The Focusing Optics X-ray Solar Imager (FOXSI)

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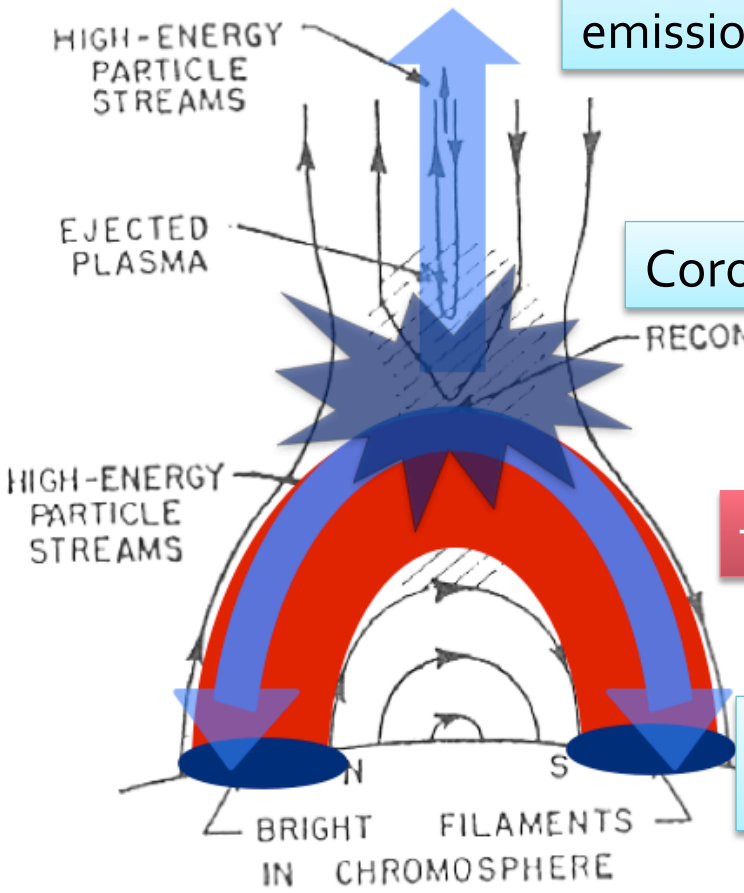
Science

Sturrock (1966)



