Program Status

Physics of the Cosmos Program (PCOS)
Cosmic Origins Program (COR)

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Briefing to Astrophysics Subcommittee of NAC

October 19, 2011

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Physics of the Cosmos Program (PCOS)

PCOS Program Objective

The Objective of the PCOS program is to understand how the universe works starting with the very basic building blocks of our existence - matter, energy, space, and time - and how they behave under the extreme physical conditions that characterize the evolving universe. The PCOS program incorporates cosmology, high-energy astrophysics, and fundamental physics projects aimed at addressing directly central questions about the nature of complex astrophysical phenomena such as black holes, neutron stars, dark energy, and gravitational waves.

Program Office: GSFC

Mansoor Ahmed – Program Manager

Jean Cottam Allen– Chief Scientist

Thai Pham– Program Technologist

PCOS Program Elements

4 Projects in operations: Chandra, Fermi, Planck, XMM-Newton

1 Project in development: ST-7

Explorer missions with PCOS Science

- 3 Projects in operation: Suzaku, Swift, RXTE and WMAP (in data analysis phase)
- 3 Projects in development: GEMS, NuSTAR, Astro-H

Einstein Fellowship - The Einstein fellowship supports recent Ph.D.'s in astronomy, physics and related disciplines for research that is broadly related to the NASA Physics of the Cosmos program as addressed by any of the missions of this program.

Website Link - http://pcos.gsfc.nasa.gov/

Cosmic Origins Program (COR)

COR Program Objectives

The objectives of Cosmic Origins Program are to discover how the universe evolved from free electrons and protons into complex structures like galaxies, stars, and planetary systems. Expand scientific understanding of the Earth and the universe in which we live; discover how the universe works, explore how it began and evolved, and search for Earth-like planets.

The science goals of Cosmic Origins are to discover how the universe evolved from free electrons and protons into complex structures like galaxies, stars, and planetary systems.

