AMERICAN ASTRONOMICAL SOCIETY
HIGH ENERGY ASTROPHYSICS DIVISION

NEWSLETTER

November 2015

HEAD Division & Meeting News

Nick White (HEAD Chair)

My tenure as chair will come to an end at the HEAD business meeting at the Winter AAS meeting. It has been an exciting two years with solid progress. I want to thank the entire HEAD executive committee for their team approach over the past two years, it as been a pleasure working with such a committed group. A notable event was the HEAD special meeting on "High-Energy Space Missions in the 2020s" held in Chicago, IL. This meeting, held June 29-July 1, 2015, was driven by NASA announcing plans to fund mission concepts in preparation for the next Decadal Survey. This quick turn around meeting was a great example of how HEAD can advocate for its science. The schedule and many of the talks are now available at the meeting website https://aas.org/meetings/high_energy_decadal. In the Spring we will come together at the 15th HEAD meeting in Naples Florida from April 3-7, 2016. At this meeting HEAD will be awarding the first mid-career prize, which has I was very pleased to advocate for during my tenure. Please reserve those dates, we look forward to seeing you there! At the coming winter AAS in Kissimmee, Florida there are two timely HEAD-sponsored special sessions on "The Origin of the First Super Massive Black Holes" and "High Energy Astrophysical Neutrinos" (Tuesday morning and afternoon). Plus we will award the 2015 Rossi Prize to Prof. Fiona Harrison (Wednesday at 4.30pm). Please look out for and attend these sessions as well as the HEAD business meeting (Wednesday 6.30pm). We have much to look forward to over the coming year including the launch of Astro-H, NICER and LISA Pathfinder, and as well we hope the selection of a new mission to open the unexplored window of X-ray polarization. New discoveries are coming soon! It will be a pleasure to hand over the reins of the HEAD in January to the incoming Chair Prof Chris Reynolds!

News from the Secretary

Randall Smith (HEAD Secretary)

After four years as HEAD Secretary, I am moving on to a new position within the AAS as Vice-Chair of the Laboratory Astrophysics Division (I urge all to join!). It has been a busy time, including two regular HEAD meetings and one special meeting on high energy astrophysics in the 2020s, as well as many, many HEAD bulletins. It has also been a great opportunity to meet and work with people from all over astronomy and in other fields; my thanks to you all for making the job an enjoyable one. I have always felt that this job was primarily about communication, obviously with other astronomers but also with those who fund our work. To that end, I would like to highlight the Aesthetics & Astronomy project (http://astroart.cfa.harvard.edu), which studies how astronomical images and captions are recieved by the general public and tries to discover ways to improve interest and understanding. Please feel free to send other outreach projects to me for highlighting in a future HEAD Bulletin.

Composite image of Galactic Center, where Sgr A has been flaring far more often than usual – just after the passage of the G2 molecular cloud. [see Ponti et al. 2015, astro-ph:1507.02690]*

Contents

HEAD Division & Meeting News 1
News from the Secretary 1
HEAD in the News 2
XMM-Newton Mission News 2
Chandra X-ray Observatory Report 3
Fermi Gamma-Ray Space Telescope 4
Athena: Revealing the hot and energetic Universe 4
Swift Mission News 5
The gravitational wave spectrum 6
Progress Towards the Astro-H Mission 7
Spektrum Roentgen Gamma Update 8
Suzaku Status 8
INTEGRAL Mission News 9
Development of NICER 10
NuSTAR Mission News 11
Gamma-Ray Interest Group (GammaSIG) 12
X-ray Science Interest Group 12

HEAD in the News

Megan Watzke, HEAD Press Officer

Science from the range of HEAD missions and instruments is often of interest to the media and the public at large. From black holes to supernova remnants to fundamental questions in physics, the results generated by scientists using HEAD missions and telescopes often get the attention of those outside of the scientific community.

Scientists often ask questions about what makes a result newsworthy, and why some topics are publicized and others are not. Last April, Peter Edmonds, the Chandra Press Scientist, gave a talk to the CfA community called "Publicizing Astronomy: Motivation, Newsworthiness, and Practical Tips." It is available on YouTube and I highly recommend it as a valuable resource for all HEAD scientists: https://www.youtube.com/watch?v=LS9IytekvHU. Peter's talk may be of particular interest because we have both the January AAS and the HEAD AAS quickly approaching in April. If you think you may have an interesting result, please contact me (mwatzke@cfa.harvard.edu; 617-496-7998). It's never too early to begin discussions about possible publicity, bearing in mind that we almost always coordinate any public announcement of a result with a peer-reviewed accepted paper.

The following is a sample of recent press releases generated by HEAD missions:

- April 2, 2015, "Suzaku Studies Supernova 'Crime Scene,' Shows a Single White Dwarf to Blame" http://www.nasa.gov/content/goddard/suzaku-studies-supernova-crime-scene-shows-a-single-white-dwarf-to-blame
- April 29, 2015. "NASA's NuSTAR Captures Possible 'Screams' from Zombie Stars" https://www.nasa.gov/press-release/nasas-nustar-captures-possible-screams-from-zombie-stars
- April 30, 2015. "NASA's Chandra Suggests Black Holes Gorging at Excessive Rates" http://chandra.si.edu/press/15_releases/press_043015.html
- May 7, 2015, "Star Explosion is Lopsided, Finds NASA's NuSTAR" https://www.nasa.gov/jpl/star-explosion-is-lopsided-finds-nasas-nustar
- May 28, 2015, "NASA Telescopes Set Limits on Space-time Quantum 'Foam'" http://chandra.si.edu/press/15_releases/press_052815.html
- June 23, 2015, "NASA's Chandra Captures X-ray Echoes Pinpointing Distant Neutron Star" http://chandra.si.edu/press/15_releases/press_062315.html
- June 30, 2015, "NASA Missions Monitor a Waking Black Hole" http://www.nasa.gov/feature/goddard/nasa-missions-monitor-a-waking-black-hole
- July 6, 2015, "Astronomers Use Cosmic Gravity to Create a 'Black-Hole-Scope" http://sci.esa.int/integral/56128-astronomers-use-cosmic-gravity-to-create-a-black-hole-scope/
- July 9, 2015, "NASA's Swift Reveals a Black Hole's Bull's-eye", http://www.nasa.gov/feature/goddard/nasas-swift-reveals-a-black-hole-bulls-eye
- July 10, 2015, "NASA's Fermi Sees Record Flare from a Black Hole in a Distant Galaxy". http://www.nasa.gov/feature/goddard/nasas-fermi-sees-record-flare-from-a-black-hole-in-a-distant-galaxy
- July 22, 2015. "Pulsar Punches Hole in Stellar Disk" http://chandra.si.edu/press/15_releases/press_072215.html
- August 11, 2015, "Oxymoronic Black Hole Provides Clues to Growth" http://chandra.si.edu/press/15_releases/press_081115.html
- August 20, 2015, "The Tumultuous Heart of our Galaxy" http://sci.esa.int/xmm-newton/56371-the-tumultuous-heart-of-our-galaxy/
- September 23, 2015, "Milky Way's Black Hole Shows Signs of Increased Chatter" http://chandra.si.edu/press/15_releases/press_092315.html

XMM-Newton Mission News

Steve Snowden & Lynne Valencic (GSFC)

The 15th Call for Proposals for XMM-Newton closed October 9, 2015; successful submissions will be announced in late December. Any NASA GOF funding for successful AO-15 US PIs will be dependent on the results of the 2016 Senior Review. Eligible GOs, if any, will be notified after the release of the SR results, likely in late spring or early summer of 2016.