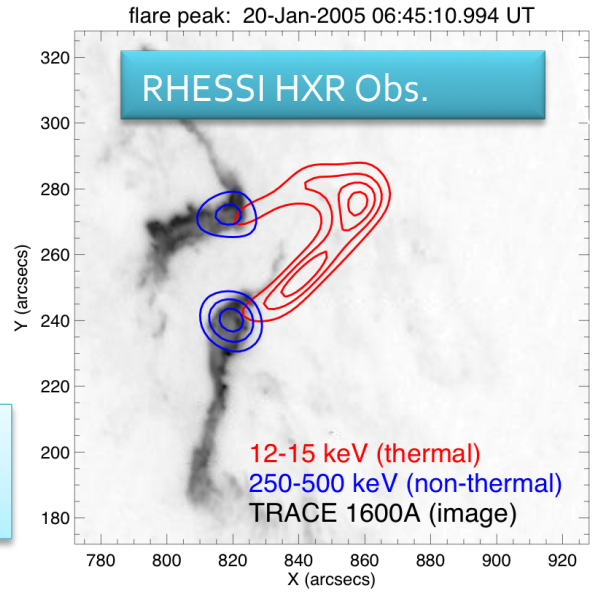
(weak) Thin target emission

Coronal source

thermal

(intense) Thick target footpoints

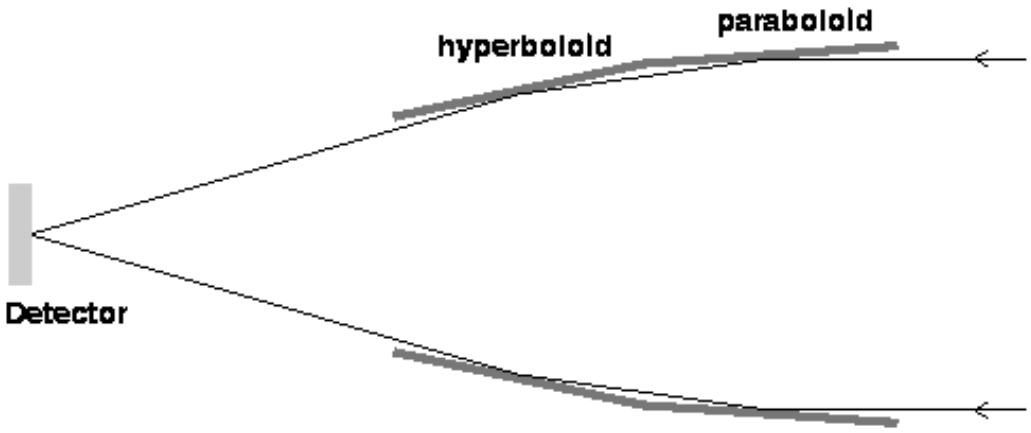
Currently we only observe the coronal source (acceleration region?) when we are lucky and we never observe electrons in the loop legs or escaping.

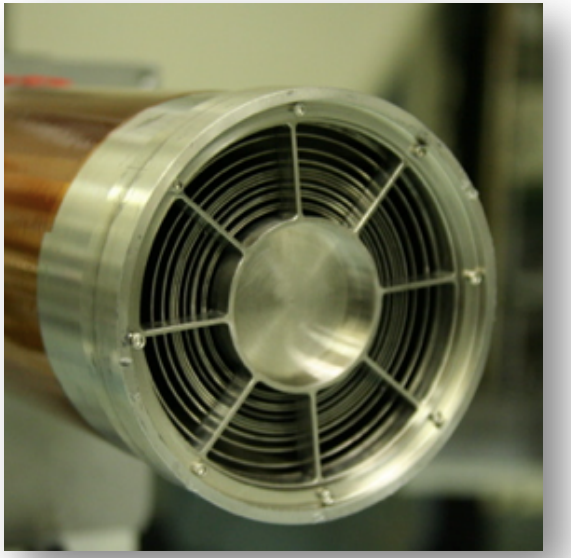


We need higher dynamic range and sensitivity in HXRs!

Grazing Incidence Optics

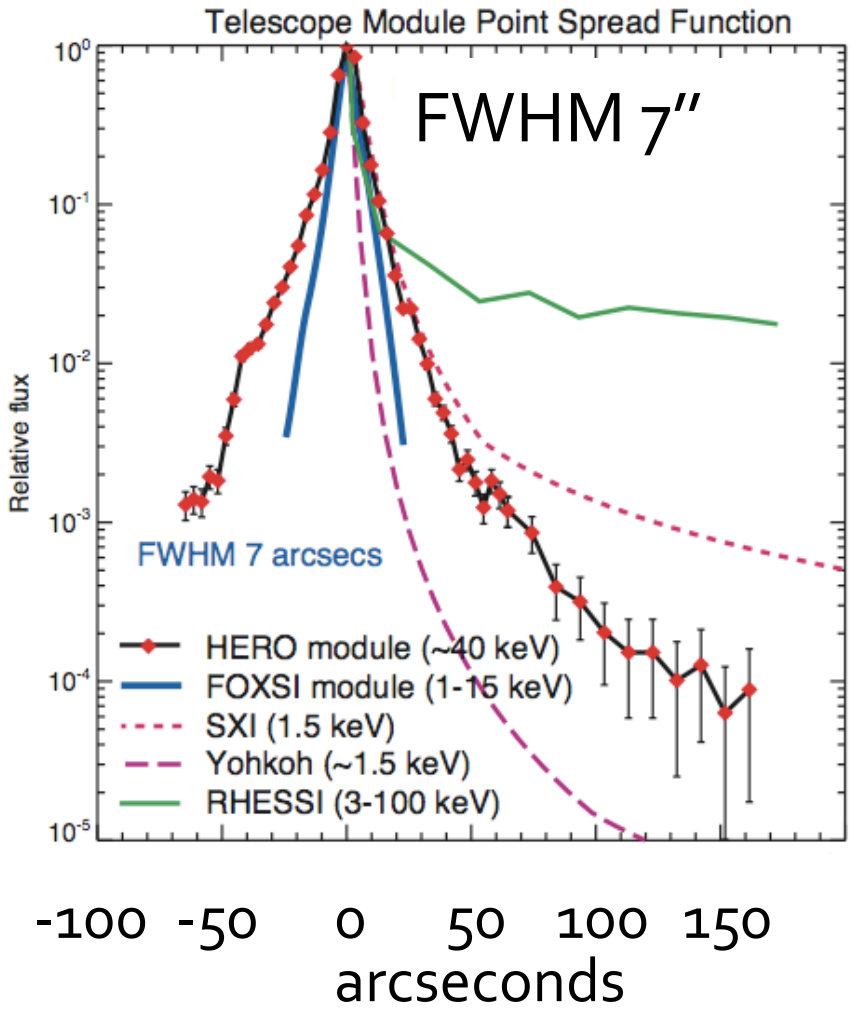
- HXRs undergo total internal reflection at shallow graze angle (<0.5 degree).
- Using mirror shells with a Wolter I geometry (confocal paraboloid and hyperboloid) HXRs can be brought to a common focus.
- Telescope shells are nested together to form telescope modules to increase area.





