



Physics of the Cosmos Newsletter

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Welcome from The Program Office

Mansoor Ahmed, *PCOS Program Manager*

Welcome to the inaugural publication of the Physics of the Cosmos (PCOS) newsletter. I hope you will find it informative and engaging, and that it will motivate you to join us in our quest to define the future for PCOS science.

The Program Office is committed to building a robust PCOS program, while also being mindful of the current budget realities. Although the loss of U.S. partnership in the International X-ray Observatory (IXO) and Laser Interferometer Space Antenna (LISA) missions has been a major setback for PCOS science, we hope to develop a range of viable missions at various cost points to take advantage of any possible funding scenario in this decade, as well as offer affordable flagship-class missions for the next decade. I urge you to join us in this critical endeavor by actively participating through our Analysis Groups, and responding to solicitations.

The first step toward this goal is to establish a strong Program Office that can work closely with NASA Headquarters (HQ) and the science community. We have achieved this objective already. On August 3rd, the Agency gave the Program Office approval to enter into the implementation phase. This decision follows a thorough review by a Standing Review Board (SRB), chaired by Dr. Michael Bicay, Head of Science at NASA Ames Research Center. One key position within the Program Office remains to be filled—that of the Chief Technologist. A nationwide search is currently under way for a person who can take on this important position within the Program Office. Your recommendations are welcome.

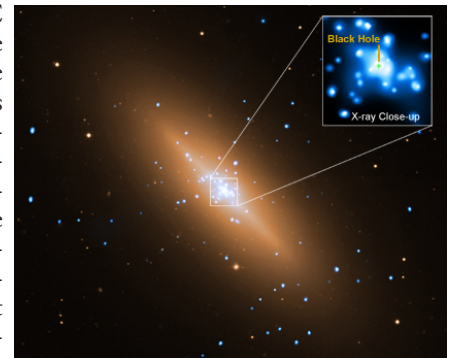
The next step is to develop a 10-year roadmap for conducting PCOS science. The roadmap needs to be robust against dramatic changes in the NASA budget. The Program Office will work closely with NASA SMD/Astrophysics Division and the science community to identify a range of mission concepts (\$300 million to \$2 billion) that will pursue focused scientific objectives. These efforts will be coordinated with the scientific communities through the initiation of mission concept studies that can serve as an anchor for specific enabling technologies that can be

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NASA's Chandra Observatory Images Gas Flowing Toward Black Hole

The galaxy NGC 3115 is shown here in a composite image of data from NASA's Chandra X-ray Observatory and the European Southern Observatory's Very Large Telescope (VLT). Using the Chandra image, the flow of hot gas toward the supermassive black hole in the center of this galaxy has been imaged.



Credit: X-ray: NASA/CXC/Univ. of Alabama/K.Wong et al, Optical: ESO/VLT
This is the first time that clear evidence for such a flow has been observed in any black hole.

See full article at http://chandra.harvard.edu/press/11_releases/press_072711.html

funded this decade. The Program Office is making preparations to initiate these concept studies and will invite the larger science and technology community to bring forward new ideas for mission concepts and technologies that will enable PCOS science.

We are looking forward to working with you in paving the future for PCOS.

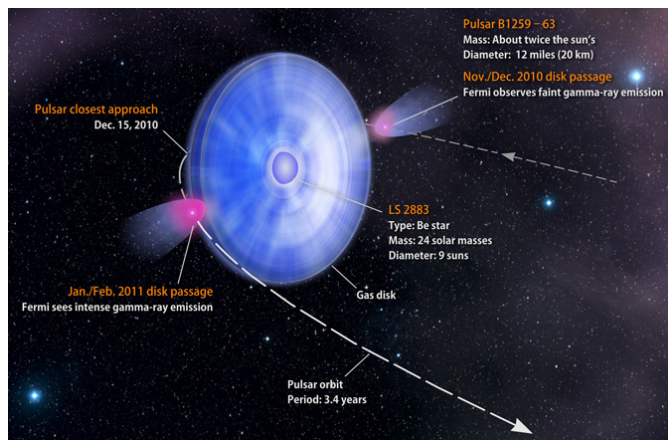
PCOS Science

Jean Cottam, *PCOS Chief Scientist*

We are doing exciting science in the PCOS program. As you can see from the science highlights in this newsletter, and as you know from your own research and that of your colleagues, PCOS science is active and vibrant. Chandra and XMM-Newton are producing excellent data and important results well in their 12th years of operations. Swift and Suzaku are both doing break-through science. Fermi is opening a whole new phase space of observation and producing interesting and often unexpected results. We are eagerly awaiting the first cosmological results from Planck and the analysis of the full nine years of data from WMAP. While RXTE is ending operations, it leaves behind an invaluable and lasting legacy.