In June, the XMM-Newton Science Operations Centre (SOC) hosted a workshop on "The Extremes of Black Hole Accretion" in Madrid. The presentations are now available online at http://xmm.esac.esa.int/external/xmm_science/workshops/2015_science/. The next workshop will take place in May 2016 in Madrid. It will cover the topic "XMM-Newton: The Next Decade" and will focus on identifying a set of fundamental questions that must still be addressed by X-ray astrophysics, which will have the highest importance and impact on the astronomical community. More information can be found here: http://xmm.esac.esa.int/external/xmm_science/workshops/2016_science.

Now nearing 16 years in operation, XMM-Newton is still providing relevant and necessary data in astrophysical investigations that cover a broad range of topics. For instance, in the last year alone, data from XMM-Newton was used in conjunction with that from NuSTAR to examine the role of black hole feedback on the host galaxy: http://www.sciencemag.org/content/347/6224/860.full.pdf. It has also been combined with optical observations to investigate magnetic star-planet interactions with hot Jupiters: http://iopscience.iop.org/article/10.1088/2041-8205/811/1/L2/pdf. Finally, it has been used to examine interstellar dust grain size and porosity, and the relation between optical extinction and X-ray scattering optical depth in the ISM: http://iopscience.iop.org/article/10.1088/0004-637X/809/1/66/pdf

For more of the latest, exciting science being done with XMM-Newton, check out the GOF's bibliography page: https://heasarc.gsfc.nasa.gov/docs/xmm/xmmbib_author.html.

Chandra X-ray Observatory Report

Roger Brissenden (SAO) & Martin C. Weisskopf (MSFC)

Chandra has carried out more than 16 years of highly successful and productive science operations. The Chandra X-ray Observatory is unique in its capability for producing the sub-arcsecond X-ray images that are essential to accomplish the science goals of many key X-ray and multi-wavelength investigations in current astrophysical research. NASA has exercised the second of two contract options for the Chandra X-ray Center (CXC), to continue the Chandra mission through September 2019. The project is looking forward to many more years of scientific productivity.

It is with great sadness that we report the death of Dr. Stephen Murray, Principal Investigator of Chandra's High Resolution Camera (HRC). In a long and distinguished career, Dr. Murray contributed to four major high-energy missions, starting with Uhuru, which was launched in 1970. He built instruments for Einstein in the 1970s and ROSAT in the 1980s, and most recently built the HRC for Chandra. In addition to his work on instrumentation, Dr. Murray carried out a wide-ranging research program in astrophysics, and was Principal Investigator for NASA's Astrophysics Data System (ADS), which provides the scientific community with unfettered access to the published literature in astronomy and astrophysics.

Dr. Patrick Slane, leader of the CXC's science mission planning group, has been appointed to the additional role of CXC Assistant Director for Science. Dr. Ralph Kraft, a long-term member of the HRC Instrument Principal Investigator team, has been appointed as the HRC Principal Investigator.

The CXC constantly explores ways to streamline mission operations procedures to make them more efficient and robust, and to be able to adapt to potential future budget constraints. In response to a recommendation by NASA's 2014 Senior Review, the CXC invited a panel of highly experienced mission operations managers and aerospace engineers to review Chandra mission operations. The review took place in May 2015 at the CXC's Cambridge, Massachusetts, Operations Control Center. In its report the panel said:

> "... the Chandra Operations Team has done an excellent job in operating the spacecraft over the last 15 years, maximizing the science return while being excellent custodians of the spacecraft. They have been proactive in making substantial and beneficial modifications to operations during this time period, in order to adapt to hardware issue[s] on the vehicle and funding constraints from NASA."

The panel also noted the results of a detailed lifetime engineering study of the Chandra satellite carried out by the spacecraft prime contractor, Northrop Grumman, that found no show-stoppers to 10 more years of operation. As a result they made several recommendations "... based on the assumption that Chandra will continue to operate for 10+ more years, potentially until 2028, resulting in a spacecraft lifetime of 25–30 years." CXC staff are working to follow up on the recommendations.

The Observatory continues to operate with only minor incremental changes in performance, due primarily to the gradual accumulation of molecular contamination on the UV filter that protects the ACIS detector, and to slow degradation of the spacecraft's thermal insulation. Condensation on the filter reduces the detection of low-energy x-rays by ACIS (but not by the HRC), while the decline in insulation effectiveness requires extra effort in scheduling observations and the use of special strategies to ensure continued safe operation in the evolving thermal environment. Operations staff developed and uploaded several modifications to the spacecraft's flight software to increase operational flexibility. These modifications include an improvement to the thruster system used to unload excess angular momentum that provides additional options when selecting thrusters, and a new diagnostic capability to record spacecraft engineering data at a rapid cadence. The Chandra Project Science group at NASA, together with the CXC, is revisiting the possibility of baking out the ACIS filters to remove condensed contamination that has reduced the instrument's low-energy sensitivity. The teams are working to fully understand the consequences of a bakeout and to define any ground-based experiments that would inform a decision. Science data processing, archiving, and distribution proceed smoothly, with average time from observation to data delivery to observers remaining at about a day.

Chandra's overall observing efficiency has been high over the past few years because gradual changes in Chandra's orbit reduced the non-observing time spent in Earth's radiation belts. However, the efficiency, which averaged 72% over the past six months, is beginning to decline toward mission-average levels (~68%) as the orbit continues to evolve.

In December 2014 the CXC issued a call for proposals for Cycle 17 observations, with a deadline for proposals in March 2015. Scientists worldwide submitted 578 proposals (including archive and theory research), requesting 4.8 times the observing time available. The Peer Review, held in June 2015, approved 175 proposals for a total of 18.8 Msec.

The CXC conducted a workshop on The Universe in High-Resolution X-ray Spectra, in Cambridge in August 2015. More information is available at http://cxc.harvard.edu/cdo/hrxs2015/.

The Chandra Press Office has been active in issuing image releases, science press releases and other communications of Chandra research results. A complete listing is available at http://chandra.harvard.edu/press. Information about the Chandra Observatory and the Chandra X-ray Center can be found at http://cxc.harvard.edu/.

Fermi Gamma-Ray Space Telescope

Julie McEnery, Chris Shrader, Dave Thompson, Liz Hays (GSFC) & Lynn Cominsky (Sonoma State)

The Fermi Gamma-ray Space Telescope continues to operate nominally. The Large Area Telescope Pass 8 data, which provide substantial improvements on the entire database back to the beginning of the mission, are available for use, including updated software and documentation, through the Fermi Science Support Center, http://fermi.gsfc.nasa.gov/ssc/

Observers who are undertaking multiwavelength observations that would benefit from Fermi simultaneous coverage are reminded to tell the Fermi Project about plans, using the Web form at http://fermi.gsfc.nasa.gov/ssc/observations/multi/reporting/, so that Fermi will avoid any interruptions to observing during such campaigns.

The Sixth International Fermi Symposium will be held in Arlington, Virginia, just outside Washington, D.C., from November 9-13, 2015. See http://fermi.gsfc.nasa.gov/science/mtgs/symposia/2015/. There will be a short multiwavelength workshop after the symposium. Anyone interested in multiwavelength observations that might involve Fermi (whether or not you are attending the meeting) is encouraged to provide comments on a short questionnaire at https://goo.gl/EEcJd2.

Recent Fermi Highlights

In June, blazar 3C279 produced the brightest gamma-ray flare ever seen from this source. The rapid rise enabled alerts to be sent to multiwavelength observers while the flare was still bright. See http://www.nasa.gov/feature/goddard/nasas-fermi-sees-record-flare-from-a-black-hole-in-a-distant-galaxy

In cooperation with radio astronomers at Jodrell Bank, Fermi scientists discovered that one of the pulsars discovered by Fermi is in a 25-year orbit about a Be star, with periastron expected in 2018. See http://www.nasa.gov/feature/goddard/astronomers-predict-fireworks-from-rare-stellar-encounter-in-2018

A catalog of sources seen at energies above 50 GeV has been released by the Fermi LAT team. See http://arxiv.org/abs/1508.04449.

