Update on Solar Orbiter / STIX

Spectrometer/Telescope for Imaging X-rays

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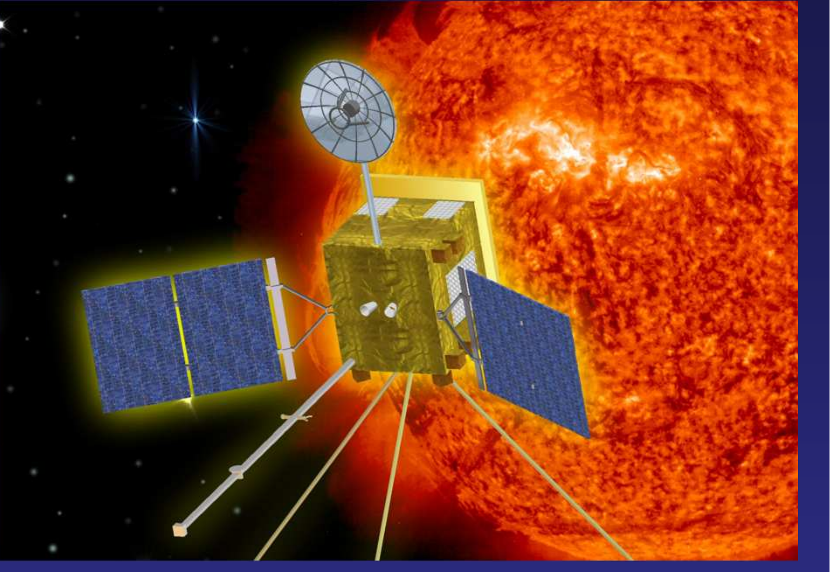
Solar Orbiter Mission



0.284 AU perihelion

Inclination to 34 degrees

Key science objectives

- **Particles, plasmas and fields in inner heliosphere**
- **Links between solar surface, corona and inner heliosphere**
- **Magnetic field dynamics geometry and dynamics**
- **Solar dynamo using high latitude fields and flows and helioseismology**

