7.160100E-04	1.529532E+01	8.088600E-04
1.715376E+01	9.133000E-04	1.923466E+01	1.030700E-03	2.156430E+01	1.162500E-03
2.417442E+01	1.310000E-03	2.709740E+01	1.474400E-03	3.037216E+01	1.657500E-03
3.404070E+01	1.860100E-03	3.815234E+01	2.083000E-03	4.276254E+01	2.327600E-03
4.793135E+01	2.593600E-03	5.373154E+01	2.880200E-03	6.023854E+01	3.187300E-03
6.755091E+01	3.512900E-03	7.576738E+01	3.853900E-03	8.500710E+01	4.205800E-03
9.540710E+01	4.565200E-03	1.071423E+02	4.926000E-03	1.203541E+02	5.278800E-03
1.352905E+02	5.618300E-03	1.521613E+02	5.934000E-03	1.713748E+02	6.217900E-03
1.930143E+02	6.455600E-03	2.178676E+02	6.643000E-03	2.461532E+02	6.766800E-03
2.781110E+02	6.818300E-03	3.147252E+02	6.791700E-03	3.571010E+02	6.682400E-03
4.053476E+02	6.490100E-03	4.617689E+02	6.211100E-03	5.268134E+02	5.854000E-03
6.024618E+02	5.427000E-03	6.913280E+02	4.939000E-03	7.956862E+02	4.407700E-03
9.191872E+02	3.849600E-03	1.067888E+03	3.278300E-03	1.245753E+03	2.721700E-03
1.453242E+03	2.212700E-03	1.709641E+03	1.739600E-03	2.016451E+03	1.332200E-03
2.396919E+03	9.843400E-04	2.863224E+03	7.044900E-04	3.444241E+03	4.861800E-04
4.156085E+03	3.261000E-04	5.040332E+03	2.118800E-04	6.133931E+03	1.339300E-04
7.488086E+03	8.258400E-05	9.166967E+03	4.977800E-05	1.126486E+04	2.930300E-05
1.386132E+04	1.697900E-05	1.709441E+04	9.679400E-06	2.112206E+04	5.440500E-06
2.615197E+04	3.018000E-06	3.243614E+04	1.655400E-06	4.023251E+04	9.031700E-07
5.000000E+04	4.879300E-07	–	–	–	–

Table B.2.19: Energy per Nucleon versus ^{39}K Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	2.616800E-07	1.408122E-02	3.811600E-07	1.982806E-02	5.545500E-07
2.780981E-02	8.024200E-07	3.875467E-02	1.151700E-06	5.332453E-02	1.628700E-06
7.201205E-02	2.254800E-06	9.504214E-02	3.042600E-06	1.222573E-01	3.990700E-06
1.535488E-01	5.098500E-06	1.887641E-01	6.362800E-06	2.276714E-01	7.776900E-06
2.714374E-01	9.385300E-06	3.199159E-01	1.118500E-05	3.737161E-01	1.320000E-05
4.336543E-01	1.546500E-05	5.006712E-01	1.801800E-05	5.754554E-01	2.088700E-05
6.594890E-01	2.413500E-05	7.538421E-01	2.780600E-05	8.598675E-01	3.195900E-05
9.791078E-01	3.665800E-05	1.111958E+00	4.192500E-05	1.262183E+00	4.791500E-05
1.430260E+00	5.465500E-05	1.619384E+00	6.228200E-05	1.831895E+00	7.090300E-05
2.070313E+00	8.063300E-05	2.337882E+00	9.162000E-05	2.638686E+00	1.040500E-04
2.976327E+00	1.180900E-04	3.354537E+00	1.339400E-04	3.779000E+00	1.518400E-04
4.255003E+00	1.720700E-04	4.788643E+00	1.949300E-04	5.386816E+00	2.207700E-04
6.057149E+00	2.499600E-04	6.808107E+00	2.829600E-04	7.649509E+00	3.202600E-04
8.591997E+00	3.624400E-04	9.647560E+00	4.101100E-04	1.082961E+01	4.640000E-04
1.215322E+01	5.248800E-04	1.363491E+01	5.936300E-04	1.529532E+01	6.712900E-04
1.715376E+01	7.587600E-04	1.923466E+01	8.572600E-04	2.156430E+01	9.679100E-04
2.417442E+01	1.092000E-03	2.709740E+01	1.230400E-03	3.037216E+01	1.384600E-03
3.404070E+01	1.555400E-03	3.815234E+01	1.743300E-03	4.276254E+01	1.949300E-03
4.793135E+01	2.173100E-03	5.373154E+01	2.413700E-03	6.023854E+01	2.670700E-03
6.755091E+01	2.942200E-03	7.576738E+01	3.224900E-03	8.500710E+01	3.514500E-03
9.540710E+01	3.807800E-03	1.071423E+02	4.098900E-03	1.203541E+02	4.379500E-03
1.352905E+02	4.644800E-03	1.521613E+02	4.885800E-03	1.713748E+02	5.095600E-03
1.930143E+02	5.263000E-03	2.178676E+02	5.384400E-03	2.461532E+02	5.450100E-03
2.781110E+02	5.454900E-03	3.147252E+02	5.394900E-03	3.571010E+02	5.268000E-03
4.053476E+02	5.076600E-03	4.617689E+02	4.818900E-03	5.268134E+02	4.504500E-03
6.024618E+02	4.141100E-03	6.913280E+02	3.737100E-03	7.956862E+02	3.307200E-03
9.191872E+02	2.864500E-03	1.067888E+03	2.419300E-03	1.245753E+03	1.992500E-03
1.453242E+03	1.607600E-03	1.709641E+03	1.254400E-03	2.016451E+03	9.537700E-04
2.396919E+03	6.997700E-04	2.863224E+03	4.973900E-04	3.444241E+03	3.409100E-04
4.156085E+03	2.271100E-04	5.040332E+03	1.465500E-04	6.133931E+03	9.199600E-05
7.488086E+03	5.632000E-05	9.166967E+03	3.369700E-05	1.126486E+04	1.968400E-05
1.386132E+04	1.131500E-05	1.709441E+04	6.397100E-06	2.112206E+04	3.565000E-06
2.615197E+04	1.960200E-06	3.243614E+04	1.065500E-06	4.023251E+04	5.759700E-07
5.000000E+04	3.082400E-07	–	–	–	–

Table B.2.20: Energy per Nucleon versus ^{40}Ca Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	8.868500E-07	1.408122E-02	1.288500E-06	1.982806E-02	1.870400E-06
2.780981E-02	2.701100E-06	3.875467E-02	3.870500E-06	5.332453E-02	5.466200E-06
7.201205E-02	7.559800E-06	9.504214E-02	1.019400E-05	1.222573E-01	1.336300E-05
1.535488E-01	1.706700E-05	1.887641E-01	2.129500E-05	2.276714E-01	2.602600E-05
2.714374E-01	3.140900E-05	3.199159E-01	3.743400E-05	3.737161E-01	4.418500E-05
4.336543E-01	5.177500E-05	5.006712E-01	6.033300E-05	5.754554E-01	6.996100E-05
6.594890E-01	8.086300E-05	7.538421E-01	9.319600E-05	8.598675E-01	1.071500E-04
9.791078E-01	1.229600E-04	1.111958E+00	1.406900E-04	1.262183E+00	1.608700E-04
1.430260E+00	1.836000E-04	1.619384E+00	2.093300E-04	1.831895E+00	2.384500E-04
2.070313E+00	2.713500E-04	2.337882E+00	3.085500E-04	2.638686E+00	3.506700E-04
2.976327E+00	3.983400E-04	3.354537E+00	4.521800E-04	3.779000E+00	5.131300E-04
4.255003E+00	5.821100E-04	4.788643E+00	6.601900E-04	5.386816E+00	7.486000E-04
6.057149E+00	8.487100E-04	6.808107E+00	9.620800E-04	7.649509E+00	1.090500E-03
8.591997E+00	1.236100E-03	9.647560E+00	1.401000E-03	1.082961E+01	1.587800E-03
1.215322E+01	1.799300E-03	1.363491E+01	2.038700E-03	1.529532E+01	2.309500E-03
1.715376E+01	2.614900E-03	1.923466E+01	2.959100E-03	2.156430E+01	3.345800E-03
2.417442E+01	3.779000E-03	2.709740E+01	4.261300E-03	3.037216E+01	4.797100E-03
3.404070E+01	5.387700E-03	3.815234E+01	6.032600E-03	4.276254E+01	6.733900E-03
4.793135E+01	7.487300E-03	5.373154E+01	8.285800E-03	6.023854E+01	9.124500E-03
6.755091E+01	9.992100E-03	7.576738E+01	1.087300E-02	8.500710E+01	1.175000E-02
9.540710E+01	1.260600E-02	1.071423E+02	1.341900E-02	1.203541E+02	1.416100E-02
1.352905E+02	1.481500E-02	1.521613E+02	1.535400E-02	1.713748E+02	1.575900E-02
1.930143E+02	1.600700E-02	2.178676E+02	1.608700E-02	2.461532E+02	1.598500E-02
2.781110E+02	1.570200E-02	3.147252E+02	1.523700E-02	3.571010E+02	1.459400E-02
4.053476E+02	1.380000E-02	4.617689E+02	1.285600E-02	5.268134E+02	1.180400E-02
6.024618E+02	1.066800E-02	6.913280E+02	9.475700E-03	7.956862E+02	8.266300E-03
9.191872E+02	7.070900E-03	1.067888E+03	5.909800E-03	1.245753E+03	4.828400E-03
1.453242E+03	3.875800E-03	1.709641E+03	3.017300E-03	2.016451E+03	2.295700E-03
2.396919E+03	1.690900E-03	2.863224E+03	1.210400E-03	3.444241E+03	8.382200E-04
4.156085E+03	5.658200E-04	5.040332E+03	3.709800E-04	6.133931E+03	2.371700E-04
7.488086E+03	1.481700E-04	9.166967E+03	9.062100E-05	1.126486E+04	5.419700E-05
1.386132E+04	3.193000E-05	1.709441E+04	1.852000E-05	2.112206E+04	1.059700E-05
2.615197E+04	5.986500E-06	3.243614E+04	3.345100E-06	4.023251E+04	1.859400E-06
5.000000E+04	1.023700E-06	–	–	–	–

Table B.2.21: Energy per Nucleon versus ^{43}Sc Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	1.586700E-07	1.408122E-02	2.306000E-07	1.982806E-02	3.348400E-07
2.780981E-02	4.836200E-07	3.875467E-02	6.930300E-07	5.332453E-02	9.786800E-07
7.201205E-02	1.353300E-06	9.504214E-02	1.824500E-06	1.222573E-01	2.391200E-06
1.535488E-01	3.053100E-06	1.887641E-01	3.808400E-06	2.276714E-01	4.653100E-06
2.714374E-01	5.613700E-06	3.199159E-01	6.688500E-06	3.737161E-01	7.892300E-06
4.336543E-01	9.244900E-06	5.006712E-01	1.077000E-05	5.754554E-01	1.248400E-05
6.594890E-01	1.442400E-05	7.538421E-01	1.661800E-05	8.598675E-01	1.910000E-05
9.791078E-01	2.190900E-05	1.111958E+00	2.505900E-05	1.262183E+00	2.864200E-05
1.430260E+00	3.267400E-05	1.619384E+00	3.723900E-05	1.831895E+00	4.239900E-05
2.070313E+00	4.822700E-05	2.337882E+00	5.481000E-05	2.638686E+00	6.226200E-05
2.976327E+00	7.068500E-05	3.354537E+00	8.019200E-05	3.779000E+00	9.094400E-05
4.255003E+00	1.031000E-04	4.788643E+00	1.168400E-04	5.386816E+00	1.323900E-04
6.057149E+00	1.499700E-04	6.808107E+00	1.698500E-04	7.649509E+00	1.923400E-04
8.591997E+00	2.177900E-04	9.647560E+00	2.465700E-04	1.082961E+01	2.791300E-04
1.215322E+01	3.159100E-04	1.363491E+01	3.574700E-04	1.529532E+01	4.044100E-04
1.715376E+01	4.572400E-04	1.923466E+01	5.167000E-04	2.156430E+01	5.834100E-04
2.417442E+01	6.580600E-04	2.709740E+01	7.411100E-04	3.037216E+01	8.333400E-04
3.404070E+01	9.350600E-04	3.815234E+01	1.046300E-03	4.276254E+01	1.167500E-03
4.793135E+01	1.298100E-03	5.373154E+01	1.437300E-03	6.023854E+01	1.584300E-03
6.755091E+01	1.737700E-03	7.576738E+01	1.895100E-03	8.500710E+01	2.053600E-03
9.540710E+01	2.210900E-03	1.071423E+02	2.363500E-03	1.203541E+02	2.506300E-03
1.352905E+02	2.636700E-03	1.521613E+02	2.749700E-03	1.713748E+02	2.841600E-03
1.930143E+02	2.907200E-03	2.178676E+02	2.944800E-03	2.461532E+02	2.950300E-03
2.781110E+02	2.922300E-03	3.147252E+02	2.859800E-03	3.571010E+02	2.762700E-03
4.053476E+02	2.634100E-03	4.617689E+02	2.473800E-03	5.268134E+02	2.288400E-03
6.024618E+02	2.082500E-03	6.913280E+02	1.860900E-03	7.956862E+02	1.631400E-03
9.191872E+02	1.400600E-03	1.067888E+03	1.173100E-03	1.245753E+03	9.589200E-04
1.453242E+03	7.686800E-04	1.709641E+03	5.963700E-04	2.016451E+03	4.513000E-04
2.396919E+03	3.298600E-04	2.863224E+03	2.338100E-04	3.444241E+03	1.599700E-04
4.156085E+03	1.064900E-04	5.040332E+03	6.872300E-05	6.133931E+03	4.318000E-05
7.488086E+03	2.647800E-05	9.166967E+03	1.587700E-05	1.126486E+04	9.300500E-06
1.386132E+04	5.363400E-06	1.709441E+04	3.043100E-06	2.112206E+04	1.702500E-06
2.615197E+04	9.399400E-07	3.243614E+04	5.131200E-07	4.023251E+04	2.786200E-07
5.000000E+04	1.497900E-07	–	–	–	–

Table B.2.22: Energy per Nucleon versus ^{47}Ti Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	7.595200E-07	1.408122E-02	1.100600E-06	1.982806E-02	1.593900E-06
2.780981E-02	2.296800E-06	3.875467E-02	3.284600E-06	5.332453E-02	4.630500E-06
7.201205E-02	6.394400E-06	9.504214E-02	8.611100E-06	1.222573E-01	1.127700E-05
1.535488E-01	1.439000E-05	1.887641E-01	1.794200E-05	2.276714E-01	2.191400E-05
2.714374E-01	2.643300E-05	3.199159E-01	3.149000E-05	3.737161E-01	3.715500E-05
4.336543E-01	4.352200E-05	5.006712E-01	5.070200E-05	5.754554E-01	5.877800E-05
6.594890E-01	6.792400E-05	7.538421E-01	7.826900E-05	8.598675E-01	8.997800E-05
9.791078E-01	1.032400E-04	1.111958E+00	1.181100E-04	1.262183E+00	1.350400E-04
1.430260E+00	1.541100E-04	1.619384E+00	1.757100E-04	1.831895E+00	2.001500E-04
2.070313E+00	2.277800E-04	2.337882E+00	2.590100E-04	2.638686E+00	2.944000E-04
2.976327E+00	3.344400E-04	3.354537E+00	3.797000E-04	3.779000E+00	4.309400E-04
4.255003E+00	4.889500E-04	4.788643E+00	5.546300E-04	5.386816E+00	6.290200E-04
6.057149E+00	7.132900E-04	6.808107E+00	8.087400E-04	7.649509E+00	9.169200E-04
8.591997E+00	1.039500E-03	9.647560E+00	1.178400E-03	1.082961E+01	1.335600E-03
1.215322E+01	1.513600E-03	1.363491E+01	1.714800E-03	1.529532E+01	1.942200E-03
1.715376E+01	2.198200E-03	1.923466E+01	2.486100E-03	2.156430E+01	2.808700E-03
2.417442E+01	3.168900E-03	2.709740E+01	3.568000E-03	3.037216E+01	4.009300E-03
3.404070E+01	4.492800E-03	3.815234E+01	5.017000E-03	4.276254E+01	5.582500E-03
4.793135E+01	6.184400E-03	5.373154E+01	6.815600E-03	6.023854E+01	7.470700E-03
6.755091E+01	8.139300E-03	7.576738E+01	8.807800E-03	8.500710E+01	9.460300E-03
9.540710E+01	1.008400E-02	1.071423E+02	1.066200E-02	1.203541E+02	1.117100E-02
1.352905E+02	1.160000E-02	1.521613E+02	1.192900E-02	1.713748E+02	1.214500E-02
1.930143E+02	1.223500E-02	2.178676E+02	1.219100E-02	2.461532E+02	1.200800E-02
2.781110E+02	1.169100E-02	3.147252E+02	1.124300E-02	3.571010E+02	1.066800E-02
4.053476E+02	9.992900E-03	4.617689E+02	9.218600E-03	5.268134E+02	8.380100E-03
6.024618E+02	7.497000E-03	6.913280E+02	6.589000E-03	7.956862E+02	5.686000E-03
9.191872E+02	4.809300E-03	1.067888E+03	3.972400E-03	1.245753E+03	3.206000E-03
1.453242E+03	2.541800E-03	1.709641E+03	1.952800E-03	2.016451E+03	1.465800E-03
2.396919E+03	1.064300E-03	2.863224E+03	7.505900E-04	3.444241E+03	5.117300E-04
4.156085E+03	3.399400E-04	5.040332E+03	2.192200E-04	6.133931E+03	1.377900E-04
7.488086E+03	8.460800E-05	9.166967E+03	5.084300E-05	1.126486E+04	2.986600E-05
1.386132E+04	1.728000E-05	1.709441E+04	9.840400E-06	2.112206E+04	5.527200E-06
2.615197E+04	3.064600E-06	3.243614E+04	1.680400E-06	4.023251E+04	9.166200E-07
5.000000E+04	4.951200E-07	–	–	–	–