Fermi Guest Investigator Program

A total of 36 new guest investigations were selected for the Cycle-8 program which is currently ongoing and continuing through August 2016. In addition there are 12 active previously selected multi-year programs that have been approved for continuation during cycle 8, thus a total of 48 active guest investigations. The call for Cycle-9 GI proposals was issued as part of the ROSES 2015 NRA and copies are available from the FSSC website or from NSPIRES. Cycle-9 proposals are due on January 22, 2016. Interested HEAD members should also be cognizant of the various joint guest observation opportunities available through the Fermi GI program through which significant observing-time allotments are available on various facilities of NRAO and NOAO as well as on INTEGRAL, VERITAS and Arecibo.

Continued at right

Athena:
Revealing the hot and energetic Universe

Kirpal Nandra (MPE), Xavier Barcons (CSIC-UC), Didier Barret (IRAP), and Randall Smith (CfA)

The Athena study phase is well underway, with two independent European industrial consortia performing Phase A studies. The instrument AO is expected in mid-2016, on the path towards completing the mission definition (Phases A & B1) and then official mission adoption, targeted for early 2020. More information about the Athena mission and timeline is available at http://sci.esa.int/cosmic-vision/54517-athena/.

The first scientific conference dedicated to the Athena X-ray Observatory was held September 8-10, 2015 at ESAC near Madrid, Spain, including a large number of US astronomers. The agenda and copies of most of the presentations and posters are available at http://www.sciops.esa.int/index.php?project=CONF2015&page=ATHENA2015.

Organization of Scientific Input to Athena

ESA directs Athena mission development, and has appointed a 10 member Athena Science Study Team (ASST) who advise ESA on all scientific aspects of the mission. The ASST in turn has created three Science Working Groups, focusing on the Hot Universe (SWG1), The Energetic Universe (SWG2), and Observatory Science (SWG3). Each WG contains a number of Topical Panels (TPs) that address different scientific areas of interest; see http://www.cosmos.esa.int/web/athena/community-wg for details. The ASST also created a Telescope Working Group (TWG) and a Mission Performance Working Groups (MWG). The latter has topical panels addressing issues such as end-to-end simulations, and inter-calibration.

The ASST designed this distributed system to enable fast responses to complex questions. This was put to the test

Continued on Page 5

Attendees at the first Athena Science Meeting held at ESAC

Fermi Education/Public Outreach

The Fermi team developed a new all-sky map summarizing Fermi discoveries to date. It will be distributed at the Sixth International Fermi Symposium during November 9-13, 2015. Anyone who is interested in receiving a copy should contact Lynn Cominsky (lynnc@universe.sonoma.edu).

Swift Mission News

Eleonora Troja (UMCP/GSFC),
Lynn Cominsky (Sonoma State), & Neil Gehrels (GSFC)

The Swift mission continues to operate flawlessly. The mission was ranked number one in the 2014 Senior Review of NASA operating astrophysics missions (excluding Chandra and HST). The mission continues to support more than 3 Target of Opportunity requests per day in addition to observing gamma-ray bursts (GRBs) and Guest Investigator targets. Below is an update on recent science findings, GI program and news from the EPO program.

Swift reveals a black hole's bull eye

Swift detected a rising tide of high-energy X-rays from the constellation Cygnus on June 15, just before 2:32 p.m. EDT. The outburst came from V404 Cygni, a binary system that contains a black hole. Every couple of decades the black hole fires up in an outburst of high-energy light, becoming an X-ray nova. Until the Swift detection, it had been dormant since 1989. The Swift XRT revealed a stunning "dust echo", a series concentric rings extending about one-third the apparent size of a full moon. Swift observations will allow astronomers to make a detailed study of the normally invisible interstellar dust in the direction of this black hole.

Swift Discovers a Strong Ultraviolet Pulse from a Newborn Type Ia Supernova

New observations made by the Swift satellite provided an unprecedented clue to the origin of Type Ia supernova explosions. The UVOT telescope aboard Swift started observing the Type Ia supernova iPTF14atg only four days after the explosion, and unveiled a bright pulse of ultraviolet emission. This is consistent with theoretical expectations of collision between material being ejected from a supernova explosion and the companion star from which it has been accreting matter. Alternative models, involving the merger of two white dwarfs, are instead disfavored by the Swift data. These results show that early time ultraviolet observations of young supernovae could hold the key to fully understanding the pre-explosion interaction between a supernova's white dwarf progenitor and its companion.

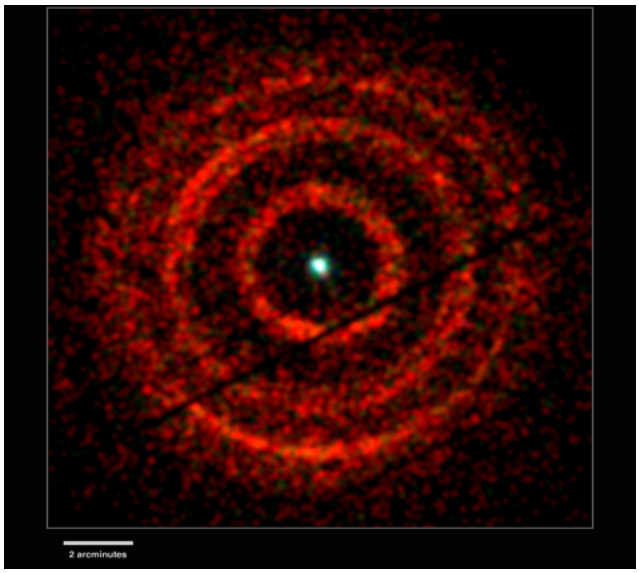
Swift Guest Investigator Program

The deadline for submitting scientific/technical proposals for the Swift Cycle 12 GI program was September 25. NASA received 185 proposals for Swift Cycle 12, requesting a total observing time of 15.8 Ms and $6.0M in funds for 1,555 targets. Additional 34 proposals were received through the Swift GI joint programs.

The Swift Cycle 12 Peer Review will be held in December to evaluate the merits of submitted proposals and choose those that are recommended for funding and observing time. The accepted targets will shape the science program for Swift's next year. Cycle 12 observations will commence on or around April 1, 2016, and will last 12 months.

Swift E/PO News

Swift participated to the Explore@NASAGoddard event held at the Goddard Space Flight Center on September 26, 2015. The open house attracted a record crowd of over 20,000 visitors. More than 300 families played in the Swift's "Gamma-Ray Burst Lottery" activity and learned about GRBs.



Rings of X-ray light centered on a binary system containing an erupting black hole (dot at center) were imaged by the X-ray Telescope aboard NASA's Swift satellite on June 30.

The Swift team also developed an "infographic" summarizing Swift "by the numbers" that was distributed to attendees at the IAU General Assembly meeting in Hawaii. Anyone who is interested in receiving a copy should contact Lynn Cominsky (lynnc@universe.sonoma.edu).

Athena (cont'd)

for the first time after ESA's initial design and cost effort for Athena indicated that a reduction in the mirror size from the as-proposed mission might be needed to achieve the €1B ESA cost cap. The potential impact affects the many Athena science goals differently, requiring new simulations and analyses to understand. The ASST passed this question to the SWGs and TPs, requesting a fast turnaround. Within two months, the Athena Science Impact Exercise was complete, showing which science was unaffected, which would require longer observing times, and a small segment that was unrecoverable. This was presented both to ESA and its advisory boards, and as a result ESA's ITT requested evaluation of both the mission as proposed and the reduced mirror version, so that they could be compared at a Mission Consolidation Review mid-way through Phase A..

