

## D.6 FERMI GUEST INVESTIGATOR – CYCLE 12

**NOTICE: Amended January 31, 2019.** The proposal due dates for this program element were previously temporarily changed to "TBD" as a result of the partial government shutdown. This amendment releases new due dates for the effected program elements in Appendix D. For this program element Phase-1 proposals are now due (via ARK RPS) at 4:30 pm March 20, 2019.

**December 13, 2018.** Section 2.1 General Information has been corrected by referring to in Section 3 to make it consistent with the higher average award amounts provided on November 28. New Text is in bold and deleted text is struck through. The due date remains unchanged.

**November 28, 2018.** Three things have been clarified in this program element: 1) A new Section 1.3 has been inserted on the solar array anomaly and its implications on nonuniform sky coverage and Fermi's ability to respond to Targets of Opportunity and to perform pointed observations; 2) lower number of expected awards due to higher average award amounts; 3) uncertainties of future joint Fermi-Arecibo proposals (section 1.4.3). New Text is in bold and deleted text is struck through. The due date remains unchanged.

### 1. Scope of Program

#### 1.1 Overview

The Fermi Guest Investigator (GI) program solicits proposals for basic research relevant to the Fermi mission. The primary goal of this mission is to perform 20 MeV to >300 GeV gamma-ray measurements over the entire celestial sphere, with sensitivity a factor of 30 or more greater than that obtained by earlier space missions. A secondary goal includes the study of transient gamma-ray sources with energies extending from 8 keV up to 300 GeV.

The Fermi GI program is intended to encourage scientific participation by providing funding to carry out investigations using Fermi data, to conduct correlative observations at other wavelengths, to develop data analysis techniques applicable to the Fermi data, and to carry out theoretical investigations in support of Fermi observations.

The Fermi GI program also encompasses a number of joint observation program opportunities. Fermi investigators may apply for radio, optical, X-ray, or Gamma-ray observing time through joint programs with the National Radio Astronomy Observatory (NRAO), the National Optical Astronomy Observatory (NOAO), ~~Arecibo Observatory~~, the VERITAS ground-based Cerenkov telescope facility and, the INTERNATIONAL Gamma-Ray Astrophysics Laboratory (INTEGRAL). Please refer to section 1.3.3 for important details. They may also apply for high-end computing resources.

Investigators may propose Fermi pointed observations, but such observations will require strong scientific justification through simulations and exposure calculations

because default survey mode observations will satisfy the scientific requirements of most studies.

The Fermi GI program is open to all investigators, but NASA funding is available only to principal investigators (PIs) who are employed at a U.S. institution at the time the Phase-2 proposal is submitted by that institution via NSPIRES.

There will be no exclusive-use period associated with the data from Fermi observations. All data will be made available through the [HEASARC public data archive](#) after ground processing.

## 1.2 The Fermi Mission

Fermi is an international and multiagency observatory-class mission that studies the cosmos in the 10 keV to 300 GeV energy range. The primary instrument, the Large Area Telescope (LAT), has a peak effective area ( $>8000 \text{ cm}^2$ ), angular resolution ( $<3.5^\circ$  at 100 MeV,  $<0.15^\circ$  above 10 GeV), field-of-view ( $>2 \text{ sr}$ ), and deadtime ( $<100 \mu\text{s}$  per event) that provides a factor of 30 or more advance in sensitivity compared to previous missions. The Fermi Gamma-ray Burst Monitor (GBM) also provides the capability for studying transient phenomena, with a field-of-view larger than the LAT and a spectral range that extends from the LAT's lower limit down to less than 10 keV. Although pointed observations are possible, the observatory primarily scans the sky continuously because of the LAT's large field-of-view. In survey mode – the main mode of operation – Fermi provides nearly uniform sky exposure every  $\sim 3$  hours.

Modifications to this standard sky-survey mode were implemented during mission cycle 7 and may be considered in the future. Those alternative sky-survey strategies were designed to maximize the exposure at the Galactic Center and in turn to optimize the pursuit of several specific scientific objectives. They resulted from a solicitation of ideas from the community leading to an external committee recommendation to the Fermi project. It is anticipated that the resulting non-uniformity of sky exposure leaves Fermi's monitoring capability largely intact with a tolerable impact on other scientific endeavors. See [http://fermi.gsfc.nasa.gov/ssc/proposals/alt\\_obs/obs\\_modes.html](http://fermi.gsfc.nasa.gov/ssc/proposals/alt_obs/obs_modes.html) for details.

