ASTRA initiative in Physics of the Cosmos

Report from the PhysCOS Executive Committee

PHYSICS OF THE COSMOS
How does the universe work?

ASTRA process

- PhysPAG, ExoPAG and COPAG, via their executive committees, have been tasked with:
  - Collecting input about mission concepts that the community would like to see studied in preparation for the Astro 2030 decadal.
  - Proposing 4-6 mission concepts to NASA Astrophysics Division for entrance into the ASTRA process.
- In PhysPAG, we have asked our nine Science Interest Groups (SIGs = working groups) to reach out to their communities and collect mission concept ideas that people would like to see studied.
  - Some SIGs have started Science Analysis Groups (SAGs = task-forces) to steer this process.

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Who to contact about ASTRA mission concepts?

- **Astrophysics form the Moon, Mars, and beyond (AMMB STIG)**
  - *Nivedita Mahesh, Caltech (EC)*
- **Cosmic Ray and Neutrino (CRN SIG)**
  - Tsuguo Aramaki, Northeastern Univ.
  - *Stephanie Wissel, Penn State (EC)*
  - Priyarshini Ghosh, GSFC
  - Keith McBride, U Chicago
  - *Philip von Doetinchem, U Hawaii (EC)*
- **Cosmic Structure (CoS SIG)**
  - Johannes Lange, American Univ.
  - *Dida Makovic, JPL (EC)*
  - Pam Marcum, Ames
- **Gamma Ray (GR SIG)**
  - *Manel Errando, Washington Univ. St Louis (EC)*
  - *Jeremy Perkins, GSFC (EC)*
  - Cori Fletcher, MSFC
  - Sylvain Guiriec, George Washington Univ.
  - *Tiffany Lewis, Michigan Tech. Univ. (EC)*
  - *Veronica Dexheimer, Kent State (EC)*
- **Gravitational Wave (GW SIG)**
  - Tingting Liu, Georgia State
  - Simon Barke, Univ. of Florida
  - *Michael Katz, JPL (EC)*
  - *Francois Foucart, New Hampshire (EC)*
- **Inflation Probe (IP SIG)**
  - Abigail Crites, Cornell
  - *Tom Essinger-Hileman, GSFC (EC)*
- **Time Domain and Multi-Messenger Astrophysics (TDAMM SIG)**
  - Rebekah Hounsell, GSFC
  - Brad Cenko, GSFC
  - Christos Panagiotou, MIT
  - *Igor Andreoni, University. North Carolina (EC)*
  - Lauren Alderoty, GSFC
- **X-ray (XR SIG)**
  - *David Pooley, Trinity Univ. (EC)*
  - *Chien-Ting Chen, MSFC (EC)*
  - Breana Binder, Cal Poly Pomona
  - Steven Ehlert, MSFC
  - *Scott Randall, SAO (EC)*
  - *Fabio Pacucci, CfA (EC)*

(EC) denotes a member of the PhysPAG Executive Committee

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Who to contact about ASTRA mission concepts?

- **Broad-Band X-ray Observatory (BX SAG)**
  - Chien-Ting Chen, MSFC
  - Kristin Madsen, GSFC
  - Daniel Stern, JPL
- **Cosmic Microwave Background Probe (CMB SAG)**
  - Shaul Hanany, Univ. Minnesota
  - Brendan Crill, JPL
  - Tom Essinger-Hileman, GSFC
- **Future Large Gamma-Ray Mission Concepts (FLAG SAG)**
  - Elizabeth Hays, GSFC
  - Henric Krawczinsky, Washington Univ. St Louis
- **High Angular Resolution X-ray Imager (Hi-ReX SAG)**
  - Kimberly Weaver, GSFC
  - Herman Marshall, MIT
  - Mark Schauenburg, MIT
  - Breanna Binder, Cal Poly Pomona
- **Lynx 2030 (Lynx2030 SAG)**
  - Steven Ehlert, MSFC
  - Fabio Pacucci, CfA

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Mission Concepts

- Please contact the relevant SIG and/or SAG if you have a mission concept idea, or if you have a science question that you think should be addressed in the next decade and that no current or planned mission will address.
- We have so far collected interest from > 35 mission concepts / science questions / desired tech capabilities.
- Mission Concept Description documents (~5 pages) are requested with a due date of June 26.
- Concepts at any maturity level are welcome.
- While anyone can submit their mission concept description, we recommend you contact your relevant SIG/SAG representative to attempt to coordinate efforts with similar concepts and maximize the impact that your community will have have on the process.

Mission Concept Description template

1. Science Investigation *(1-2 pages of text and figures) [Delete instructions below when submitting]*

- *Science background for the concept, including science gap(s), that the investigation addresses. This may be a broad set, if the concept is about a general-purpose capability (for example, a general-purpose constellation of telescopes at different wavelengths).*
- *Please reference all the relevant strategic documents: Astro 2020 decadal report, 2014 Astrophysics Roadmap, and any more recent findings.*
- *Please indicate why the concept should enter the ASTRA incubator now, given the existing and upcoming landscape of missions and capabilities.*
- *Science objective(s). Please cast these as questions to be answered or gaps to be closed. E.g. To determine …, to distinguish between alternative hypotheses, to understand a certain process, to explore…*

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Mission Concept Description template

2. Science Table *(<1 page) [Delete instructions below when submitting]*
List the 2-3 (or more) key science questions that this concept would address. Please fill in the table below, adding rows as needed. Quantitative statements are desired but are not absolutely necessary at this stage for all science objectives. This is not meant to be as detailed as a typical science traceability matrix.

Science Objectives	**Physical Parameters**	**Observables**	**Potential Challenges**
The objectives of thismission. E.g.: To determine x,y,z, to distinguish between, to discriminate between	*E.g. Mass, radii, temperatures, size, densities*	*E.g., transit depth, surface flux in a certain band, line flux polarization level, etc under specified conditions or for specific targets.*	*What makes this difficult? Why has this not been done? This can include science priors & modeling, expected technology, and/or other implementation details.*

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Mission Concept Description template

3. Instrument Description *(<1 page of text and figures) [Delete instructions below when submitting]*

This could include:

- *Instrument type and high-level description of the instrument(s), if known.*
- *Any noteworthy technology issues: e.g. immature technology that would need to be matured.*
- *If applicable, use of other observing resources, such as ground-based observatories.*
- *Key enabling technologies. If you have a high-level tech development plan or suggestions, please indicate it here.*

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Mission Concept Description template

4. Mission Implementation *(<1 page of text and figures) [Delete instructions below when submitting]*
In this high-level context, "mission" could refer to the launch, the spacecraft, and the overall operations.

Mission Architecture (to include elements from below list)

- *High-level observing program description (types of targets to be observed and any unique data processing steps).*
- *Mission destination (e.g. the moon, specific orbit) or driving constraint (e.g., low-radio noise environment).*
- *Estimated mission lifetime needed to achieve the science goals.*
- *The number of spacecraft and any potential spacecraft design drivers (e.g., high-precision pointing, low-disturbance bus, fast re-pointing capability, cryogenic payload).*
- *Ways to leverage industry and commercial capabilities.*
- *Ways to leverage the Artemis Program and infrastructure.*
- *Potential partnerships (foreign partners, philanthropic organizations, etc). Please indicate if these will be in instrument development, science, launch, operations, etc.*
- *Any cost saving initiatives.*

Questions?

Email me at errando@wustl.edu or reach out to your SIG / SAG representatives

Useful links:

SIG / SAG contacts

ASTRA Website

Mission Concept Description template

ASTRA FAQ page