Topical Panel Applications Re-Opened

To ensure that all interested scientists have an opportunity to participate in Athena, the ASST has recently reopened the application process to join a TP at the following web site: http://fs6.formsite.com/ATHENA2028/form4/index.html. The deadline for applications is 31 December 2015. Applications will be assessed soon after this with the aim to appoint new members in February 2016.

The gravitational wave spectrum

Gabriela Gonzalez, James Ira Thorpe (NASA/GSFC), John Conklin (U-Florida), Guido Mueller (U-Florida)

The gravitational wave community highlights two major developments: Advanced LIGO started its first science run (O1) at the best sensitivity ever while the LISA Pathfinder arrived at the launch site in Kourou, French Guiana, waiting for its launch later this year. Furthermore, the PhysPAG released its recommendation on NASA's preparation for the next decadal survey, the GOAT released its intermediate report, and ESA initiated discussions with the European member states and NASA how to proceed with the technology development for L3.

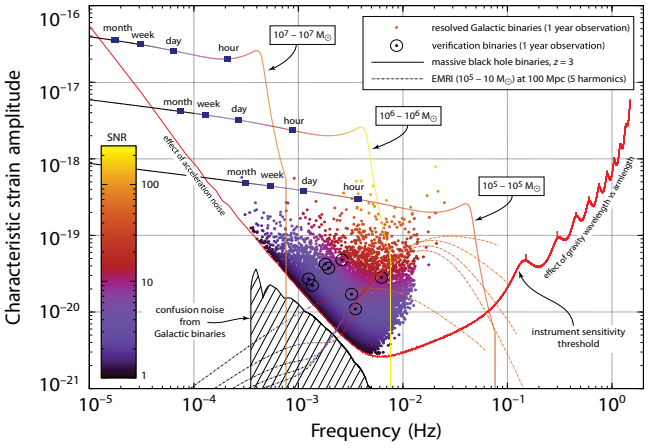
Following the construction, installation and commissioning phase, Advanced LIGO started taking data in September, with an observing run planned to last approximately three months. The observatories in Hanford, WA, and Livingston, LA, are now routinely operating with a range of around 70 Mpc (compared to 20 Mpc in initial LIGO) for 1.4 solar mass neutron star binary mergers. This range is averaged over all sky positions and orientations and is about a factor of two larger for optimally aligned neutron star binary systems. The improved low frequency response also increases the range for mergers between black holes in the 10 to 100 solar mass range to many hundred Mpc.

Uncertainties in the merger rates of all these objects lead to fairly unreliable predictions of potential detection rates; we could be positively surprised by an early detection or might have to wait for another factor three improvements in sensitivity which we expect for a year long O3 science run in 2017/18. Note that the LIGO Science Collaboration will continue to send out alerts to astronomers for potential signals in their data stream. These near-real time alerts of mostly unvetted signals increase the chances of coincidence detection which would also increase the confidence in the GW-signal itself. However, the LSC hopes that these alerts will not lead to unsubstantiated rumors about potential detections. Each promising signal will undergo a substantial and time consuming vetting process after the alerts go out.

The gravitational wave science community is also eagerly anticipating the launch of its first space mission. The LISA Pathfinder (LPF) is currently scheduled for launch on December 2nd, 2015 aboard a VEGA rocket. Led by the European Space Agency, with contributions from European industrial partners, universities, and NASA, LPF will validate several key technologies for a future space-based gravitational wave observatory. The primary objective is to demonstrate the technique of drag-free control as a way of placing an object in a pure free-fall state. The deviations in acceleration from an ideal freely-falling test particle for the LPF test masses are expected to be at a level of a few femto-g /Hz$^{1/2}$, more than a thousand times smaller than for test masses used for satellite geodesy missions.

NASA's Physics of the Cosmos Program Analysis Group (PhysPAG) recently released its report on candidate large space missions that should be considered by the 2020 astrophysics decadal survey (see: http://pcos.gsfc.nasa.gov/docs/PCOS_facility_missions_report_final.pdf). This report is in response to the charge given to all three PAG Executive Committees by the Astrophysics Division Director, Paul Hertz, issued January 4, 2015 (see: http://science.nasa.gov/media/medialibrary/2015/01/02/White_Paper_-_Planning_for_the_2020_Decadal_Survey.pdf). The PhysPAG report begins with an executive summary that represents the consensus that was reached by all three PAGs, representing the broad astrophysics community. The PAGs concur that all four large mission concepts identified in the charge are good candidates for mission concept maturation prior to the 2020 decadal survey. These include the Far–IR Surveyor, the Habitable–Exoplanet Imaging Mission, the UV/Optical/IR Surveyor, and the X–ray Surveyor. One important assumption related to this consensus is that NASA will partner with the European Space Agency on its L3 Gravitational Wave Surveyor, and conduct the necessary studies, technology development, and preparatory work for the 2020 decadal review that are needed for a viable L3 collaboration. The report states that if this assumption were to change, the conclusions of the report would need to be re-evaluated. This represents an important show of support from the astrophysics community for NASA's plan to actively participate in the L3 gravitational wave mission.

ESA's Gravitational Observatory Advisory Team (GOAT) released an intermediate report (available at http://www.cosmos.esa.int/web/goat). The team concluded that, contingent on the success of LISA Pathfinder, laser interferometry is the only technology which is mature enough to be developed following the L3 launch schedule. The team also reviewed the science capabilities of a LISA-like mission for various mission design parameters (arm length, number of arms, mission duration, …). Recommendations for an immediate start to develop several key technologies have been made and are expected to lead to early investments in LISA technology at ESA and NASA. The focus of the GOAT is shifting towards ESAs development plan and the expected early payload engineering model.



Gravitational wave sources detectable with a space-based laser interferometry mission (armlength 10^6 km, 1-year observations)

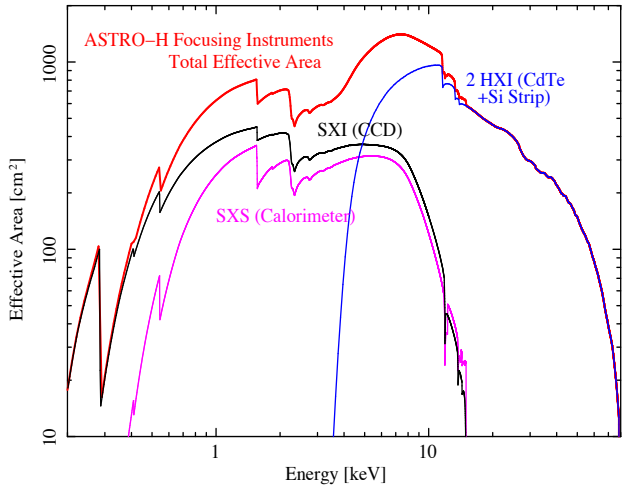
Progress Towards the Astro-H Mission

Richard Kelley, Takashi Okajima,
Lorella Angelini, Rob Petre (NASA/GSFC)

The JAXA Astro-H project continues to make steady progress toward launch in early 2016. The spacecraft has recently completed system-level thermal-vacuum and vibration tests, and passed subsequent performance tests. Figure 1 shows the fully assembled spacecraft. The project is now proceeding with final preparations of the spacecraft and readiness reviews in advance of shipping the spacecraft to JAXA's Tanegashima Space Center by early December.