STIX Spectrometer/Telesope for Imaging X-rays

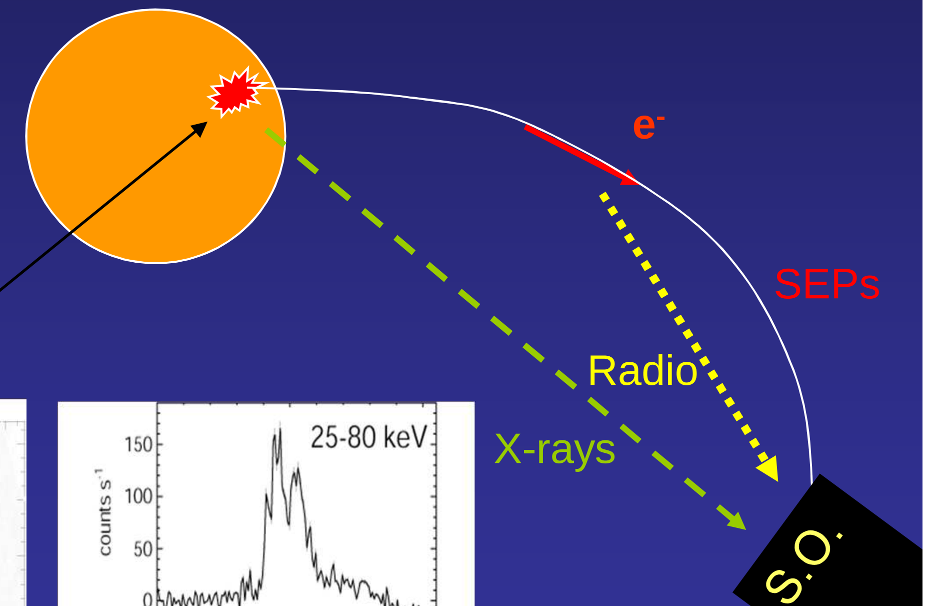
Primary Science Objective

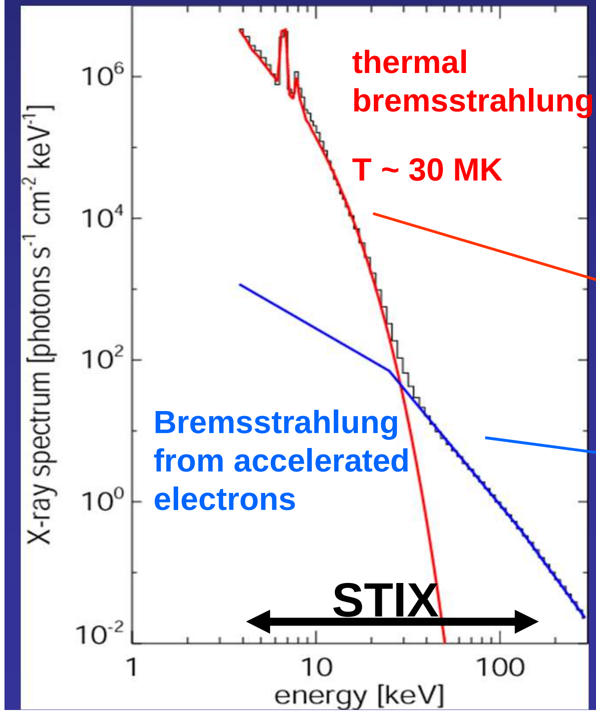
To serve as the high-energy link between Solar Orbiter remote sensing and in situ observations

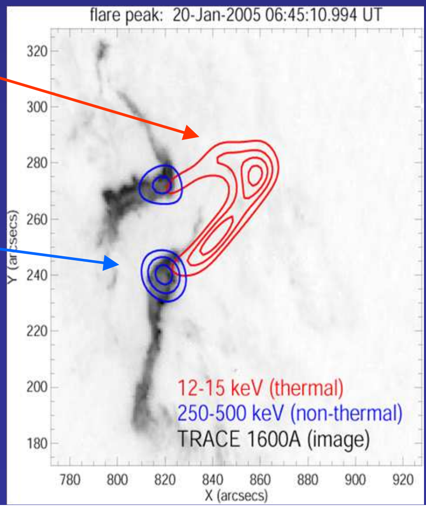
Location, structure, timing and imaging spectroscopy of hard X-ray sources