Program Office: GSFC

Mansoor Ahmed – Program Manager

Dominic Benford– Chief Scientist

Thai Pham– Program Technologist

COR Program Elements

3 Projects in operations: Hubble, Herschel, Spitzer

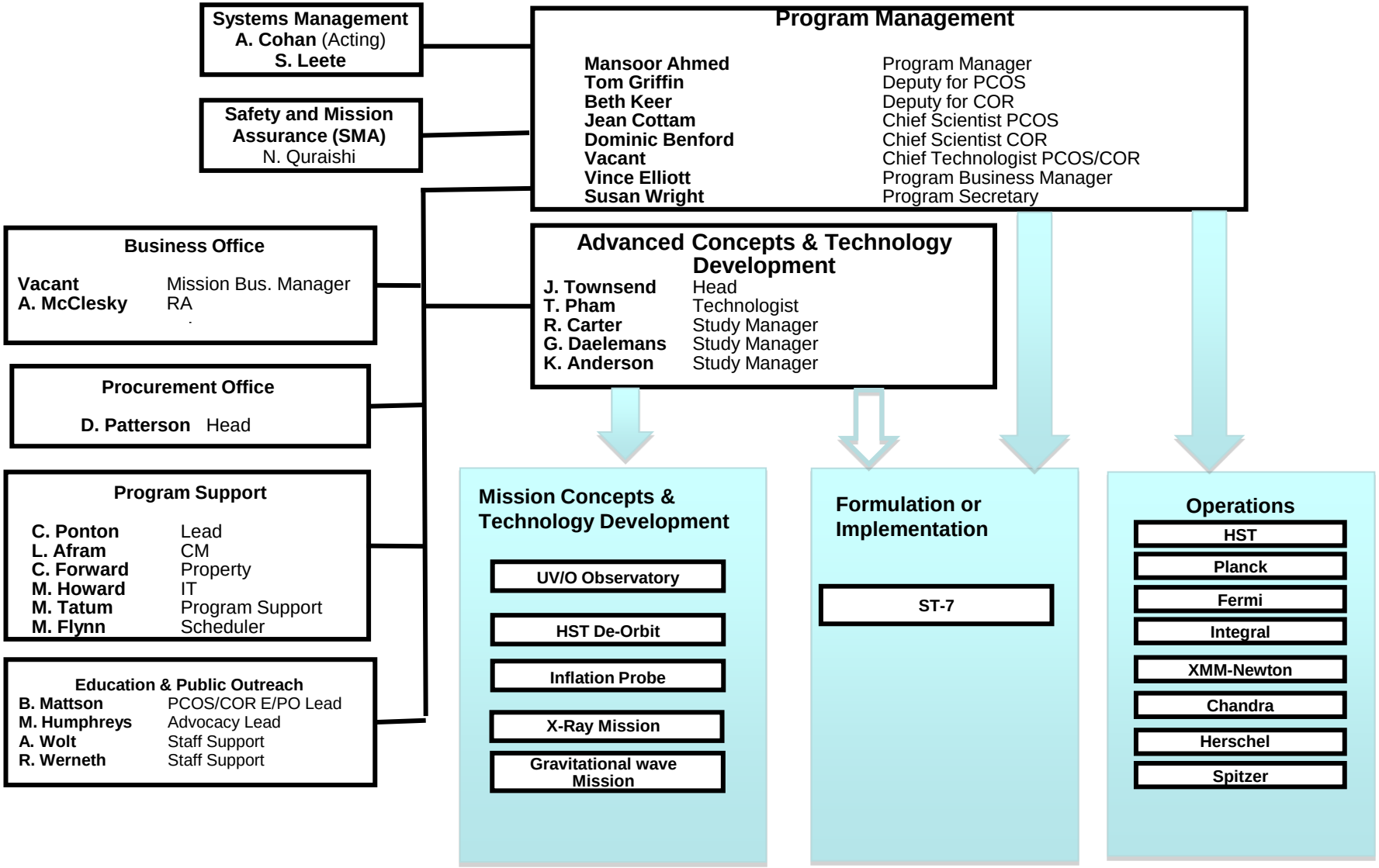
Explorer missions with COR Science

- 1 Project in operation: GALEX. WISE (in data analysis phase)

Hubble Fellowship - The Hubble Postdoctoral Fellowship Program supports outstanding postdoctoral scientists whose research is broadly related to NASA Cosmic Origins scientific goals as addressed by any of the missions in that program.

Website Link: http://cor.gsfc.nasa.gov/

Integrated Program Office Organization



Program Acceptance Review: SRB Findings

- **Program Acceptance review process completed August 2011**
  - SRB chaired by Dr. Michael Bicay, Director of Science, NASA Ames Research Center
  - Agency approved the PCOS & COR programs to proceed into Implementation phase
- **Key findings from the review:**
  - Strengths
    - Science objectives of both Programs aligned well with 2010 NASA Strategic Plan
    - Program Offices are well-organized by functional responsibilities, and are adequately staffed with capable managers
    - Technology & Risk Management Plans are sound
  - Concerns
    - Lack of viable 10-year roadmap for PCOS, with executable flight missions
    - Health of the scientific community because of the above
    - Impact of HST de-orbit mission on Astrophysics science budget

Status: Mission Concepts

Advanced Concept Studies Under Consideration

- **X-Ray Observatory, Gravitational Wave Observatory, Inflation Probe, UV/Optical Observatory and SPICA**
  - Develop strategy to mature mission concepts to a pre-phase-A level by the end of this decade
  - Develop preliminary science, mission and budgetary requirements
  - Identify and develop enabling technologies

- **Hubble De-Orbit Mission Study**
  - Determine optimum time frame for HST de-orbit (prior to uncontrolled re-entry)
  - Develop mission technical and budgetary requirements
  - Identify and develop enabling technologies
  - Identify potential partnerships

X-Ray Astronomy and Gravitational-Wave Science

- **Request for Information (RFI) - Sept '11**
  - Solicits enabling technologies, instruments, and mission concepts at various cost points between $300M to $2,000M that can enable some or all LISA and IXO science objectives endorsed by "NWNH'
- **Community Science Team (CST) – Oct '11**
  - Formed through an open solicitation/Dear Colleague letter
  - To work with the astronomy community and the PCOS Program Office to review all RFI responses and define mission concepts.
- **Open forum Workshops – Dec '11**
  - Present a summary of the information received in response to the RFI and potential mission scenarios for further study
- **Develop concepts for mission scenarios at up to three cost points – Jan-May '12**
  - Map the trade space of mission science return versus mission cost
- **Final report released to community. Anticipate presenting results to the National Academy of Sciences Committee on Astronomy and Astrophysics (CAA) – June '12**

UV/Optical Telescope

- **Study Background**
  - 4-meter class UV/Optical telescope consistent with decadal survey recommendations: *"Key advances could be made with a telescope with a 4-meter diameter aperture with large field of view and fitted with high-efficiency UV and optical cameras/spectrographs operating at shorter wavelengths than HST. This is a compelling vision that requires further technology development."*
  - Cosmic Origins community is considering telescope compatible with coronagraphs and starshades for ExoPlanet detection and characterization
- **Mission study planned to support the UV/Optical technologies called out in the Decadal Survey**
  - UV Optical and COPAG Workshops held in September
  - Initiated conversation with science community with regard to UV Optical Mission concept development
- **Study plan**
  - Study kickoff by January 2012
  - Initial concept formulation including top level mission trades

