NASA Research Announcement: GALEX GI Program Cycle 1

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GALAXY EVOLUTION EXPLORER (GALEX)

GUEST INVESTIGATOR PROGRAM - Cycle 1

Note: Sections 1.2 and 2.4 updated 24 March 2004.

GALEX GUEST INVESTIGATOR PROGRAM - Cycle 1

1 Guest Investigator (GI) Program Description

1.1 Overview

This program element (NNH04ZSS001N-GALEX) of the 2004 ROSS NRA solicits proposals for the acquisition and analysis of new scientific data from the Galaxy Evolution Explorer (GALEX). GALEX operates in two broad bands, Far-UV (FUV, 1350-1800 Å) and Near-UV (NUV, 1800-2800 Å), providing wide-field (1.2^{o}) imaging and low resolution (R = 150-300) grism spectroscopy, with sufficient sensitivity to study a wide variety of objects within and outside of our Galaxy. GALEX was launched on April 28, 2003. The GALEX primary mission will have exclusive use of the satellite until October 2004, and is scheduled for completion in September 2005. During the period from October 2004-September 2005, the scientific capabilities of GALEX will be available to the astronomical community for scientific investigations that do not duplicate the GALEX PI team investigations. This solicitation is for Cycle 1 of the GALEX Guest Investigator (GI) Program, to be carried out beginning on or after October 1, 2004, and lasting approximately 12 months. Section 2 contains instructions for proposal preparation. A brief description of the GALEX mission is provided in Section 3; a more detailed description can be found at http://galexgi.gsfc.nasa.gov/.

Proposals will be accepted for both new observations and for archival research. Proposed scientific investigations should not duplicate GALEX primary science investigations, which are listed on the GALEX GI website (http://galexgi.gsfc.nasa.gov/piscience). GI investigations may be proposed for fields already observed by the GALEX science team, as long as the science investigation is clearly different. Many projects may be best addressed as archival investigations, using the data already collected for the primary mission; all data in the first GALEX data release (DR1) will be available for archival investigations. Potential proposers are strongly encouraged to examine the descriptions of the GALEX primary science investigations and of the first GALEX data release (http://galexgi.gsfc.nasa.gov/targets/DR1) before proposing.

1.2 Program Types

Proposals submitted in response to this program may be for new observations with GALEX, or for analysis of existing GALEX data. Approximately 1500 orbital nights (1/3 of the available observing time) will be available to the community for new observations in Cycle 1. There are four proposal categories: 1) Standard, 2) Legacy, and 3) Snap proposals are for new observations; 4) Archival proposals are for investigations using the rich GALEX archival data set. Mixed proposals may be submitted that include some new observations and some archival work, provided the archival work is not expected to comproise more than ~‹1/3 of the investigation's effort; these should be submitted as the relevant type of observing proposal. If more than ~1/3 of a combined investigation is expected to comprise work with archival data, *and the investigators wish to request funding for the archival work,* then two separate proposals (one new observing, one archival) should be submitted and the connection noted in each proposal. More information on these different proposal types may be found in the following sections.

For the first three proposal categories, proposals submitted in response to this NRA constitute the first phase of the GALEX GI proposal process. The following information is required: a scientific justification, a description of the observations, astronomical target data, exposure time estimates, and any special operational requirements (e.g., orientation constraints, timing considerations, etc.). Section 1.3 describes important

capabilities and constraints that affect how GI programs will be evaluated and implemented in Cycle 1. After selection by NASA, successful GI's will be required to submit a detailed observing plan (Phase 2 proposal) so that detailed planning, feasibility assessment, and observation scheduling can be performed. No Phase 2 submission will be required for successful archival proposals.

There are two types of unscheduled observing time that can be made available with the approval of the GALEX Mission Scientist. The first deals with major Targets of Opportunity (ToO), such as supernovae, novae, and comets. The second type, called Mission Scientist's Discretionary Observing Time (DOT), is intended for observations of an urgent nature requiring a small amount of observing time and of sufficiently high scientific priority that they should not be delayed to the next observing cycle (See Section 1.2.3 for more details).

1.2.1 New Observations: Program Categories and Time Allocation

GALEX observing time is allocated in orbital nights (orbits). Proposals should request only the time needed for scientific exposures.

Observing Program Categories - Each GALEX observing proposal must be designated in one of three proposal categories at the time of submission - Standard, Legacy, or Snap - and this category must apply to all proposed targets in the proposal. Approximately 1/3 of the available observing time during Cycle 1 (~ 1500 orbits) will be available to the community for new observations.

1. **Standard proposals** correspond to regular observing proposals of targets specified by the proposer. These may include shallow or deep imaging, shallow or deep grism observations, repeated visits to observe time variable phenomena, or mapping of regions of the sky not observed by the GALEX primary science surveys. NASA intends to execute all observations associated with accepted proposals.

2. **Legacy proposals** provide the opportunity for large, coherent projects of general and lasting importance to a wide astrophysical audience. These proposals are expected to request a minimum of 100 orbits. Legacy proposals are expected to use GALEX to perform major observing programs that will enhance significantly the overall scientific contribution of the mission. NASA intends to execute all observations associated with the allocated observing time for accepted proposals.

3. **Snap proposals** are intended to maximize the science return of GALEX and to provide scheduling flexibility by providing a large pool of targets to the mission schedulers; they will receive lower priority in target scheduling. Snap programs provide the opportunity for observations of a class of objects to be undertaken without the requiring that any specific object in the class be observed. It is unlikely that all targets in an accepted Snap program will be observed.

NASA anticipates that at least 25% of the GI observing time in Cycle 1 will be allocated to Legacy proposals. Although there is no assurance that any specific target in a Snap program will be observed, NASA expects that data will be obtained for many targets in this category. Following the evaluation of submitted proposals, some proposals submitted but not accepted by NASA under the Standard category may be recommended for inclusion in the Snap category. It will be the proposer's option to

accept or reject such reprogramming of a submitted Standard proposal.