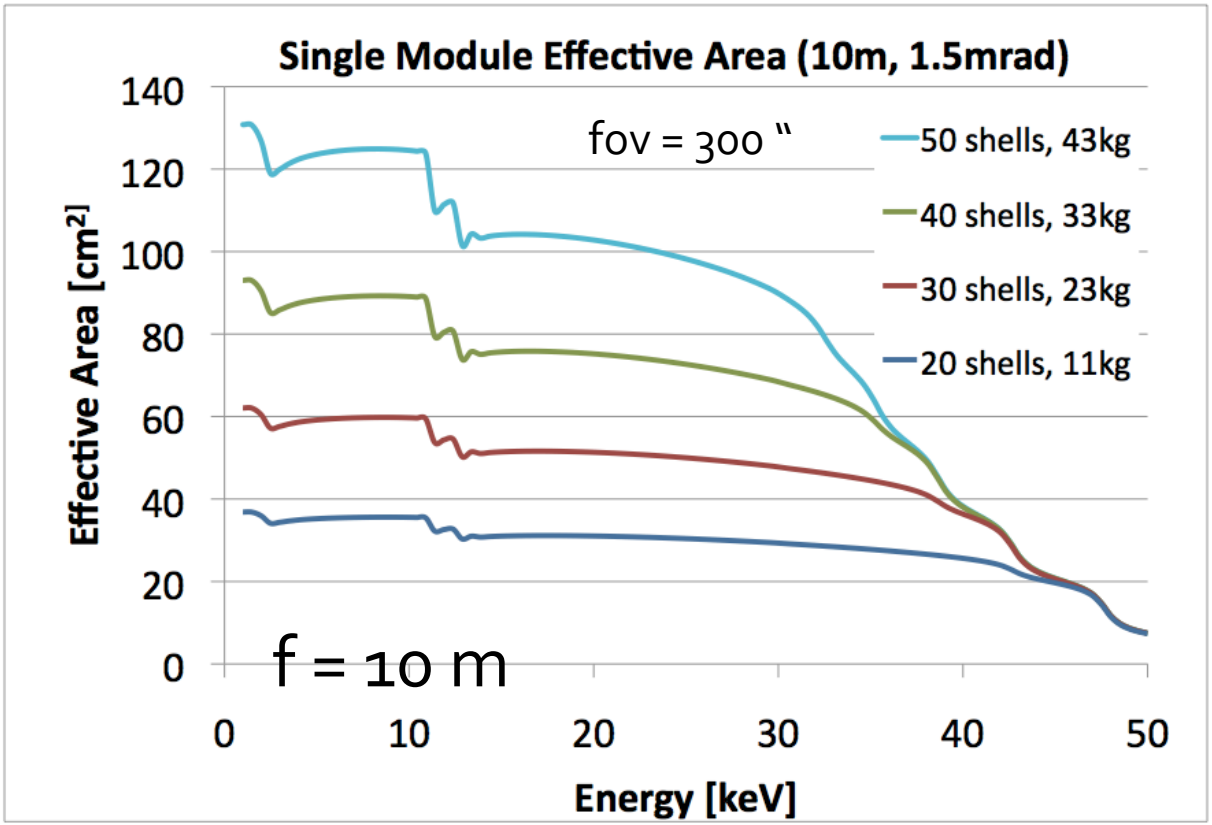
Optics Resolution

- Individual shell resolution of **7″** (FWHM).
- Telescope module resolution of **12″** (limited by shell alignment)
- Dynamic range of **100** for separations >30″ (up to 10^4 for larger separation).
- Better shells and better alignment may bring telescope resolution down to **6″** (FWHM).