Table B.2.23: Energy per Nucleon versus ^{49}V Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	3.205900E-07	1.408122E-02	4.649600E-07	1.982806E-02	6.738300E-07
2.780981E-02	9.716000E-07	3.875467E-02	1.390200E-06	5.332453E-02	1.960700E-06
7.201205E-02	2.708400E-06	9.504214E-02	3.648100E-06	1.222573E-01	4.778000E-06
1.535488E-01	6.097500E-06	1.887641E-01	7.602700E-06	2.276714E-01	9.286000E-06
2.714374E-01	1.120000E-05	3.199159E-01	1.334200E-05	3.737161E-01	1.574100E-05
4.336543E-01	1.843800E-05	5.006712E-01	2.147700E-05	5.754554E-01	2.489500E-05
6.594890E-01	2.876400E-05	7.538421E-01	3.314000E-05	8.598675E-01	3.809200E-05
9.791078E-01	4.369800E-05	1.111958E+00	4.998500E-05	1.262183E+00	5.713900E-05
1.430260E+00	6.519300E-05	1.619384E+00	7.431400E-05	1.831895E+00	8.463100E-05
2.070313E+00	9.628500E-05	2.337882E+00	1.094600E-04	2.638686E+00	1.243700E-04
2.976327E+00	1.412500E-04	3.354537E+00	1.603000E-04	3.779000E+00	1.818700E-04
4.255003E+00	2.062700E-04	4.788643E+00	2.338700E-04	5.386816E+00	2.651200E-04
6.057149E+00	3.004800E-04	6.808107E+00	3.405100E-04	7.649509E+00	3.858300E-04
8.591997E+00	4.371500E-04	9.647560E+00	4.952400E-04	1.082961E+01	5.609700E-04
1.215322E+01	6.352700E-04	1.363491E+01	7.192300E-04	1.529532E+01	8.140700E-04
1.715376E+01	9.207600E-04	1.923466E+01	1.040700E-03	2.156430E+01	1.175200E-03
2.417442E+01	1.325300E-03	2.709740E+01	1.491800E-03	3.037216E+01	1.676000E-03
3.404070E+01	1.878300E-03	3.815234E+01	2.098200E-03	4.276254E+01	2.336200E-03
4.793135E+01	2.590600E-03	5.373154E+01	2.858700E-03	6.023854E+01	3.139000E-03
6.755091E+01	3.427200E-03	7.576738E+01	3.718400E-03	8.500710E+01	4.006100E-03
9.540710E+01	4.285500E-03	1.071423E+02	4.549100E-03	1.203541E+02	4.787700E-03
1.352905E+02	4.996000E-03	1.521613E+02	5.165400E-03	1.713748E+02	5.289800E-03
1.930143E+02	5.361500E-03	2.178676E+02	5.377700E-03	2.461532E+02	5.333800E-03
2.781110E+02	5.230000E-03	3.147252E+02	5.066400E-03	3.571010E+02	4.844100E-03
4.053476E+02	4.572100E-03	4.617689E+02	4.250800E-03	5.268134E+02	3.894200E-03
6.024618E+02	3.510700E-03	6.913280E+02	3.109200E-03	7.956862E+02	2.703100E-03
9.191872E+02	2.302900E-03	1.067888E+03	1.915600E-03	1.245753E+03	1.556400E-03
1.453242E+03	1.241500E-03	1.709641E+03	9.594400E-04	2.016451E+03	7.240500E-04
2.396919E+03	5.283500E-04	2.863224E+03	3.743400E-04	3.444241E+03	2.563100E-04
4.156085E+03	1.709300E-04	5.040332E+03	1.106300E-04	6.133931E+03	6.977900E-05
7.488086E+03	4.298700E-05	9.166967E+03	2.591400E-05	1.126486E+04	1.527000E-05
1.386132E+04	8.862600E-06	1.709441E+04	5.063000E-06	2.112206E+04	2.852800E-06
2.615197E+04	1.586900E-06	3.243614E+04	8.729700E-07	4.023251E+04	4.777400E-07
5.000000E+04	2.589200E-07	–	–	–	–

Table B.2.24: Energy per Nucleon versus ^{52}Cr Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	6.787400E-07	1.408122E-02	9.842000E-07	1.982806E-02	1.426100E-06
2.780981E-02	2.056000E-06	3.875467E-02	2.941600E-06	5.332453E-02	4.148400E-06
7.201205E-02	5.730400E-06	9.504214E-02	7.718800E-06	1.222573E-01	1.011000E-05
1.535488E-01	1.290300E-05	1.887641E-01	1.608900E-05	2.276714E-01	1.965300E-05
2.714374E-01	2.370700E-05	3.199159E-01	2.824300E-05	3.737161E-01	3.332400E-05
4.336543E-01	3.903600E-05	5.006712E-01	4.547500E-05	5.754554E-01	5.271800E-05
6.594890E-01	6.091900E-05	7.538421E-01	7.019500E-05	8.598675E-01	8.069300E-05
9.791078E-01	9.258100E-05	1.111958E+00	1.059100E-04	1.262183E+00	1.210900E-04
1.430260E+00	1.381800E-04	1.619384E+00	1.575300E-04	1.831895E+00	1.794300E-04
2.070313E+00	2.041700E-04	2.337882E+00	2.321400E-04	2.638686E+00	2.638300E-04
2.976327E+00	2.996800E-04	3.354537E+00	3.401800E-04	3.779000E+00	3.860300E-04
4.255003E+00	4.379200E-04	4.788643E+00	4.966500E-04	5.386816E+00	5.631600E-04
6.057149E+00	6.384700E-04	6.808107E+00	7.237500E-04	7.649509E+00	8.203700E-04
8.591997E+00	9.298100E-04	9.647560E+00	1.053800E-03	1.082961E+01	1.194100E-03
1.215322E+01	1.352900E-03	1.363491E+01	1.532400E-03	1.529532E+01	1.735200E-03
1.715376E+01	1.963500E-03	1.923466E+01	2.220400E-03	2.156430E+01	2.508300E-03
2.417442E+01	2.829900E-03	2.709740E+01	3.186600E-03	3.037216E+01	3.581400E-03
3.404070E+01	4.014600E-03	3.815234E+01	4.485100E-03	4.276254E+01	4.993700E-03
4.793135E+01	5.536600E-03	5.373154E+01	6.107800E-03	6.023854E+01	6.703000E-03
6.755091E+01	7.313300E-03	7.576738E+01	7.927100E-03	8.500710E+01	8.530600E-03
9.540710E+01	9.112800E-03	1.071423E+02	9.657500E-03	1.203541E+02	1.014500E-02
1.352905E+02	1.056500E-02	1.521613E+02	1.089900E-02	1.713748E+02	1.113400E-02
1.930143E+02	1.125600E-02	2.178676E+02	1.126000E-02	2.461532E+02	1.113700E-02
2.781110E+02	1.089000E-02	3.147252E+02	1.052100E-02	3.571010E+02	1.003200E-02
4.053476E+02	9.444600E-03	4.617689E+02	8.760200E-03	5.268134E+02	8.008600E-03
6.024618E+02	7.207400E-03	6.913280E+02	6.374500E-03	7.956862E+02	5.537300E-03
9.191872E+02	4.716300E-03	1.067888E+03	3.924700E-03	1.245753E+03	3.192500E-03
1.453242E+03	2.551600E-03	1.709641E+03	1.977500E-03	2.016451E+03	1.497900E-03
2.396919E+03	1.098300E-03	2.863224E+03	7.826100E-04	3.444241E+03	5.394700E-04
4.156085E+03	3.625100E-04	5.040332E+03	2.366100E-04	6.133931E+03	1.506100E-04
7.488086E+03	9.369200E-05	9.166967E+03	5.706600E-05	1.126486E+04	3.399200E-05
1.386132E+04	1.995000E-05	1.709441E+04	1.152800E-05	2.112206E+04	6.572300E-06
2.615197E+04	3.699800E-06	3.243614E+04	2.060300E-06	4.023251E+04	1.141400E-06
5.000000E+04	6.263300E-07	–	–	–	–

Table B.2.25: Energy per Nucleon versus ^{54}Mn Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	3.972400E-07	1.408122E-02	5.760700E-07	1.982806E-02	8.347600E-07
2.780981E-02	1.203500E-06	3.875467E-02	1.722000E-06	5.332453E-02	2.428500E-06
7.201205E-02	3.354500E-06	9.504214E-02	4.518300E-06	1.222573E-01	5.917900E-06
1.535488E-01	7.552200E-06	1.887641E-01	9.416800E-06	2.276714E-01	1.150200E-05
2.714374E-01	1.387400E-05	3.199159E-01	1.652700E-05	3.737161E-01	1.950000E-05
4.336543E-01	2.284000E-05	5.006712E-01	2.660700E-05	5.754554E-01	3.084200E-05
6.594890E-01	3.563800E-05	7.538421E-01	4.106100E-05	8.598675E-01	4.719800E-05
9.791078E-01	5.414800E-05	1.111958E+00	6.194100E-05	1.262183E+00	7.081000E-05
1.430260E+00	8.079600E-05	1.619384E+00	9.210500E-05	1.831895E+00	1.049000E-04
2.070313E+00	1.193500E-04	2.337882E+00	1.356900E-04	2.638686E+00	1.541900E-04
2.976327E+00	1.751300E-04	3.354537E+00	1.987700E-04	3.779000E+00	2.255300E-04
4.255003E+00	2.558100E-04	4.788643E+00	2.900800E-04	5.386816E+00	3.288800E-04
6.057149E+00	3.727900E-04	6.808107E+00	4.225100E-04	7.649509E+00	4.788200E-04
8.591997E+00	5.425800E-04	9.647560E+00	6.147800E-04	1.082961E+01	6.965000E-04
1.215322E+01	7.889000E-04	1.363491E+01	8.933300E-04	1.529532E+01	1.011300E-03
1.715376E+01	1.144100E-03	1.923466E+01	1.293400E-03	2.156430E+01	1.460600E-03
2.417442E+01	1.647500E-03	2.709740E+01	1.854700E-03	3.037216E+01	2.083900E-03
3.404070E+01	2.335500E-03	3.815234E+01	2.608900E-03	4.276254E+01	2.904600E-03
4.793135E+01	3.220300E-03	5.373154E+01	3.553000E-03	6.023854E+01	3.900100E-03
6.755091E+01	4.256700E-03	7.576738E+01	4.616300E-03	8.500710E+01	4.971200E-03
9.540710E+01	5.315000E-03	1.071423E+02	5.638700E-03	1.203541E+02	5.931300E-03
1.352905E+02	6.186000E-03	1.521613E+02	6.392700E-03	1.713748E+02	6.544200E-03
1.930143E+02	6.631400E-03	2.178676E+02	6.651200E-03	2.461532E+02	6.598400E-03
2.781110E+02	6.473400E-03	3.147252E+02	6.276700E-03	3.571010E+02	6.009700E-03
4.053476E+02	5.683300E-03	4.617689E+02	5.297800E-03	5.268134E+02	4.869800E-03
6.024618E+02	4.409000E-03	6.913280E+02	3.925300E-03	7.956862E+02	3.434500E-03
9.191872E+02	2.948600E-03	1.067888E+03	2.475400E-03	1.245753E+03	2.033100E-03
1.453242E+03	1.641700E-03	1.709641E+03	1.287000E-03	2.016451E+03	9.868999E-04
2.396919E+03	7.334700E-04	2.863224E+03	5.303700E-04	3.444241E+03	3.714700E-04
4.156085E+03	2.538800E-04	5.040332E+03	1.687400E-04	6.133931E+03	1.094700E-04
7.488086E+03	6.947500E-05	9.166967E+03	4.320600E-05	1.126486E+04	2.630100E-05
1.386132E+04	1.578300E-05	1.709441E+04	9.331900E-06	2.112206E+04	5.446500E-06
2.615197E+04	3.140400E-06	3.243614E+04	1.792000E-06	4.023251E+04	1.017500E-06
5.000000E+04	5.724600E-07	–	–	–	–

Table B.2.26: Energy per Nucleon versus ^{56}Fe Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	4.919800E-06	1.408122E-02	7.126200E-06	1.982806E-02	1.031600E-05
2.780981E-02	1.486000E-05	3.875467E-02	2.124600E-05	5.332453E-02	2.994500E-05
7.201205E-02	4.134700E-05	9.504214E-02	5.567500E-05	1.222573E-01	7.290800E-05
1.535488E-01	9.303200E-05	1.887641E-01	1.160000E-04	2.276714E-01	1.416800E-04
2.714374E-01	1.709100E-04	3.199159E-01	2.036100E-04	3.737161E-01	2.402600E-04
4.336543E-01	2.814600E-04	5.006712E-01	3.279100E-04	5.754554E-01	3.801800E-04
6.594890E-01	4.393800E-04	7.538421E-01	5.063500E-04	8.598675E-01	5.821600E-04
9.791078E-01	6.680400E-04	1.111958E+00	7.643800E-04	1.262183E+00	8.740700E-04
1.430260E+00	9.976299E-04	1.619384E+00	1.137600E-03	1.831895E+00	1.296100E-03
2.070313E+00	1.475200E-03	2.337882E+00	1.677800E-03	2.638686E+00	1.907400E-03
2.976327E+00	2.167300E-03	3.354537E+00	2.461100E-03	3.779000E+00	2.793900E-03
4.255003E+00	3.170800E-03	4.788643E+00	3.597800E-03	5.386816E+00	4.081600E-03
6.057149E+00	4.629900E-03	6.808107E+00	5.251300E-03	7.649509E+00	5.955900E-03
8.591997E+00	6.754700E-03	9.647560E+00	7.660300E-03	1.082961E+01	8.686600E-03
1.215322E+01	9.848300E-03	1.363491E+01	1.116300E-02	1.529532E+01	1.264900E-02
1.715376E+01	1.432200E-02	1.923466E+01	1.620500E-02	2.156430E+01	1.831500E-02
2.417442E+01	2.067100E-02	2.709740E+01	2.328000E-02	3.037216E+01	2.616300E-02
3.404070E+01	2.931900E-02	3.815234E+01	3.273500E-02	4.276254E+01	3.641400E-02
4.793135E+01	4.032100E-02	5.373154E+01	4.440400E-02	6.023854E+01	4.862900E-02
6.755091E+01	5.292000E-02	7.576738E+01	5.719000E-02	8.500710E+01	6.133400E-02
9.540710E+01	6.526800E-02	1.071423E+02	6.887600E-02	1.203541E+02	7.202500E-02
1.352905E+02	7.463700E-02	1.521613E+02	7.659900E-02	1.713748E+02	7.783500E-02
1.930143E+02	7.826600E-02	2.178676E+02	7.786200E-02	2.461532E+02	7.660000E-02
2.781110E+02	7.451800E-02	3.147252E+02	7.164400E-02	3.571010E+02	6.801500E-02
4.053476E+02	6.379200E-02	4.617689E+02	5.898800E-02	5.268134E+02	5.381400E-02
6.024618E+02	4.838100E-02	6.913280E+02	4.280100E-02	7.956862E+02	3.724600E-02
9.191872E+02	3.183400E-02	1.067888E+03	2.663700E-02	1.245753E+03	2.183400E-02
1.453242E+03	1.762100E-02	1.709641E+03	1.382800E-02	2.016451E+03	1.063200E-02
2.396919E+03	7.936400E-03	2.863224E+03	5.773600E-03	3.444241E+03	4.075600E-03
4.156085E+03	2.811500E-03	5.040332E+03	1.888900E-03	6.133931E+03	1.240300E-03
7.488086E+03	7.975400E-04	9.166967E+03	5.030000E-04	1.126486E+04	3.107900E-04
1.386132E+04	1.894200E-04	1.709441E+04	1.138000E-04	2.112206E+04	6.752000E-05
2.615197E+04	3.959200E-05	3.243614E+04	2.298300E-05	4.023251E+04	1.327800E-05
5.000000E+04	7.602600E-06	–	–	–	–