Observing Program Constraints – Proposers may request observations using only GALEX standard observing modes. These are described briefly in Section 3.3.1 and in more detail in the GALEX Observers Guide.

Program Execution and Carryover - NASA intends that all observations for non-ToO Standard and Legacy observing programs will be performed. If necessary, observations not executed during the current cycle will be carried over into the following cyle. GIs do not need to repropose for these observations, and any such programs will be given priority for execution in the next cycle. However, ToO programs will not be carried over into the next Cycle. ToO programs that are not activated and executed within the nominal one-year observing cycle must repropose in order to be considered in the next observing year. Unobserved targets in Snap programs must also be reproposed each Cycle.

1.2.2 Archival Investigations

Proposals will be accepted for scientific investigations based on the first GALEX data release (DR1). DR1 will become publicly available on October 1, 2004, and will contain ~10% of the data for each of the GALEX primary mission surveys. A listing of the expected contents of DR1 may be found at http://galexgi.gsfc.nasa.gov/targets/DR1. This listing may be updated after the NRA release but will not be changed after 12 March, 2004. *There is no guarantee that all of the observations expected to be in DR1 will be successful*; archival proposals based on fields that are not observed in time to be included in DR1 will not be funded in Cycle 1 and must be reproposed in future cycles as the relevant data becomes available. Investigators considering an Archival proposal should pay close attention to the GALEX primary science investigations. Although Archival proposals may be based on any data released in GALEX DR1, they may not duplicate the science goals of type 1 PI science team investigations.

1.2.3 Unscheduled Observing Time

Targets of Opportunity -- The GALEX mission is poorly suited for Targets of Opportunity (ToO). However, because of the potential scientific impact of ToO observations (for targets such as supernovae, novae, cataclysmic variables in outburst, comets, etc.), limited ToO observations will be supported in Cycle 1. Scientists wishing to observe such targets should prepare and submit proposals according to the same procedures used for a Standard program (i.e., as described in Section 2. A proposal may not contain a mixture of ToO targets and non-ToO targets. Target of Opportunity status should be noted in the Special Requirements section of the proposal. ToO proposals will be reviewed in the regular review cycle, and successful proposals will be approved but will not be allocated specific amounts of observing time. (However, the review panels may recommend a maximum amount of observing time that should be allocated to a given ToO program.) Up to four ToO programs requiring a response time between one week and one month will be approved for Cycle 1.

The lack of a real-time observing capability constrains the speed with which a ToO observation can be implemented. The GALEX ToO response time is expected to be *no less than* 7 days during Cycle 1. ToO proposals must clearly state the required response time. It will be the GI's responsibility to notify the GALEX Mission Scientist and the GALEX Science Operations Center at the California Institute of Technology (CIT) when

any approved opportunity has occurred. The Mission Scientist will consult with the GALEX PI and other members of the GALEX operations team to determine the feasibility of observing the particular event and the impact of disrupting ongoing observations, before deciding whether or not to activate the ToO program and approve the observation.

Discretionary Observing Time -- Mission Scientist's Discretionary Observing Time (DOT) is intended for observations of an urgent nature for which no approved observing program exists, and that are of sufficiently high scientific merit and priority that they should not be delayed to the next observing cycle. The total amount of DOT available during Cycle 1 is extremely limited. The GALEX Mission Scientist may approve DOT in those cases where the scientific timeliness of the project is such that it should be done quickly, the need for the observation could not have been foreseen and proposed for in the current observing cycle, and the observation does not duplicate or infringe on PI or approved GI programs. A proposal for DOT may be submitted to the Mission Scientist in the form of a letter (printed or electronic) and should describe the observations and their feasibility and scientific objectives, and explain why DOT should be granted in lieu of consideration during the next proposal cycle. All requests for DOT will be reviewed for scientific merit and technical feasibility.

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1.3 Mission Capabilities and Constraints During Cycle 1

This section summarizes GALEX capabilities that should be considered by all GALEX proposers. Complete information on the GALEX instrument and other topics is available from the GALEX Observer's Guide and the Mission and Instrument Overview (both available from http://galexgi.gsfc.nasa.gov/Documents).

Sensitivity Limits – There are *fundamental detector performance limitations* which preclude observations of individual bright targets, of target fields containing bright stars, and of bright or crowded fields (section 3.3.2). Proposers should pay particular attention to this issue in the "Feasibility and Safety" section of their proposals. New observing techniques are being tested that may permit limited (FUV only) observations of objects at or near the bright limits cited here, *if the observation poses no risk to the instrument* (as determined in technical review by the GALEX operations team). Updated information about this option will be posted on the GALEX GI web site (http://galexgi.gsfc.nasa.gov/), as it becomes available. Further information on brightness limits may be found in Section 3.3.2 and in the detector section of the GALEX Observers Guide. Further information on the detectors may be found in the GALEX Detector Operations Guide.

Observing Modes - GALEX has two observing modes, broad-band imaging and grism spectroscopy. The exposure time alone defines the achievable signal-to-noise ratio for a given image or spectrum. Imaging observations are typically done either in "single-visit" ("stare/dither" mode - observe one field for one orbital night) or in "All-sky Imaging Survey (AIS)" mode (observe several contiguous or overlapping fields, each for the same exposure time, in one orbital night). Grism spectroscopy is done only in "single visit" mode with a different grism angle used for each orbital night. Observations are generally obtained in both FUV and NUV bands simultaneously. Further information on observing modes may be found in Section 3.3.1 and in the GALEX Observers Guide.

Targets of Opportunity - The GALEX ToO response time for prompt events is expected to be *no less than* 7 days during Cycle 1, and is more likely to be 2 weeks or more (Section 1.2.3).