While we continue to pursue the science enabled by these PCOS missions and PCOS-related Explorer missions, we're also look-

Fermi Detects Dual Gamma-ray Flares from 'Odd Couple' Binary



This diagram, which illustrates the view from Earth, shows the binary's anatomy as well as key events in the pulsar's recent close approach. (Credit: NASA's Goddard Space Flight Center/Francis Reddy)

In December 2010, a pair of mismatched stars in the southern constellation Crux whisked past each other at a distance closer than Venus orbits the sun. The system possesses a so-far unique blend of a hot and massive star with a compact fast-spinning pulsar. Every 3.4 years, pulsar B1259-63 dives twice through the gas disk surrounding the massive blue star it orbits. With each pass, it produces gamma rays. During the most recent event, NASA's Fermi observed that the pulsar's gamma-ray flare was much more intense the second time it plunged through the disk. Astronomers don't yet know why. They are continuing to analyze their bounty of data and working to understand the surprising flares. And in May 2014, when the pulsar once again approaches its giant companion, they'll be watching.

See full story at http://www.nasa.gov/mission_pages/GLAST/news/odd-couple.html

ing to the next science enabled by the next missions. The New Worlds, New Horizons report outlines the science priorities for the next decade. For Physics of the Cosmos, the highest priority objectives are the following: study the nature of dark energy by mapping the expansion of the universe and the growth of structure; test the theory of Inflation by measuring the CMB polarization caused by primordial gravitational waves, and; probe the properties of black holes and, hence, the theory of General Relativity using the X-ray emission from accreting gas, the multi-wavelength beams of radiation from jets, and the gravitational waves generated by merging black holes. These are ambitious but achievable objectives.

The PCOS Program is carefully considering possible paths to realizing these objectives. Given the current and projected NASA budgets and the federal and global fiscal environment, we cannot expect to build multiple, multi-billion dollar missions any time soon. We have to rethink how we can achieve our science objectives. We need to focus our efforts on those measurements that can only be done from space. We need to seriously consider what science is possible on smaller platforms and how to achieve large objectives iteratively. We need to engage and coordinate with all available partners. We need to continue to support the theory, laboratory science, and data analysis programs that allow us to optimally prepare for missions and then extract the most meaningful science. The roadmap described above by the PCOS Program Manager will lay out this path. The technology development process that is led by the Advanced Concepts and Technology Office is an essential component. The RFIs for mission concepts that are described in the article from NASA Headquarters are the first step in redefining the gravitational wave and X-ray missions. The PhysPAG, led by Steve Ritz, will coordinate the community to provide the necessary analyses. There is real work ahead of us. Stay involved so that we realize these goals.

News from NASA Headquarters

Rita Sambruna, *PCOS Program Scientist*

Jaya Bajpayee, *PCOS Program Executive*

The News from NASA Headquarters will focus on programmatic updates, science opportunities, and personnel changes.

We applaud the creativity of the science community in producing breakthrough science in these difficult financial times. We share the common goal of maximizing science return with a balanced portfolio of investments within the grand design outlined in the New Worlds New Horizons 2010 Report. We are working hard to achieve that goal.

The much-anticipated announcement of the ESA down-selection of M-class missions, which include Euclid, PLATO and Solar Orbiter, is scheduled for the Fall of 2011.

NASA HQ has assigned scientists as its representatives on the European-led Advanced Telescope for High ENergy Astrophysics (ATHENA) and New Gravitational-wave Observatory (NGO) representing the new X-ray and gravitational wave mission concepts, as ESA's revised L-class process moves forward. Nick White, Director of the Sciences and Exploration Directorate at GSFC, is representing NASA for ATHENA. Tuck Stebbins, the LISA Project Scientist, is representing NASA for NGO. These distinguished scientists are leading the U.S. effort to assist ESA in achieving these common science goals. The down-selection is expected to take place in February 2012. Stay tuned for more updates on these activities in future newsletters.

We are also pursuing parallel efforts to define lower-cost NASA-led missions. The PCOS Program is initiating studies of X-ray and gravitational wave missions. The first step in this process is the release of a Request for Information (RFI) for enabling technologies and concepts for missions within cost ranges of \$300M to \$1B and \$1B to \$2B. This will be followed by open workshops to discuss the results of the RFI and the study process. A Community Science Team (CST) will be formed to provide scientific guidance through this process. As a result of these studies we expect to understand the science reach of missions at various cost points and ultimately optimize the science return given the constraints of the current fiscal environment.

