The Focusing Optics X-ray Solar Imager (FOXSI)

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FOXSI Science Motivation



Current flare observations (e.g. RHESSI) show only where electrons are stopped(footpoints) and hot thermal loops.

FOXSI Motivation



- Current (RHESSI) observations do not have the sensitivity or dynamic range to observe energetic electrons in the corona where they are thought to be accelerated.
- Grazing incidence focusing optics coupled with position-sensitive solid state detectors can provide both high sensitivity and dynamic range!

Focusing Optics X-ray Solar Imager (FOXSI)

- Sounding rocket mission (LCAS) program.
- Launch scheduled for October 2011.
- FOXSI is leveraging new technologies
 - HXR grazing-incidence replicated optics (as flown on the HERO balloon payload, Ramsey et al. 2002)
 - Double-sided Si strip detectors (developed by JAXA/ISAS for Astro-H/NeXT)
- FOXSI will be ~50 times more sensitive than RHESSI and will have greater than 10 times its dynamic range!





Replicated optics telescope module (7 shells & 7 modules) 2 m focal length Si strip detectors (75µm)





FOXSI Science Targets

Energy Release in its many forms...



Many science targets are available for future FOXSI flights.





The first FOXSI flight (Oct 2011) will focus on

- thermal and flare emission from active regions
- 2. HXR emission from nanoflares in the quiet Sun.

Time (UT) 2005111

- Optics
 - Fabrication of telescopes finished in two weeks.
 - Calibration in ongoing (4/7 done so far)
 - Better than expected resolution (8 arcsec FWHM, 25 arcsec HPD) resulting from new nesting process.



• Detectors

SI DE LECIO

- Si strip detectors
- Test detector board fabricated, ASICs mounted and wire bonded to detectors.
- First spectrum measured!

(*Above*) FOXSI strip detectors wirebonded to ASICS (*Right*) Am-241 spectrum as measured by FOXSI





FOXSI 2



The dashed line represent the area provided by the optics. The effective area is also shown.

- Funded for a second flight 2013. Optimize for higher energies.
 - Adding inner shells
 - Replacing Si for CdTe detectors
- FOXSI's effective area
 - Blue represents the current configuration for flight in 2011
 - Red represents an upgraded configuration for a future flight in 2013



- A FOXSI white paper was submitted and presented (by invitation) to the Heliophysics decadal survey panel.
- FOXSI is included in two (chosen) mission concepts (SEE 2020, RAM)
- On track for a launch in October of this year!
- Keep track of FOXSI (<u>link</u>)

BACKUP SLIDES

FOXSI Numbers

- Energy range : 4 15 keV
- Energy resolution : 0.5 keV



- FOV : ¼ Sun (16' x 16', 128 x 128 pixels)
- Resolution : 8" (FWHM)
- Effective area : ~4 x RHESSI (180 cm²)
- Sensitivity :
 50 x RHESSI
- Dynamics Range : >10 x RHESSI

(*Right*) The detector plane with shutter mechanism and thermal blankets.



• Effective area measurements.

Module X0



- Outstanding issues
 - Resonance in mechanical structure matches resonance found in optics.
 - Reinforcing fixture being designed to shift the frequency of the resonance in structure.

(*Below*) A FOXSI telescope module at MSFC about to be vibration tested.



(*Right*) The FOXSI payload with telescope mass models ready for a vibration test.