As part of the performance testing, the NASA/GSFC team worked with JAXA on further cryogen-free mode tests, which were very successful. It was demonstrated that the Soft X-Ray Spectrometer (SXS) instrument achieves ~ 5 eV energy resolution across the 36-pixel array in this mode, essentially the same as in cryogen mode, and can maintain the 50 mK operational temperature for about 85% of the time, with 15% going for recycling 2 of the 3 refrigerator stages. The nominal operation will be with liquid He for the first 3.5 years of the mission and then cryogen-free mode thereafter.

The X-ray mirror systems have been attached to the spacecraft and aligned, and verified after spacecraft vibration. Figure 2 shows the overall effective area of the SXS in context with the other focusing instruments on Astro-H (JAXA's Soft X-ray Imager, SXI, and Hard X-Ray Imager, HXI). The combined effective area peaks at approximately 1300 cm^2. The Astro-H Soft Gamma Detector (SGD), also developed by JAXA, is a non-focusing instrument designed to cover the energy range 40-600 keV.



The projected effective area for the focusing x-ray instruments on Astro-H (SXS, SXI, and the two HXI modules). The combined effective area peaks at about 1300 cm^2.

The Astro-H Science Data center continues pre-launch activities on pipeline data processing, instrument software, collection of calibration information and preparing the necessary documentation and simulation software to support the GO program for all four Astro-H instruments. A milestone was achieved with the completion of the software Build 7 to include all the tasks necessary to calibrate the instruments. This was exercised with the telemetry data transformed into FITS obtained during the satellite integration and testing and thermal-vacuum test. The Astro-H Science Data Center is now preparing for an end-to-end test of the ground system scheduled for early December, where data will flow from Japan to the US for processing and archiving. It is anticipated that the NASA AO-1 for guest investigations will be released approximately 3 months after launch.

For further information and news as the mission progresses, please see http://astro-h.isas.jaxa.jp/en/.

The fully assembled Astro-H spacecraft at JAXA's Tsukuba Space Center being prepared for acoustic vibration tests.

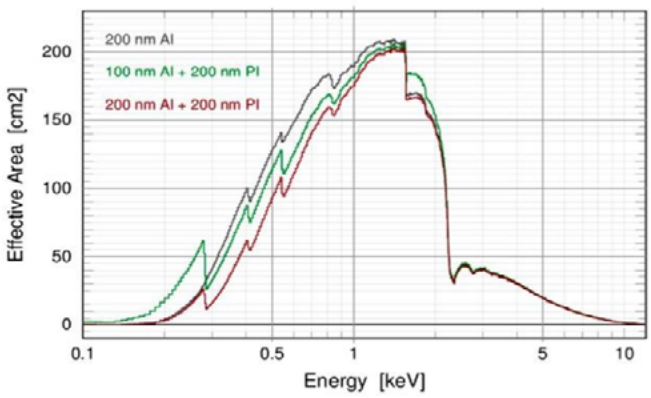
Spektrum Roentgen Gamma Update

A. Merloni, M. Pavlinski, P. Predehl, S. Sazonov
for the SRG, eROSITA, and ART-XC teams

The SRG launch from Baikonour is now scheduled for February 2017. An agreement reached between the Ukrainian Security Minister and Roscosmos ensures that Zenit launchers can be used in Baykonour. The next one will bring into orbit the meterorolgical satellite Elektro L2, later in December 2015.

eROSITA

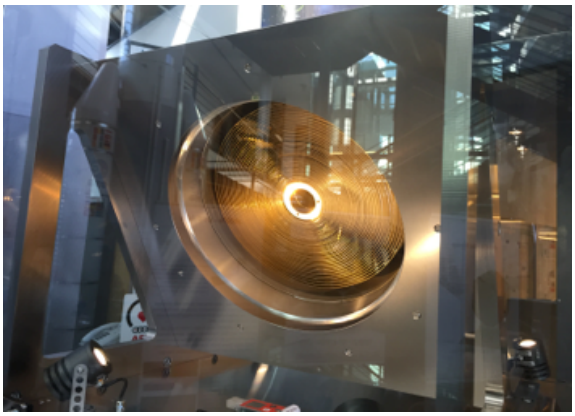
The final calibration of the eight mirror assemblies (integrated mirror and baffles) is ongoing at the PANTER facility in Munich, using the eROSITA QM Camera. In parallel, 7 out of 9 Flight CCD Modules (including spares) have been tested in X-rays. 5 of them have on-chip aluminum filters, two of them are without; their filter wheels will be equipped with separate polyimide+aluminum filters. The transmission of these filters have been calibrated last months at the synchrotron facility BESSY from optical to X-ray wavelengths. In the figure at top right we show the derived effective area for one camera, for the three filters combinations.

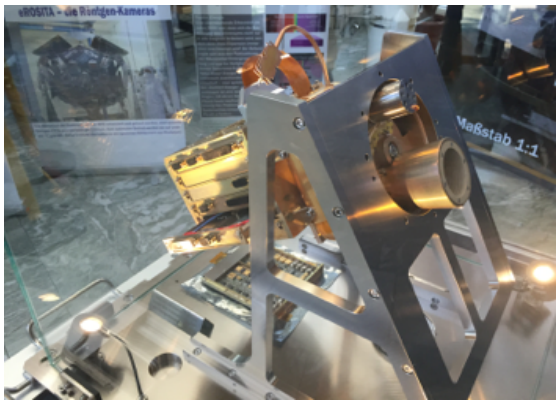


Effective area for the three filters combinations for one eROSITA camera, composed of the expected effective area of one mirror assembly (averaged over the field of view), the filters transmission and the CCD quantum efficiency. All values are preliminary.

The assembling of the FM cameras has already started; the first is under test and calibration with its flight electronics.

There are still remaining issues with the interface between the instruments and the SRG spacecraft, which led to a further delay of the completion of the ITC electronics ("Interface and Thermal Controller"). All other telescope components have been ready for integration already at the time of the last report (May 2015).





One eROSITA mirror module (flight spare, left) and QM camera assembly (camera+electronics+filterwheel, right) arranged for an open house exhibition at MPE in June 2015.

Suzaku Status

Koji Mukai (GSFC / CRESST)

The Suzaku satellite was found to be in an anomalous state on June 1, 2015. For almost 2 months since then, the operations team made a valiant effort to diagnose the problem and to recover normal operation. Unfortunately, given the damaged status of the battery and the attitude control system, JAXA was forced to abandon this heroic effort, and declared the mission complete on August 26.

By the end of April, a large majority (but not all) of priority A and B AO-9 observations had been completed. Observations of AO-10 targets started in May, but of course only a small fraction of the observations intended to fill 6 months of Suzaku time could be performed. Data from all successfully performed observations have been processed and distributed by now. The instrument teams continue to work on the production of HXD background files and the continued refinement of calibration. We plan to reprocess the entire set of Suzaku data with the final calibration, resources permitting.

Papers based on Suzaku data continue to appear in journals at a healthy rate, on subjects ranging from clusters of galaxies, normal and active galaxies, X-ray binaries and cataclysmic variables, supernova remnants and Galactic diffuse emission. In particular, a recent paper based on the Virgo Cluster key project (Simionescu et al. 2015, ApJ, 811, L25) found that the chemical composition of the intracluster medium was approximately constant over large scales, suggestive of an early phase of enrichment and mixing to which both core collapse and thermonuclear supernovae contributed. This result is featured in a NASA news release (http://www.nasa.gov/feature/goddard/suzaku-finds-common-chemical-makeup-at-largest-cosmic-scales).

With nearly 10 years of operations (compared with a nominal 2-year lifetime), Suzaku was the longest-lived Japanese X-ray observatory, and leaves a rich archive of data that can be explored for many more years to come. We thank the community for their support during the active phase of the Suzaku mission, and hope to see continued interest in the Suzaku archive.