Table B.2.27: Energy per Nucleon versus ^{57}Co Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	2.180400E-08	1.408122E-02	3.161900E-08	1.982806E-02	4.581800E-08
2.780981E-02	6.605900E-08	3.875467E-02	9.451400E-08	5.332453E-02	1.332900E-07
7.201205E-02	1.841200E-07	9.504214E-02	2.480100E-07	1.222573E-01	3.248400E-07
1.535488E-01	4.145600E-07	1.887641E-01	5.169300E-07	2.276714E-01	6.314100E-07
2.714374E-01	7.616300E-07	3.199159E-01	9.073300E-07	3.737161E-01	1.070500E-06
4.336543E-01	1.254000E-06	5.006712E-01	1.460800E-06	5.754554E-01	1.693400E-06
6.594890E-01	1.956800E-06	7.538421E-01	2.254600E-06	8.598675E-01	2.591700E-06
9.791078E-01	2.973400E-06	1.111958E+00	3.401500E-06	1.262183E+00	3.888700E-06
1.430260E+00	4.437200E-06	1.619384E+00	5.058500E-06	1.831895E+00	5.761400E-06
2.070313E+00	6.555500E-06	2.337882E+00	7.453100E-06	2.638686E+00	8.469900E-06
2.976327E+00	9.620300E-06	3.354537E+00	1.092000E-05	3.779000E+00	1.239100E-05
4.255003E+00	1.405500E-05	4.788643E+00	1.593900E-05	5.386816E+00	1.807200E-05
6.057149E+00	2.048600E-05	6.808107E+00	2.322100E-05	7.649509E+00	2.631700E-05
8.591997E+00	2.982500E-05	9.647560E+00	3.379700E-05	1.082961E+01	3.829300E-05
1.215322E+01	4.337800E-05	1.363491E+01	4.912600E-05	1.529532E+01	5.562100E-05
1.715376E+01	6.293100E-05	1.923466E+01	7.115200E-05	2.156430E+01	8.036600E-05
2.417442E+01	9.065600E-05	2.709740E+01	1.020700E-04	3.037216E+01	1.147000E-04
3.404070E+01	1.285600E-04	3.815234E+01	1.436200E-04	4.276254E+01	1.599000E-04
4.793135E+01	1.772800E-04	5.373154E+01	1.955900E-04	6.023854E+01	2.146800E-04
6.755091E+01	2.342800E-04	7.576738E+01	2.540300E-04	8.500710E+01	2.734900E-04
9.540710E+01	2.923300E-04	1.071423E+02	3.100200E-04	1.203541E+02	3.259700E-04
1.352905E+02	3.398100E-04	1.521613E+02	3.509900E-04	1.713748E+02	3.591000E-04
1.930143E+02	3.636600E-04	2.178676E+02	3.645100E-04	2.461532E+02	3.613600E-04
2.781110E+02	3.542700E-04	3.147252E+02	3.432700E-04	3.571010E+02	3.284300E-04
4.053476E+02	3.103800E-04	4.617689E+02	2.891300E-04	5.268134E+02	2.656100E-04
6.024618E+02	2.403400E-04	6.913280E+02	2.138700E-04	7.956862E+02	1.870500E-04
9.191872E+02	1.605500E-04	1.067888E+03	1.347600E-04	1.245753E+03	1.106800E-04
1.453242E+03	8.938300E-05	1.709641E+03	7.009200E-05	2.016451E+03	5.377700E-05
2.396919E+03	3.999400E-05	2.863224E+03	2.894500E-05	3.444241E+03	2.029500E-05
4.156085E+03	1.388700E-05	5.040332E+03	9.242500E-06	6.133931E+03	6.005400E-06
7.488086E+03	3.817400E-06	9.166967E+03	2.378000E-06	1.126486E+04	1.450200E-06
1.386132E+04	8.718900E-07	1.709441E+04	5.164900E-07	2.112206E+04	3.020300E-07
2.615197E+04	1.744900E-07	3.243614E+04	9.976900E-08	4.023251E+04	5.676400E-08
5.000000E+04	3.200200E-08	–	–	–	–

Table B.2.28: Energy per Nucleon versus ^{58}Ni Flux Data for the Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	1.863100E-07	1.408122E-02	2.703800E-07	1.982806E-02	3.920700E-07
2.780981E-02	5.656600E-07	3.875467E-02	8.098300E-07	5.332453E-02	1.142800E-06
7.201205E-02	1.579400E-06	9.504214E-02	2.128300E-06	1.222573E-01	2.788700E-06
1.535488E-01	3.560100E-06	1.887641E-01	4.440400E-06	2.276714E-01	5.425100E-06
2.714374E-01	6.545400E-06	3.199159E-01	7.799000E-06	3.737161E-01	9.203600E-06
4.336543E-01	1.078200E-05	5.006712E-01	1.256300E-05	5.754554E-01	1.456500E-05
6.594890E-01	1.683200E-05	7.538421E-01	1.939700E-05	8.598675E-01	2.229900E-05
9.791078E-01	2.558600E-05	1.111958E+00	2.927300E-05	1.262183E+00	3.346900E-05
1.430260E+00	3.819300E-05	1.619384E+00	4.354500E-05	1.831895E+00	4.959900E-05
2.070313E+00	5.643900E-05	2.337882E+00	6.417200E-05	2.638686E+00	7.293100E-05
2.976327E+00	8.284200E-05	3.354537E+00	9.403800E-05	3.779000E+00	1.067100E-04
4.255003E+00	1.210500E-04	4.788643E+00	1.372900E-04	5.386816E+00	1.556700E-04
6.057149E+00	1.764900E-04	6.808107E+00	2.000600E-04	7.649509E+00	2.267700E-04
8.591997E+00	2.570200E-04	9.647560E+00	2.913000E-04	1.082961E+01	3.301100E-04
1.215322E+01	3.740300E-04	1.363491E+01	4.237000E-04	1.529532E+01	4.798700E-04
1.715376E+01	5.431300E-04	1.923466E+01	6.143600E-04	2.156430E+01	6.942800E-04
2.417442E+01	7.836500E-04	2.709740E+01	8.829200E-04	3.037216E+01	9.929501E-04
3.404070E+01	1.113900E-03	3.815234E+01	1.245600E-03	4.276254E+01	1.388300E-03
4.793135E+01	1.541000E-03	5.373154E+01	1.702200E-03	6.023854E+01	1.870900E-03
6.755091E+01	2.044500E-03	7.576738E+01	2.220000E-03	8.500710E+01	2.393600E-03
9.540710E+01	2.562400E-03	1.071423E+02	2.721800E-03	1.203541E+02	2.866500E-03
1.352905E+02	2.993400E-03	1.521613E+02	3.097300E-03	1.713748E+02	3.174800E-03
1.930143E+02	3.221600E-03	2.178676E+02	3.236100E-03	2.461532E+02	3.215800E-03
2.781110E+02	3.160900E-03	3.147252E+02	3.071600E-03	3.571010E+02	2.948400E-03
4.053476E+02	2.796500E-03	4.617689E+02	2.616100E-03	5.268134E+02	2.414800E-03
6.024618E+02	2.197000E-03	6.913280E+02	1.967400E-03	7.956862E+02	1.733100E-03
9.191872E+02	1.499700E-03	1.067888E+03	1.270900E-03	1.245753E+03	1.055100E-03
1.453242E+03	8.622200E-04	1.709641E+03	6.854000E-04	2.016451E+03	5.337900E-04
2.396919E+03	4.037400E-04	2.863224E+03	2.976600E-04	3.444241E+03	2.130100E-04
4.156085E+03	1.489800E-04	5.040332E+03	1.015100E-04	6.133931E+03	6.761200E-05
7.488086E+03	4.411000E-05	9.166967E+03	2.823200E-05	1.126486E+04	1.770800E-05
1.386132E+04	1.095800E-05	1.709441E+04	6.686100E-06	2.112206E+04	4.029700E-06
2.615197E+04	2.400800E-06	3.243614E+04	1.416300E-06	4.023251E+04	8.315300E-07
5.000000E+04	4.839900E-07	–	–	–	–

B.3 Low Earth Orbit Distributed Source used in OLTARIS

There is not an exact definition of LEO, but for the purposes of this document, all human space flight except for Apollo VIII through XVII has occurred in LEO. With this definition, standard orbital parameters were used with NASA Langley's environment codes to generate the data in Tables B.3.1 through B.3.31. Now, the LEO environment is split into three pieces:

1. neutron albedo,
2. magnetic field modulated GCR, and
3. magnetic field trapped protons and electrons.

Each component has a different set of physics and can be treated separately or together as a source to the transport solver. The GCR component is modulated by the magnetic field through a cutoff. The albedo neutron component is the splash of neutrons emanating from the atmosphere because of the interactions of the GCR with the atmosphere.

The data used for this source are orbit averaged over a day's worth of orbits. There is no method from these data to obtain a single orbit's worth of data. Currently, other transport solution methods like an adjoint or variational method would be needed to efficiently analyze a spacecraft orbit-by-orbit. A brute force approach, analyzing each orbit separately with a forward method, can be performed if the method used is very fast. For this source, there is also a velocity (or angular) component to the source because of the direction the spacecraft is moving through the magnetic field. These analyses are not part of this benchmark, but when sources exist and are validated, then this benchmark will be expanded to cover them.

Table B.3.1: Energy versus Albedo Neutron Flux Data for the LEO Source

Energy $\frac{\text{MeV}}{\text{A}}$	Fluence $\frac{\text{neutron}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Fluence $\frac{\text{neutron}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Fluence $\frac{\text{neutron}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	1.208700E+05	1.875291E-02	6.445500E+04	3.480407E-02	3.472900E+04
6.234330E-02	1.938800E+04	1.040279E-01	1.161900E+04	1.596987E-01	7.568700E+03
2.286180E-01	5.287000E+03	3.128875E-01	3.863100E+03	4.148185E-01	2.913800E+03
5.395213E-01	2.240300E+03	7.616098E-01	1.587000E+03	1.041454E+00	1.160600E+03
1.410684E+00	8.568300E+02	1.899600E+00	6.363000E+02	2.545671E+00	4.748100E+02
3.398159E+00	3.557000E+02	4.521955E+00	2.673000E+02	6.000909E+00	2.014200E+02
7.945456E+00	1.521300E+02	1.050000E+01	4.080900E+01	1.179048E+01	4.028500E+01
1.323618E+01	3.970700E+01	1.485678E+01	3.906900E+01	1.667132E+01	3.836600E+01
1.870472E+01	3.759400E+01	2.098246E+01	3.674800E+01	2.353477E+01	3.582100E+01
2.639553E+01	3.481100E+01	2.960152E+01	3.371300E+01	3.319499E+01	3.252300E+01
3.722440E+01	3.123800E+01	4.174413E+01	2.985800E+01	4.681490E+01	2.838200E+01
5.250602E+01	2.681200E+01	5.889565E+01	2.515200E+01	6.607767E+01	2.340900E+01
7.415042E+01	2.159300E+01	8.323253E+01	1.971900E+01	9.345976E+01	1.780200E+01
1.050000E+02	1.586100E+01	1.096041E+02	1.514800E+01	1.144101E+02	1.443700E+01
1.194268E+02	1.373100E+01	1.246635E+02	1.303000E+01	1.301769E+02	1.233100E+01
1.359375E+02	1.164100E+01	1.419529E+02	1.096100E+01	1.482346E+02	1.029400E+01
1.548600E+02	9.634000E+00	1.618074E+02	8.987400E+00	1.690665E+02	8.358100E+00
1.766513E+02	7.747600E+00	1.845764E+02	7.157300E+00	1.928569E+02	6.588500E+00
2.015492E+02	6.040000E+00	2.108366E+02	5.504300E+00	2.205519E+02	4.994700E+00
2.307150E+02	4.512000E+00	2.413463E+02	4.057000E+00	2.524675E+02	3.630000E+00
2.691319E+02	3.072800E+00	2.851141E+02	2.618900E+00	3.005194E+02	2.245000E+00
3.159144E+02	1.924700E+00	3.308495E+02	1.657600E+00	3.453702E+02	1.433600E+00
3.595152E+02	1.244500E+00	3.733171E+02	1.084100E+00	3.868039E+02	9.473000E-01
4.000000E+02	8.301900E-01	4.586163E+02	4.619600E-01	5.135421E+02	2.667300E-01
5.664912E+02	1.570800E-01	6.173520E+02	9.445600E-02	6.669916E+02	5.749700E-02
7.152148E+02	3.549900E-02	7.627025E+02	2.207900E-02	8.090546E+02	1.388900E-02
8.550492E+02	8.768400E-03	9.000000E+02	5.593800E-03	9.449130E+02	3.569800E-03
9.889814E+02	2.297500E-03	1.033872E+03	1.466600E-03	1.078632E+03	9.373800E-04
1.122773E+03	6.028500E-04	1.166335E+03	3.899600E-04	1.209354E+03	2.536300E-04
1.251862E+03	1.658000E-04	1.293889E+03	1.089100E-04	1.335459E+03	7.186700E-05
1.376596E+03	4.762900E-05	1.417322E+03	3.169600E-05	1.457657E+03	2.117500E-05
1.497618E+03	1.420000E-05	1.539820E+03	9.311100E-06	1.581894E+03	6.113300E-06
1.623689E+03	4.025000E-06	1.665214E+03	2.657200E-06	1.706481E+03	1.758700E-06
1.747498E+03	1.167000E-06	–	–	–	–

Table B.3.2: Energy per Nucleon versus ^{1}H Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	0.0	2.156430E+01	0.0
2.417442E+01	0.0	2.709740E+01	0.0	3.037216E+01	0.0
3.404070E+01	0.0	3.815234E+01	0.0	4.276254E+01	0.0
4.793135E+01	0.0	5.373154E+01	0.0	6.023854E+01	0.0
6.755091E+01	0.0	7.576738E+01	3.089100E-02	8.500710E+01	1.639000E-01
9.540710E+01	3.088200E-01	1.071423E+02	4.434900E-01	1.203541E+02	5.914500E-01
1.352905E+02	9.430600E-01	1.521613E+02	1.295100E+00	1.713748E+02	1.821700E+00
1.930143E+02	2.449000E+00	2.178676E+02	3.035500E+00	2.461532E+02	3.574600E+00
2.781110E+02	4.193300E+00	3.147252E+02	4.841500E+00	3.571010E+02	5.432600E+00
4.053476E+02	6.076500E+00	4.617689E+02	6.887000E+00	5.268134E+02	7.524100E+00
6.024618E+02	7.881300E+00	6.913280E+02	8.164500E+00	7.956862E+02	8.243100E+00
9.191872E+02	8.122700E+00	1.067888E+03	8.114500E+00	1.245753E+03	7.973600E+00
1.453242E+03	7.601900E+00	1.709641E+03	7.021800E+00	2.016451E+03	6.457800E+00
2.396919E+03	5.877600E+00	2.863224E+03	5.295700E+00	3.444241E+03	4.561900E+00
4.156085E+03	3.740400E+00	5.040332E+03	2.920200E+00	6.133931E+03	2.210000E+00
7.488086E+03	1.663100E+00	9.166967E+03	1.260800E+00	1.126486E+04	8.962400E-01
1.386132E+04	5.940400E-01	1.709441E+04	3.751400E-01	2.112206E+04	2.284700E-01
2.615197E+04	1.352000E-01	3.243614E+04	7.826800E-02	4.023251E+04	4.470800E-02
5.000000E+04	2.518500E-02	–	–	–	–