Documents providing a more complete description of Fermi can be found at <http://fermi.gsfc.nasa.gov/ssc>.

The product of a collaboration among NASA, the U.S. Department of Energy, and several international partners, the LAT is a pair-conversion telescope. Gamma rays pair-produce in tungsten foils, silicon strip detectors track the resulting pairs, and the resulting particle shower deposits energy in a CsI calorimeter. An anticoincidence detector provides discrimination against the large flux of charged particles incident on the LAT. The anticoincidence detector is segmented to eliminate the self-vetoing problem encountered by previous experiments.

Astrophysical photons are only a small fraction of all the events detected by the LAT on orbit. Most events are primary cosmic rays and their associated secondary charged and neutral particles produced in the surrounding spacecraft and the Earth's atmosphere. Therefore, event filtering on board reduces the  $\sim 3 \text{ kHz}$  detected event rate to  $\sim 350 \text{ Hz}$ . Events that survive the onboard filter are telemetered to the ground. Further ground processing yields a "true" celestial photon average rate of about 1 to 2 Hz.

The GBM detects gamma-ray bursts. Consisting of 12 NaI(Tl) (8–1000 keV) and 2 BGO (0.2–30 MeV) detectors, the GBM extends Fermi's burst spectral sensitivity from ~8 keV to ~30 MeV and monitors more than 8 sr of the sky, including the LAT's field-of-view. Bursts are localized by comparing rates in different detectors and rapidly distributed via the Gamma-ray bursts Coordinates Network (GCN). An initial location, computed automatically, is sent within several seconds, and is expected to have an accuracy of 5 to 10 degrees for strong bursts (fluence > ~10 photons cm<sup>-2</sup>). A more accurate location (~3 degrees for strong bursts) is sent within 24 hours. The threshold of the onboard trigger is a flux of about 0.7 photons cm<sup>-2</sup> s<sup>-1</sup> (50 to 300 keV band), for a 1-second burst, and uses a variety of energy band and time windows.

Fermi was launched on June 11, 2008, into a circular, initial orbit of ~565 km altitude at an inclination of 25.6°. The mission design lifetime is five years, with a goal of ten years. After a checkout period, science operations began on August 4, 2008. Based upon the results of the NASA 2016 Senior Review, support for mission operations was extended through September 30, 2019.

The GI community is supported by the Fermi Science Support Center (FSSC), which is managed by NASA's Goddard Space Flight Center. All publicly available data products, software, calibration files, and technical documents that have been developed jointly with the instrument teams are available through the FSSC (see <http://fermi.gsfc.nasa.gov/ssc/>).

### **1.3 Solar Array Anomaly [This Section added November 28, 2018]**

**Recently, due to an anomaly with one of the solar array drive motors, alternative sky-survey strategies have been employed to ensure safe spacecraft operation. This leads to exposure nonuniformity on short (~ weekly) timescales but near uniformity is eventually achieved. It also limits LAT coverage of the Sun and surrounding sky regions. The ability to respond to Targets of Opportunity (ToOs) or, more generally, to perform pointed observations or customized observation strategies will be very limited. Prospective proposers considering such observations are strongly advised to consult the Fermi Science Support Center prior to preparing their proposal.**

### **1.4 Types of Proposals**

The Cycle 12 Fermi GI program solicits proposals in the following areas:

1. The analysis of LAT or GBM data from the beginning of science operations or development of data analysis techniques. Investigators are encouraged, but not required, to make software or other resources supporting such new analysis techniques publicly available through the FSSC;
2. Requests for LAT pointed observations (but proposers should be aware that compelling science justification and analysis will be required to quantify the additional scientific benefit of such observations – see the Fermi Users' Group (FUG) analysis at [http://fermi.gsfc.nasa.gov/ssc/proposals/pointing\\_analysis/](http://fermi.gsfc.nasa.gov/ssc/proposals/pointing_analysis/)). The total time allocated to pointed observations will be between 0 and 15% of the total available observing time in Cycle 12. Pointed observations will follow the same open data policy as sky survey data, i.e., they will become public immediately;

3. Analysis of correlative multiwavelength observations with other instruments and observatories (but excluding operation of such facilities) that are directly relevant to Fermi science objectives (see FUG recommendation at <http://fermi.gsfc.nasa.gov/ssc/resources/multi/>); and
4. Theoretical investigations that will advance the science return of the Fermi mission.