Effective area

- Many possible configurations for optics



Configuration optimized for 30 keV (no multilayers)

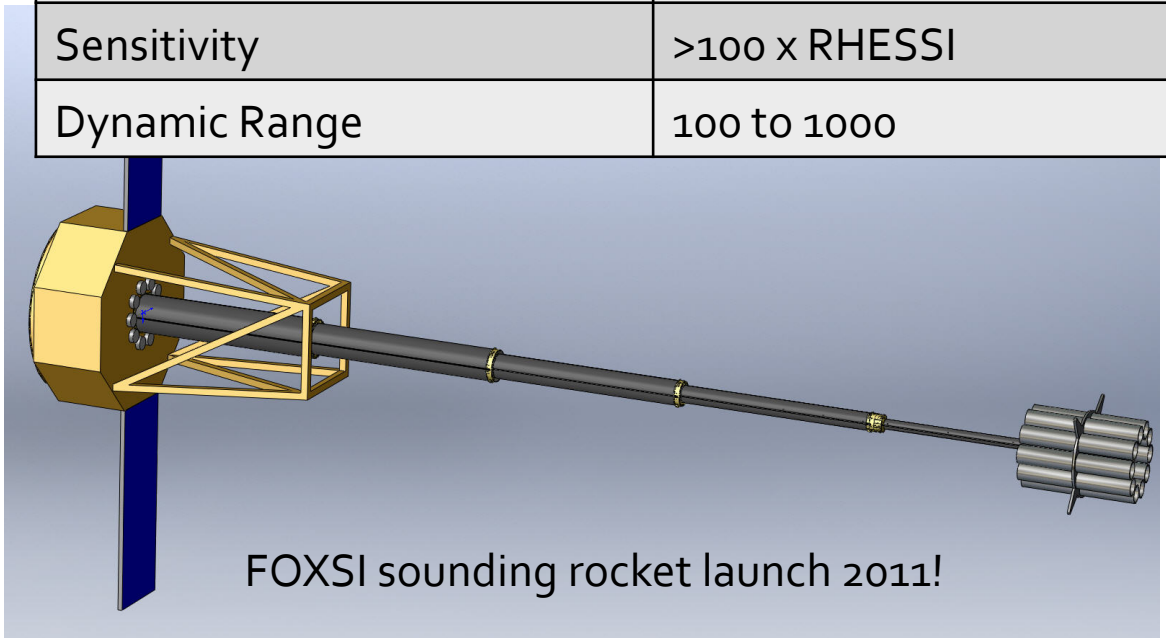
- Large *f* means higher energies and more area
- Multilayers increase reflectivity at large graze angles (double fov)
- **~2.4 cm²/kg**

Detectors

- Si detectors - good efficiency up to ~12 keV
  - Fano-limited energy resolution (~200 eV)
  - Small pixels and fast readout
- CZT/CdTe detectors – good efficiency up to ~60 keV
  - Good energy resolution (1 keV)
- Combine detectors (CZT/CdTe behind Si) – front/rear
- Need to over-sampling of PSF (< 6 arcsec)
  - For f = 10 m, pixel pitch < 300 micron
- Small pixels mean much lower background (>=10x smaller than RHESSI)
- Want individual pixels that can handle high count rates

FOXSI Straw Man

Energy Range	1 to 40 keV
Weight of optics	184 kg (8 modules)
Effective Area	400 cm^2
Energy Resolution	200 eV (< 15 keV) 1 keV (<60 keV)
Spatial resolution	7 arcsec
Sensitivity	>100 x RHESSI
Dynamic Range	100 to 1000



FOXSI sounding rocket launch 2011!

"Spectroscopic imaging of the electron acceleration region and tracking energetic electrons in the corona to understand electron acceleration and transport."