Table B.3.3: Energy per Nucleon versus ^{4}He Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	1.670100E-03	2.156430E+01	1.075800E-02
2.417442E+01	2.170500E-02	2.709740E+01	3.323800E-02	3.037216E+01	4.290500E-02
3.404070E+01	6.867200E-02	3.815234E+01	1.009100E-01	4.276254E+01	1.390500E-01
4.793135E+01	1.980800E-01	5.373154E+01	2.641400E-01	6.023854E+01	3.311100E-01
6.755091E+01	4.040900E-01	7.576738E+01	4.920100E-01	8.500710E+01	5.931900E-01
9.540710E+01	6.998700E-01	1.071423E+02	8.159500E-01	1.203541E+02	9.568800E-01
1.352905E+02	1.126300E+00	1.521613E+02	1.288300E+00	1.713748E+02	1.434400E+00
1.930143E+02	1.573400E+00	2.178676E+02	1.705300E+00	2.461532E+02	1.824400E+00
2.781110E+02	1.912100E+00	3.147252E+02	2.005700E+00	3.571010E+02	2.107200E+00
4.053476E+02	2.184000E+00	4.617689E+02	2.238800E+00	5.268134E+02	2.223600E+00
6.024618E+02	2.186700E+00	6.913280E+02	2.133700E+00	7.956862E+02	2.066600E+00
9.191872E+02	1.983200E+00	1.067888E+03	1.886300E+00	1.245753E+03	1.752200E+00
1.453242E+03	1.574700E+00	1.709641E+03	1.367700E+00	2.016451E+03	1.148400E+00
2.396919E+03	9.313200E-01	2.863224E+03	7.374500E-01	3.444241E+03	5.794400E-01
4.156085E+03	4.537300E-01	5.040332E+03	3.356900E-01	6.133931E+03	2.323100E-01
7.488086E+03	1.529200E-01	9.166967E+03	9.667300E-02	1.126486E+04	5.893100E-02
1.386132E+04	3.502500E-02	1.709441E+04	2.034200E-02	2.112206E+04	1.159600E-02
2.615197E+04	6.512700E-03	3.243614E+04	3.617500E-03	4.023251E+04	1.999000E-03
5.000000E+04	1.094200E-03	–	–	–	–

Table B.3.4: Energy per Nucleon versus ^{7}Li Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	1.231200E-06	1.529532E+01	1.560100E-05
1.715376E+01	3.984900E-05	1.923466E+01	6.661000E-05	2.156430E+01	8.680100E-05
2.417442E+01	1.290100E-04	2.709740E+01	2.008800E-04	3.037216E+01	2.781500E-04
3.404070E+01	3.993500E-04	3.815234E+01	5.525500E-04	4.276254E+01	7.163500E-04
4.793135E+01	8.845100E-04	5.373154E+01	1.098600E-03	6.023854E+01	1.355100E-03
6.755091E+01	1.648400E-03	7.576738E+01	1.969800E-03	8.500710E+01	2.358400E-03
9.540710E+01	2.868800E-03	1.071423E+02	3.419900E-03	1.203541E+02	3.998900E-03
1.352905E+02	4.549700E-03	1.521613E+02	5.168000E-03	1.713748E+02	5.775000E-03
1.930143E+02	6.383300E-03	2.178676E+02	6.950000E-03	2.461532E+02	7.618900E-03
2.781110E+02	8.310500E-03	3.147252E+02	8.950900E-03	3.571010E+02	9.540800E-03
4.053476E+02	9.862700E-03	4.617689E+02	1.010000E-02	5.268134E+02	1.023300E-02
6.024618E+02	1.029400E-02	6.913280E+02	1.023200E-02	7.956862E+02	1.006900E-02
9.191872E+02	9.733100E-03	1.067888E+03	9.100900E-03	1.245753E+03	8.211500E-03
1.453242E+03	7.173700E-03	1.709641E+03	6.019900E-03	2.016451E+03	4.899900E-03
2.396919E+03	3.867500E-03	2.863224E+03	3.020700E-03	3.444241E+03	2.320000E-03
4.156085E+03	1.684600E-03	5.040332E+03	1.138400E-03	6.133931E+03	7.278600E-04
7.488086E+03	4.448300E-04	9.166967E+03	2.616500E-04	1.126486E+04	1.485300E-04
1.386132E+04	8.225200E-05	1.709441E+04	4.452500E-05	2.112206E+04	2.367500E-05
2.615197E+04	1.240700E-05	3.243614E+04	6.424400E-06	4.023251E+04	3.308200E-06
5.000000E+04	1.685700E-06	–	–	–	–

Table B.3.5: Energy per Nucleon versus ^{9}Be Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	1.474000E-06
1.715376E+01	8.794400E-06	1.923466E+01	1.738500E-05	2.156430E+01	2.634100E-05
2.417442E+01	3.400000E-05	2.709740E+01	5.489700E-05	3.037216E+01	8.053900E-05
3.404070E+01	1.119800E-04	3.815234E+01	1.608600E-04	4.276254E+01	2.170100E-04
4.793135E+01	2.766000E-04	5.373154E+01	3.448300E-04	6.023854E+01	4.307600E-04
6.755091E+01	5.356900E-04	7.576738E+01	6.552400E-04	8.500710E+01	7.947000E-04
9.540710E+01	9.740300E-04	1.071423E+02	1.206300E-03	1.203541E+02	1.458300E-03
1.352905E+02	1.729400E-03	1.521613E+02	2.021000E-03	1.713748E+02	2.352700E-03
1.930143E+02	2.700900E-03	2.178676E+02	3.062900E-03	2.461532E+02	3.455000E-03
2.781110E+02	3.921900E-03	3.147252E+02	4.411000E-03	3.571010E+02	4.915300E-03
4.053476E+02	5.350100E-03	4.617689E+02	5.696400E-03	5.268134E+02	5.997800E-03
6.024618E+02	6.249800E-03	6.913280E+02	6.436900E-03	7.956862E+02	6.533800E-03
9.191872E+02	6.520100E-03	1.067888E+03	6.301700E-03	1.245753E+03	5.833000E-03
1.453242E+03	5.208500E-03	1.709641E+03	4.436000E-03	2.016451E+03	3.632800E-03
2.396919E+03	2.860100E-03	2.863224E+03	2.203400E-03	3.444241E+03	1.671000E-03
4.156085E+03	1.203800E-03	5.040332E+03	8.003800E-04	6.133931E+03	5.000500E-04
7.488086E+03	2.969700E-04	9.166967E+03	1.690000E-04	1.126486E+04	9.245400E-05
1.386132E+04	4.922600E-05	1.709441E+04	2.555500E-05	2.112206E+04	1.300400E-05
2.615197E+04	6.511600E-06	3.243614E+04	3.218100E-06	4.023251E+04	1.580700E-06
5.000000E+04	7.676800E-07	–	–	–	–

Table B.3.6: Energy per Nucleon versus ^{11}B Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	2.374600E-06
1.715376E+01	3.139100E-05	1.923466E+01	8.161500E-05	2.156430E+01	1.367300E-04
2.417442E+01	1.786600E-04	2.709740E+01	2.642300E-04	3.037216E+01	4.126000E-04
3.404070E+01	5.713000E-04	3.815234E+01	8.198800E-04	4.276254E+01	1.135200E-03
4.793135E+01	1.471500E-03	5.373154E+01	1.816200E-03	6.023854E+01	2.255000E-03
6.755091E+01	2.780800E-03	7.576738E+01	3.380700E-03	8.500710E+01	4.036600E-03
9.540710E+01	4.832400E-03	1.071423E+02	5.878800E-03	1.203541E+02	6.996100E-03
1.352905E+02	8.172700E-03	1.521613E+02	9.284600E-03	1.713748E+02	1.053900E-02
1.930143E+02	1.173900E-02	2.178676E+02	1.295100E-02	2.461532E+02	1.406300E-02
2.781110E+02	1.539800E-02	3.147252E+02	1.675200E-02	3.571010E+02	1.798100E-02
4.053476E+02	1.900500E-02	4.617689E+02	1.950400E-02	5.268134E+02	1.982900E-02
6.024618E+02	1.998100E-02	6.913280E+02	1.991800E-02	7.956862E+02	1.961100E-02
9.191872E+02	1.908400E-02	1.067888E+03	1.808600E-02	1.245753E+03	1.647400E-02
1.453242E+03	1.453700E-02	1.709641E+03	1.228800E-02	2.016451E+03	1.002200E-02
2.396919E+03	7.887800E-03	2.863224E+03	6.085100E-03	3.444241E+03	4.655200E-03
4.156085E+03	3.423000E-03	5.040332E+03	2.331300E-03	6.133931E+03	1.494200E-03
7.488086E+03	9.122100E-04	9.166967E+03	5.346200E-04	1.126486E+04	3.017100E-04
1.386132E+04	1.659200E-04	1.709441E+04	8.905600E-05	2.112206E+04	4.689200E-05
2.615197E+04	2.431300E-05	3.243614E+04	1.245100E-05	4.023251E+04	6.339900E-06
5.000000E+04	3.193600E-06	–	–	–	–

Table B.3.7: Energy per Nucleon versus ^{12}C Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	4.496000E-05	2.156430E+01	2.896300E-04
2.417442E+01	5.843500E-04	2.709740E+01	8.948500E-04	3.037216E+01	1.155100E-03
3.404070E+01	1.848700E-03	3.815234E+01	2.716100E-03	4.276254E+01	3.742300E-03
4.793135E+01	5.330000E-03	5.373154E+01	7.105800E-03	6.023854E+01	8.904700E-03
6.755091E+01	1.086400E-02	7.576738E+01	1.322200E-02	8.500710E+01	1.593400E-02
9.540710E+01	1.879100E-02	1.071423E+02	2.189600E-02	1.203541E+02	2.566500E-02
1.352905E+02	3.019300E-02	1.521613E+02	3.451800E-02	1.713748E+02	3.841700E-02
1.930143E+02	4.212300E-02	2.178676E+02	4.563800E-02	2.461532E+02	4.881400E-02
2.781110E+02	5.115700E-02	3.147252E+02	5.366800E-02	3.571010E+02	5.640000E-02
4.053476E+02	5.848800E-02	4.617689E+02	6.000800E-02	5.268134E+02	5.967100E-02
6.024618E+02	5.877500E-02	6.913280E+02	5.746700E-02	7.956862E+02	5.580300E-02
9.191872E+02	5.371800E-02	1.067888E+03	5.129100E-02	1.245753E+03	4.786100E-02
1.453242E+03	4.323500E-02	1.709641E+03	3.778300E-02	2.016451E+03	3.194500E-02
2.396919E+03	2.611300E-02	2.863224E+03	2.086100E-02	3.444241E+03	1.655500E-02
4.156085E+03	1.310400E-02	5.040332E+03	9.808500E-03	6.133931E+03	6.873100E-03
7.488086E+03	4.584100E-03	9.166967E+03	2.938200E-03	1.126486E+04	1.817100E-03
1.386132E+04	1.096100E-03	1.709441E+04	6.464300E-04	2.112206E+04	3.743200E-04
2.615197E+04	2.136200E-04	3.243614E+04	1.206000E-04	4.023251E+04	6.775100E-05
5.000000E+04	3.770900E-05	–	–	–	–

Table B.3.8: Energy per Nucleon versus ^{14}N Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	9.992400E-06	2.156430E+01	6.431300E-05
2.417442E+01	1.296800E-04	2.709740E+01	1.985500E-04	3.037216E+01	2.563400E-04
3.404070E+01	4.105700E-04	3.815234E+01	6.040900E-04	4.276254E+01	8.341000E-04
4.793135E+01	1.191500E-03	5.373154E+01	1.594500E-03	6.023854E+01	2.007800E-03
6.755091E+01	2.463600E-03	7.576738E+01	3.018900E-03	8.500710E+01	3.666600E-03
9.540710E+01	4.362300E-03	1.071423E+02	5.133500E-03	1.203541E+02	6.081900E-03
1.352905E+02	7.238400E-03	1.521613E+02	8.378500E-03	1.713748E+02	9.447700E-03
1.930143E+02	1.050000E-02	2.178676E+02	1.153700E-02	2.461532E+02	1.251800E-02
2.781110E+02	1.330600E-02	3.147252E+02	1.415600E-02	3.571010E+02	1.508400E-02
4.053476E+02	1.584800E-02	4.617689E+02	1.646200E-02	5.268134E+02	1.655300E-02
6.024618E+02	1.646400E-02	6.913280E+02	1.622900E-02	7.956862E+02	1.585500E-02
9.191872E+02	1.532000E-02	1.067888E+03	1.464400E-02	1.245753E+03	1.363800E-02
1.453242E+03	1.225700E-02	1.709641E+03	1.061800E-02	2.016451E+03	8.867300E-03
2.396919E+03	7.130600E-03	2.863224E+03	5.582000E-03	3.444241E+03	4.322600E-03
4.156085E+03	3.326900E-03	5.040332E+03	2.412800E-03	6.133931E+03	1.633100E-03
7.488086E+03	1.049200E-03	9.166967E+03	6.463200E-04	1.126486E+04	3.832600E-04
1.386132E+04	2.213300E-04	1.709441E+04	1.247700E-04	2.112206E+04	6.897500E-05
2.615197E+04	3.753700E-05	3.243614E+04	2.019000E-05	4.023251E+04	1.080100E-05
5.000000E+04	5.720100E-06	–	–	–	–

Table B.3.9: Energy per Nucleon versus ^{16}O Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	4.601700E-05	2.156430E+01	2.965300E-04
2.417442E+01	5.983800E-04	2.709740E+01	9.163800E-04	3.037216E+01	1.182800E-03
3.404070E+01	1.892400E-03	3.815234E+01	2.778800E-03	4.276254E+01	3.825700E-03
4.793135E+01	5.442900E-03	5.373154E+01	7.246200E-03	6.023854E+01	9.065200E-03
6.755091E+01	1.103700E-02	7.576738E+01	1.340100E-02	8.500710E+01	1.610500E-02
9.540710E+01	1.893400E-02	1.071423E+02	2.198800E-02	1.203541E+02	2.567800E-02
1.352905E+02	3.008700E-02	1.521613E+02	3.425100E-02	1.713748E+02	3.794800E-02
1.930143E+02	4.141800E-02	2.178676E+02	4.465800E-02	2.461532E+02	4.753200E-02
2.781110E+02	4.957100E-02	3.147252E+02	5.175400E-02	3.571010E+02	5.412800E-02
4.053476E+02	5.587700E-02	4.617689E+02	5.707700E-02	5.268134E+02	5.653000E-02
6.024618E+02	5.548000E-02	6.913280E+02	5.407400E-02	7.956862E+02	5.237500E-02
9.191872E+02	5.032400E-02	1.067888E+03	4.799800E-02	1.245753E+03	4.477900E-02
1.453242E+03	4.048100E-02	1.709641E+03	3.543900E-02	2.016451E+03	3.004800E-02
2.396919E+03	2.466100E-02	2.863224E+03	1.980400E-02	3.444241E+03	1.581600E-02
4.156085E+03	1.261200E-02	5.040332E+03	9.520000E-03	6.133931E+03	6.733400E-03
7.488086E+03	4.536400E-03	9.166967E+03	2.939100E-03	1.126486E+04	1.838600E-03
1.386132E+04	1.122300E-03	1.709441E+04	6.700500E-04	2.112206E+04	3.929400E-04
2.615197E+04	2.271700E-04	3.243614E+04	1.299600E-04	4.023251E+04	7.398800E-05
5.000000E+04	4.174200E-05	–	–	–	–

Table B.3.10: Energy per Nucleon versus ^{19}F Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	3.522800E-07	1.923466E+01	2.650800E-06	2.156430E+01	5.513600E-06
2.417442E+01	8.583200E-06	2.709740E+01	1.108900E-05	3.037216E+01	1.752600E-05
3.404070E+01	2.611300E-05	3.815234E+01	3.596800E-05	4.276254E+01	5.169500E-05
4.793135E+01	7.002200E-05	5.373154E+01	8.917100E-05	6.023854E+01	1.101300E-04
6.755091E+01	1.362800E-04	7.576738E+01	1.675400E-04	8.500710E+01	2.022100E-04
9.540710E+01	2.410800E-04	1.071423E+02	2.897700E-04	1.203541E+02	3.512400E-04
1.352905E+02	4.149100E-04	1.521613E+02	4.794600E-04	1.713748E+02	5.448400E-04
1.930143E+02	6.141700E-04	2.178676E+02	6.835000E-04	2.461532E+02	7.479200E-04
2.781110E+02	8.138700E-04	3.147252E+02	8.911700E-04	3.571010E+02	9.655700E-04
4.053476E+02	1.035200E-03	4.617689E+02	1.081300E-03	5.268134E+02	1.108900E-03
6.024618E+02	1.125200E-03	6.913280E+02	1.134300E-03	7.956862E+02	1.130000E-03
9.191872E+02	1.114300E-03	1.067888E+03	1.079300E-03	1.245753E+03	1.009400E-03
1.453242E+03	9.124200E-04	1.709641E+03	7.919400E-04	2.016451E+03	6.635500E-04
2.396919E+03	5.366900E-04	2.863224E+03	4.238000E-04	3.444241E+03	3.326600E-04
4.156085E+03	2.550800E-04	5.040332E+03	1.819300E-04	6.133931E+03	1.218100E-04
7.488086E+03	7.762700E-05	9.166967E+03	4.749100E-05	1.126486E+04	2.799800E-05
1.386132E+04	1.608300E-05	1.709441E+04	9.024200E-06	2.112206E+04	4.968600E-06
2.615197E+04	2.694700E-06	3.243614E+04	1.444500E-06	4.023251E+04	7.701300E-07
5.000000E+04	4.064700E-07	–	–	–	–