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1.4 General Guidelines and Policies

1.4.1 Proposal Process

Proposers should submit a Notice of Intent to Propose in order to facilitate the timely selection of peer review panels. Although Notices of Intent are strongly recommended, they are not required to propose for the GALEX GI program.

Proposals submitted in response to this NRA should provide a strong scientific justification and careful feasibility analysis, which will form the basis for selection by NASA, and an overview of planned observations and targets. Proposals that are awarded observing time based on the evaluation process described in Section 1.7 subsequently will be required to submit more detailed observation specifications (Phase 2 proposals) following guidelines provided by the GALEX Project. These data will provide the GALEX Science Operations Center (SOC) with the detailed definition of each observation to be executed for the program. In addition, successful U.S. proposers will be invited to submit a budget based on funding guidelines provided by NASA (section 1.8).

Proposal submission steps are summarized in Section 2.4.

1.4.2 Who May Propose

Participation in the GALEX GI Program is open to individuals associated with all categories of U.S. and non-U.S. organizations, including educational institutions, industry, nonprofit institutions, NASA Centers, and other Government agencies. Each GALEX GI proposal must identify a single Principal Investigator (PI) who assumes full responsibility for the conduct of the scientific investigation. Proposal Co-Investigators must have well-defined roles in the investigation, which will be evaluated as part of the proposal review process. Following selection by NASA, the various participants in the GALEX GI program (GALEX GI Center at GSFC, the GALEX SOC at CIT, and the Multimission Archive at Space Telescope (MAST)) will communicate formally only with the PI (or his/her designee) of each proposal. It is this person's responsibility to provide the GSC at CIT with the necessary data that defines each observation in a timely manner and to respond promptly to any questions concerning observational constraints or configurations.

1.4.3 Late Proposals

Consistent with NASA policy, a late proposal may be considered only if it is judged to be in the best interests of the Government. However, a proposal submitted after the published deadline is unlikely to be considered of uniquely greater value to NASA than proposals submitted on time. A proposal is considered “on time” *only* if all necessary components, including electronic material, have been received by the published deadline. Finally, note that processing delays at the proposer's home institution, delays due to mail inspection, late delivery due to the method of shipment, or Internet delays do

not excuse late submission of a proposal.

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1.5 Data Rights and Distribution

Data rights for GALEX GI observations (Legacy, Standard and Snap programs) reside solely with each observing program's Principal Investigator for a period of six months following delivery of the processed data to the GALEX data archive in MAST (http://archive.stsci.edu/galex). GIs will be notified electronically when their data are available from the archive. After this period, the data become available for public access through MAST. Investigators, particularly for Legacy Proposals, are encouraged to consider waiving the proprietary period for their data

Observations of calibration targets/fields generally have no proprietary period and will be released through the GALEX archive as soon as the processed data products are available. The GALEX Project reserves the right to use any GALEX observation to assist in assessing the performance of the instrument, but the confidentiality of data obtained for scientific programs will be maintained.

1.6 Targets

The Cycle 1 observing opportunity primarily seeks to identify new targets for observation with the GALEX satellite or to obtain significantly deeper exposures of already-observed targets. Lists of all targets planned for observation in the GALEX Prime Mission may be found at (http://galexgi.gsfc.nasa.gov/observations/planned). Each target's name and celestial coordinates (right ascension and declination, epoch J2000) will be considered when judging any potential target duplications.

Target Duplication – By design, the GALEX prime mission will obtain moderate exposures of a large fraction of the sky in the All-Sky Imaging Survey (AIS). Many GI projects may be well suited to archival investigations using the data collected for the primary mission. Any target duplication between Cycle 1 GI observing programs and those observed (or expected to be observed) by the GALEX primary mission must be strongly justified in the proposal (e.g., expected variability, need for deeper exposures, etc.) Review panels will receive a summary of any perceived duplications between pending and existing observations and those proposed for Cycle 1. The panels will also receive a summary of target duplications between different Cycle 1 proposals. In general, a given target (pointing center) will be allocated to only one observing program. Failure to provide accurate target data in the proposal may result in disallowing a target if a conflict with another program is discovered after proposal acceptance and the target conflict was missed as a result of the inaccurate target data.

Target List Modifications - After selection of Cycle 1 programs, changes to a program's target list may be made with the approval of the GALEX Mission Scientist. Any new target must be consistent with the program's scientific objectives and must not already be allocated to another program.

Calibration Targets - Astronomical targets are used for photometric and wavelength calibration. Most of the calibration objects (Appendix, In-Flight Calibration Guide) will be observed for calibration purposes. GI's are allowed to include calibration targets as

scientific targets in their programs. The GALEX Project may continue to use these objects for calibration, even if the target is allocated to a GI program.

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1.7 Proposal Evaluation and Selection Process

Proposals submitted to NASA in response to this opportunity will be evaluated in a competitive peer review conducted by NASA Headquarters, using review panels organized by research area. Upon completion of the review by the individual panels, a final cross-discipline panel review chaired by a NASA HQ representative will synthesize the results of the individual panels. Legacy proposals will first be reviewed with other GALEX proposals in the same scientific discipline (binary stars, ISM, large scale structure, etc). Each scientific panel will have the option to forward a small number of Legacy proposals for final evaluation by the chairs of the GALEX peer panels; this panel of chairs will formulate the final recommendations to NASA for the Cycle 1 observing program. Based on these results, the GALEX Program Scientist will then develop a recommendation for the total program to be submitted to the Selection Official. The final proposal selection will be made by the GALEX Program Executive.