INTEGRAL Mission News

Erik Kuulkers (ESA) & Steven Sturner (UMBC/GSFC)

The spacecraft, payload and ground segment are performing nominally. The MOC performed a study to reduce fuel usage by modifying the angular momentum control strategy. During engineering windows planned in June, the reaction wheel behaviour at very low speeds, at or close to zero speed, and zero speed crossing conditions were investigated. SPI annealing #25 was performed from September 7–23, with a subsequent cooling phase on September 24–26. Observations that did not rely on SPI were executed during this period. Preliminary results show a good degradation recovery for the SPI detectors. Work at the MOC and ISOC has begun to plan for another Earth/CXB observation in November. These observations are special operations which require significant preparation. As part of this preparation, the evolution of the radiation belt environment for INTEGRAL, due to the changing orbit, has been assessed in greater detail than before.

The INTEGRAL TAC met on May 26-28, 2015, to review proposals in response to the AO-13 call for proposals. It recommended an observing programme with targets visibilities covering the entire year. Out of the 62 proposals submitted, the TAC selected 44 proposals, including 19 Target-of-Opportunity (ToO) follow-up observations, and 6 GRB observations which do not request additional dedicated observing time. The TAC also granted 153 ks of Swift observing time to a total of 5 INTEGRAL proposals. In this round no XMM-Newton observing time was granted. The programme was approved by ESA's D/SRE on June 5. A rough preliminary schedule for AO-14 has been set up, with the call opening from probably February 29 to April 8, 2016, with a possible TAC meeting again in May.

Scientific observations prior to June 17 and after July 13 were performed as per the AO-12 long-term plan. Due to the source V404 Cyg (GS 2023+338) becoming active (see below), the GO program was disrupted beginning June 17 to enable a series of public (to maximise the scientific return) observations. A pre-approved AO-12 ToO program (PI: Rodriguez) was performed on June 20-25. The PI kindly agreed to make the consolidated data publicly available. As a further service to the community, ready-to-use scientific data products (light curves and spectra) of all publicly available observations of the source were made available through the ISDC Data Centre for Astrophysics in Switzerland. Further out-of-TAC, public ToO observations were performed on another black-hole X-ray transient, GS 1354-645 (July 5 and August 6), and the transient X-ray binary pulsar V0332+53 (July 30 – August 1, September 11 and October 7-9). A pre-approved ToO observation was performed on the transient millisecond X-ray pulsar IGR J00291+5934 (July 27–29; PI: Falanga). During this reporting period, GRBs occurred in the FoV of the gamma-ray instruments on August 31 (GRB 150831A) and again on September 12 (GRB 150912A).

As of October 20, the total number of INTEGRAL refereed publications since launch is 880 with a total of 45 refereed papers thus far in 2015. Some recent INTEGRAL-related scientific highlights include:

- The ephemeris, orbital decay, and masses of 10 eclipsing HMXBs (M. Falanga, et al. 2015, A&A 577, A130);
- 3 publications on NGC 5548:
  - A fast and long-lived outflow from the supermassive black hole in NGC 5548 (J.S. Kaastra, et al. 2014, Science 345, 64);
  - Anatomy of the AGN in NGC 5548. I. A global model for the broadband spectral energy distribution (M. Mehdipour, et al. 2015, A&A, 575, A22);
  - Anatomy of the AGN in NGC 5548. III. The high-energy view with NuSTAR and INTEGRAL (F. Ursini, et al. 2015, A&A, 577, A38);
- Correlated optical, X-ray, and γ-ray flaring activity seen with INTEGRAL during the 2015 outburst of V404 Cygni (J. Rodriguez, et al. 2015, A&A 581, L9);
- Central engine of a gamma-ray blazar resolved through the magnifying glass of gravitational microlensing (A. Neronov, et al. 2015, Nature Physics 11, No 8, 664); this paper served as the basis for an ESA PR release on July 6 ('Astronomers use cosmic gravity to create a 'black-hole-scope'') featuring INTEGRAL and Fermi;
- Source Identification in the IGR J17448-3232 Field: Discovery of the Scorpius Galaxy Cluster (N.M. Barrière, et al. 2015, ApJ 799, 24)
- IGR J17463-2854, a possible symbiotic binary system in the Galactic center region (.I. Karasev, et al. 2015, Astronomy Letters 41, 394).

The black-hole binary X-ray transient V404 Cygni (GS 2023+338) made its comeback after 26 years of being quiet. It is one of the best-established accreting black-hole binary systems, with a black-hole mass of about 9.0 $M_{\odot}$. The distance to V404 Cygni is only 2.4 kpc, i.e., it is one of the closest of its kind. During its outbursts, the luminosity of the system increases by 6 orders of magnitude, reaching the Eddington limit. First signs of renewed X/gamma-activity in V404 Cygni were spotted by NASA's Swift/BAT on June 15, it detecting a sudden burst of gamma-rays. Soon after, MAXI onboard the ISS, observed an X-ray flare from the same patch of the sky. These first detections triggered a massive campaign of observations from ground-based telescopes and from space-based observatories, to monitor V404 Cygni at many different wavelengths. As part of this worldwide effort, INTEGRAL started monitoring V404 Cygni already on June 17. The behaviour of this source was extraordinary, with repeated bright flashes of X-rays on time scales shorter than an hour, something rarely seen in other black-hole systems. In these moments, it became the brightest object in the X-ray sky - up to 50 times brighter than the Crab Nebula (see the INTEGRAL IBIS/ISGRI observations shown in

Continued on Page 10

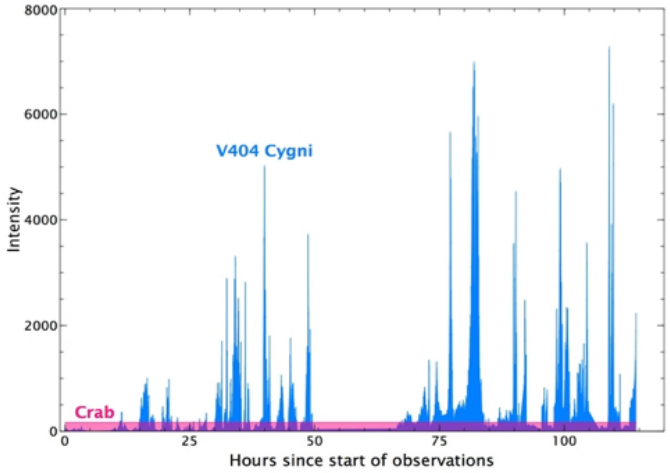
INTEGRAL Mission News (con't)

Erik Kuulkers (ESA) & Steven Sturner (UMBC/GSFC)

the Figure)! INTEGRAL observed the source almost continuously during the outburst, in the hope to detect 511 keV emission as well as polarization. It spent a total of 1.45 Msec (about 17 elapsed days) on the source from June 17 to July 13. Although for INTEGRAL the activity ceased by the end of June (unlike the outburst observed in 1989 where activity lasted for a couple of weeks more), "officially" the source went into quiescence again around early August, where it keeps radiating at an X-ray luminosity of about 1034 erg/s. The extreme brightness of the source and the excitement of the astronomical community, was the basis of an ESA PR release on June 25 ('Monster black hole wakes up after 26 years') and a NASA PR release on June 30 ('NASA missions monitor a waking black hole'), both featuring INTEGRAL.