Table B.3.11: Energy per Nucleon versus ^{20}Ne Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	6.255000E-06	2.156430E+01	4.028100E-05
2.417442E+01	8.124700E-05	2.709740E+01	1.243900E-04	3.037216E+01	1.605400E-04
3.404070E+01	2.569300E-04	3.815234E+01	3.775300E-04	4.276254E+01	5.202800E-04
4.793135E+01	7.412900E-04	5.373154E+01	9.888400E-04	6.023854E+01	1.240100E-03
6.755091E+01	1.514400E-03	7.576738E+01	1.845400E-03	8.500710E+01	2.227200E-03
9.540710E+01	2.630800E-03	1.071423E+02	3.071500E-03	1.203541E+02	3.607800E-03
1.352905E+02	4.254200E-03	1.521613E+02	4.876000E-03	1.713748E+02	5.441600E-03
1.930143E+02	5.983700E-03	2.178676E+02	6.502800E-03	2.461532E+02	6.977200E-03
2.781110E+02	7.335500E-03	3.147252E+02	7.720300E-03	3.571010E+02	8.139800E-03
4.053476E+02	8.468000E-03	4.617689E+02	8.715100E-03	5.268134E+02	8.691800E-03
6.024618E+02	8.585000E-03	6.913280E+02	8.415100E-03	7.956862E+02	8.189600E-03
9.191872E+02	7.898200E-03	1.067888E+03	7.552400E-03	1.245753E+03	7.054200E-03
1.453242E+03	6.375000E-03	1.709641E+03	5.570400E-03	2.016451E+03	4.706300E-03
2.396919E+03	3.841900E-03	2.863224E+03	3.063300E-03	3.444241E+03	2.424700E-03
4.156085E+03	1.913200E-03	5.040332E+03	1.426800E-03	6.133931E+03	9.957100E-04
7.488086E+03	6.611200E-04	9.166967E+03	4.217100E-04	1.126486E+04	2.594700E-04
1.386132E+04	1.556900E-04	1.709441E+04	9.131000E-05	2.112206E+04	5.257500E-05
2.615197E+04	2.983000E-05	3.243614E+04	1.674200E-05	4.023251E+04	9.349300E-06
5.000000E+04	5.172200E-06	–	–	–	–

Table B.3.12: Energy per Nucleon versus ^{23}Na Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	4.477600E-07	1.923466E+01	4.580400E-06	2.156430E+01	1.062300E-05
2.417442E+01	1.731000E-05	2.709740E+01	2.239000E-05	3.037216E+01	3.408300E-05
3.404070E+01	5.207800E-05	3.815234E+01	7.178800E-05	4.276254E+01	1.028100E-04
4.793135E+01	1.407400E-04	5.373154E+01	1.806100E-04	6.023854E+01	2.217500E-04
6.755091E+01	2.734900E-04	7.576738E+01	3.347300E-04	8.500710E+01	4.028600E-04
9.540710E+01	4.765200E-04	1.071423E+02	5.668500E-04	1.203541E+02	6.815800E-04
1.352905E+02	7.995500E-04	1.521613E+02	9.185900E-04	1.713748E+02	1.030900E-03
1.930143E+02	1.151800E-03	2.178676E+02	1.264400E-03	2.461532E+02	1.368900E-03
2.781110E+02	1.466900E-03	3.147252E+02	1.583800E-03	3.571010E+02	1.695100E-03
4.053476E+02	1.793000E-03	4.617689E+02	1.853900E-03	5.268134E+02	1.876100E-03
6.024618E+02	1.881000E-03	6.913280E+02	1.872800E-03	7.956862E+02	1.846300E-03
9.191872E+02	1.802800E-03	1.067888E+03	1.733600E-03	1.245753E+03	1.614600E-03
1.453242E+03	1.454800E-03	1.709641E+03	1.261100E-03	2.016451E+03	1.056700E-03
2.396919E+03	8.560000E-04	2.863224E+03	6.776100E-04	3.444241E+03	5.339900E-04
4.156085E+03	4.131000E-04	5.040332E+03	2.981700E-04	6.133931E+03	2.020600E-04
7.488086E+03	1.304500E-04	9.166967E+03	8.090200E-05	1.126486E+04	4.838500E-05
1.386132E+04	2.820900E-05	1.709441E+04	1.607200E-05	2.112206E+04	8.989000E-06
2.615197E+04	4.953600E-06	3.243614E+04	2.699100E-06	4.023251E+04	1.462900E-06
5.000000E+04	7.851700E-07	–	–	–	–

Table B.3.13: Energy per Nucleon versus ^{24}Mg Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	8.946300E-06	2.156430E+01	5.763200E-05
2.417442E+01	1.162700E-04	2.709740E+01	1.780100E-04	3.037216E+01	2.297000E-04
3.404070E+01	3.674500E-04	3.815234E+01	5.395000E-04	4.276254E+01	7.427100E-04
4.793135E+01	1.056700E-03	5.373154E+01	1.407000E-03	6.023854E+01	1.760500E-03
6.755091E+01	2.144200E-03	7.576738E+01	2.604600E-03	8.500710E+01	3.132200E-03
9.540710E+01	3.685100E-03	1.071423E+02	4.283200E-03	1.203541E+02	5.007000E-03
1.352905E+02	5.873500E-03	1.521613E+02	6.694900E-03	1.713748E+02	7.427900E-03
1.930143E+02	8.119000E-03	2.178676E+02	8.768100E-03	2.461532E+02	9.348000E-03
2.781110E+02	9.765700E-03	3.147252E+02	1.021300E-02	3.571010E+02	1.070100E-02
4.053476E+02	1.106500E-02	4.617689E+02	1.132200E-02	5.268134E+02	1.123100E-02
6.024618E+02	1.103900E-02	6.913280E+02	1.077400E-02	7.956862E+02	1.044700E-02
9.191872E+02	1.004800E-02	1.067888E+03	9.589700E-03	1.245753E+03	8.950200E-03
1.453242E+03	8.091500E-03	1.709641E+03	7.081900E-03	2.016451E+03	6.000800E-03
2.396919E+03	4.920000E-03	2.863224E+03	3.945300E-03	3.444241E+03	3.145300E-03
4.156085E+03	2.502800E-03	5.040332E+03	1.884600E-03	6.133931E+03	1.329400E-03
7.488086E+03	8.930500E-04	9.166967E+03	5.768100E-04	1.126486E+04	3.596400E-04
1.386132E+04	2.188000E-04	1.709441E+04	1.301700E-04	2.112206E+04	7.606500E-05
2.615197E+04	4.381600E-05	3.243614E+04	2.497400E-05	4.023251E+04	1.416500E-05
5.000000E+04	7.961900E-06	–	–	–	–

Table B.3.14: Energy per Nucleon versus ^{27}Al Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	3.423800E-07	1.923466E+01	4.470200E-06	2.156430E+01	1.157800E-05
2.417442E+01	1.939300E-05	2.709740E+01	2.530900E-05	3.037216E+01	3.745600E-05
3.404070E+01	5.833500E-05	3.815234E+01	8.054800E-05	4.276254E+01	1.152300E-04
4.793135E+01	1.586900E-04	5.373154E+01	2.043700E-04	6.023854E+01	2.503200E-04
6.755091E+01	3.080900E-04	7.576738E+01	3.760300E-04	8.500710E+01	4.515200E-04
9.540710E+01	5.320400E-04	1.071423E+02	6.285700E-04	1.203541E+02	7.521700E-04
1.352905E+02	8.791200E-04	1.521613E+02	1.006900E-03	1.713748E+02	1.121800E-03
1.930143E+02	1.245700E-03	2.178676E+02	1.358800E-03	2.461532E+02	1.463100E-03
2.781110E+02	1.554700E-03	3.147252E+02	1.667100E-03	3.571010E+02	1.774000E-03
4.053476E+02	1.864200E-03	4.617689E+02	1.920900E-03	5.268134E+02	1.933500E-03
6.024618E+02	1.930900E-03	6.913280E+02	1.915300E-03	7.956862E+02	1.884700E-03
9.191872E+02	1.838500E-03	1.067888E+03	1.770700E-03	1.245753E+03	1.656200E-03
1.453242E+03	1.500500E-03	1.709641E+03	1.311600E-03	2.016451E+03	1.109700E-03
2.396919E+03	9.093400E-04	2.863224E+03	7.295600E-04	3.444241E+03	5.836400E-04
4.156085E+03	4.603700E-04	5.040332E+03	3.398500E-04	6.133931E+03	2.357500E-04
7.488086E+03	1.560100E-04	9.166967E+03	9.927800E-05	1.126486E+04	6.100100E-05
1.386132E+04	3.656700E-05	1.709441E+04	2.143800E-05	2.112206E+04	1.234600E-05
2.615197E+04	7.009700E-06	3.243614E+04	3.937300E-06	4.023251E+04	2.200500E-06
5.000000E+04	1.218400E-06	–	–	–	–

Table B.3.15: Energy per Nucleon versus ^{28}Si Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	6.505800E-06	2.156430E+01	4.191700E-05
2.417442E+01	8.458100E-05	2.709740E+01	1.295300E-04	3.037216E+01	1.671800E-04
3.404070E+01	2.675200E-04	3.815234E+01	3.929100E-04	4.276254E+01	5.411000E-04
4.793135E+01	7.701600E-04	5.373154E+01	1.025900E-03	6.023854E+01	1.284300E-03
6.755091E+01	1.564900E-03	7.576738E+01	1.901900E-03	8.500710E+01	2.288300E-03
9.540710E+01	2.693700E-03	1.071423E+02	3.132700E-03	1.203541E+02	3.664200E-03
1.352905E+02	4.300900E-03	1.521613E+02	4.905500E-03	1.713748E+02	5.446300E-03
1.930143E+02	5.957300E-03	2.178676E+02	6.438700E-03	2.461532E+02	6.870400E-03
2.781110E+02	7.184100E-03	3.147252E+02	7.521200E-03	3.571010E+02	7.889400E-03
4.053476E+02	8.168900E-03	4.617689E+02	8.371200E-03	5.268134E+02	8.318300E-03
6.024618E+02	8.191800E-03	6.913280E+02	8.012900E-03	7.956862E+02	7.789800E-03
9.191872E+02	7.513500E-03	1.067888E+03	7.195200E-03	1.245753E+03	6.740900E-03
1.453242E+03	6.119600E-03	1.709641E+03	5.381700E-03	2.016451E+03	4.584100E-03
2.396919E+03	3.780800E-03	2.863224E+03	3.051600E-03	3.444241E+03	2.450300E-03
4.156085E+03	1.964700E-03	5.040332E+03	1.491700E-03	6.133931E+03	1.061400E-03
7.488086E+03	7.195500E-04	9.166967E+03	4.691800E-04	1.126486E+04	2.954400E-04
1.386132E+04	1.815700E-04	1.709441E+04	1.091500E-04	2.112206E+04	6.446100E-05
2.615197E+04	3.753500E-05	3.243614E+04	2.163000E-05	4.023251E+04	1.240500E-05
5.000000E+04	7.051000E-06	–	–	–	–

Table B.3.16: Energy per Nucleon versus ^{29}P Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	0.0	2.156430E+01	3.132600E-07
2.417442E+01	1.131100E-06	2.709740E+01	1.971000E-06	3.037216E+01	2.714700E-06
3.404070E+01	3.776500E-06	3.815234E+01	6.032400E-06	4.276254E+01	8.422600E-06
4.793135E+01	1.205700E-05	5.373154E+01	1.691100E-05	6.023854E+01	2.201100E-05
6.755091E+01	2.729700E-05	7.576738E+01	3.381900E-05	8.500710E+01	4.168500E-05
9.540710E+01	5.073400E-05	1.071423E+02	6.061300E-05	1.203541E+02	7.244600E-05
1.352905E+02	8.803900E-05	1.521613E+02	1.049900E-04	1.713748E+02	1.228700E-04
1.930143E+02	1.396200E-04	2.178676E+02	1.586500E-04	2.461532E+02	1.769700E-04
2.781110E+02	1.949100E-04	3.147252E+02	2.118000E-04	3.571010E+02	2.326700E-04
4.053476E+02	2.531200E-04	4.617689E+02	2.722700E-04	5.268134E+02	2.857700E-04
6.024618E+02	2.933700E-04	6.913280E+02	2.979900E-04	7.956862E+02	3.005000E-04
9.191872E+02	2.993400E-04	1.067888E+03	2.949900E-04	1.245753E+03	2.847100E-04
1.453242E+03	2.646600E-04	1.709641E+03	2.364800E-04	2.016451E+03	2.034200E-04
2.396919E+03	1.678400E-04	2.863224E+03	1.343100E-04	3.444241E+03	1.056300E-04
4.156085E+03	8.298300E-05	5.040332E+03	6.198300E-05	6.133931E+03	4.305000E-05
7.488086E+03	2.828500E-05	9.166967E+03	1.778700E-05	1.126486E+04	1.075600E-05
1.386132E+04	6.328900E-06	1.709441E+04	3.633300E-06	2.112206E+04	2.045000E-06
2.615197E+04	1.132700E-06	3.243614E+04	6.201100E-07	4.023251E+04	3.376600E-07
5.000000E+04	1.820700E-07	–	–	–	–

Table B.3.17: Energy per Nucleon versus ^{32}S Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	9.341800E-07	2.156430E+01	6.013300E-06
2.417442E+01	1.212600E-05	2.709740E+01	1.856600E-05	3.037216E+01	2.396900E-05
3.404070E+01	3.838500E-05	3.815234E+01	5.646400E-05	4.276254E+01	7.793500E-05
4.793135E+01	1.112800E-04	5.373154E+01	1.488400E-04	6.023854E+01	1.872800E-04
6.755091E+01	2.296100E-04	7.576738E+01	2.811000E-04	8.500710E+01	3.410700E-04
9.540710E+01	4.053400E-04	1.071423E+02	4.764600E-04	1.203541E+02	5.638600E-04
1.352905E+02	6.703700E-04	1.521613E+02	7.751900E-04	1.713748E+02	8.734100E-04
1.930143E+02	9.701600E-04	2.178676E+02	1.065700E-03	2.461532E+02	1.156500E-03
2.781110E+02	1.230200E-03	3.147252E+02	1.310500E-03	3.571010E+02	1.399300E-03
4.053476E+02	1.474500E-03	4.617689E+02	1.537900E-03	5.268134E+02	1.554500E-03
6.024618E+02	1.556500E-03	6.913280E+02	1.547000E-03	7.956862E+02	1.526700E-03
9.191872E+02	1.493200E-03	1.067888E+03	1.448300E-03	1.245753E+03	1.372200E-03
1.453242E+03	1.257300E-03	1.709641E+03	1.114300E-03	2.016451E+03	9.546000E-04
2.396919E+03	7.903700E-04	2.863224E+03	6.391700E-04	3.444241E+03	5.132500E-04
4.156085E+03	4.108300E-04	5.040332E+03	3.108800E-04	6.133931E+03	2.201500E-04
7.488086E+03	1.483600E-04	9.166967E+03	9.607100E-05	1.126486E+04	6.002700E-05
1.386132E+04	3.658100E-05	1.709441E+04	2.179600E-05	2.112206E+04	1.275300E-05
2.615197E+04	7.354200E-06	3.243614E+04	4.196100E-06	4.023251E+04	2.382300E-06
5.000000E+04	1.340300E-06	–	–	–	–

Table B.3.18: Energy per Nucleon versus ^{35}Cl Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	1.127900E-08	1.923466E+01	3.250000E-07	2.156430E+01	1.014100E-06
2.417442E+01	1.739800E-06	2.709740E+01	2.347900E-06	3.037216E+01	3.337100E-06
3.404070E+01	5.308500E-06	3.815234E+01	7.376000E-06	4.276254E+01	1.059400E-05
4.793135E+01	1.481800E-05	5.373154E+01	1.930800E-05	6.023854E+01	2.398000E-05
6.755091E+01	2.985300E-05	7.576738E+01	3.697600E-05	8.500710E+01	4.522500E-05
9.540710E+01	5.435500E-05	1.071423E+02	6.548300E-05	1.203541E+02	8.017800E-05
1.352905E+02	9.644000E-05	1.521613E+02	1.138400E-04	1.713748E+02	1.308600E-04
1.930143E+02	1.501200E-04	2.178676E+02	1.695700E-04	2.461532E+02	1.895100E-04
2.781110E+02	2.084300E-04	3.147252E+02	2.317300E-04	3.571010E+02	2.561500E-04
4.053476E+02	2.791400E-04	4.617689E+02	2.991800E-04	5.268134E+02	3.118800E-04
6.024618E+02	3.221900E-04	6.913280E+02	3.298000E-04	7.956862E+02	3.342200E-04
9.191872E+02	3.346200E-04	1.067888E+03	3.299400E-04	1.245753E+03	3.149900E-04
1.453242E+03	2.896500E-04	1.709641E+03	2.559600E-04	2.016451E+03	2.176100E-04
2.396919E+03	1.780800E-04	2.863224E+03	1.418300E-04	3.444241E+03	1.119000E-04
4.156085E+03	8.684300E-05	5.040332E+03	6.290700E-05	6.133931E+03	4.258700E-05
7.488086E+03	2.739700E-05	9.166967E+03	1.689300E-05	1.126486E+04	1.002900E-05
1.386132E+04	5.796900E-06	1.709441E+04	3.271200E-06	2.112206E+04	1.810600E-06
2.615197E+04	9.867400E-07	3.243614E+04	5.314900E-07	4.023251E+04	2.847100E-07
5.000000E+04	1.509800E-07	–	–	–	–