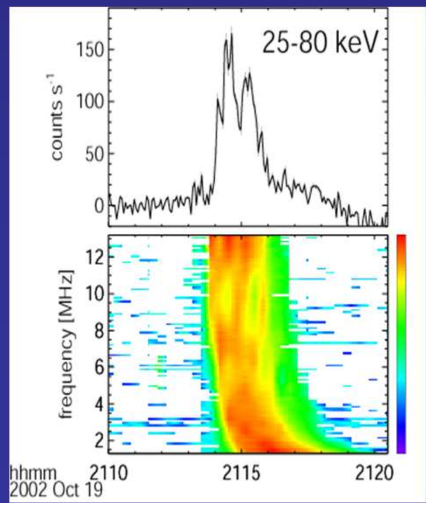
Secondary: * Directivity

* Coronal-chromospheric transport using occulted events







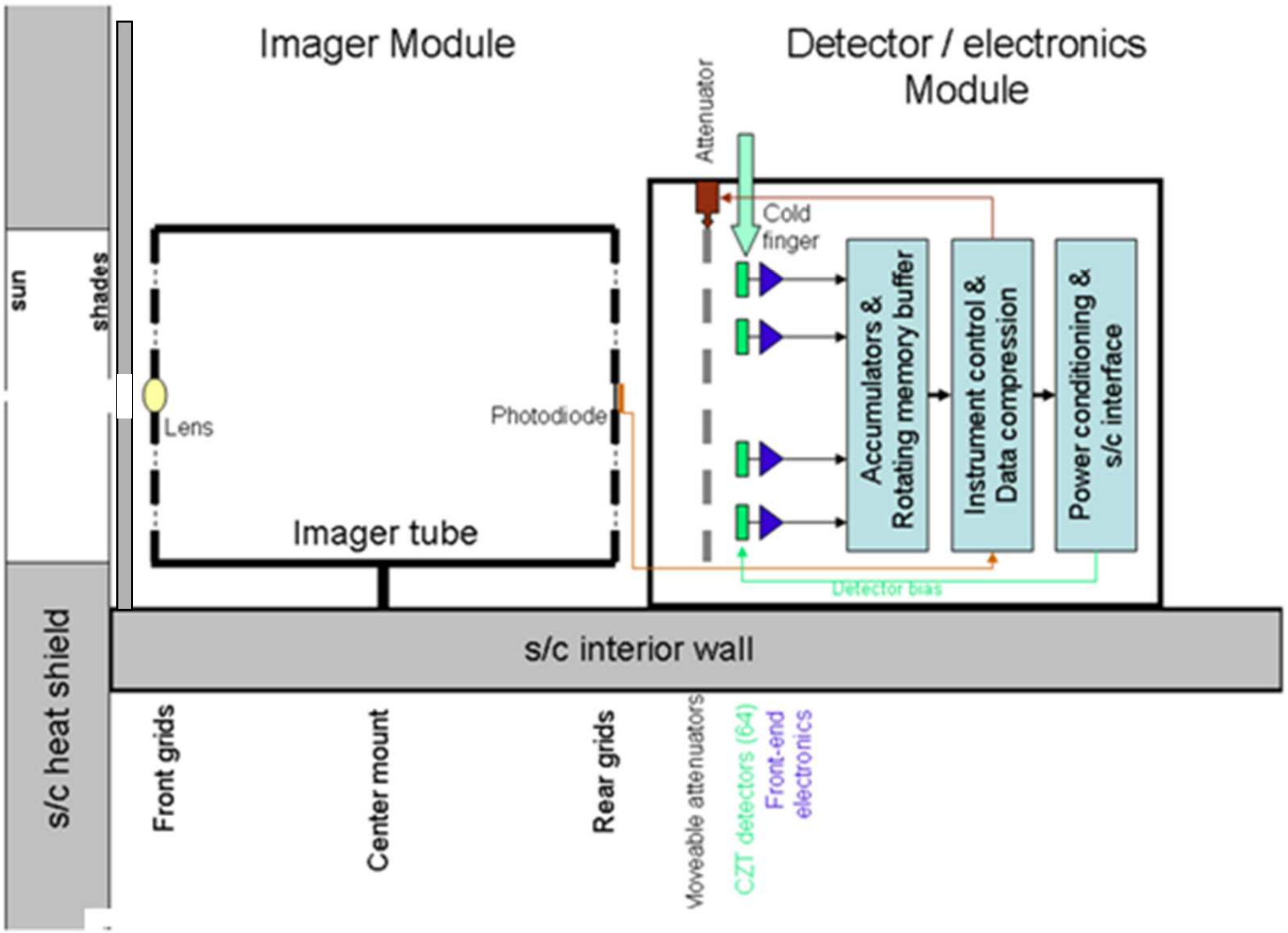


STIX Requirements Summary

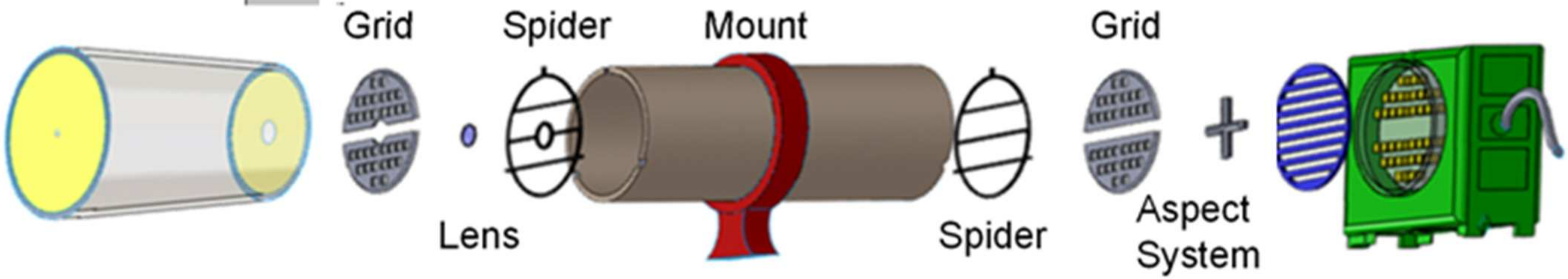
Energy Range	4 – 150 keV	
Energy Resolution (FWHM)	1 keV @ 6 keV to 15 keV @ 150 keV	
Effective area	6 cm^2	
Finest angular resolution	7 arcsec	
Coarsest angular resolution	3 arcmin	
Field of view	2° (Full Sun at perihelion)	
Image placement accuracy	<4 arcsec	
Time resolution (statistics limited)	~0.1 s	RHESSI
Mass	6 kg	131 kg
Power	4 watts	142 w
Telemetry	25 B/s	20 kB/s

➔ STIX is a much more modest instrument than RHESSI

STIX



Imager Module
Detector / electronics Module
Attenuator
Cold finger
sun shades
Lens
Photodiode
Imager tube