The usual "off-year" INTEGRAL Workshop was organized by INAF, Rome, Italy, and held from October 5–9, 2015 in Rome. It had the theme "The New High Energy Sky after a Decade of Discoveries". The central focus of this Workshop was to provide an up-to-date view of the high-energy sky. The goal was to present and discuss, via invited and contributed talks (and posters), the main results obtained during the last decade in the field of high-energy astrophysics using INTEGRAL, and place these results in the context of other observatory-like space-based missions, as well as ground-based observatories. A special session (the whole day of October 6) was devoted to the multi-wavelength results on V404 Cygni. One participant showed the amazing fact that this source was observed by many observatories in space and on the ground, at wavelengths spanning ~19 orders of magnitude from 150 Mhz to 10 TeV.

The next bi-yearly, 11th, INTEGRAL Conference will be held on October 10–14, 2016, in Amsterdam, The Netherlands.



INTEGRAL IBIS/ISGRI lightcurve of V404 Cygni, showing flares orders of magnitude brighter than the Crab Nebula.

Development of the Neutron Star Interior Composition Explorer (NICER)

Keith Gendreau (NASA/GSFC), Zaven Arzoumanian (GSFC/CRESST/USRA)

Integration and testing of flight hardware for NICER, an X-ray astrophysics payload to be launched to the International Space Station (ISS) in late 2016, continues at NASA Goddard Space Flight Center. Offering a novel combination of time resolution, energy resolution, and sensitivity, NICER will probe the structure, dynamics, and energetics of neutron stars in all of their manifestations. It will also be accessible to the community through prompt data releases and a Guest Observer opportunity beginning in 2018; NICER will then participate in the anticipated 2018 Senior Review of active missions for possible further continuation.

As of this writing, NICER's flight optics (56 single-grazing-reflection "concentrators" developed at GSFC) and associated commercial (Amptek, Inc.) silicon drift detectors have been calibrated, integrated, and co-aligned into the flight optical bench. Together with the detector readout electronics developed at MIT and a μASC star tracker camera from the Technical University of Denmark, this assembly – the X-ray

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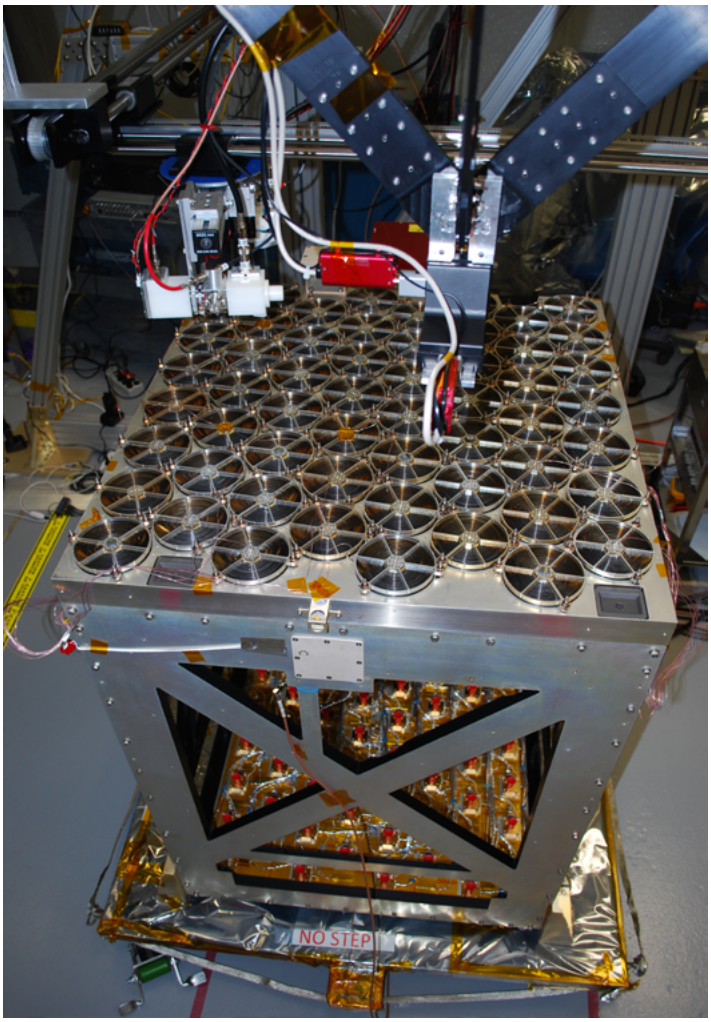


NICER's fully integrated X-ray Timing Instrument undergoing testing of its photon time-stamping capability.

NuSTAR Mission News

Daniel Stern (JPL), Fiona Harrison (Caltech), and Lynn Cominsky (Sonoma State)

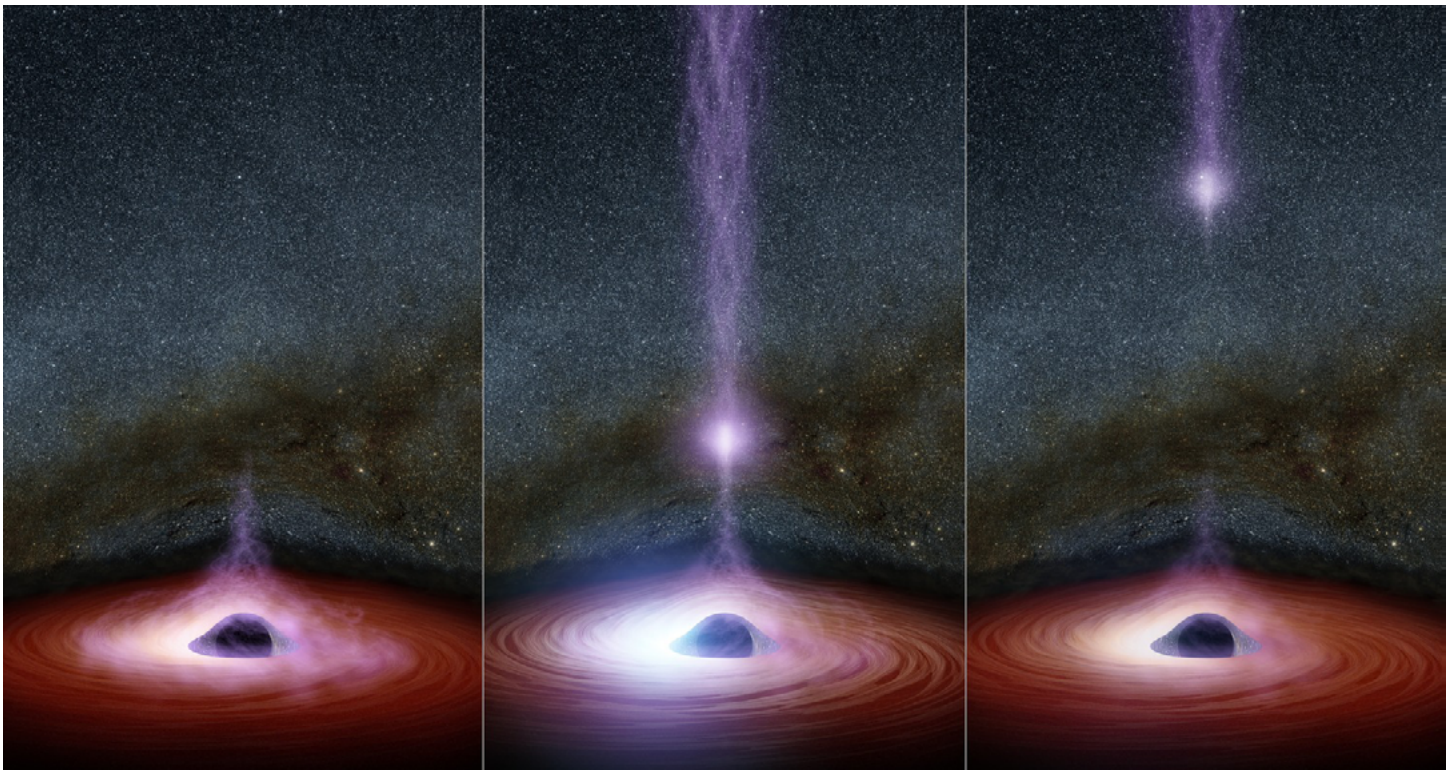
The 2nd Announcement of Opportunity (AO) for NuSTAR observations is released, with proposals due on December 11th. There are several changes from the Cycle 1 AO: (1) a total of 1.5 Ms of XMM-Newton observing time is available through the Cycle 2 AO for NuSTAR/XMM-Newton joint programs; (2) Target of Opportunity (TOO) observations are now solicited, with up to 500 ks of time available for such observations; (3) more time is now available for bright source observations (1 Ms, compared to 300 ks in AO1). See the Cycle 2 AO for more details on this and other aspects of the AO. In particular, the availability of XMM-Newton time through NuSTAR AO2 compliments the availability of NuSTAR time through recent and planned Chandra and XMM-Newton AOs.

