PCOS XRSAG: Long term technology development plan

Paul Reid, Abe Falcone, Brian Ramsey

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Introduction

- **Produce a community guided "long term" technology development plan**
- **Long term implies technology ready for the 2020 and 2030 Decadal reviews**
- **Not mission-driven, but should support mission-concept goals**

Scope

- **Optics and detectors**
- **Optics: coordinated by Ramsey and Reid**
- **Detectors: coordinated by Falcone**

Optics: Potential requirements

- **Mass**
  - ≤ 400 kg (mirror ass'y) per square meter effective area
  - *Chandra* ~ 1600 kg/0.08 m^2, or ~ 20,000 kg/m^2
- **Resolution**
  - < 1 arc sec
  - Avoid source confusion flux limits of ~ few x 10^{-18} to 10^{-19} ergs/cm2/s
- **Field of View**
  - 10 arc min, but design dependent?
- **Cost**
  - Consistent with 10 – 20 per cent of an ~ 2 billion dollar mission
  - (technology development + fabrication/assembly)

Potential technologies: lightweight, high resolution optics - I

- **Adjustable X-ray optics (SAO) – TRL3 (*TRL5/6 targeted for 2018*)**
  - thin film piezoelectric layer with independently addressable cells
  - Correct low freq figure error of mounted mirrors on ground, correct once as required on-orbit
  - Can account for mount induced errors and ground to orbit errors
- **Differential deposition (MSFC, RXO) – TRL2**
  - Inverse of polishing – add material under computer control
  - Segmented or full shell mirrors
  - Correct fabrication errors and some mounting errors
- **Si optics (GSFC, MSFC) – TRL3**
  - Nominally stress free Si wafer shaped into Wolter-I segment
- **Non-contact thermal forming (MIT) – TRL ?**
  - Air bearing hot mandrels

Potential technologies: lightweight, high resolution optics - II

- **Magnetostrictive optics (NU) – TRL2**
  - Use thin magnetorestrictive layer to correct for manufacturing figure error
  - Higher spatial frequency bandwidth correction than adjustable optics
- **Refractive/diffractive - 2030?**
  - Hybrid approach of low Z lens with integrated diffractive elements
  - Very large area with very light weight – long focal length and narrow X-ray bandwidth
- **Alternative hybrid approaches**
  - Some combination of technologies
    - Adjustable Si optics
    - Adjustable differential deposition optics, et.

Detectors/Instruments: Potential requirements (large format detectors)

- **Count rate**
  - Large area → High Rates: >100 frame/sec
    (need : > Giga-pixel/sec *effective* readout)
- **Pixel Size/number**
  - Sub arcsec resolutin → Small pixels: <15 micron pixels
  - FOV → Large format: >20 arcmin FOV
- **Energy resolution**
  - Large format devices need < 4 e^- RMS read noise
- **Response/QE**
  - Need reasonable response across entire 0.3-9 keV band pass
    (>90% QE at ~1 keV, >10% QE at ~9 keV)

Potential technologies: detectors

- **Active pixel sensors**
  - PSU, JHU,MIT, SAO
- **Calorimeters**
  - GSFC, NRL, MIT, NIST, SAO?
- **Dispersive spectrometers**
  - CAT gratings (MIT)
  - Off-plane reflective gratings (Colorado, Iowa)

Development plan schedule

- **Outline requirements, implementation approaches: *current***
- **Get community feedback: *5/1/13***
- **Incorporate feedback and plan outline: *5/14/13***
- **1st draft: *6/1/13***
- **Review…*7/1/13***

- **43rd draft…*7/11/28***