

Memorandum of Understanding
for
Collaborative Science
between
The National Radio Astronomy Observatory
and
The Fermi Gamma-ray Space Telescope (formerly GLAST)

27 August 2013

1. Purpose

In recognition of the importance of radio observations using the National Radio Astronomy Observatory (NRAO) facilities to the scientific exploration by the Fermi Gamma-ray Space Telescope (formerly, GLAST), this agreement aims to continue the long-term cooperative arrangement, first established by MOU in 2007, under which commitments of observing time on NRAO telescopes is made towards coordinated observations with Fermi on a competitive basis. As before, the scientific programs that will be supported under this program will be those that are enhanced by the combination of Fermi observations with investigations using the radio facilities operated by NRAO. The philosophy of the approach, in keeping with the missions of both Fermi and NRAO, will be that of maximum data availability and maximum scientific return for the entire user community.

2. Background Description of Fermi (GLAST) Mission

The Fermi Gamma-ray Space Telescope (formerly the Gamma-ray Large Area Space Telescope, GLAST), was launched in June 2008. The spacecraft contains two instruments, the Large Area Telescope (LAT) and the GLAST Burst Monitor (GBM). The LAT was originally designed to observe the entire sky every three hours, with the potential for occasional follow-up, pointed observations. The GBM is able to see the entire sky at any instant (with the exception the region blocked by the Earth).

The five-year primary mission of the spacecraft ended on August 11, 2013, and Fermi has now entered an extended operational phase, with the goal of completing a full decade of observations ending in 2018. During this extended operational period, the original all-sky sampling model will be modified: Fermi is capable of flexible survey mode patterns, and inertially-pointed observations; both of these allow increased coverage of selected parts of the sky. Survey and observation modes can thus be combined or modified to execute alternate observing strategies that more effectively accommodate specific science drivers, such as more focused monitoring of sources near the Galactic center. Beginning no later than December 2013, Fermi will begin a modified one-year observing run that will emphasize coverage of the Galactic center. After one year, the Fermi Project Scientist will organize a community review to determine whether the new strategy should be continued, modified, or whether a return to survey operations would be preferable.

Both LAT and GBM data are non-proprietary and released as soon as possible.

3. Background Description of NRAO Radio Telescopes and NRAO Time Allocation Process

NRAO is funded by NSF as a research facility that operates state-of-the-art telescopes in an "open skies" mode for the U.S. astronomical community. Currently, the NRAO operates the Very Long Baseline Array (VLBA), a milliarcsecond-resolution continentwide interferometer array; the recently expanded Jansky Very Large Array (VLA), a 28-antenna centimeter-wave interferometer that provides arcsecond resolution; and the Robert C. Byrd Green Bank Telescope (GBT), a high-precision 100m single-aperture telescope. NRAO is also the dominant member of the North American Executive for the Atacama Large Millimeter/Submillimeter Array (ALMA), which began early science operations in 2012. ALMA's North American partners are currently completing their remaining construction responsibilities, and full science commissioning of the array is underway.

The GBT, VLA, and VLBA are pointed telescopes with the majority of their time generally allocated to PI proposals; their data proprietary period is 12 months, beginning at the time of the last observation associated with a proposal. NRAO also accepts PI "Large Proposals" that request at least 200 hours of observing time, and also designates a range of highly-ranked projects each semester as Key Science Projects (KSPs). The designation of an approved observing program as a KSP is based on its scientific ranking in the proposal review process, nomination by the NRAO Time Allocation Committee, and approval by the NRAO Director. Proposal submission deadlines for its North American telescopes occur twice a year, in early February and August. Director's Discretionary time may be allocated under appropriate special circumstances.

Owing to serious cutbacks in NSF funding over the past few years, NRAO has reduced the number of hours it allocates for open PI-driven science, with additional time being offered to partner users who share in the operational costs of the VLBA or other telescopes.

4. Collaborative Proposal Process within Fermi GI Program

The processes described in this MOU will be in effect for the Fermi Guest Investigator (GI) Program, and will be implemented under the normal Fermi GI

Program. Note that regular proposals to NRAO are currently evaluated every six months, whereas the Fermi GI Cycles are expected to remain annual.

This MOU includes two distinct types of collaborative observations and funding opportunities between NRAO and Fermi that will take place within the GI program. To distinguish these two opportunities, we call them the "Joint Proposal Opportunity" and the "Cooperative Proposal Opportunity," respectively. The two opportunities are described in turn below.

4.1 Joint Proposal Opportunity

The first Fermi/NRAO opportunity is a Joint Proposal Opportunity, whereby potential radio observers submit proposals for Fermi funding and future NRAO observations through the Fermi GI portal. The implementation plan for this opportunity will be described in a separate document, which may be modified by mutual Fermi/NRAO agreement and without renegotiating this MOU. A range of telescope time (see below) will be made available by NRAO for the Fermi GI program. In turn, Fermi/NASA will make data-analysis funding available to successful U.S. based investigators requesting NRAO observing time through the GI process. These proposals will make use of Fermi survey data products and may include NRAO and/or Fermi pointed observations. The peer-reviewed GI proposal evaluation process will identify programs with sufficient science justification to be allocated funding by Fermi, and those that fall within the agreed-on range of NRAO observing time will be allocated NRAO observing time without additional scientific review. (NRAO reserves the right to review all proposals for technical feasibility, however; see below.)