SPICA Instrument

- **COR Program Office is working with JAXA to understand and preserve allocations for a potential U.S. instrument**
- **JAXA is working toward a System Design Review (SDR) in April 2012 and Launch late in 2018**
- **Instrument study team established within the COR Program Office**
  - Analyze available information on designs that were submitted to the Decadal Survey
  - Determine that JAXA allocations are/remain capable of supporting the requirements of the known potential U.S. instruments
  - Identify potential instrument technologies and maturities
  - Identify potential schedule needs and risks

HST De-orbit Study

- **The HST De-orbit mission cost will impact science missions if the cost has to come from the overall COR science budget.**
- **HST action projected to be necessary in 2025**
- **Program Office study underway**
  - Independent assessment task initiated with Aerospace to obtain available options for the HST end-of-life disposal. Deliverables include
    - Independent Risk Assessment
    - High-level mission architecture trades of risk and cost
    - Reference mission concept with mission schedule and independent cost estimate
  - Identify potential partners within NASA, industry and other government agencies for various mission elements
  - Identify options for best value solution

Status: Technology Investments in FY-12

Potential NASA Contribution to ESA L1 Mission

- **Potential contributions to ESA L1 mission were identified, based on IXO and LISA technology development activities in the US**
  - **X-ray mission:**
    - Micro-calorimeter, Wide field imaging, Grating spectrometer, X-ray telescope
  - **Gravitational Wave mission:**
    - Micro-Newton Thrusters, Telescope sub-system, Laser sub-system, Telescope sub-system, Phase Measurement System
- **Special Technology Management Board (TMB) was convened to prioritize continued investments in the above activities in FY-12**
- **Criteria included**
  - A clear connection to a possible contribution to the ESA L-1 missions or be a key enabling technology for a possible US-led mission, or both
  - A clearly defined end product in FY-12
  - Reasonableness of the proposed budget
- **Awards were announced in September 2011**

Targeted Technology Awards

Proposed Work	PI	Institution
X-ray Mission Mirrors: Develop glass mirror segment fabrication and mounting techniques toward demonstration of TRL 5	W. Zhang	Goddard Space Flight Center
X-ray Mission Micro-calorimeter: Develop 32 x 32 arrays that incorporate Athena "pitch" and 3 X 16 readout for demonstration of TRL 5	C. Kilbourne	Goddard Space Flight Center
Gravitational Wave Mission Telescope: Establish telescope design that meets pathlength stability and wavefront error requirements for NGO; demonstrate optical and scattered light performance for on-axis telescope.	J. Livas	Goddard Space Flight Center
Gravitational Wave Mission Phasemeter: Design and demonstrate modifications to phasemeter that support relaxation of LISA's requirements on laser noise, orbital parameters, and received optical power; Assemble and test analog signal chain pre-amp board	W. Klipstein	Jet Propulsion Laboratory

Technology Prioritization for FY-13 and Beyond

- **Starting in FY-13, all technology funds will be awarded through the SAT process, until specific mission concepts are selected to proceed**
  - If a contribution to an ESA L1 mission is formalized in FY-12, then some targeted technology development may continue in FY-13 and beyond
- **A prioritization process has been put in place that will**
  - Inform the call for SAT proposals
  - Inform technology developers of the program needs
  - Guide the selection of technology awards to be aligned with program goals
- **Community inputs for technology needs solicited through**
  - Program Analysis Groups
  - Chief scientists for the programs
  - Program scientists at NASA headquarters
- **The TMB is in the process of prioritizing the inputs based on established criteria**
- **Program priorities will be published in the Program Annual Technology Report (PATR)**

Summary

- **Both PCOS and COR programs are formally in implementation phase**
- **A short term strategy is in place to keep the door open for international partnerships**
  - With ESA for ATHENA or NGO
  - With JAXA for SPICA
- **A long range approach is established to:**
  - Pursue lower-cost mission concepts for X-Ray and Gravitational Wave science
  - Develop mission concepts for UV/Optical observatory and Inflation Probe
  - Investigate synergy between the COR and ExEP communities in the next large UV/Optical observatory
  - Investigate options for HST de-orbit that minimize impact on Astrophysics science budget
- **A merit-based, transparent process is established for technology development that will ensure alignment with program goals**