Table B.3.19: Energy per Nucleon versus ^{38}Ar Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	2.205400E-07	1.923466E+01	1.659000E-06	2.156430E+01	3.449600E-06
2.417442E+01	5.367700E-06	2.709740E+01	6.930500E-06	3.037216E+01	1.094600E-05
3.404070E+01	1.629400E-05	3.815234E+01	2.241900E-05	4.276254E+01	3.218200E-05
4.793135E+01	4.352700E-05	5.373154E+01	5.533800E-05	6.023854E+01	6.822000E-05
6.755091E+01	8.424300E-05	7.576738E+01	1.033300E-04	8.500710E+01	1.244100E-04
9.540710E+01	1.479400E-04	1.071423E+02	1.773300E-04	1.203541E+02	2.143400E-04
1.352905E+02	2.524600E-04	1.521613E+02	2.908800E-04	1.713748E+02	3.295500E-04
1.930143E+02	3.704100E-04	2.178676E+02	4.110400E-04	2.461532E+02	4.485400E-04
2.781110E+02	4.868500E-04	3.147252E+02	5.318700E-04	3.571010E+02	5.751000E-04
4.053476E+02	6.155600E-04	4.617689E+02	6.421300E-04	5.268134E+02	6.580800E-04
6.024618E+02	6.676700E-04	6.913280E+02	6.733800E-04	7.956862E+02	6.716900E-04
9.191872E+02	6.637800E-04	1.067888E+03	6.449000E-04	1.245753E+03	6.056800E-04
1.453242E+03	5.503800E-04	1.709641E+03	4.808800E-04	2.016451E+03	4.061000E-04
2.396919E+03	3.315700E-04	2.863224E+03	2.646900E-04	3.444241E+03	2.103800E-04
4.156085E+03	1.635800E-04	5.040332E+03	1.184700E-04	6.133931E+03	8.065100E-05
7.488086E+03	5.232000E-05	9.166967E+03	3.261800E-05	1.126486E+04	1.961700E-05
1.386132E+04	1.150400E-05	1.709441E+04	6.595100E-06	2.112206E+04	3.712200E-06
2.615197E+04	2.059500E-06	3.243614E+04	1.129900E-06	4.023251E+04	6.167100E-07
5.000000E+04	3.333600E-07	–	–	–	–

Table B.3.20: Energy per Nucleon versus ^{39}K Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	9.318400E-09	1.923466E+01	6.762600E-07	2.156430E+01	2.293200E-06
2.417442E+01	3.975700E-06	2.709740E+01	5.435700E-06	3.037216E+01	7.631000E-06
3.404070E+01	1.217100E-05	3.815234E+01	1.693500E-05	4.276254E+01	2.426300E-05
4.793135E+01	3.393800E-05	5.373154E+01	4.406900E-05	6.023854E+01	5.448200E-05
6.755091E+01	6.728200E-05	7.576738E+01	8.258900E-05	8.500710E+01	9.997300E-05
9.540710E+01	1.186700E-04	1.071423E+02	1.408500E-04	1.203541E+02	1.695500E-04
1.352905E+02	2.005200E-04	1.521613E+02	2.322200E-04	1.713748E+02	2.614200E-04
1.930143E+02	2.931600E-04	2.178676E+02	3.233100E-04	2.461532E+02	3.523900E-04
2.781110E+02	3.775500E-04	3.147252E+02	4.082800E-04	3.571010E+02	4.390100E-04
4.053476E+02	4.652000E-04	4.617689E+02	4.851500E-04	5.268134E+02	4.918900E-04
6.024618E+02	4.945400E-04	6.913280E+02	4.930300E-04	7.956862E+02	4.871400E-04
9.191872E+02	4.762600E-04	1.067888E+03	4.594000E-04	1.245753E+03	4.302100E-04
1.453242E+03	3.890700E-04	1.709641E+03	3.389500E-04	2.016451E+03	2.848500E-04
2.396919E+03	2.309400E-04	2.863224E+03	1.827100E-04	3.444241E+03	1.435100E-04
4.156085E+03	1.112500E-04	5.040332E+03	8.074000E-05	6.133931E+03	5.485000E-05
7.488086E+03	3.545400E-05	9.166967E+03	2.199300E-05	1.126486E+04	1.314700E-05
1.386132E+04	7.657700E-06	1.709441E+04	4.357100E-06	2.112206E+04	2.432700E-06
2.615197E+04	1.337700E-06	3.243614E+04	7.272800E-07	4.023251E+04	3.932900E-07
5.000000E+04	2.105800E-07	–	–	–	–

Table B.3.21: Energy per Nucleon versus ^{40}Ca Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	9.025800E-07	2.156430E+01	5.813300E-06
2.417442E+01	1.172700E-05	2.709740E+01	1.795800E-05	3.037216E+01	2.318200E-05
3.404070E+01	3.710800E-05	3.815234E+01	5.453900E-05	4.276254E+01	7.518000E-05
4.793135E+01	1.071500E-04	5.373154E+01	1.429600E-04	6.023854E+01	1.793500E-04
6.755091E+01	2.190700E-04	7.576738E+01	2.670300E-04	8.500710E+01	3.223500E-04
9.540710E+01	3.808600E-04	1.071423E+02	4.447500E-04	1.203541E+02	5.225000E-04
1.352905E+02	6.162100E-04	1.521613E+02	7.063500E-04	1.713748E+02	7.883100E-04
1.930143E+02	8.668400E-04	2.178676E+02	9.419700E-04	2.461532E+02	1.010600E-03
2.781110E+02	1.062200E-03	3.147252E+02	1.117700E-03	3.571010E+02	1.178000E-03
4.053476E+02	1.224900E-03	4.617689E+02	1.260000E-03	5.268134E+02	1.255800E-03
6.024618E+02	1.239500E-03	6.913280E+02	1.213900E-03	7.956862E+02	1.180300E-03
9.191872E+02	1.137000E-03	1.067888E+03	1.085900E-03	1.245753E+03	1.012900E-03
1.453242E+03	9.139500E-04	1.709641E+03	7.972300E-04	2.016451E+03	6.722900E-04
2.396919E+03	5.476700E-04	2.863224E+03	4.356600E-04	3.444241E+03	3.439700E-04
4.156085E+03	2.706600E-04	5.040332E+03	2.012600E-04	6.133931E+03	1.400100E-04
7.488086E+03	9.265300E-05	9.166967E+03	5.889500E-05	1.126486E+04	3.610400E-05
1.386132E+04	2.158100E-05	1.709441E+04	1.260800E-05	2.112206E+04	7.230100E-06
2.615197E+04	4.085300E-06	3.243614E+04	2.283200E-06	4.023251E+04	1.269600E-06
5.000000E+04	6.993000E-07	–	–	–	–

Table B.3.22: Energy per Nucleon versus ^{43}Sc Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	0.0	1.923466E+01	3.707100E-07	2.156430E+01	1.355300E-06
2.417442E+01	2.367900E-06	2.709740E+01	3.269100E-06	3.037216E+01	4.538400E-06
3.404070E+01	7.248400E-06	3.815234E+01	1.011400E-05	4.276254E+01	1.442800E-05
4.793135E+01	2.018400E-05	5.373154E+01	2.615200E-05	6.023854E+01	3.224600E-05
6.755091E+01	3.962900E-05	7.576738E+01	4.839700E-05	8.500710E+01	5.828000E-05
9.540710E+01	6.874900E-05	1.071423E+02	8.099400E-05	1.203541E+02	9.665600E-05
1.352905E+02	1.135000E-04	1.521613E+02	1.303600E-04	1.713748E+02	1.454700E-04
1.930143E+02	1.615300E-04	2.178676E+02	1.764000E-04	2.461532E+02	1.903400E-04
2.781110E+02	2.018000E-04	3.147252E+02	2.157700E-04	3.571010E+02	2.295200E-04
4.053476E+02	2.405800E-04	4.617689E+02	2.483700E-04	5.268134E+02	2.491500E-04
6.024618E+02	2.479200E-04	6.913280E+02	2.447200E-04	7.956862E+02	2.394600E-04
9.191872E+02	2.320200E-04	1.067888E+03	2.219600E-04	1.245753E+03	2.063800E-04
1.453242E+03	1.854900E-04	1.709641E+03	1.607300E-04	2.016451E+03	1.344800E-04
2.396919E+03	1.086200E-04	2.863224E+03	8.568800E-05	3.444241E+03	6.715900E-05
4.156085E+03	5.203400E-05	5.040332E+03	3.779800E-05	6.133931E+03	2.571600E-05
7.488086E+03	1.665500E-05	9.166967E+03	1.035700E-05	1.126486E+04	6.209700E-06
1.386132E+04	3.629000E-06	1.709441E+04	2.072400E-06	2.112206E+04	1.161600E-06
2.615197E+04	6.414200E-07	3.243614E+04	3.502300E-07	4.023251E+04	1.902400E-07
5.000000E+04	1.023300E-07	–	–	–	–

Table B.3.23: Energy per Nucleon versus ^{47}Ti Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	9.570000E-07	1.923466E+01	4.867200E-06	2.156430E+01	9.228300E-06
2.417442E+01	1.366600E-05	2.709740E+01	1.774800E-05	3.037216E+01	2.890600E-05
3.404070E+01	4.166800E-05	3.815234E+01	5.813800E-05	4.276254E+01	8.250300E-05
4.793135E+01	1.088800E-04	5.373154E+01	1.356200E-04	6.023854E+01	1.660400E-04
6.755091E+01	2.024900E-04	7.576738E+01	2.442700E-04	8.500710E+01	2.882300E-04
9.540710E+01	3.370300E-04	1.071423E+02	3.973500E-04	1.203541E+02	4.678200E-04
1.352905E+02	5.364300E-04	1.521613E+02	5.982200E-04	1.713748E+02	6.590500E-04
1.930143E+02	7.162900E-04	2.178676E+02	7.696200E-04	2.461532E+02	8.106500E-04
2.781110E+02	8.529500E-04	3.147252E+02	8.995200E-04	3.571010E+02	9.371700E-04
4.053476E+02	9.660600E-04	4.617689E+02	9.679900E-04	5.268134E+02	9.573600E-04
6.024618E+02	9.374400E-04	6.913280E+02	9.136400E-04	7.956862E+02	8.814800E-04
9.191872E+02	8.440600E-04	1.067888E+03	7.946100E-04	1.245753E+03	7.234900E-04
1.453242E+03	6.401800E-04	1.709641E+03	5.456600E-04	2.016451E+03	4.512200E-04
2.396919E+03	3.618500E-04	2.863224E+03	2.849700E-04	3.444241E+03	2.241600E-04
4.156085E+03	1.722300E-04	5.040332E+03	1.233500E-04	6.133931E+03	8.332200E-05
7.488086E+03	5.375300E-05	9.166967E+03	3.337700E-05	1.126486E+04	2.001400E-05
1.386132E+04	1.171500E-05	1.709441E+04	6.706400E-06	2.112206E+04	3.771600E-06
2.615197E+04	2.091400E-06	3.243614E+04	1.147100E-06	4.023251E+04	6.259300E-07
5.000000E+04	3.382900E-07	–	–	–	–

Table B.3.24: Energy per Nucleon versus ^{49}V Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	3.583700E-07	1.923466E+01	1.951200E-06	2.156430E+01	3.772000E-06
2.417442E+01	5.647100E-06	2.709740E+01	7.284700E-06	3.037216E+01	1.185600E-05
3.404070E+01	1.719700E-05	3.815234E+01	2.390100E-05	4.276254E+01	3.399400E-05
4.793135E+01	4.509800E-05	5.373154E+01	5.641200E-05	6.023854E+01	6.913600E-05
6.755091E+01	8.451400E-05	7.576738E+01	1.022900E-04	8.500710E+01	1.211900E-04
9.540710E+01	1.421700E-04	1.071423E+02	1.680600E-04	1.203541E+02	1.990200E-04
1.352905E+02	2.294500E-04	1.521613E+02	2.575900E-04	1.713748E+02	2.854100E-04
1.930143E+02	3.123500E-04	2.178676E+02	3.379000E-04	2.461532E+02	3.584500E-04
2.781110E+02	3.795200E-04	3.147252E+02	4.032300E-04	3.571010E+02	4.233900E-04
4.053476E+02	4.399600E-04	4.617689E+02	4.446500E-04	5.268134E+02	4.431600E-04
6.024618E+02	4.371500E-04	6.913280E+02	4.293400E-04	7.956862E+02	4.172900E-04
9.191872E+02	4.024300E-04	1.067888E+03	3.816200E-04	1.245753E+03	3.500200E-04
1.453242E+03	3.117300E-04	1.709641E+03	2.673600E-04	2.016451E+03	2.223400E-04
2.396919E+03	1.792200E-04	2.863224E+03	1.417600E-04	3.444241E+03	1.119400E-04
4.156085E+03	8.640100E-05	5.040332E+03	6.215600E-05	6.133931E+03	4.215000E-05
7.488086E+03	2.729200E-05	9.166967E+03	1.700400E-05	1.126486E+04	1.023000E-05
1.386132E+04	6.007500E-06	1.709441E+04	3.450200E-06	2.112206E+04	1.946600E-06
2.615197E+04	1.082900E-06	3.243614E+04	5.958700E-07	4.023251E+04	3.262200E-07
5.000000E+04	1.769000E-07	–	–	–	–

Table B.3.25: Energy per Nucleon versus ^{52}Cr Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	1.341300E-06	1.923466E+01	5.130500E-06	2.156430E+01	9.013300E-06
2.417442E+01	1.253500E-05	2.709740E+01	1.732100E-05	3.037216E+01	2.774100E-05
3.404070E+01	3.887200E-05	3.815234E+01	5.539700E-05	4.276254E+01	7.772700E-05
4.793135E+01	1.008700E-04	5.373154E+01	1.245600E-04	6.023854E+01	1.530000E-04
6.755091E+01	1.868000E-04	7.576738E+01	2.250100E-04	8.500710E+01	2.651500E-04
9.540710E+01	3.116100E-04	1.071423E+02	3.705000E-04	1.203541E+02	4.348400E-04
1.352905E+02	4.986800E-04	1.521613E+02	5.553700E-04	1.713748E+02	6.147300E-04
1.930143E+02	6.691100E-04	2.178676E+02	7.208100E-04	2.461532E+02	7.622800E-04
2.781110E+02	8.094300E-04	3.147252E+02	8.576400E-04	3.571010E+02	8.976400E-04
4.053476E+02	9.288400E-04	4.617689E+02	9.325800E-04	5.268134E+02	9.282000E-04
6.024618E+02	9.165000E-04	6.913280E+02	8.990800E-04	7.956862E+02	8.739500E-04
9.191872E+02	8.435400E-04	1.067888E+03	7.986100E-04	1.245753E+03	7.311000E-04
1.453242E+03	6.512200E-04	1.709641E+03	5.592900E-04	2.016451E+03	4.661400E-04
2.396919E+03	3.773800E-04	2.863224E+03	3.008300E-04	3.444241E+03	2.396900E-04
4.156085E+03	1.856900E-04	5.040332E+03	1.341100E-04	6.133931E+03	9.150800E-05
7.488086E+03	5.970700E-05	9.166967E+03	3.753400E-05	1.126486E+04	2.280400E-05
1.386132E+04	1.353300E-05	1.709441E+04	7.858100E-06	2.112206E+04	4.484900E-06
2.615197E+04	2.524900E-06	3.243614E+04	1.406400E-06	4.023251E+04	7.794500E-07
5.000000E+04	4.279600E-07	–	–	–	–