Proposals for NRAO observing time submitted through the Fermi GI program will be successful only if they make use of the unique capabilities of the NRAO telescopes; proposal evaluation will include an assessment of the radio telescope requirements, and those that are more appropriately done with other radio telescopes will be rejected. Only proposals equivalent to "regular" NRAO proposals, those requesting fewer than 200 hours of observing time, will be eligible to be submitted for future observing time. NRAO Large Proposals (200 hours or more) will not be eligible because of their potential large impact on the available funding and observing time, but will be eligible for funding via the Cooperative Proposal mechanism (see below).

The radio data will be proprietary to the proposers for the standard NRAO 12-month period.

The actual amount of NRAO observing time allocated via the Joint Fermi Process will depend on the amount of proposal pressure and the scientific quality of the proposals. Based on prior usage in this program, we anticipate that a maximum of 5% of NRAO observing time would be made available on GBT, VLA, and VLBA, or up to 200-300 hours per year on each telescope. If there are very strong scientific proposals for more time, and the Fermi mission has funds available to support data analysis, the Fermi Project Scientist may request additional time from the NRAO Director, who has the option of setting up an NRAO mechanism to evaluate and respond to this request.

We recognize the possibility that previously accepted regular NRAO proposals may include observations that have some overlap with observations approved in the Fermi GI Cycle. NRAO and the Fermi mission will resolve such duplications on a case-by-case basis.

4.2 Cooperative Proposal Opportunities

Direct proposals for NRAO observing time that will enhance the scientific return associated with the Fermi mission also may be eligible for NASA funding through the GI program. These proposals will be of two NRAO types: Large Proposals (requesting 200 or more hours of NRAO observing time), and Target of Opportunity proposals, which respond to time-critical transient events. NRAO typically accepts and evaluates Large Proposals annually, whereas Target of Opportunity proposals are accepted at any time. These are distinguished from the proposals in Section 4.1 because they would involve requests for Fermi GI funding that are made subsequent to NRAO approval of observing time. Proposers of NRAO observations who also intend to propose for Fermi funding via this route must indicate their intentions clearly in the NRAO proposal, and all information related to the NRAO review of successful proposals will be forwarded to the Fermi mission for their evaluation. Note that the award of NRAO observing time is not a guarantee of Fermi funding; likewise, the award of NRAO observing time is not contingent on funding in this case.

See <http://www.nrao.edu/administration/directorsoffice/largeprop.shtml> and <http://www.vla.nrao.edu/astro/proposals/rapid> for further information on the NRAO Large and Target of Opportunity proposals.

5. Scope and Terms of NRAO's Commitment of Telescope Time

The present agreement covers the GBT, VLA, and VLBA, and caps the total amount of time offered on each instrument under this program at 5% of the mean annual telescope usage, with no more than 10% of available time in a given sidereal interval being offered. Annual telescope usage level varies according to instrument, and the annual usage level does not include time secured through shared operational support arrangements.

ALMA is excluded from this program at the present time. Special requests for access should be made through the NRAO Director's Discretionary Time process.

NRAO retains the right to refuse scheduling of TAC-approved joint Fermi-NRAO proposals that do not pass its internal technical review feasibility process. In such cases, NRAO will return the impacted proposal with a brief description of the technical problem(s). NASA proposers may, of course, contact NRAO instrument staff for advice/consultation as to whether or how such problems may be avoided.

Finally, NRAO notes that proposal time pressure on its instruments varies with respect to location on the sky, season (particularly on the GBT), and (in the case of the VLA) array configuration. Pre-existing commitments to observing programs may make it very difficult or impossible to schedule certain types of joint programs in an optimally timely fashion. If time-critical access to an NRAO telescope is required for any proposal under this program, that information should be clearly communicated to the Observatory in advance.

6. Credits and Attributions

For results obtained using Fermi and NRAO facilities, proper attribution to NRAO facilities must be included in all publications, conference proceedings, posters, abstracts and talks and colloquia, as in the following: "The National Radio Astronomy Observatory is a facility of the National Science Foundation operated under cooperative agreement by Associated Universities, Inc;" additional NRAO requirements may be found at <http://www.nrao.edu/library/pagecharges.shtml>. Proper attributions to NRAO facilities must also be included in all NASA press releases and press conferences. Fermi attribution will be the same as for all other uses of Fermi Gamma-ray Space Telescope data products.

7. Signatures:

Anthony Beasley, Director, NRAO

xxxx, Fermi Project Scientist

Concurred:

Ethan J. Scheier, President, AUI

yyyyy, NASA Program Scientist