#### 1.4.1 *Analysis of all LAT gamma-ray and GBM event data*

The LAT team's science goals are: (1) development of event-reconstruction and background-rejection techniques; (2) production of a comprehensive full-sky catalog of gamma-ray sources; and (3) a description of the diffuse gamma-ray emission. Proposed Fermi investigations should avoid duplication of the first two of these goals. The extent to which the proposed research will enhance the science return from Fermi will be considered in the proposal evaluation process (see Section 2.2 below).

The LAT's primary science data product is a list of events detected within the LAT's field-of-view. These events can be used to detect sources and study their temporal and spectral properties. Fermi observes the sky in a survey mode that provides nearly uniform sky exposure every ~3 hours; this mode will suffice for nearly all scientific observations. GIs may request funding to analyze any accumulated data and may receive funding even if they did not request a specific observation.

The GBM provides event lists with measured energies and arrival times, permitting both temporal and spectral studies. In addition, binned background count rates with differing temporal and spectral resolution are also available, enabling background studies and source detection through occultation steps.

The GBM science team is already funded to provide the community with a catalog of GRBs, including localizations and spectra. Proposals construed by peer reviewers as duplicative of this goal may, therefore, be deemed to have lower priority than those perceived as addressing other objectives.

New data analysis techniques that will maximize the mission's scientific yield are also encouraged. While the Fermi mission will provide a set of analysis tools with which a complete analysis of the data can be accomplished (refer to <http://fermi.gsfc.nasa.gov/ssc/data/analysis/> for details), specialized analyses to address specific scientific issues, such as blind pulsar period searches, the discovery of faint transients, or the detection of sources through occultation steps in the GBM background light curves, may require alternative techniques and additional software. GI proposals for such new data analysis techniques must specifically address how the proposed techniques will advance Fermi science objectives.

#### 1.4.2 *Requests for LAT pointed observations or modified observation strategies*

GIs may also request pointed observations, or in exceptional cases modified observation strategies, to accumulate sky exposure of a particular source at a rate higher than provided by survey mode observations. Similarly, GIs may request Target-of-Opportunity observations. Because pointed observations often provide only moderate advantage over survey mode, requests for pointed observations must provide a

compelling scientific justification for interrupting survey mode. It will, therefore, be incumbent upon the proposer to demonstrate that a pointed observation is required to achieve the scientific objectives. Proposers thinking of requesting pointed observations are strongly encouraged to contact the FSSC and anyone considering modified observation strategies must do so. (<http://fermi.gsfc.nasa.gov/ssc/help/>).

#### 1.4.3 *Multiwavelength observations* [This Section edited November 28, 2018]

Because correlative observations will substantially augment the science return from Fermi, such proposals are encouraged. Examples of correlative observations that will add significantly to the Fermi science include monitoring of blazars, follow-up observations of gamma-ray bursts, and determination of pulsar ephemerides. To foster correlative observations, the Fermi project has established joint observation programs with other ground- and space-based facilities. The Fermi GI program can award optical, radio, X-ray or high-energy gamma-ray observations through Fermi's joint programs with NRAO, NOAO, ~~Arecibo~~, VERITAS, and INTEGRAL. Note that only a single year of joint-program observations can be awarded through the Fermi GI Program regardless of the duration of awarded Fermi support. **As noted the future of the previously supported joint program agreement with the Arecibo Observatory is uncertain. Any updated information will be posted on the FSSC website well in advance of the Phase-1 proposal deadline.** There are a number of important technical and policy details regarding these joint programs and prospective proposers are strongly encouraged to refer to the respective MOUs:

<http://fermi.gsfc.nasa.gov/ssc/proposals/nrao.html>,

<http://fermi.gsfc.nasa.gov/ssc/proposals/noao.html>,

<http://fermi.gsfc.nasa.gov/ssc/proposals/arecibo.html>,

<http://fermi.gsfc.nasa.gov/ssc/proposals/veritas.html>, and

<http://fermi.gsfc.nasa.gov/ssc/proposals/integral.html>

The LAT instrument team will post the light curves (including spectral information) of the sources listed at

[http://fermi.gsfc.nasa.gov/ssc/data/policy/LAT\\_Monitored\\_Sources.html](http://fermi.gsfc.nasa.gov/ssc/data/policy/LAT_Monitored_Sources.html). They will also announce the discovery of high-amplitude variations among these sources or of newly discovered bright transients to the community via Astronomer's Telegrams and GCN notices. The FSSC will provide light curves and locations for these new sources.