Table B.3.26: Energy per Nucleon versus ^{54}Mn Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	6.988800E-07	1.923466E+01	2.896100E-06	2.156430E+01	5.140900E-06
2.417442E+01	7.243300E-06	2.709740E+01	9.873500E-06	3.037216E+01	1.586500E-05
3.404070E+01	2.236200E-05	3.815234E+01	3.172600E-05	4.276254E+01	4.474100E-05
4.793135E+01	5.815200E-05	5.373154E+01	7.193500E-05	6.023854E+01	8.835200E-05
6.755091E+01	1.079200E-04	7.576738E+01	1.301500E-04	8.500710E+01	1.535500E-04
9.540710E+01	1.805400E-04	1.071423E+02	2.146300E-04	1.203541E+02	2.525600E-04
1.352905E+02	2.903500E-04	1.521613E+02	3.241700E-04	1.713748E+02	3.594700E-04
1.930143E+02	3.923400E-04	2.178676E+02	4.239700E-04	2.461532E+02	4.497300E-04
2.781110E+02	4.786600E-04	3.147252E+02	5.090600E-04	3.571010E+02	5.350600E-04
4.053476E+02	5.563200E-04	4.617689E+02	5.618000E-04	5.268134E+02	5.621800E-04
6.024618E+02	5.581700E-04	6.913280E+02	5.511800E-04	7.956862E+02	5.395700E-04
9.191872E+02	5.248800E-04	1.067888E+03	5.015800E-04	1.245753E+03	4.638900E-04
1.453242E+03	4.176000E-04	1.709641E+03	3.628600E-04	2.016451E+03	3.062600E-04
2.396919E+03	2.513500E-04	2.863224E+03	2.032400E-04	3.444241E+03	1.644900E-04
4.156085E+03	1.297000E-04	5.040332E+03	9.546600E-05	6.133931E+03	6.643400E-05
7.488086E+03	4.423800E-05	9.166967E+03	2.840200E-05	1.126486E+04	1.763800E-05
1.386132E+04	1.070400E-05	1.709441E+04	6.360400E-06	2.112206E+04	3.716400E-06
2.615197E+04	2.143100E-06	3.243614E+04	1.223200E-06	4.023251E+04	6.948000E-07
5.000000E+04	3.911300E-07	–	–	–	–

Table B.3.27: Energy per Nucleon versus ^{56}Fe Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	8.136400E-06	1.923466E+01	3.540500E-05	2.156430E+01	6.367900E-05
2.417442E+01	9.091200E-05	2.709740E+01	1.224100E-04	3.037216E+01	1.973800E-04
3.404070E+01	2.797400E-04	3.815234E+01	3.950200E-04	4.276254E+01	5.579300E-04
4.793135E+01	7.268400E-04	5.373154E+01	8.987300E-04	6.023854E+01	1.100700E-03
6.755091E+01	1.340400E-03	7.576738E+01	1.611600E-03	8.500710E+01	1.893900E-03
9.540710E+01	2.215000E-03	1.071423E+02	2.615600E-03	1.203541E+02	3.062700E-03
1.352905E+02	3.500400E-03	1.521613E+02	3.882900E-03	1.713748E+02	4.271900E-03
1.930143E+02	4.627000E-03	2.178676E+02	4.960400E-03	2.461532E+02	5.216700E-03
2.781110E+02	5.499400E-03	3.147252E+02	5.798200E-03	3.571010E+02	6.041800E-03
4.053476E+02	6.230800E-03	4.617689E+02	6.244900E-03	5.268134E+02	6.200300E-03
6.024618E+02	6.109200E-03	6.913280E+02	5.993600E-03	7.956862E+02	5.833600E-03
9.191872E+02	5.647900E-03	1.067888E+03	5.381200E-03	1.245753E+03	4.969000E-03
1.453242E+03	4.471700E-03	1.709641E+03	3.890000E-03	2.016451E+03	3.292700E-03
2.396919E+03	2.714200E-03	2.863224E+03	2.207000E-03	3.444241E+03	1.799700E-03
4.156085E+03	1.433200E-03	5.040332E+03	1.067100E-03	6.133931E+03	7.519800E-04
7.488086E+03	5.075300E-04	9.166967E+03	3.305400E-04	1.126486E+04	2.083800E-04
1.386132E+04	1.284500E-04	1.709441E+04	7.756000E-05	2.112206E+04	4.607200E-05
2.615197E+04	2.701900E-05	3.243614E+04	1.568800E-05	4.023251E+04	9.066700E-06
5.000000E+04	5.194500E-06	–	–	–	–

Table B.3.28: Energy per Nucleon versus ^{57}Co Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	1.542800E-08	1.923466E+01	1.162700E-07	2.156430E+01	2.420900E-07
2.417442E+01	3.770300E-07	2.709740E+01	4.868900E-07	3.037216E+01	7.685400E-07
3.404070E+01	1.142300E-06	3.815234E+01	1.567400E-06	4.276254E+01	2.241000E-06
4.793135E+01	3.014800E-06	5.373154E+01	3.806000E-06	6.023854E+01	4.651600E-06
6.755091E+01	5.684600E-06	7.576738E+01	6.887500E-06	8.500710E+01	8.176100E-06
9.540710E+01	9.568100E-06	1.071423E+02	1.126500E-05	1.203541E+02	1.335200E-05
1.352905E+02	1.539400E-05	1.521613E+02	1.733400E-05	1.713748E+02	1.916300E-05
1.930143E+02	2.099700E-05	2.178676E+02	2.268100E-05	2.461532E+02	2.407400E-05
2.781110E+02	2.541000E-05	3.147252E+02	2.698900E-05	3.571010E+02	2.836300E-05
4.053476E+02	2.952600E-05	4.617689E+02	2.996800E-05	5.268134E+02	2.992300E-05
6.024618E+02	2.962000E-05	6.913280E+02	2.920000E-05	7.956862E+02	2.853700E-05
9.191872E+02	2.770600E-05	1.067888E+03	2.652600E-05	1.245753E+03	2.464100E-05
1.453242E+03	2.223900E-05	1.709641E+03	1.937900E-05	2.016451E+03	1.639400E-05
2.396919E+03	1.347200E-05	2.863224E+03	1.087500E-05	3.444241E+03	8.781200E-06
4.156085E+03	6.965600E-06	5.040332E+03	5.167300E-06	6.133931E+03	3.616000E-06
7.488086E+03	2.418200E-06	9.166967E+03	1.558200E-06	1.126486E+04	9.707600E-07
1.386132E+04	5.907300E-07	1.709441E+04	3.519000E-07	2.112206E+04	2.060800E-07
2.615197E+04	1.190700E-07	3.243614E+04	6.809700E-08	4.023251E+04	3.875900E-08
5.000000E+04	2.186400E-08	–	–	–	–

Table B.3.29: Energy per Nucleon versus ^{58}Ni Flux Data for the LEO Galactic Cosmic Ray Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{particle}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	0.0	1.408122E-02	0.0	1.982806E-02	0.0
2.780981E-02	0.0	3.875467E-02	0.0	5.332453E-02	0.0
7.201205E-02	0.0	9.504214E-02	0.0	1.222573E-01	0.0
1.535488E-01	0.0	1.887641E-01	0.0	2.276714E-01	0.0
2.714374E-01	0.0	3.199159E-01	0.0	3.737161E-01	0.0
4.336543E-01	0.0	5.006712E-01	0.0	5.754554E-01	0.0
6.594890E-01	0.0	7.538421E-01	0.0	8.598675E-01	0.0
9.791078E-01	0.0	1.111958E+00	0.0	1.262183E+00	0.0
1.430260E+00	0.0	1.619384E+00	0.0	1.831895E+00	0.0
2.070313E+00	0.0	2.337882E+00	0.0	2.638686E+00	0.0
2.976327E+00	0.0	3.354537E+00	0.0	3.779000E+00	0.0
4.255003E+00	0.0	4.788643E+00	0.0	5.386816E+00	0.0
6.057149E+00	0.0	6.808107E+00	0.0	7.649509E+00	0.0
8.591997E+00	0.0	9.647560E+00	0.0	1.082961E+01	0.0
1.215322E+01	0.0	1.363491E+01	0.0	1.529532E+01	0.0
1.715376E+01	4.364700E-08	1.923466E+01	6.609900E-07	2.156430E+01	1.801500E-06
2.417442E+01	3.040300E-06	2.709740E+01	4.005700E-06	3.037216E+01	5.845100E-06
3.404070E+01	9.168900E-06	3.815234E+01	1.265500E-05	4.276254E+01	1.807100E-05
4.793135E+01	2.490000E-05	5.373154E+01	3.201000E-05	6.023854E+01	3.910500E-05
6.755091E+01	4.793200E-05	7.576738E+01	5.822300E-05	8.500710E+01	6.956300E-05
9.540710E+01	8.148200E-05	1.071423E+02	9.552300E-05	1.203541E+02	1.134900E-04
1.352905E+02	1.317200E-04	1.521613E+02	1.497300E-04	1.713748E+02	1.654200E-04
1.930143E+02	1.821400E-04	2.178676E+02	1.969600E-04	2.461532E+02	2.103500E-04
2.781110E+02	2.214800E-04	3.147252E+02	2.355800E-04	3.571010E+02	2.487900E-04
4.053476E+02	2.595900E-04	4.617689E+02	2.661000E-04	5.268134E+02	2.664800E-04
6.024618E+02	2.651600E-04	6.913280E+02	2.624000E-04	7.956862E+02	2.581700E-04
9.191872E+02	2.522700E-04	1.067888E+03	2.440800E-04	1.245753E+03	2.300300E-04
1.453242E+03	2.105000E-04	1.709641E+03	1.865200E-04	2.016451E+03	1.604000E-04
2.396919E+03	1.340700E-04	2.863224E+03	1.100800E-04	3.444241E+03	9.043600E-05
4.156085E+03	7.355000E-05	5.040332E+03	5.618800E-05	6.133931E+03	4.043000E-05
7.488086E+03	2.782100E-05	9.166967E+03	1.844600E-05	1.126486E+04	1.183400E-05
1.386132E+04	7.418000E-06	1.709441E+04	4.553900E-06	2.112206E+04	2.749400E-06
2.615197E+04	1.638300E-06	3.243614E+04	9.666500E-07	4.023251E+04	5.677600E-07
5.000000E+04	3.306400E-07	–	–	–	–

Table B.3.30: Energy versus Trapped Proton Flux Data for the LEO Source

Energy $\frac{\text{MeV}}{\text{A}}$	Fluence $\frac{\text{proton}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Fluence $\frac{\text{proton}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Fluence $\frac{\text{proton}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$
1.000000E-02	3.436200E+08	1.875291E-02	3.350300E+08	3.480407E-02	3.192900E+08
6.234330E-02	2.922900E+08	1.040279E-01	2.514100E+08	1.596987E-01	1.867000E+08
2.286180E-01	1.171600E+08	3.128875E-01	7.469900E+07	4.148185E-01	4.694600E+07
5.395213E-01	2.838100E+07	7.616098E-01	1.311000E+07	1.041454E+00	6.506000E+06
1.410684E+00	3.556100E+06	1.899600E+00	2.042000E+06	2.545671E+00	1.146400E+06
3.398159E+00	6.923100E+05	4.521955E+00	3.962700E+05	6.000909E+00	2.165200E+05
7.945456E+00	1.142500E+05	1.050000E+01	6.377200E+04	1.179048E+01	5.095700E+04
1.323618E+01	4.248800E+04	1.485678E+01	3.339600E+04	1.667132E+01	2.877700E+04
1.870472E+01	2.360000E+04	2.098246E+01	1.977900E+04	2.353477E+01	1.742900E+04
2.639553E+01	1.479400E+04	2.960152E+01	1.373300E+04	3.319499E+01	1.262400E+04
3.722440E+01	1.170200E+04	4.174413E+01	1.118200E+04	4.681490E+01	1.059800E+04
5.250602E+01	1.017400E+04	5.889565E+01	9.745900E+03	6.607767E+01	9.259700E+03
7.415042E+01	8.699500E+03	8.323253E+01	8.069300E+03	9.345976E+01	7.373800E+03
1.050000E+02	6.594600E+03	1.096041E+02	6.283800E+03	1.144101E+02	5.959300E+03
1.194268E+02	5.674800E+03	1.246635E+02	5.387500E+03	1.301769E+02	5.084900E+03
1.359375E+02	4.768800E+03	1.419529E+02	4.438800E+03	1.482346E+02	4.094100E+03
1.548600E+02	3.739900E+03	1.618074E+02	3.513900E+03	1.690665E+02	3.277800E+03
1.766513E+02	3.031100E+03	1.845764E+02	2.773300E+03	1.928569E+02	2.504000E+03
2.015492E+02	2.221300E+03	2.108366E+02	1.980800E+03	2.205519E+02	1.827900E+03
2.307150E+02	1.668000E+03	2.413463E+02	1.500700E+03	2.524675E+02	1.325700E+03
2.691319E+02	1.063400E+03	2.851141E+02	8.801600E+02	3.005194E+02	7.831700E+02
3.159144E+02	6.862600E+02	3.308495E+02	5.922300E+02	3.453702E+02	5.008200E+02
3.595152E+02	4.117700E+02	3.733171E+02	3.277000E+02	3.868039E+02	3.099500E+02
4.000000E+02	2.925900E+02	4.586163E+02	2.154700E+02	5.135421E+02	1.432100E+02
5.664912E+02	7.354600E+01	6.173520E+02	6.631600E+00	6.669916E+02	0.0
7.152148E+02	0.0	7.627025E+02	0.0	8.090546E+02	0.0
8.550492E+02	0.0	9.000000E+02	0.0	9.449130E+02	0.0
9.889814E+02	0.0	1.033872E+03	0.0	1.078632E+03	0.0
1.122773E+03	0.0	1.166335E+03	0.0	1.209354E+03	0.0
1.251862E+03	0.0	1.293889E+03	0.0	1.335459E+03	0.0
1.376596E+03	0.0	1.417322E+03	0.0	1.457657E+03	0.0
1.497618E+03	0.0	1.539820E+03	0.0	1.581894E+03	0.0
1.623689E+03	0.0	1.665214E+03	0.0	1.706481E+03	0.0
1.747498E+03	0.0	–	–	–	–

Table B.3.31: Energy versus Trapped Electron Flux Data for the Low Earth Orbit Source

Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{electron}}{\text{cm}^2-\text{MeV}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{electron}}{\text{cm}^2-\text{MeV}-\text{day}}$	Energy $\frac{\text{MeV}}{\text{A}}$	Flux $\frac{\text{electron}}{\text{cm}^2-\text{MeV}-\text{day}}$
1.000000E-01	3.528192E+10	1.042224E-01	3.444084E+10	1.086231E-01	3.356426E+10
1.132096E-01	3.265066E+10	1.179898E-01	3.137875E+10	1.229718E-01	2.982271E+10
1.281642E-01	2.820097E+10	1.335758E-01	2.656920E+10	1.392159E-01	2.515491E+10
1.450942E-01	2.368089E+10	1.512207E-01	2.214465E+10	1.576059E-01	2.081117E+10
1.642606E-01	1.950831E+10	1.711964E-01	1.815045E+10	1.784250E-01	1.685524E+10
1.859589E-01	1.573809E+10	1.938108E-01	1.457376E+10	2.019943E-01	1.336028E+10
2.105233E-01	1.227299E+10	2.194125E-01	1.115320E+10	2.286770E-01	9.986133E+09
2.383327E-01	8.929960E+09	2.483961E-01	7.981814E+09	2.588844E-01	6.993633E+09
2.698156E-01	6.017022E+09	2.812083E-01	5.470759E+09	2.930821E-01	4.901429E+09
3.054572E-01	4.308059E+09	3.183548E-01	3.902760E+09	3.317971E-01	3.578254E+09
3.458070E-01	3.240045E+09	3.604083E-01	2.921026E+09	3.756263E-01	2.678228E+09
3.914868E-01	2.425179E+09	4.080169E-01	2.161445E+09	4.252451E-01	1.948272E+09
4.432007E-01	1.736175E+09	4.619145E-01	1.515123E+09	4.814184E-01	1.322896E+09
5.017459E-01	1.170498E+09	5.229316E-01	1.011667E+09	5.450120E-01	8.494808E+08
5.680247E-01	7.762844E+08	5.920090E-01	6.999976E+08	6.170061E-01	6.204894E+08
6.430587E-01	5.586581E+08	6.702112E-01	5.073384E+08	6.985103E-01	4.538516E+08
7.280043E-01	4.021081E+08	7.587436E-01	3.638402E+08	7.907808E-01	3.239565E+08
8.241709E-01	2.823886E+08	8.589709E-01	2.561934E+08	8.952402E-01	2.334535E+08
9.330410E-01	2.097534E+08	9.724379E-01	1.887332E+08	1.013498E+00	1.729742E+08
1.056292E+00	1.565497E+08	1.100893E+00	1.394317E+08	1.147377E+00	1.292121E+08
1.195825E+00	1.188390E+08	1.246317E+00	1.080278E+08	1.298942E+00	9.909934E+07
1.353788E+00	9.173392E+07	1.410951E+00	8.405750E+07	1.470527E+00	7.636198E+07
1.532619E+00	7.028781E+07	1.597332E+00	6.395720E+07	1.664778E+00	5.735924E+07
1.735072E+00	5.173814E+07	1.808334E+00	4.636794E+07	1.884689E+00	4.077099E+07
1.964269E+00	3.561249E+07	2.047208E+00	3.176704E+07	2.133650E+00	2.775920E+07
2.223741E+00	2.358213E+07	2.317637E+00	2.095264E+07	2.415497E+00	1.841518E+07
2.517490E+00	1.577058E+07	2.623788E+00	1.351012E+07	2.734575E+00	1.169649E+07
2.850040E+00	9.806287E+06	2.970381E+00	7.894063E+06	3.095803E+00	6.697657E+06
3.226521E+00	5.450733E+06	3.362757E+00	4.151165E+06	3.504747E+00	3.298723E+06
3.652732E+00	2.680016E+06	3.806965E+00	2.035184E+06	3.967711E+00	1.459635E+06
4.135244E+00	1.169454E+06	4.309851E+00	8.670221E+05	4.491830E+00	5.518188E+05
4.681494E+00	4.077177E+05	4.879167E+00	2.967534E+05	5.085186E+00	1.811037E+05
5.299903E+00	1.015941E+05	5.523686E+00	7.805729E+04	5.756919E+00	5.352652E+04
6.000000E+00	2.795996E+04	–	–	–	–

C OLTARIS Transport

The OLTARIS website currently utilizes the NASA developed transport code based on HZETRN[12] with many improvements and corrections. It has two algorithms to analyze full vehicles: interpolation and ray-by-ray. These algorithms are described below; however, the ray-by-ray code can analyze a single ray which can be used to analyze a slab of material and will not be discussed as a separate topic.