The LISA and IXO Projects at NASA will be closed out September 30, 2011. Study Managers in the Advanced Concepts and Technology Office (ACTO) of the PCOS Program Office will lead future X-Ray Astronomy and gravitational wave efforts. Jaya Bajpayee will serve as the Program Executive and Rita Sambruna will serve as the Program Scientist for these efforts beginning in the new fiscal year. The HQ discipline scientists

for these themes—Wilt Sanders, Bill Danchi, Ilana Harrus, and Lou Kalouzienski—will continue to play key roles.

NASA continues to encourage and support PCOS-related technology development to reduce risk for future strategic missions. The Astronomy and Physics Research and Analysis (APRA) program supports the development of technologies up to TRL 4, and the Strategic Astrophysics Technology (SAT) program supports technology development for TRLs 4–6. Further development of technologies at TRL 6 will be supported by flight projects. We expect this strategy for technology development to reduce the risk and, therefore, the cost of our future strategic missions.

The PCOS community provides input through its Program Analysis Group, PhysPAG (see the contribution by S. Ritz, Chair of the Executive Committee). The PhysPAG membership is open to everyone interested; its meetings, held two to three times per year, are open to the community. The next PhysPAG meeting will be held Sunday, January 8, 2012, at the AAS conference in Austin, TX. We encourage you to actively participate in the PhysPAG. This is your community—take part in its future! Please visit the PhysPAG website at <http://pcos.gsfc.nasa.gov/physpag/> to sign up for announcements or contact one of the members of the Executive Committee to get involved.

Finally, the Astrophysics Division Director, Dr. Jon Morse, announced his departure from the Agency in September to start a new position in academia. In bidding him farewell and wishing him great success, we also wish to express our gratitude for his leadership, commitment, and vision while at NASA HQ. The Deputy Director for Astrophysics, Geoffrey Yoder, will be acting Division Director until a new Director is selected.

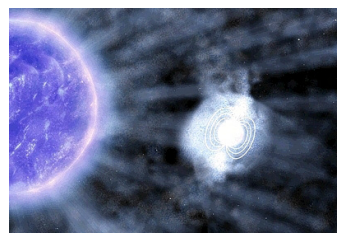
We welcome your comments, thoughts, questions, and suggestions. Please contact us at Rita.M.Sambruna@NASA.gov and Jaya.Bajpayee-1@NASA.gov.

PhysPAG Report

Steve Ritz, *Chair of the Executive Committee*

The Physics of the Cosmos Program Analysis Group (PhysPAG) provides important conduits for information exchange across Physics of the Cosmos (PCOS) subfields in the community and with the PCOS Program Office at NASA Goddard and HQ. PhysPAG is open to the entire community, and everyone is encouraged to participate. Visit the webpage at <http://pcos.gsfc.nasa.gov/physpag.php>. Here you can find news, links to the presentations from recent meetings, and sign up to receive announcements. Some of my recent reports to the Astrophysics Subcommittee can be found here: <http://science.nasa.gov/science-committee/subcommittees/nac-astrophysics-subcommittee/>.

PhysPAG has two technical Science Analysis Groups (SAGs). The Technology SAG (TechSAG: <http://pcos.gsfc.nasa.gov/sags/techsag.php>) led by Roger Brissenden has been working to assess and analyze the technology drivers to meet PCOS science goals. In August, the TechSAG posted and received community feedback on a draft assessment. The Inflation Probe SAG (IPSAG: <http://pcos.gsfc.nasa.gov/sags/ipsag.php>) led by Shaul Hanany has been working to provide metrics and assessments of issues related to a future Inflation Probe mission. A proposal for a Gamma-ray SAG is also being developed.



XMM-Newton Catches Neutron Star Feasting on Clump of Stellar Matter

With a stroke of luck, astronomers using the ESA-led XMM-Newton X-ray observatory have observed a neutron star in a peculiar X-ray binary system un-

dergoing an extremely rare, intense flare. This outburst of X-rays, which lasted about four hours, was due to a sudden increase in the rate at which the neutron star was accreting matter from its companion, a blue supergiant star. By monitoring this phenomenon in unprecedented detail, the data provide the first, substantive evidence to explain such luminosity variations in this type of binary system; the flare appears to be due to the ingestion of a massive clump of matter by the neutron star.