The 7th release of NuSTAR baseline mission data occurred on September 17th, releasing 334 new NuSTAR data sets, totaling ~10 Ms of observing time. The data are available through HEASARC and cover the entire baseline mission, from the start of science operations in August 2012 through the end of the extended baseline mission in April 2015. From this point forward, NuSTAR data will be released on an algorithmic basis depending on when a data set was released to the principal investigator: normal guest observer observations will go public after one year, TOO observations will go public after 6 months, and Legacy science programs will go public immediately. [Observations coordinated with another space observatory, such as Chandra or XMM-Newton, will go public with the coordinated data if that date post-dates the standard NuSTAR release date.]

Scientifically, NuSTAR continues to provide a broad set of observations, ranging from solar observations to studies of distant actively accreting black holes. One recent highlight was a paper by Dan Wilkins and collaborators reporting on flares observed in Mrk 335. An artist's concept is included here. Briefly, the time-variable X-ray spectrum supports a "lamppost" model of the corona, with the observed high-energy flaring of this source attributed to relativistic Doppler boosting of the coronal emission as it accelerated along our line of sight.

NuSTAR E/PO

The NuSTAR E/PO team at Sonoma State University has released a NASA approved Educator's Guide entitled "X-rays on Earth and From Space." It can be downloaded from http://www.nustar.caltech.edu/page/teachers



In 2014, NASA's NuSTAR and Swift space telescopes witnessed an X-flare from the SMBH in Mrk 335. The observations allowed astronomers to link a shifting corona to an X-ray flare for the first time. This diagram shows how a shifting feature, called a corona, can create a flare of X-rays around a black hole. The corona (feature represented in purplish colors) gathers inward (left), becoming brighter, before shooting away from the black hole (middle and right). This artist's impression shows the effect of relativistic boosting enhancing the X-rays, as seen on the left side of the illustration where the disk's flux is brighter on approaching left side and fainter on the receding right. Additional relativistic boosting happens when the corona shoots away from the black hole, and later collapses. (Credit: NASA/JPL-Caltech/R. Hurt (IPAC), from http://www.nustar.caltech.edu/news/nustar151026)

Gamma-Ray Interest Group (GammaSIG)

Mark McConnell (University of New Hampshire),
Henric Krawczynski (Washington University of St. Louis)

The GammaSIG is currently working on the development of a gamma-ray astronomy roadmap that could be used as input to the next decadal survey. A number of science topical groups have been defined and each group has been asked to help put together the science requirements for their respective topics.

At the Fermi Workshop in November (Nov 9-13), there will be a GammaSIG splinter session that will host a series of talks from each of the topical groups. The GammaSIG evening session at the June HEAD meeting in Chicago was partially pre-empted by other events, so this will be an opportunity to continue that discussion. The goal of these talks will be to help define the science requirements for future missions. The GammaSIG session will be held on Friday afternoon, Nov 13. At the Jan AAS meeting (Jan 4-8 in Kissimmee, FL), there will also be a dedicated GammaSIG splinter session. At that time, we will pull together all of the science requirements and discuss guidelines for how best to formulate the mission concepts. At the April HEAD meeting (April 3-7 in Naples, FL) the focus will be on presentations of instrument concepts and how each would respond to the various science requirements. The SPIE Astronomical Telescopes and Instrumentation meeting in Edinburgh (June 26 - July 1) will off another opportunity to present instrument concepts in a venue that may also attract many of our European colleagues. At the present, there is no formal GammaSIG gathering planned for this meeting.

Based on this timeline, we will be on track to complete a roadmap sometime next summer. The roadmap will include the science case for each of the various topics and a description of the various mission concepts (including, ideally, sensitivity estimates and a ROM cost in each case).

Development of NICER (cont'd)

Timing Instrument (XTI) – has successfully passed thermal cycling tests to verify survival and performance at temperature extremes beyond those expected on orbit. Similarly, an engineering model of the optical bench, complete with spare optics and detector components, has undergone qualification vibration testing. NICER's Deploy and Pointing System, an elevation-over-azimuth gimbal configuration atop a deployable boom, has been delivered to GSFC from Moog, Inc., and is being prepared for environmental testing. Additional electrical, mechanical, thermal, and flight-software subsystem components have been integrated with the XTI or are in various stages of advanced testing. The entire payload remains on track for its manifested launch on the SpaceX-12 commercial ISS resupply mission.

Prospective NICER users are encouraged to visit the HEASARC WebPIMMS and WebSPEC sites to estimate soft (0.2-12 keV) X-ray countrates and simulate NICER spectra for their favorite targets.

X-ray Science Interest Group

Jay Bookbinder (CfA) & Mark Bautz (MIT)

The X-ray Science Interest Group (XRSIG) discussed responses to NASA Astrophysics Divison Director Paul Hertz's white paper "Planning for the 2020 Decadal Survey" (http://science.nasa.gov/media/medialibrary/2015/01/02/White_Paper_-_Planning_for_the_2020_Decadal_Survey.pdf) which requested community input, via NASA's Program Analysis Groups (PAGS), on concepts for large missions that NASA should study in preparation for the 2020 Decadal Survey. An important part of the XRSIG conversation on this subject occurred at our special HEAD meeting in Chicago last June. The final reports of the Physics of Cosmos (PCOS; http://pcos.gsfc.nasa.gov/docs/PCOS_facility_missions_report_final.pdf), Cosmic Origins (http://cor.gsfc.nasa.gov/docs/COPAG_Flagship_Response_final.pdf) and Exoplanet (https://exep.jpl.nasa.gov/files/exep/ExoPAG_Large_Missions.pdf) PAGs are now public. A joint executive summary by all three PAGS endorses all four large mission concepts nominated by Paul Hertz, including the X-ray Surveyor, for study by NASA and presentation to the Decadal Survey. The PCOS report also conveys our community's strong interest in future probe-class missions and urges that the Astrophysics Division take account of this interest as it prepares for the 2020 Decadal Survey.

The XRSIG also provided significant input to the PCOS programs effort to identify strategic technology development needs. The resulting priorities for PCOS technology development are summarized in the PCOS Annual Technology Report (http://pcos.gsfc.nasa.gov/docs/2015PCOSPATRRev1.pdf).

We plan face-to-face XRSIG meetings at the January AAS meeting in Kissimee, FL , on Monday, January 4, 2015, and during the next HEAD meeting, in Naples, FL, April 3–7. Please let us know if you have agenda suggestions. For more information about the XRSIG, please contact the chair Jay Bookbinder (jay.a.bookbinder@nasa.gov) and/or the co-chair Mark Bautz (mwb@space.mit.edu).