Cosmic Origins Program Analysis Group Call for White Papers :

Large Astrophysics Missions to Be Studied by NASA Prior to the 2020 Decadal Survey

To: The Astronomical Community

From: The Cosmic Origins Program Analysis Group Executive Committee

Due Date: April 24, 2015

Submission: Submit PDF white papers to COPAG_Contact@bigbang.gsfc.nasa.gov

Dear colleague,

In January 2015, Paul Hertz (Director, NASA Astrophysics Division) issued a memo to the astronomical community[1] to stimulate planning for the 2020 Decadal Survey. In the memo, he directed the three Program Analysis Groups[2] (PAGs) to solicit input from the astronomical community on four large (>$1B) mission concepts that were drawn from the 2010 Decadal Survey[3] and NASA Visionary Roadmap[4].

- **Far Infrared Surveyor** –This telescope concept would provide an order of magnitude or more performance increase above *Herschel* in one or more of the areas of sensitivity, spectral resolution, and angular resolution.
- **Habitable-Exoplanet Imaging Mission** – This telescope would be capable of direct imaging and spectroscopy of a rocky planet in the habitable zone of a nearby star.
- **UV/Optical/IR Surveyor** – This telescope concept would provide an order of magnitude improvement in sensitivity above the *Hubble Space Telescope*, a wavelength coverage potentially as broad as 10 μm to 91 nm, and carrying one or more instruments for a variety of imaging or spectroscopic measurements.
- **X-ray Surveyor** – This telescope concept would provide as much as two orders of magnitude improvement in sensitivity above *Chandra*. It also potentially could provide improvements in one or more of the parameters of spectral resolution, field of view, or angular resolution.

Note that the use of the word "Surveyor" here denotes the mission as a flagship-class mission, and does not indicate that the mission is designed specifically to perform surveys.

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[1] see http://science.nasa.gov/media/medialibrary/2015/01/02/White_Paper_-_Planning_for_the_2020_Decadal_Survey.pdf; see also the presentation given to the PAGs by Paul Hertz: http://cor.gsfc.nasa.gov/copag/aas_jan2015/jan2015-meeting.php

[2] The 3 PAGs are: Exoplanet Exploration (ExoPAG, https://exep.jpl.nasa.gov/exopag/), Cosmic Origins (COPAG, http://cor.gsfc.nasa.gov/copag/) and Physics of the Cosmos (PhysPAG, http://pcos.gsfc.nasa.gov/physpag/)

[3] http://science.nasa.gov/astrophysics/special-events/astro2010-astronomy-and-astrophysics-decadal-survey/

[4] http://science.nasa.gov/media/medialibrary/2013/12/20/secure-Astrophysics_Roadmap_2013.pdf

This list is as a starting point to assess which large mission concepts will be funded for study in preparation for the 2020 Decadal Survey. The community is being asked to provide input regarding which large missions should be studied, in order to ensure that the limited resources available for such studies are appropriately utilized. Community feedback on each of these mission concepts (for example, pros and cons of each mission), including suggested additions or subtractions to the list, is encouraged.

The Cosmic Origins Program Analysis Group (COPAG) invites you to provide feedback via one-to-two page white papers. Participation in this activity is a way to guarantee that your voice will be heard! This initial call for white papers is only a start - the white papers will form a core set of community input for discussion regarding what the next large mission following JWST and WFIRST/AFTA should be. There will be other opportunities to provide additional comments on the survey topics (e.g., web-based "town halls" and limited in-person meetings).

While we are particularly interested in hearing your thoughts about these missions as they relate to Cosmic Origins science objectives, we will accept white papers that deal with the Physics of the Cosmos or Exoplanet science themes as well. The COPAG will share and discuss all white papers with the PhysPAG and ExoPAG so that the three PAGs can provide unified responses to the Astrophysics Subcommittee if appropriate. All responses to this call will also be posted for public reading to stimulate further discussion.

All white papers must include a title, author names, and email address of the lead author. Length is limited to 2 pages, including figures. Font size must be 10 point or greater. PDF submissions are preferred, although Microsoft Word submissions and plain text submissions are also acceptable. We recommend that you consider the following types of information below in your white paper responses.

1. KEY SCIENCE QUESTION(S)

Describe an important Cosmic Origins science question(s) that you think should be addressed by the next large (>$1B) mission, that neither JWST nor WFIRST will be able to definitely answer. Please be as specific as possible by describing science *questions* or specific investigations to be addressed rather than general capabilities or science areas. For example, “Do molecular clouds subjected to extreme environments (turbulence, strong tidal fields, shocks) favor high-mass star formation?” would be more useful than “observing star forming regions at unprecedented angular and spectral resolution” or “investigating high-mass star formation processes”. If the particular science topic is not specifically related to Cosmic Origins, we will make sure that one of the other PAGs (PhysPAG, ExoPAG) receives your input for consideration as well.

2. TECHNICAL CAPABILITIES

Describe the performance capabilities that this mission would require to address key science questions. Include the following information (as appropriate):

- Spectral coverage, e.g. far-UV, UV/visual, near-IR to mid-IR, far-IR?
- Spectral resolving power (both for imaging and spectroscopy)?
- Angular resolution?
- Field of view?
- Primary operational mode, e.g. survey, point-and-stare, etc.?
- Sensitivity? (If you can't answer in a quantitative way, try to describe in terms of the class of object that you would want to be able to detect out to a particular distance, at a desired signal-to-noise ratio, etc.).
- Other important capabilities, e.g. multi-object slit spectroscopy, high-contrast coronagraphy, time-resolved photon-counting, etc.

3. RELEVANCE OF THE FOUR MISSION CONCEPTS

Comment (pro or con) on whether one or more of the four mission concepts (**Far-Infrared Surveyor, Habitable-Exoplanet Imaging mission, UV/Optical/IR Surveyor, X-ray Surveyor**) would meet the scientific objectives you described. If *none* of the concepts are a good match to the science objectives you describe above, please state so, and add any description of your different mission concept that hasn't already been captured in your answers to previous questions. Please be specific about which of the four (or other) mission concepts is necessary, and state why this is the case.

4. NEW TECHNOLOGIES

Would new technologies be required by the large mission you describe above? If so, what new technologies would be required, and what is their current level of maturity (for example, "still in concept formulation", "separate components in test-bed research phase", "an integrated breadboard model has been lab-tested", "a prototype is ready for testing in an operational environment"). Specifying in terms of Technological Readiness Level (TRL) is okay too.

5. LARGE MISSION NEEDED?

Could the science question(s) described above be addressed (in total or in part) by a smaller mission (Explorer-class, suborbital payloads, etc), or are the science objectives clearly in the realm of a "flagship-sized" mission?