The following factors, listed in descending order of importance, will be used in evaluating proposals for their scientific merit and technical feasibility for the GALEX Guest Investigator Program:

1. The overall scientific merit of the proposed investigation;

2. The suitability and feasibility of using the GALEX observatory or GALEX data for the proposed investigation;

3. The feasibility of accomplishing the objectives of the investigation;

4. The degree to which the investigation uses the unique capabilities of GALEX;

5. The feasibility and scope of the data analysis plans;

Legacy proposals will also be evaluated on:

6. Provisions to provide legacy data to the community in a timely fashion (possibly waiving the proprietary period) and/or plans to provide enhanced data products to the community.

Scientific review panels will be given an assessment of the technical feasibility of each proposal, determined by the GALEX operations team. After acceptance of an observing program by NASA, successful proposers must prepare detailed (Phase 2) observing plans for submission to the GSC at CIT. These Phase 2 plans are required for scheduling purposes, and will be assessed again for feasibility. Should there be any question regarding the safety or feasibility of individual observations, the GALEX PI, in consultation with the GALEX Mission Scientist, will make the final decision as to whether or not to attempt or postpone a particular observation, based on the latest information available regarding the satellite's on-orbit performance.

NASA reserves the right to select only a portion of a proposed investigation, or to recommend in which case the investigator will be given the opportunity to accept or

decline such partial selection.

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1.8 Funding for U.S. Investigators

Limited funds for awards under this NRA are expected to be available to investigators at U.S. institutions, subject to the annual NASA budget cycle. Approximately $2M is expected to be available, and is expected to support approximately 20-30 investigations. Successful proposers at U.S. institutions, including U.S. Co-Investigators on successful non-U.S. proposals, will be eligible for funding. Funding will be available for both new observations and for archival investigations. Budgets should *not* be submitted with research proposals in response to this NRA. Selected investigators will receive a funding guideline from NASA based on the scope of the approved observing program and the available budget for the GALEX GI program. The primary guideline for new observations will be a program's total time allocation. Secondary factors include proposal ranking, scope of data analysis plans, and the number of targets/observations. The primary guideline for archival proposals will be scope of data analysis. A budget summary and narrative description of how these funds will be used must be submitted *after* receipt of the guideline. An institutional signature will be required when a budget is submitted.

1.9 Education and Public Outreach

The policy of NASA's Office of Space Science (OSS) continues to encourage strongly the participation by the space science community in education and public outreach activities, with the goal of enhancing the Nation's formal education system and contributing to the broad public understanding of science, mathematics, and technology. A significant national program in space science education and outreach is now underway, and OSS's demonstrated contributions to education and outreach have now become an important part of the broader justification for the public support of space science (for further details see "Education and Public Outreach" on the OSS homepage at http://spacescience.nasa.gov/). Education has also now become one of the core missions of NASA.

Proposers awarded observing time for GALEX Cycle 1 will have an opportunity to submit a supplemental E/PO element to their research proposal in conjunction with the budget phase of the proposal process. These E/PO proposals will be due 60 days after the date of the selection letter for the Cycle 1 scientific proposal. Information about and instructions for preparing and submitting E/PO proposals is available in Section Ib of the ROSS-2004 NRA Summary of Solicitation .

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2. Proposal Preparation and Submission

2.1 Proposal Preparation

General information on the preparation and submission of research proposals to NASA may be found in the 2004 NASA HQ NRA Proposers Guidebook (http://www.hq.nasa.gov/office/procurement/nraguidebook/). If you have questions about the general nature of NASA NRAs, or questions or problems with submitting NOIs or HQ Cover Pages, please consult the NASA HQ Proposal Submission FAQ page, or send technical support questions to proposals@hq.nasa.gov.

Questions about the GALEX Guest Investigator Proposals or the GALEX Cycle 1 proposal submission process should be directed to the GALEX GI help desk (send email to GALEX.helpdesk@galexgi.gsfc.nasa.gov).

2.2 Notice of Intent

In order to expedite the proposal review process and the timely selection of scientific peer review panels, investigators intending to submit proposals for participation in this program should submit a Notice of Intent (NOI) to propose by

March 12, 2004

The NOI Web site will request the tentative title of the investigation, name and affiliation of the PI and any Co-I's, and a brief summary of the objectives of the proposed investigation.

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2.3 Cover Page

All proposals must be prefaced by an integrated Cover Page / Proposal Summary that contains important information required by NASA. This item is produced by first entering the requested information electronically through the NASA Peer Review Services (NPRS) Web site (http://proposals.hq.nasa.gov/proposal.cfm) and then printing this form. Note that the Cover Page may be printed at any time for preliminary inspection and revised as necessary up to the proposal deadline. The printed copy of the electronically submitted form must be signed by the PI and submitted as part of the printed proposal .

The Cover Page/Proposal Summary includes the following information: Proposal title (both abbreviated and full length); PI name, institution, address, and telephone number; Co-I name(s) and institution(s); proposal abstract (restricted to 20 lines of 11 point text); proposal category (Section 1.2), scientific category (Section 2.4); total requested observing time (in orbits for Standard and Legacy proposals; in seconds for Snap proposals; not required for Archival proposals), and total number of targets (for all proposal types). The PI and any Co-Is must be registered in the NPRS database in order to appear on the Cover Page. The cover page may be filled out early, and modified until the closing of the solicitation; it is strongly recommended that proposers enter their cover page information well before the deadline to avoid last-minute system problems.

Since budget information for the GALEX GI program is not required until after proposal

selection, proposers should enter a placeholder value of $1 for the proposed cost of the proposed investigation in order to allow submission of the Cover Page.

The Cover Page may ask for the name of an authorizing official at the PI's institution. This information is not required *by NASA* at this stage and may be omitted, unless the proposer's institution requires it. [Only when a budget is submitted by U.S. proposers who have been awarded observing time (after proposal selection), will an institutional signature be required *by NASA*.]