#### 1.4.4 *Theoretical investigations*

Theoretical studies related to the observations conducted with Fermi hold the potential to significantly enhance the scientific impact of the mission. GI proposals for such theoretical investigations are also solicited and must specifically address how the anticipated results will advance Fermi science objectives.

### 1.5 Classes of Proposals

There are two proposal classes: (1) Regular proposals with research plans that can be completed in one year, and (2) Large proposals whose research plans are more expansive and may take up to three years to complete. Large programs will remain

prioritized for projects that are inherently resource intensive and large in scope. The number of Large projects funded in any given year will be very limited.

The burden of justifying the need for Large projects is on the proposers. The peer-review committees will not be permitted to descope Large projects and must evaluate them as proposed. Proposing a project in duplication as a single year plus as a Large program is discouraged.

PIs of approved Large projects must submit a progress report annually on the proposal due date, rather than on the anniversary of the award date. The progress report should comply with the page limit and format requirements of Phase 1 Regular proposals. It should list the deliverables (papers, public software, etc.) that have resulted from the ongoing work, as well as an adherence to the schedule specified in the original proposal. Progress reports must be submitted through the [Astrophysics Research Knowledgebase Remote Proposal System \(RPS\) system](#). Because of the significant resources allocated to large multiyear projects, those that do not make progress consistent with the proposed investigation could be reduced or terminated.

### 1.6 Proposal Length and Format

The page limit for the Science/Technical/Management section of Phase-1 proposals is four pages for Regular proposals and six pages for Large proposals. These page limits include figures and references. An additional page is required to describe the technical justification for the observation time, as well as the telescope and instrumentation configurations being requested through the joint programs with NOAO, NRAO, Arecibo, INTEGRAL, and VERITAS.

Proposals must be single-spaced, typewritten, English-language text on standard US letter paper, using one column, and using an easily read font size 12-point or larger and having, on average, no more than 15 characters per horizontal inch. No smaller font is permitted in the subsections of the proposal, including references. However, text in figures and their captions may be in fonts as small as 10-point. In addition, the proposal shall have no more than 5.5 lines per inch of text. Pages should have at least one-inch (2.5 cm) margins on all sides. Proposals not conforming to this format will be declared noncompliant and may be rejected without further review.

## 2. Programmatic Information

### 2.1 General Information [Corrected December 13, 2018]

**Awards for Regular and Large proposals will conform to the cost guidelines specified in section 3.** ~~Awards for Regular (one or two year duration) proposals are expected to average around \$55,000 per year and \$125,000 per year for Large proposals.~~ Phase-2 proposals requesting more than the above are unlikely to be approved without an extremely compelling justification.

Awards for triggered analyses (e.g., transients meeting specific criteria) will not be released until after such triggers occur.

Fermi GI funding is open only to individuals employed at U.S. institutions. Only proposals led by a US-based PI will be considered for funding.

Fermi science team members already receiving support from the Project are eligible for support, but must provide a compelling justification for the award of additional funds under the GI Program. It is the intent of this program that most of the available GI funding be awarded to proposers not formally associated with Fermi.

NASA does not anticipate awarding contracts in response to proposals submitted to this program element, because it would not be appropriate for the nature of the work solicited.

## 2.2 Proposal Submission and Evaluation

### 2.2.1 *Submission of Phase-1 Proposals to the Fermi GI Program*

The Fermi GI program will use a two-phase proposal submission process. The first phase will be the submission and evaluation of the science/technical justification. Proposals must include a management section with a statement of work and an estimate of the resources needed to accomplish the goals of this work. The required proposal forms must be submitted through RPS.

Proposals requiring more than one year of effort (Large proposals) must include a schedule and a list of expected deliverables and/or milestones for each year of the requested support. This schedule will be considered in the peer-evaluation of progress reports prior to years two and three.