C.1 Interpolated Transport Algorithms in OLTARIS

This algorithm creates a database of fluxes or fluences in up to three materials over a spatial grid in each of the materials. If there are ten spatial grid points in each material, then there will be 1000 entries in the database for each combination of material thicknesses. Achievement of this database is only because a forward marching algorithm is used to generate the flux or fluence values. These flux or fluence values are then converted to the response function of interest. If a space vehicle is to be analyzed, then the database is used as an interpolation database for the thickness distributions of the space vehicle to generate a response at the point of interest.

For the whole body effective dose, many of these interpolations occur to build up a dose equivalent profile at points to represent organs and then a weighted average is used to generate the final number. Other response functions can be modeled in this way to generate complex response functions.

The method is fast because the number of transport executions is minimized and the reliance is placed on the interpolation routines. Extrapolation is always problematic and the current algorithms adjust the grid to cover all rays up to 500 $\frac{\text{g}}{\text{cm}^2}$. Linear extrapolation is performed for rays that exceed this value.

C.2 Ray-by-ray Transport Algorithms in OLTARIS

The major limitation with the interpolation database method is the interpolation and the fact that the spacecraft model must be reduced to three materials and reordered so that all of the first material is on the outside, the second material is in the middle and the third material is on the inside. If the raw ray trace is not processed and the number of materials and their order is not modified, and since the HZETRN algorithm is one dimensional in nature, then the algorithm can be executed along each ray and the results integrated to determine a response function at the ray traced point. Also, a diffusion-like algorithm has been implemented for neutrons so that if the rays are linear through the point of interest, then the material behind the point of interest can be included for neutron production and transport. This method is used to include items like the lunar surface in a model and still enable a one dimensional transport method like HZETRN.

While this method is much slower than the interpolation database method, it is more accurate and allows many more scenarios to be analyzed. However, much data needs to be tracked and results folded together.

D Response Functions

While the raw flux values are an important set of data for understanding various transport codes and algorithms and the damage that space radiation environments cause to materials and humans; currently, the science is still being investigated on how to link flux to damage and then finally to human risk. Therefore, surrogate quantities are used to estimate the damage and predict the risk. These quantities are dose (D), dose equivalent (H), linear energy transfer (LET), and whole body effective dose equivalent (H_T). These quantities are described in this section.

D.1 Dose Algorithms in OLTARIS

While the flux of particles is a detailed quantity describing the environment inside a spacecraft, it is of little use to describe the damage caused by or the risk resulting from this particle environment to humans, materials, or electronics. As a first step, the dose is calculated from the energy deposited along every particle's track as it traverses the spacecraft. Therefore, the dose is defined as

$$D = \sum_j D_j,$$

where,

$$D_j = \int_0^\infty dE\ S_j(E)\phi_j(E) + d^\star(E)$$

with $S_j(E)$ as the stopping power of a charged particle j at energy E in the material of interest (usually tissue or silicon) in units of $\frac{\text{keV}}{\mu\text{m}}$ and $\phi_j(E)$ is the flux or fluence of particle j at energy E in units of $\frac{\text{j}}{\text{cm}^2 - \frac{\text{MeV}}{\text{A}} - \text{day}}$

or $\frac{\text{j}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}}$. Of course, the stopping power of neutral particles in any material is zero; therefore, the integral term is zero. However, since heavy target fragments and recoil nuclei are not transported in OLTARIS, their dose is added by the $d^\star(E)$ function [13].

D.2 Dose Equivalent Algorithms in OLTARIS

While dose gives the energy deposited by a particle in a material, it does not estimate the probability of stochastic effects in humans, such as cancer mortality. For the "complex mixture of high- and low-LET radiation experienced in LEO,"[14] the National Council on Radiation Protection and Measurement (NCRP) endorses the use of dose equivalent calculated with the ICRP-60[8] quality factor, $Q_{\text{ICRP}-60}$, for this purpose[14, 9, 15]. As yet, the NCRP has not made a recommendation for space environments beyond LEO, but NASA has adopted the approach of using dose equivalent for beyond LEO vehicles as well until the NCRP gives it guidance. Dose equivalent is defined as

$$H = \sum_j H_j,$$

where,

$$H_j = \int_0^\infty dE\, Q_{\text{ICRP}-60}\left(S_j(E)\right) S_j(E)\phi_j(E) + h^\star(E).$$

The quality factor $Q_{\text{ICRP}-60}$ is defined as [8]

$$Q_{\text{ICRP}-60}\left(S_j(E)\right) = \begin{cases} 1 & \text{for} \quad 0 < S_j(E) \leq 10 \\ 0.32S_j(E) - 2.2 & \text{for} \quad 10 < S_j(E) \leq 100 \\ \frac{300}{\sqrt{S_j(E)}} & \text{for} \quad 100 > S_j(E) \end{cases},$$

where $S_j(E)$ is the stopping power of a charged particle j at energy E in the material, tissue, or organ of interest in units of $\frac{\text{keV}}{\mu\text{m}}$ and $\phi_j(E)$ is the flux or fluence of particle j at energy E in units of $\frac{\text{j}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}-\text{day}}$ or $\frac{\text{j}}{\text{cm}^2-\frac{\text{MeV}}{\text{A}}}$. The stopping power of neutral particles in any materials is zero; therefore, the integral term is zero; however, since heavy target fragments and recoil nuclei are not transported in OLTARIS, their dose equivalent is added by the $h^\star(E)$ function[13].

D.3 LET Algorithms in OLTARIS

In analyzing charged particle spectra in space due to GCR, SPE, and trapped protons, the conversion or mapping of particle energy spectra into LET distributions is a convenient guide in assessing biologically significant components of these spectra. OLTARIS uses a well-defined numerical procedure, which allows for the generation of LET spectra on the open energy subintervals that are integrable in spite of their singular nature [16, 17]. LET can be reported in tissue and silicon.

D.4 Whole Body Effective Dose Equivalent Algorithms in OLTARIS

As is recommended in NCRP-132[9] and NCRP-142[14], effective dose equivalent is calculated by first calculating the averaged dose equivalent for the organs and tissues listed in Table D.4.1. The remainder organs are listed in NCRP-132 as: adrenals, brain, small intestine, large intestine, kidneys, muscle, pancreas, spleen, thymus, and uterus. A weighted average of these organ or tissue dose equivalent values, as defined in equation 1, is then calculated using the NCRP-132 tissue weighting factors given in Table D.4.1.

$$H_T = \sum_T w_T \bar{H}_T, \tag{1}$$

where w_T are the NCRP-132 tissue weighting factors in Table D.4.1 and $\bar{H}_T$ are the organ or tissue averaged dose equivalents as calculated by OLTARIS.

Organ or tissue averaged dose equivalent is obtained by calculating the dose equivalent at a large enough number of target points in the organ or tissue to accurately characterize that organ or tissue and then

Table D.4.1: NCRP 132 Organs and their Weights

Tissue Weights	0.01	0.05	0.12	0.20
Tissue Types	Bone Surface Skin	Bladder Breast Liver Esophagus Thyroid Remainder	Bone Marrow Colon Lung Stomach	Gonads

averaging these point values. Currently, four human body models (CAM, CAF, MAX, or FAX) can be selected for these calculations. Target point locations for all of the necessary organs and tissues in each of the human body models have been chosen [18, 19] and body thickness distributions are combined with vehicle thickness distributions within OLTARIS.

There are a few body model specific details that should be noted. First, there are ten remainder organs for the females, but only nine for the males. For this reason, the tissue weighting factor, w_T, for each of the remainder organs is $\frac{0.05}{10}$ for females and $\frac{0.05}{9}$ for the males. Second, in the CAF and CAM models, the colon, large intestine, and small intestine are treated as one organ. This organ labeled intestine is therefore assigned a tissue weighting factor equivalent to the sum of the tissue weighting factor specified for the colon, 0.12, and the tissue weighting factors for two remainder organs. Thus, the intestine weighting factor is $0.12 + \frac{0.05}{10} \times 2$ for CAF and $0.12 + \frac{0.05}{9} \times 2$ for CAM. Similarly, the colon and the large intestine are treated as one organ and labeled "colon" in the FAX and MAX models, but the small intestine is treated as a separate organ in these models. The weighting factor for colon is therefore $0.12 + \frac{0.05}{10}$ in FAX and $0.12 + \frac{0.05}{9}$ in MAX. Also, the organ averaged dose equivalent is calculated for several organs not included in the effective dose equivalent calculation. These organs are heart, hippocampus, lens, and salivary glands for the CAF model; heart, hippocampus, lens, prostate, and salivary glands for the CAM model; heart, hippocampus, lens, retina, salivary glands, and trachea for the FAX model; and heart, hippocampus, lens, prostate, retina, salivary glands, and trachea for the MAX model. All of these organs have a weight in the H_T calculation of 0.

References

[1] Singleterry, R.C., Blattnig, S.R., Clowdsley, M.S., Qualls, G.D., Sandridge, C.A., Simonsen, L.C., Norbury, J.W., Slaba, T.C., Walker, S.A., Badavi, F.F., Spangler, J.L, Aumann, A.R., Zapp, E.N., Rutledge, R.D., Lee, K.T., Norman, R B., "OLTARIS: On-Line Tool for the Assessment of Radiation In Space',' NASA Technical Paper 2010-216722, 2010.

[2] `http://www-rsicc.ornl.gov/` as viewed on June 27, 2013.

[3] Billings, M.P., Yucker, W.R., "The Computerized Anatomical Man (CAM) Model," Summary Final Report, MDC-G4655, McDonnell Douglas Company, 1973.

[4] Yucker, W.R., Huston, S.L., "The Computerized Anatomical Female," Final Report MDC-6107, McDonnell Douglas Company, 1990.

[5] Yucker, W.R., Reck, R.J., "Computerized Anatomical Female Body Self-Shielding Distributions," Report, MDC-92H0749, McDonnell Douglas Company, 1992.

[6] Kramer, R., Vieira, J.W., Khoury, H.J., Lima, F.R.A., Fuelle, D., "All about MAX: A Male Adult Voxel Phantom for Monte Carlo Calculations in Radiation Protection Dosimetry," Physics in Medicine and Biology, Vol. 48, pp. 1239-1262, 2003.

[7] Kramer, R., Vieira, J.W., Khoury, H.J., Lima, F.R.A., Loureiro, E.C.M., Lima, V.J.M., Hoff, G., "All about FAX: A Female Adult Voxel Phantom for Monte Carlo Calculations in Radiation Protection Dosimetry," Physics in Medicine and Biology, Vol. 49, pp. 5203-5216, 2004.

[8] International Commission on Radiological Protection (ICRP), "The 1990 Recommendations of the International Commission on Radiological Protection," ICRP Publication 60, Elsevier, New York, 1993.

[9] National Council on Radiation Protection and Measurements (NCRP), "Radiation Protection Guidance for Activities in Low-Earth Orbit," NCRP Report 132, 2000.

[10] Wilson, J.W., Townsend, L.W., Schimmerling, W., Khandelwal, G.S., Khan, F., Nealy, J.E., Cucinotta, F.A., Simonsen, L.C., Shinn, J.L, Norbury, J.W., "Transport Methods and Interactions for Space Radiations," NASA Reference Publication 1257, 1991.

[11] Jolliff, B.L., Wieczorek, M.A., Shearer, C.K., Neal, C.R. (Eds.), "New Views of the Moon," Reviews in Mineralogy & Geochemistry, Vol. 60, 2006. See Table 2.5, page 119.

[12] Wilson, J.W., Badavi, F.F., Cucinotta, F.A., Shinn, J.L, Badhwar, G.D., Silbergerg, R., Tsao, C.H., Townsend, L.W., Tripathi, R.K., "HZETRN: Description of a Free-Space Ion and Nucleon Transport and Shielding Computer Program," NASA Technical Paper 3495, 1995.

[13] Personal Communication with John W. Wilson at the NASA Langley Research Center, 1998.

[14] National Council on Radiation Protection and Measurements (NCRP), "Operational Radiation Safety Program for Astronauts in Low-Earth Orbit: A Basic Framework," NCRP Report 142, 2002.

[15] National Council on Radiation Protection and Measurements (NCRP), "Information Needed to Make Radiation Protection Recommendations for Space Missions Beyond Low Earth Orbit," NCRP Report 153, 2006.

[16] Badavi, F.F., Wilson, J.W., Hunter, A., "Numerical Study of the Generation of Linear Energy Transfer Spectra for Space Radiation Applications," NASA Technical Paper 213941, 2005.

[17] Badavi, F.F., Stewart-Sloan, C.R., Adams, D.O., Wilson, J.W., "Radiation Protection Effectiveness of Polymeric Based Shielding Materials at Low Earth Orbit," The Society for the Advancement of Material and Process Engineering (SAMPE), No. 2008-L002, 2008.

[18] Slaba, T.C., Qualls, G.D., Clowdsley, M.S., Blattnig, S.R., Simonsen, L.C., Walker, S.A., Singleterry, R.C., "Analysis of Mass Averaged Tissue Doses in CAM, CAF, MAX, and FAX," NASA Technical Paper 215562, 2009.

[19] Slaba, T.C., Qualls, G.D., Clowdsley, M.S., Blattnig, S.R., Walker, S.A., Simonsen, L.C., "Utilization of CAM, CAF, MAX, and FAX for Space Radiation Analysis Using HZETRN," Advances in Space Research, Vol. 45, pp. 866-883, 2010.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

1. REPORT DATE *(DD-MM-YYYY)*	2. REPORT TYPE	3. DATES COVERED *(From - To)*
01- 06 - 2013	Technical Memorandum	

4. TITLE AND SUBTITLE

Simple Benchmark Specifications for Space Radiation Protection

5a. CONTRACT NUMBER

5b. GRANT NUMBER

5c. PROGRAM ELEMENT NUMBER

6. AUTHOR(S)

Singleterry, Robert C., Jr.; Aghara, Sukesh K.

5d. PROJECT NUMBER

5e. TASK NUMBER

5f. WORK UNIT NUMBER

432938.11.01.07.43.40.09

7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES)

NASA Langley Research Center
Hampton, VA 23681-2199

8. PERFORMING ORGANIZATION REPORT NUMBER

L-20265

9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)

National Aeronautics and Space Administration
Washington, DC 20546-0001

10. SPONSOR/MONITOR'S ACRONYM(S)

NASA

11. SPONSOR/MONITOR'S REPORT NUMBER(S)

NASA/TM-2013-218014

12. DISTRIBUTION/AVAILABILITY STATEMENT

Unclassified - Unlimited
Subject Category 93
Availability: NASA CASI (443) 757-5802

13. SUPPLEMENTARY NOTES

14. ABSTRACT

This report defines space radiation benchmark specifications. This specification starts with simple, mono-energetic, mono-directional particles on slabs and progresses to human models in spacecraft. This report specifies the models and sources needed to what the team performing the benchmark needs to produce in a report. Also included are brief descriptions of how OLTARIS, the NASA Langley website for space radiation analysis, performs its analysis.

15. SUBJECT TERMS

OLTARIS; Space radiation analysis; Space radiation benchmarks; Space radiation engineering

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT	b. ABSTRACT	c. THIS PAGE			STI Help Desk (email: help@sti.nasa.gov)
					19b. TELEPHONE NUMBER *(Include area code)*
U	U	U	UU	90	(443) 757-5802