The last three digits of the identification number assigned to your proposal by the NASA Peer Review Services Web site must also be included in the printed proposal and in the electronically submitted target information. This identifier is displayed on the Web page and printed at the upper right-hand corner of the Cover Page/Proposal Summary. For example, in the proposal identifier "GALEX1-0000-0123," the ID number is the last three digits "123".

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2.4 Proposal Format and Content

Proposals must be written concisely, in English. The length of each section of the proposal should not exceed the page limits indicated below, using single-spaced 8.5x11 inch or A4 format paper with 1inch (2.5 cm) margins. Proposals must be printed with a font size no smaller than 11 points (about 6 characters per cm). Reviewers will be instructed to base their review only on the portion of each proposal that complies with the page limits given below in this NRA; excess pages will be rejected before being sent to the reviewers. Double-sided copies are encouraged. Illustrations contained in the printed proposal may be in black and white or color.

A GALEX proposal requires the following sections, which should be included in the proposal in the order indicated. Page limits for each section are indicated below. **Total page limits are: 8 pages for Standard or Snap observing proposals, 10 pages for Legacy proposals, 6 pages for Archival proposals** (including figures, tables and references; not including cover page or target list).

1. Summary Information – Proposal summary information, the same as that submitted to the NASA Peer Review Services Web site for the Cover Page / Proposal Summary (Section 2.3), must also be supplied with the printed proposals. The easiest way to provide this is to print out and sign the cover page submitted to the Peer Review Services, and attach the original or a copy to each proposal copy. On the cover page, each proposal must identify one of ten primary research areas as listed below that will be used to guide assignment of the proposal to the appropriate scientific review panel. These ten research areas (and some examples) are:

- **Largescale structure** (Galaxy clusters and clustering, intergalactic medium, UV background
- **Active Galactic Nuclei (AGN) and quasars** (spatial distributions, evolution, populations, influence on their environments)
- **Galaxies** (content, properties, history, demographics)
- **Stellar populations** (clusters, statistics, evolution, enviroment)

- **Interstellar medium and galactic structure** (interstellar gas and dust, extinction studies, diffuse Galactic emission, Galactic halo, gas and dust in the Magellanic Clouds)
- **Stellar ejecta and gaseous nebulae** (circumstellar material, H II regions, planetary nebulae, supernova remnants, supernovae in other galaxies)
- **Interacting binary systems** (RS CVn systems, cataclysmic variables, symbiotic stars, mass-transfer binaries, novae, evolution)
- **Hot stars** (O, B, and Wolf-Rayet stars, white dwarfs, central stars of planetary nebulae, including hot stars in the Magellanic Clouds)
- **Cool stars** (single and noninteracting binary systems)
- **Planetary and protoplanetary systems** (planets, satellites, comets, circumstellar debris and disks, extrasolar planets)

2. Scientific Justification (not to exceed 3 pages for Standard, Survey or Archival proposals, 5 pages for Legacy proposals): Fully describe the scientific objectives of the proposed investigation, clearly stating its goals, its significance to astronomy, and why GALEX data are essential to the investigation. The page limit includes all text, figures, tables, and references for this Section. The proposed scientific investigation should not duplicate GALEX primary science investigations (http://galexgi.gsfc.nasa.gov/piscience); any cases where overlap might be perceived should be clearly explained. GI investigations may be proposed for targets or fields observed by the GALEX science team, as long as the science goals of the investigation are clearly different. In Cycle 1, guest investigators will only have access to PI-team-observed data that is included in DR1.

3. Description of Observations (no more than 1 page, not required for archival proposals): Describe the desired observations. All special requirements (e.g., Target of Opportunity, monitoring program, specific grism orientation) must be summarized and justified. These requirements encompass any information affecting the scheduling of the target, such as pointing constraints (e.g., targets offset from field centers), scheduling constraints (e.g., observations at specific times, coordinated observations, phase coverage, contiguous observations, etc.), Targets of Opportunity, and information on moving targets (Actual ephemeris data for Solar System targets are not required for this phase of the proposal process. Proposers wishing to observe moving targets should be aware that they will receive time-tagged photon data and will need to reconstruct these into images themselves.

4. Feasibility and Safety (not to exceed 2 pages, not required for archival proposals): The proposed program must justify the need for the requested exposure time for each target, noting the required signal-to-noise ratio (S/N) and spectral resolution, expected flux, and any other information relevant to the observation (e.g., wavelength region of interest, spectral flux distribution, emission line intensities). This section forms the basis for technical assessment of the feasibility of the proposed observations. Describe the basis for and accuracy of the flux estimates and any concerns regarding bright stars or overbright fields.

5. Additional Information (up to 1 page, required for archival proposals): This Section may be used to provide any relevant information concerning data analysis plans, modeling capabilities, corollary data from other telescopes, etc. *A data analysis plan is required for Archival*

proposals or for mixed new observation & archival proposals.

6. Principal Investigator and Co-Investigator Data (1 page maximum): An abbreviated biographical sketch for the PI and Co-Is should be provided, including recent refereed publications relevant to the scientific proposal.

7. Proposed Target List (Not included in page count) – In all cases, including Archive Proposals, a table of proposed targets must be submitted. Archival observations do not need to enter target safety information, but should include target name, coordinates, desired S/N, observing mode, time on source, number of visits and total integration time. Proposers using the LATEX proposal template may submit the filled-in template form, including targets, as instructed in the template. Proposers not using the LATEX form to prepare their proposal may submit target information using the target entry tool at the GALEX GI website, and should attach a printed version of their final table (obtained from the target tool) to their printed proposals. **LaTeX formatting, e.g. 1×10^{-12} is not permitted in the target data entries – instead, proposers should use, e.g. 1e-12.**

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2.5 Proposal Template, Example, and Instructions

The printed GALEX proposals may be prepared using the proposer's choice of word processor, so long as they follow the guidelines given in Section 2.4.

