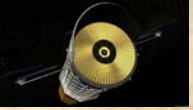


AXSIO in Light of ATHENA+
or
Implementing Decadal Priorities

Jay Bookbinder

Smithsonian Astrophysical Observatory

2013 Monterey HEAD Meeting

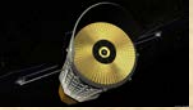
The Decadal View of IXO

What is Required?

- "Large-aperture, time-resolved, high-resolution X-ray spectroscopy is required for future progress on all of these fronts, and this is what IXO can deliver."

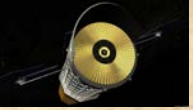
How will it be achieved?

- "The key component of the IXO focal plane is an X-ray microcalorimeter spectrometer—a 40 × 40 array of transition-edge sensors covering several arcminutes of sky that measure X-ray energy with an accuracy of roughly 1 part per 1,000 (depending on energy)."



What is ATHENA+?

- The European community's response to the call for L/L3 "themes"
- ATHENA+ is *very* different from the previous incarnation of ATHENA
- Strawman key stats:
  - Design: Single telescope, MIP, 2 instruments.
  - Effective area: 2m^2 at 1 keV; 0.25m^2 At 6 keV
  - Instrument Complement: calorimeter + WFI
  - Spatial Resolution: 5 arcsec (3 arcsec goal)
  - Field of View: 40 arcmin (WFI), 5x5arcmin (cal.)

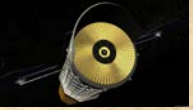


What is the L2/L3 process / timeline?

- Cost cap: €1B plus member state contributions
- White papers (~14p) on themes due: 2013/05/24
- Workshop 2013/09/02 (TBD)
- Selection of science themes 2013/11
- Mission Call 2014/02
- L2 Launch: 2028
- L3 launch: 2034
- Constraints:
  - Foreign participation limited to 20% (ie., ~200M). (ESA)
  - Europe must be able to provide all the critical tech
  - TRL 5 must be demonstrated by 2018.

How is the US supporting ATHENA?

- For the white paper, US scientists can interact freely.
- NASA has indicated it will support efforts towards ATHENA+ at the ~15% level (about $150M). ***Viewed by NASA as a strategic investment supporting NWNH objectives.***
- The ATHENA+ team has decided to push forward without formal US participation at this time.
- If selected (2016 timeframe?) will need to have formal agreements in place between NASA and ESA
- What can the US do in support of ATHENA?
  - calorimeter (entire instrument or front end)
  - grating spectrometer
  - mirror technology
  - mission operations

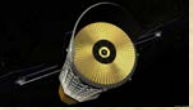


Looking forward

- **In this Decade:**
- WFIRST is FIRST
- AXSIO is considered by NASA to meet the goals of ASTRO2010.
- X-ray Probe/AXSIO SDTD to be formed in 2013
  - Develops mission case, oversee CATE process
  - Interim Report to NASA 2014/03 (PPBE16)
  - Final Report to NASA 2015/01 (PPBE17)
- Potential for a new start in 2017 timeframe

For the 2020 Decadal:

- Earliest possible launch late 2020s
- Will be heavily competed (Exoplanets, UV mission, possibly other X-ray missions)



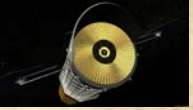
Current NASA Climate

- NASA is looking for cost effective ways to fulfill the recommendations of New Worlds, New Horizons (NWNH)
- One mission will be selected in 2015 for 2017 start. The mission selected depends on several factors, including:
  - The post-JWST NASA Astrophysics budget
  - The U.S. Government's receptiveness to starting a large astrophysics mission
  - WFIRST is the first choice ; but Explorers are alive and well.. NuSTAR/GEMS/Astro-H SXS; NICER
- As lower cost alternatives, NASA is studying a small number of "probe-class" missions
  - X-ray probe; Contributions to ESA L class; One of two Exoplanet probes under study; etc.

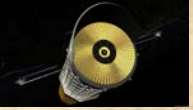
AXSIO Moving Forward

Two clear study paths for AXSIO

- Calorimeter only with “small” optic
  - Augment with larger optic OR
  - Augment with a grating system
- Calorimeter plus grating with “small” optic
  - Work to fit budget (ie., <<1.6B, close to $1B).
- Post selection, work with ESA & JAXA for contrib
  that would enable achieving both augmentations
- Community inputs welcome via X-ray SAG, SDTD
- Relevant Sessions:
  - 207 at 7:30 pm TONIGHT: the science of future X-ray missions
  - X-ray SAG meeting Friday



BACKUP



ATHENA Working Groups

- Cluster and group physics
- High redshift groups and clusters
- WHIM and missing baryons
- Cosmic feedback
- Obscured Accretion and galaxy evolution
- High redshift SMBH
- Strong Gravity
- Accretion Physics
- Diffuse galactic hot gas (SNRs, Starbursts)
- Neutron stars
- Stars, planets and Solar System

AXSIO

- Developed in direct response to NWNH recommendations
  - Calorimeter is prime instrument
  - Preserve grating spectrometer
  - Reduce angular resolution to 10 arcsec
  - Keep cost ≤$1B
- Top level capabilities
  - ≥ 9000 cm^2 at 1 keV; 2000 cm^2 at 6 keV
  - 5-10 arcsec angular resolution
  - 4-5 arcmin field of view
  - 2 eV resolution everywhere
  - $\lambda/\Delta\lambda \geq 3000$ in 0.3-1.0 keV band