Each proposer who anticipates requesting funding must provide a budget estimate, i.e., an estimated maximum of the total cost to NASA (including overhead) of his/her proposed investigation. A field for entering the total budget is provided on the RPS Cover Form.

In the second phase, proposers whose Phase 1 proposals are accepted will be invited to submit a budget for review through their home institution. Proposers must append, as an NSPIRES attachment, a budget narrative for each year of proposed work and specify what they expect to accomplish at the end of each of the years proposed. Every line item in the NSPIRES budget needs to be explained in the accompanying text. All proposal materials will be submitted electronically.

Proposers to the Fermi GI Program must adhere to the following procedures for proposal submission:

- Proposers will submit their Phase 1 proposals electronically through the RPS website at: <http://heasarc.gsfc.nasa.gov/ark/rps/>. Instructions for doing so are provided at the FSSC web site at: <http://fermi.gsfc.nasa.gov/ssc/proposals/>.
- Target lists are submitted through the RPS form. All proposals involving joint-program correlated observations or Fermi pointed observations, must include a target list.
- Due to the nature of prospective investigations within the Fermi GI program, the Scientific/Technical/Management section of proposals is limited to four pages for Regular proposals and six pages for Large proposals, instead of the default 15 pages specified in the *NASA Guidebook for Proposers*. Figures and references are included within these four or six page limits. An additional page must be

added to describe the technical details of proposed joint gamma-ray, X-ray, radio, or optical observing programs.

- The standard ROSES requirement for a table of contents in the body of the proposal is waived.
- The Scientific/Technical/Management section will be uploaded to the RPS website as a PDF file.

All Phase-1 proposal materials must be submitted electronically by 4:30 p.m. Eastern Time on the due date for this program given in Tables 2 and 3 of the *ROSES Summary of Solicitation* in order to be considered in the proposal review for this cycle of the Fermi Guest Investigator program. Note that the 4:30 p.m. deadline replaces the standard midnight deadline.

NASA uses a single, uniform set of instructions for the submission of ROSES proposals. These instructions are given in the *NASA Guidebook for Proposers* (<http://www.hq.nasa.gov/office/procurement/nraguidebook/>). Fermi GI proposers must follow these instructions, except where they are overridden by the instructions given in the *ROSES Summary of Solicitation* or in this program element.

### *2.2.2 Evaluation of Phase 1 Proposals Submitted to the Fermi GI Program*

A peer review panel will evaluate all proposals with respect to the criteria specified in Section C.2 of the *NASA Guidebook for Proposers*, where it is understood that the intrinsic merit of a proposal shall include the following factors:

- The suitability of using the Fermi observatory and data products for the proposed investigation;
- The extent to which the investigation enhances the anticipated science return from the Fermi mission;
- The degree to which the proposed investigation places demands upon mission resources (this is particularly relevant for pointed observations); and
- In the case of Progress Reports (i.e., requests to continue multiyear projects), demonstrable progress towards the stated milestones of the original science proposal.

For data analysis development and theoretical investigations, the evaluation of relevance of a proposal shall include the degree to which the investigation directly advances Fermi science goals.

### *2.2.3 Submission and Evaluation of Phase 2 proposals*

Subject to the availability of funding, successful Phase 1 proposers will be contacted by the NASA Selecting Official and invited to submit a cost proposal in Phase 2. Upon notification of selection of a Phase 1 proposal, a proposer must respond as follows:

- Follow the instructions for submitting a Phase 2 proposal given in the selection notification from the Phase 1 review. Phase 2 (cost) proposals must be submitted through the NASA NSPIRES electronic proposal website (<http://nspires.nasaprs.com/>) by an Authorized Organizational Representative (AOR) of the proposing organization.
- The total budget may not exceed the budget estimate the proposer provided in the Phase 1 proposal.

- Budget Details are limited to three pages, and the Budget Narrative is limited to two pages. Any substantive changes from the budget management plan already submitted in Phase 1 must be justified explicitly.

NASA program personnel (as opposed to peer reviewers) will evaluate the Phase 2 cost proposals against the third evaluation criterion, cost realism and reasonableness, and will also compare the proposed cost to available funds, as allowed by Section VI(a) of the *ROSES Summary of Solicitation*.