The standard GALEX proposal template is an ASCII LaTeX file that allows the proposer to supply important information via keywords, including the proposed target list. Some keywords are required (e.g., Title, PI name and address, Proposal Number (obtained by submitting the official cover page), Abstract, total observing time requested, target coordinates, etc.) and some are optional (e.g., special requirements). The LATEX proposal template may be used to format the final printed proposal, and is the preferred method of proposal submission. If the proposer does not wish to use the template provided, s/he must still provide the required minimum set of proposal / target keywords to the GALEX project, either by filling out a skeleton LATEX form, or by using the online target entry form (http://galexgi.gsfc.nasa.gov/targets). The information collected through the keywords and target list will be part of the database used to support the proposal review. *Electronic submission of the minimum set of GALEX target information (either through the provided templates, or through the Web form) is a required part of the proposal submission*. Submission procedures are described in Section 2.6.

The GALEX LaTeX proposal form and style file, plus more detailed instructions for preparing the proposal form, a sample filled-in form, and resulting sample proposal are available electronically from the GALEX GI Program Web site (http://galexgi.gsfc.nasa.gov/propforms).

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2.6 Proposal Submission

A complete proposal submission consists of the following three steps.

1. Provide basic summary information through the NASA Peer Review Services Web site and print the Cover Page/Proposal Summary. Note that the proposal number in the upper right-hand corner of the Cover Page must be inserted in the LaTeX proposal form in the appropriate keyword or included in the Target Submission tool.

2. Submit target information electronically to the GALEX GI website. E-mail the filled in LateX template form (LaTeX only, no postscript or pdf) to galexprop@galexgi.gsfc.nasa.gov **OR** fill out and submit the web-based Target Entry Form at the GALEX GI website. An acknowledgment of receipt will be sent to the proposal submitter by return E-mail.

3. Send 12 printed copies of the proposal to the NASA Peer Review Services organization, at the address given below. The PI must sign the printed Cover Page/Proposal Summary (see Section 2.3) and attach it to the front of the proposal. Copies of the Cover Page/Proposal Summary must also be attached to the other 11 copies of the proposal that are be submitted (i.e., one original and 11 copies must be submitted). Proposers are advised to mail early or to use commercial delivery companies to avoid delays caused by mail inspection.

GALEX GI Program - Cycle 1
Office of Space Science
NASA Peer Review Services
500 E Street, SW, Suite 200
Washington, DC 20024
USA

Telephone: 202-497-9030

All printed and electronic proposal materials must arrive at the above addresses by

4:30 pm EDT on 16 April 2004

in order to be included in the proposal review for this cycle of the GALEX Guest Investigator program.

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3 The GALEX Mission

3.1 Mission Overview

GALEX is a PI-class mission, developed in collaboration by the California Institute of Technology (CIT) in Pasadena, California, the Laboratoire d'Astrophysique Spatiale (LAS) in Marseilles, France, the University of California at Berkeley, the Johns Hopkins University in Baltimore Maryland, and the Yonsei University, South Korea. The GALEX Principal Investigator, Dr. Christopher Martin of CIT, is responsible to NASA for the

mission design, development, and operations. The GALEX Science Operations Center is located on the CIT campus in Pasadena, California.

The GALEX PI is responsible for achieving the several important scientific objectives of the mission. GALEX's primary objective is to map the global history and probe the causes of star formation over the redshift range $0 < z < 2$. This timespan traces 80% of the life of the universe, the period over which galaxies have evolved dramatically, and the time that most stars, elements, and galaxy disks had their origins. GALEX uses the space ultraviolet ($\lambda < 3000$ Å) to simultaneously measure redshift (using emission lines and the Lyman Break), extinction (using the UV spectral slope), and star formation rate (using the UV luminosity, which is proportional to the instantaneous star formation rate). Other scientific objectives supporting this overarching goal are: 1) Determining the UV properties of local galaxies and how their rest-UV properties, measured at high redshift by other missions, relate to star formation rate, extinction, metallicity, and burst history; 2) Measuring the star formation and metal production history of galaxies over the redshift range $0 < z < 2$; 3) Determining the time and location of the origins of the stars and elements we see today, and connecting this to the evolution between $0 < z < 2$; and 4) Identifying the global (galaxy-wide) factors that drive star formation and evolution in galaxies.

The GALEX prime mission will address these objectives by performing a set of eight complementary imaging and spectroscopic surveys. Approximately 2000 orbits will be devoted to each survey. Details of the GALEX primary science plan, and how it will use these surveys, can be found on the GALEX GI Website. Approximately 10% of each survey will be included in the first GALEX data release (DR1) and will be available for GI archival proposals in Cycle 1.

Five imaging surveys will be carried out in the FUV (1350-1800 Å) and NUV (1800-2800 Å) bands with 4-6 arcseconds resolution, a 1.2 degree field-of-view, and better than 1 arcsec astrometric accuracy. These surveys will detect millions of galaxies in the local universe and many thousands in the more distant universe over the redshift range $0.5 < z < 2$. More detailed information may be found in Table 1, or at http://galexgi.gsfc.nasa.gov/surveys.

- AIS - All-sky Imaging Survey: 90% of the sky, Galactic caps first, avoiding Galactic plane.
- MIS - Medium Imaging Survey: SDSS and 2df overlap
- DIS - Deep Imaging Survey: Overlaps other deep surveys (see list of surveys included)
- UDIS - Ultra Deep Imaging Survey: 4 degrees^2, includes e.g., CDFS, Groth, NOAO Deep-Wide, others
- NGS - Nearby Galaxy Survey: 150 nearby galaxies, with exposures of 1 or 2 orbits per galaxy.