See full story at <http://sci.esa.int/science-e/www/object/index.cfm?fobjectid=48733>

Our most recent face-to-face meeting was at the American Physical Society Meeting in May, where we discussed SAG developments, further expanding community connections, and the implications of the recent decisions by ESA and NASA HQ for the X-ray and gravitational wave communities. As a result of these discussions, the PhysPAG provided this statement to the Astrophysics Subcommittee:

“The PhysPAG understands the X-ray and Gravity Wave communities in the U.S., after decades of investment, have great interest in finding a minor, but significant, hardware role in the emerging European-led missions, and continued deep involvement in this science. The opportunity costs and priorities for such a role should be understood in a timely manner. Regardless of the outcome of the European selection process, the communities see as vital the continued support of technology to enable possible future US-led missions in these science areas, as highlighted in the Astro2010/ NWNH Decadal Survey.”

Our next face-to-face meeting will be held on Sunday, January 8, 2012, at the AAS meeting in Austin, TX. All are welcome to attend this full-day meeting. Over the next few months, we will be developing the agenda, which will include presentations from the community on ways to address X-ray and gravitational wave science goals in a changing international landscape, as well as reports and discussions about ongoing and future PhysPAG work. Representatives from NASA HQ will also be on hand to answer questions, including expectations for future funding opportunities. We will also have a special AAS session on January

Next meeting of the PhysPAG will be held

January 8, 2012 9:00 AM - 5:00 PM

AAS Meeting, Austin, Texas

Special Session: Reports from NASA's PAGs

January 10, 2012 10:00 AM - 11:30 AM

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10, 2012, summarizing the activities of all the PAGs (PhysPAG, Cosmic Origins COPAG, and Exoplanets ExoPAG). Please join us!

The current members of the PhysPAG Executive Committee are Jason Rhodes (JPL), Shaul Hanany (Minnesota), Roger Brissenden (Harvard-Smithsonian CfA), Liz Hays (Goddard), Guido Mueller (U. Florida), and Steve Ritz (UCSC). You can sign up for the PhysPAG mailing list at: <http://pcos.gsfc.nasa.gov/physpag/announce.php>.

Advanced Concepts and Technology Office

News

Jackie Townsend, *Head of ACTO*

The Advanced Concepts and Technology Office (ACTO) within the PCOS Program Office works with the PCOS community to shepherd mission concepts and enabling technologies along the path from ideas to projects in formulation. We have spent much of 2011 establishing the processes for doing this.

This summer, the ACTO is preparing the first PCOS Program Annual Technology Report, which will be released each October. The report describes the results of the previous year's technology investments and identifies the technology development needs and priorities for investments in the upcoming year.

Assembling this report begins with your input regarding the technologies that will enable the PCOS science objectives. Members of the PCOS community can provide this input directly through the PCOS website or work with the broader community through the PhysPAG. The PCOS Technology Management Board (TMB) prioritizes these needs by considering the science priorities established in the Decadal Survey and the current programmatic environment. The report captures the recommendations of the PCOS TMB and the rationale behind those recommendations.

The PCOS program will use this report to craft the Strategic Astrophysics Technology (SAT) call, communicate with other organizations about our technology development needs, and evaluate the proposals received. The report also serves as part of

Upcoming Events

September 7 - 10	High Energy Astrophysics Division (HEAD) Meeting Newport, RI http://www.confcon.com/head2011/
September 28	Swift Cycle 8 Phase I proposal submission deadline
October 7	XMM-Newton AO-11 proposal submission deadline http://xmm.esac.esa.int/external/xmm_science/AO11/index.shtml
October 25 - 26	Einstein Fellows Symposium Greenbelt, MD
November 3	2012 Einstein Fellowship proposal submission deadline http://cxc.harvard.edu/fellows/CfPfellow.2012.html
November 18	Nancy Grace Roman Technology Fellowship proposal deadline http://science.nasa.gov/researchers/sara/student-programs/nancy-grace-roman-technology-fellowships-astrophysics-early-career-researchers/
November 29 - December 1	"Near Field Cosmology as a Probe of Early Universe, Dark Matter and Gravity" - 2011 Joint Space-Science Institute Conference Annapolis, MD http://jsi.astro.umd.edu/news/110-jsi-workshop-2011.html
January 8, 2012	3rd Meeting of the PhysPAG Austin, TX http://pcos.gsfc.nasa.gov/physpag.php
January 8 - 12, 2012	American Astronomical Society Meeting Austin, TX http://aas.org/meetings/aas219

an ongoing discussion with our science community. Throughout the year, we welcome your feedback when we get something right and when we need a course correction.

Please visit the PCOS website (<http://pcos.gsfc.nasa.gov/>) to keep informed about the exciting news related to PCOS technology development, to access the PCOS Annual Technical Report, and to learn about upcoming opportunities to participate in creating the technology that will enable the future.

Visit our
Physics of the Cosmos
Web site at
<http://pcos.gsfc.nasa.gov/>