Note that since the Phase-2 proposals will not be peer reviewed, the requirement to redact the budget information (per Section IV(b)(iii) of the *Summary of Solicitation*) is waived. All costs should be included in the proposal.

### 2.3 Supplemental Information

Further details concerning the proposal submission requirements and process can be found at the Fermi Science Support Center website <http://fermi.gsfc.nasa.gov/ssc/>. This website provides a detailed mission description; technical information about the Fermi mission, instruments, and feasibility of different types of observations; and instructions for completing the required proposal forms.

### 3. Summary of Key Information

Number of new awards pending adequate proposals of merit.	The selection of <del>~30-40</del> Regular proposals with average awards of <del>\$55K</del> <b>\$65K</b> and generally less than <del>\$70K</del> <b>\$60K</b> per year, and 1-2 Large proposals with average awards of \$125K per year and generally less than \$150K per year). Deviations from these targeted figures are possible.
Maximum duration of awards	1 year for Regular proposals and up to 3 years for Large proposals (see Section 1.3)
Due date for Notice of Intent to propose (NOI)	Option not available
Due date for Phase-1 proposals	See Tables <u>2</u> and <u>3</u> of this ROSES NRA.
Planning date for start of investigation	5-10 months after proposal due date.
Page limit for the central Science-Technical-Management section of Phase 1 proposal	4 pages for regular proposals, 6 pages for large proposals; 1 additional page is required to describe joint program observations (see Section 1.5). Page limits include figures and references. This instruction supersedes the limits given in the <i>NASA Guidebook for Proposers</i> .
Relevance	This program is relevant to the Astrophysics questions and goals in the NASA Science Plan. Proposals that are relevant to this program are, by definition, relevant to NASA.
General information and overview of this solicitation	See the <i>ROSES Summary of Solicitation</i> .

Detailed instructions for the preparation and submission of proposals	See <a href="#">Section I(g)</a> Order of Precedence and <a href="#">Table 1</a> of the <i>ROSES Summary of Solicitation</i> and the <i>NASA Guidebook for Proposers</i> .
Submission medium	Electronic proposal submission is required in PDF format; no hard copy is required. See Section IV of the <i>ROSES Summary of Solicitation</i> and Chapter 3 of the <i>NASA Guidebook for Proposers</i> .
Web site for submission of Notice of Intent to propose (NOI)	Option not available
Web site for submission of Phase-1 proposal and required forms	<a href="http://fermi.gsfc.nasa.gov/ssc/proposals/">http://fermi.gsfc.nasa.gov/ssc/proposals/</a> (Help Desk available at <a href="http://heasarc.gsfc.nasa.gov/ark/rps/help/">http://heasarc.gsfc.nasa.gov/ark/rps/help/</a> )
Web site for submission of Phase-1 proposal via NSPIRES	Option not available
Web site for submission of Phase-1 proposal via Grants.gov	Option not available
Fermi Science Support Center helpdesk	<a href="http://fermi.gsfc.nasa.gov/ssc/help/">http://fermi.gsfc.nasa.gov/ssc/help/</a>
Programmatic information may be obtained from the Fermi Program Scientist	Stefan Immler Astrophysics Division Science Mission Directorate NASA Headquarters Washington, DC 20546-0001 Telephone: (202) 358-0615 Email: <a href="mailto:Stefan.M.Immler@nasa.gov">Stefan.M.Immler@nasa.gov</a>
Technical questions concerning this program element may be directed to the Fermi Science Support Center	Chris Shrader Code 661 NASA Goddard Space Flight Center Greenbelt, MD 20771-0001 Telephone: (301) 286-8434 Email: <a href="mailto:Chris.R.Shrader@nasa.gov">Chris.R.Shrader@nasa.gov</a> Help Desk: <a href="http://fermi.gsfc.nasa.gov/ssc/help/">http://fermi.gsfc.nasa.gov/ssc/help/</a>
Questions concerning Fermi capabilities may be directed to the Fermi Project Scientist	Julie McEnery Code 661 NASA Goddard Space Flight Center Greenbelt, MD 20771 Telephone: 301-286-1632 Email: <a href="mailto:Julie.E.McEnery@nasa.gov">Julie.E.McEnery@nasa.gov</a>