Three spectroscopic surveys will be done over the 1350-2800 A band, using a slitless grism with spectral resolution of R=150-300. These surveys will measure approximately 100,000 galaxies over a wide range of luminosities and star formation rates, over the redshift range of $0 < z < 2$.

- WSS - Wide-field Spectroscopic Survey: Same fields as DIS
- MSS - Medium-deep Spectroscopic Survey: Centers of WSS fields
- DSS - Deep Spectroscopic Survey: Chandra DFS, NOAO Deep-Wide Fields

Table 1 – Survey Summary – see also Survey Summary

Survey	Survey Parameters					Scientific objectives		
	Area [deg^2]	Time [Mo.]	Expos [ksec]	Mag. Limit [m_{AB}*]	Flux Limit**_	# Gals (est.)	Vol. [Gpc^3]	<z>
All-sky Imaging (AIS)	40,000	4	0.1	20.5	1.5×10^{-16}	10^7	1.5	0.2
Wide Spectroscopic (WSS)	80	4	30	20	2.4×10^{-16}	10^{4-5}	0.03	0.15
Nearby Galaxies (NGS)	---	0.5	1.5	27.5 [arcsec^{-2}]	3.8×10^{-19}	100	---	--
Medium Imaging (MIS)	1000	2	1.5	23.5	9.6×10^{-18}	3 x 10^6	~1	0.6
Medium Spectroscopic (MSS)	8	2	300	21.5 R=100] 23.3 [R=20]	4.7×10^{-17} 1.1×10^{-17}	10^{4-5}	0.03	0.5
Deep Spectroscopic (DSS)	2	4	1500	22.5 R=100] 24.3 [R=20]	2.4×10^{-17} 4.6×10^{-18}	10^{4-5}	0.05	0.9
Deep Imaging (DIS)	80	4	30	25	2.4×10^{-18}	10^7	1.0	0.85
Ultra-Deep Imaging (UDIS)	4	1	150	26	9.0×10^{-19}	3×10^5	0.05	0.9

* $m_{AB} = m_0 - 2.5 \log (\text{Flux} / U)$, where

$U_{FUV} = 2.05 \times 10^{-16}$ ergs cm^{-2} Å^{-1} s^{-1}, $U_{NUV} = 1.40 \times 10^{-15}$ ergs cm^{-2} Å^{-1} s^{-1}

$m_{0\_FUV} = 18.82$, $m_{0\_NUV} = 20.18$

**Flux limits are given for the NUV band, and are in ergs cm^{-2} Å^{-1} sec^{-1}

All of the observing time during the first 18 months of GALEX science operations, and ~2/3 of the observing time during the 19-28th month will be used by the PI Team to carry out these surveys.

The wide field-of-view and and spectral windows provided by GALEX permits the study of many astrophysically important subjects besides galaxy evolution. These include, but are not limited to: stellar winds and outflows, post-main-sequence star evolution, binary star evolution, globular cluster structure and evolution, massive stars, supernova remnants, reflection nebulae, interstellar dust, structure of the ISM, the UV background, nearby galaxy populations, galaxy clusters, intergalactic material, and QSO evolution.

More information on GALEX science objectives may be found at http://galexgi.gsfc.nasa.gov/piscience and further information on GALEX survey content and strategy may be found at http://galexgi.gsfc.nasa.gov/surveys.

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3.2 Instrument Overview

GALEX is a 50cm UV-optimized telescope that obtains images simultaneously in the 1350-1800 Å far-UV (FUV) band and in 1800-2800 Å near-UV (NUV) band, with a field of view of 1.2 degrees and an angular resolution of 4-6 arcseconds. It can also obtain slitless spectroscopy with the same field of view and spatial resolution, with spectral resolution of R=200-350 (FUV) and 80-150 (NUV). GALEX has one primary 50 cm mirror, which feeds light through either an imaging window or an imaging grism, to a dichroic beamsplitter, and into two sealed-tube microchannel-plate photon-counting detectors. The effective area is 35 cm^2 for the FUV channel and 65 cm^2 for the NUV channel. The high throughput results from an optical design utilizing a high-efficiency beam splitter, a high–efficiency CaF_2 grism, and multilayer reflective coatings optimized for wavelength coverage in the GALEX range. Further details on the GALEX instrument can be found in the GALEX Mission and Instrument Summary, the GALEX Observer's Guide, and the GALEX Detector Handbook and the GALEX project website (http://www.galex.caltech.edu).

3.3 Satellite Operations and Observation Planning

GALEX is in a nearly circular orbit with a mean altitude of 690 km, an orbital inclination of 29¡, and an orbital period of 98 minutes with ~2100 sec orbital nights. The plane of the orbit precesses with a period of 60 days. Typically, GALEX is in contact with the ground station for 8-12 minutes per orbit for 10 consecutive orbits, followed by five orbits with no contact. All GALEX scientific observations are conducted autonomously by the onboard instrument data system, from week-long observing plans. Science observations are made only during orbital nights, with a maximum possible time of 1700 sec available for science observations.

3.3.1 Observation modes

All science data collection uses a spiral dither, to prevent bright-star-induced fatigue of localized regions on the detectors and to improve image flat-fielding. In "single-visit" (or "stare/dither") mode, only one field center is observed for the entire eclipse. In "sub-visit observations" (or "AIS mode"), several (typically 10-12) contiguous field centers are observed during one orbital night. Grism observations are always done in "single visit" mode at a single grism orientation; multiple observations (typically ~20 for WSS) are made at different grism orientations. All GALEX science data is sent down as time-tagged photon lists, allowing ex-post-facto aspect determination and image reconstruction. GI observations may use *only* these standard GALEX observing modes.