Accumulators & Rotating memory buffer
Instrument control & Data compression
Power conditioning & s/c interface
Detector bias
s/c interior wall
s/c heat shield
Front grids
Center mount
Rear grids
Moveable attenuators
CZT detectors (64)
Front-end electronics



Grid
Spider
Mount
Grid
Lens
Spider
Aspect System

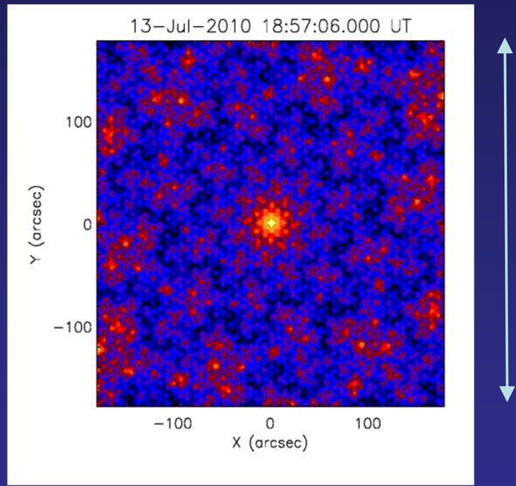
STIX Imaging Concept

- 3-axis stabilized s/c
  ➔ Use spatial modulation, not time modulation to measure visibilities.

- Each collimator can measure one Fourier component of the source distribution

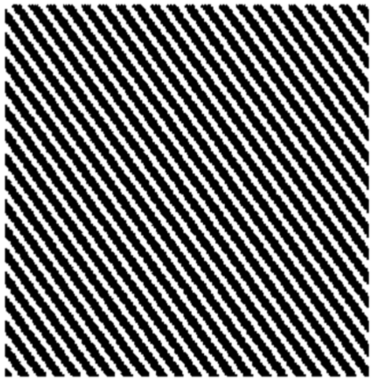
- 32 subcollimators
  - 30 Fourier components
  + Flare locator
  + Background monitor / high flux spectrometer

- Image quality comparable to Yohkoh / HXT but with much better spectral resolution

