

## A.6 BEYOND EINSTEIN FOUNDATION SCIENCE

### 1. Scope of Program

The *Beyond Einstein Foundation Science (BEFS)* program has been created to provide ancillary theoretical and experimental support for the future Beyond Einstein missions. These missions include two Einstein Observatories,

- *Laser Interferometer Space Antenna (LISA) Observatory*, which will measure gravitational radiation from a variety of astrophysical sources including the mergers of super massive black holes, binary compact objects, and possibly from the inflation era, and
- *Constellation-X (Con-X) Observatory*, which will perform high-resolution spectroscopy of x-ray emission near the horizons of matter-accreting super massive black holes, and from clusters of galaxies;

and three Einstein Probes,

- *Dark Energy Probe*, whose goal is to accurately determine the amount of dark energy and search for the time variations in the dark energy density,
- *Inflation Probe*, to map the polarization of the cosmic microwave background, determine all the sources of this polarization on both the large and small scales, and search for the signature of gravitational waves from the Big Bang, and
- *Black Hole Finder Probe*, which will survey the Universe over a wide range of black hole observations and accretion rates, and discover ordinary stars being torn apart as they approach black holes.

Note: A complete description of the Beyond Einstein Program can be found on the Website <http://universe.gsfc.nasa.gov>.

The BEFS Program is specifically designed to provide ancillary theoretical and experimental support for the missions and objectives of the Beyond Einstein Program. Note that some of the theoretical research areas previously supported by the Astrophysics Theory program (Appendix A.4 in this NRA) is now supported by this BEFS program, including theoretical topics in gravitation, fundamental physics, cosmology, and x-ray astrophysics related to Con-X science. In addition, the Gravity and Fundamental Physics components that were previously in the Astronomy and Physics Research and Analysis (APRA) program (Appendix A.5) are now incorporated in this BEFS program as well. Therefore, proposers are urged to carefully read this section and that of the ATP (Appendix A.4) to ensure that submissions are made to the appropriate program. For this year only, no proposal will be disqualified for having been submitted to an inappropriate program, and NASA reserves the right to move a proposal from one program to another if deemed appropriate; for this reason the proposal due dates of both programs (ATP and BEFS) are the same.

For the purposes of conducting the review, every proposal for this program must be labeled with one (or more, if appropriate) suggested Topic Categories from the current list below in both its Notice of Intent and in the proposal submission itself:

1. *Active Galaxies and AGN*
2. *X-ray Astrophysics related to Con-X and the Black Hole Finder Probe (e.g., stars, x-ray binaries, neutron stars)*
3. *Dark Energy (CMB, gravitational lensing, SZ effect, etc.)*
4. *Gravitational Astrophysics and Fundamental Physics (including Relativity):*
  - a. *Theoretical:* Examples (not exhaustive) include: gravitational wave sources; development of data analysis methods for LISA signal extraction; computation of gravitational radiation waveforms; theory supporting space tests of the fundamental laws of physics.
  - b. *Experimental:* Examples (not exhaustive) include: lunar ranging tests of relativity; violations of the equivalence principle (must show applicability to potential future space missions); low-frequency gravitational wave astronomy.
5. *Other* (NASA HQ will assign the proposal to what it deems is the most appropriate review panel.)

Theoretical proposals to the BEFS program should:

- Support the development of Beyond Einstein missions, for example, by estimating source rates for various astrophysical phenomena;
- Investigate general theoretical issues related to the science goals of the Beyond Einstein missions; or,
- Develop data analysis and statistical techniques for the extraction of signals from future BE missions.

Conversely, theoretical proposals to the Beyond Einstein Foundation Science Program may not:

- Consist primarily of data reduction or data analysis of currently existing data (such proposals should be directed to the mission-specific programs, the Astrophysics Data (A.2) or the Long Term Space Astrophysics (A.3) programs);
- Address theoretical topics supported by the ATP program (A.4 in this NRA);
- Request support for organizing and/or hosting scientific meetings; or
- Request support for substantial computing facilities or resources.

In any case, theoretical proposals will only be accepted from individual Principal Investigators whose proposed work has a clear, single focus (that is, "group proposals" are not solicited in which several researchers submit an omnibus proposal of related, but separate, theoretical research investigations under a designated PI). Individual theory PIs may still include as many Co-Investigators and Collaborators as they wish on their proposals.

Finally, note that to enable the NASA Office of Space Science to properly evaluate the relevance of proposals submitted to its programs, as well as track its progress towards achieving its goals as mandated by the Government Performance Review Act (GPRA), it is mandatory that all research supported by NASA's programs demonstrate its relationship to NASA Goals and Research Focus Areas (RFAs) as stated in the latest version of its Agency and/or OSS Strategic Plans (follow links from the Web site <http://spacescience.nasa.gov/>); see also the discussion in Section I of the *Summary of Solicitation* of this NRA. Therefore, all proposers must explain the relevance of their proposed work not only with expository text in the main body of their proposal, but also in terms of the Goals, Science Objectives, and RFAs given above (also found in Table 1 of the *Summary of Solicitation*). The appropriate place for this latter statement of relevancy is in the introduction to the proposal's "Scientific/Technical/Management" section (see Section 2.3.5 in the *Guidebook for Proposers*). The index numbers in this table may be used to identify a specific RFA, for example, "Goal 5, Structure and Evolution of the Universe Theme, RFA 1(c)."

## 2. Programmatic Considerations

Investigators may submit more than one proposal to the BEFS Program if the research areas of each are significantly distinct. If a new proposal for this program element is itself based on a previously funded research effort, the proposal must identify that work and clearly summarize all significant results from it.

The maximum length of awards will be three years.

It is anticipated that approximately \$1.5M will be available through this solicitation to fund the first year of new awards in this program element. The *average* level of support per grant per year is expected to be on the order of \$100K for theoretical investigations, with a recommended maximum of approximately \$300K per year for experimental investigations

### IMPORTANT INFORMATION

- As discussed in the *Summary of Solicitation* of this NRA, the Office of Space Science (OSS) now uses a unified set of instructions for the preparation and submission of proposals given in the document entitled *NASA Guidebook for Proposers Responding to NASA Research Announcement - 2004* (or *NASA Guidebook for Proposers* for short) that may be accessed by opening <http://research.hq.nasa.gov/> and linking through "Helpful References," or by direct access at <http://www.hq.nasa.gov/office/procurement/nraguidebook/> (note that the updated 2004-edition of the *Guidebook* is used for this solicitation).
- Section IV(b) of this NRA's *Summary of Solicitation* contains the Web address relevant to the electronic submission of a Notice of Intent (NOI) to propose and a proposal's *Cover Page/Proposal Summary/Budget Summary*, as

well as the mailing address for the submission of the hard copies of a proposal.

For further information, contact the Program Officer for this program:

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