3.3.2 Brightness Limits

There are bright star detector limits that, because of the wide field of view, significantly

affect flexibility of mission planning when choosing targets. *Fundamental detector safety requirements* limit observations of bright targets. Currently, point sources, with flat spectra, may not be observed (imaging or grism) that are brighter than:

m_{AB} = 9.5 or F_n = 0.6 Jy or $F_l = 7 \times 10^{-12}$ erg cm^{-2} s^{-1} Å^{-1} in the FUV;

m_{AB} = 10.8 or F_n = 0.2 Jy or $F_l = 1 \times 10^{-12}$ erg cm^{-2} s^{-1} Å^{-1} in the NUV.

Bright and / or crowded fields may not be observed if they exceed total brightness levels of 65,000 cps), or:

F_n = 7.8 Jy or $F_l = 9 \times 10^{-11}$ erg cm^{-2} s^{-1} Å^{-1} (FUV);

F_n = 2.6 Jy or $F_l = 1.5 \times 10^{-11}$ erg cm^{-2} s^{-1} Å^{-1} (NUV).

Pointing centers must be separated from bright stars by :

0.75^o	for an object with	$F_{l\_NUV} = 1 \times 10^{-12}$, or m_{AB} = 10.8	(5,000 cps)
0.88^o	for an object with	$F_{l\_NUV} = 1 \times 10^{-11}$, or m_{AB} = 8.3	(50,000 cps)
1.00^o	for an object with	$F_{l\_NUV} = 4 \times 10^{-11}$, or m_{AB} = 6.8	(200,000 cps)
1.50^o	for an object with	$F_{l\_NUV} = 1 \times 10^{-10}$, or m_{AB} = 5.8	(500,000 cps)
2.00^o	for an object with	$F_{l\_NUV} = 2 \times 10^{-10}$, or m_{AB} = 5.0	(1,000,000 cps)

(Fluxes and magnitudes in NUV band (~ 2300 Å), F_l in ergs cm^{-2} s^{-1} Å^{-1})

A bright star finder, star catalogue listing observed TD-1 UV fluxes, an astrographic catalogue (AC2000 combined with Tycho), an exposure calculator, and other tools may be found at the Tools for Proposers site (http://galexgi.gsfc.nasa.gov/proposals).

Proposers expecting to observe objects near these brightness limits should consult the GALEX Observer's Guide and the GALEX Detector Guide for further information and restrictions, and should pay particular attention to this issue in the "Feasibility and Safety" section of their proposals. New observing techniques are being tested that may permit limited observations (FUV only) of objects at/near the bright limits cited here, *if the observation poses no risk to the instrument* (as determined in technical review by the GALEX operations team). Updated information about this option will be posted on the GALEX GI web site (http://galexgi.gsfc.nasa.gov/) as it becomes available.

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3.4 Data Processing, Calibration, and Distribution

3.4.1 Pipeline Processing

Data pipeline processing is done at the GALEX SOC, including image construction from time-tag photon lists, flat-fielding, background subtraction, photometric calibration, image rectifying, astrometric solution, and transformation into North-up FITS images. In the case of imaging observations, the pipeline then detects objects in the field, extracts object properties, and collects the objects and their properties into catalogues. In the case of grism observations, the different grism orientations are stacked, individual source spectra are extracted, wavelength calibrated, corrected for spectral response, and collected into catalogues. The astrometric accuracy of the resulting images is currently better than 1 arcsec, the photometric accuracy is currently about 10% (but is

expected to improve as more in-flight calibration is obtained), and the wavelength accuracy of the spectra ranges is 1-2 Å relative, 2-4 Å absolute. More details may be found in the GALEX Observer's Guide, the Early Release Data Description, the GALEX Pipeline Data Guide, and the GALEX In-Flight Calibration Guide (all available, with several others, at http://galexgi.gsfc.nasa.gov/Documents).

The GALEX project will produce a series of image and spectroscopic products in addition to the images and spectra. These will be delivered, with the images and spectra, in Data Releases (DR). The first public data release (DR1) will occur on 1 October 2004, and will contain approximately 10% of the data for each of the GALEX primary mission surveys, as well as accompanying data products. All data in DR1 may be used in GALEX Cycle 1 archival proposals. A small sample of GALEX data was released in November 2003, as Early Release Observations (ERO).

3.4.2 Data Distribution

The GALEX data is permanently archived at the Multimission Archive at Space Telescope (MAST) (http://archive.stsci.edu). GALEX ERO data are available now (http://archive.stsci.edu/galex), with a sampling of typical GALEX data and variety of useful tools for exploring the data and associated data products. Starting October 1, 2004, all of GALEX DR1 will also be available through MAST. Guest Investigators will access their data through MAST, and MAST will provide selective access to proprietary data. Access procedures for public and proprietary data are similar to those for Hubble Space Telescope data. Only the PI of each GI program (and their designees) can access that program's data during the proprietary period. GALEX data distribution is by electronic file transfer from the MAST. Observations of calibration targets generally have no proprietary period. See Section 1.5 for additional information about GALEX data rights.

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4.0 Important Dates

Primary Science Mission:

The primary GALEX mission is expected to run for 28 months, from 1 August 2003 to 30 November 2005. During the last year of the primary mission, approximately one third of the observing time will be available for Guest Investigators as Cycle 1.

Cycle 1 Proposals:

NRA Release – 30 January 2004

Notices of Intent –- 4:30pm, EST, 12 March 2004.
(NOIs are not required but are strongly encouraged.)

Proposal Deadline -- 4:30pm, EDT, 16 April 2004.

Cycle 1 Observations: 1 October 2004 through 30 September 2005.

GALEX Data Releases: **Early Release Observations –** 1 December 2003
Data Release 1 -- 1 October 2004

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5.0 Contact Information

Scientific and technical questions concerning the GALEX GI Program should be directed to:

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Technical information about the GALEX mission, the proposal template, and electronic form submission should be obtained, starting in early February 2004, from:

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