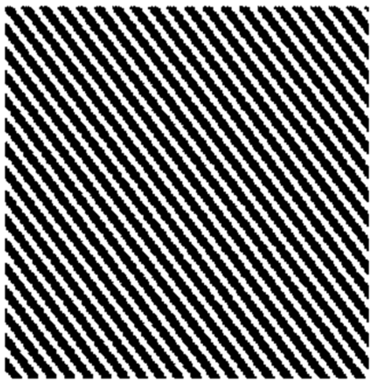


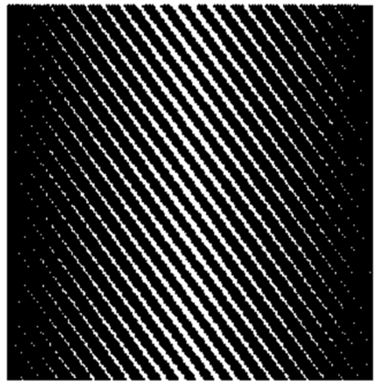
400 arcsec

STIX Measurement of Visibilities

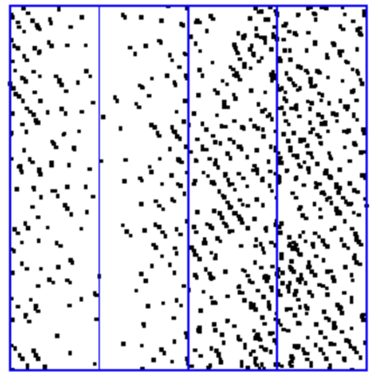


Front and rear grids have slightly different pitch and/or orientation

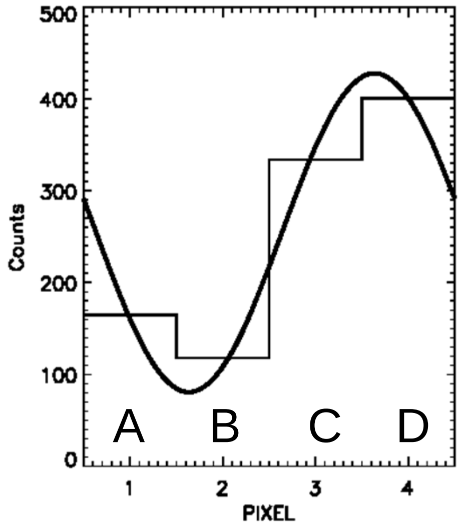




Joint transmission forms a Moire pattern



4 pixels measure Moire pattern

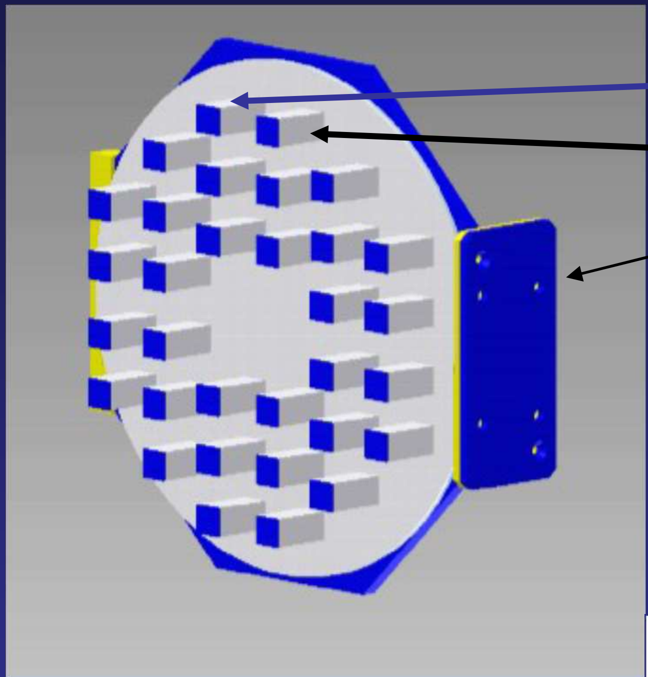


*Real (V) = C - A
*Imag (V) = D – B
**Flux = A+B+C+D
**Check: A + C = B + D

* Independent of background
**Independent of source morphology

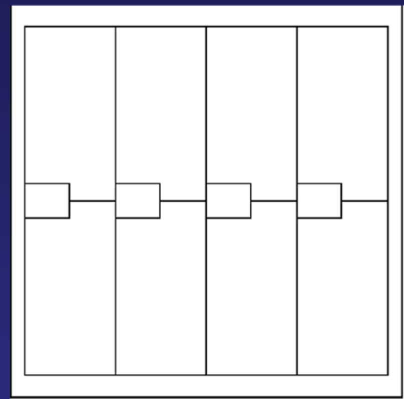
Relative count rates among 4 pixels ➔ redundant measurement of visibility and flux

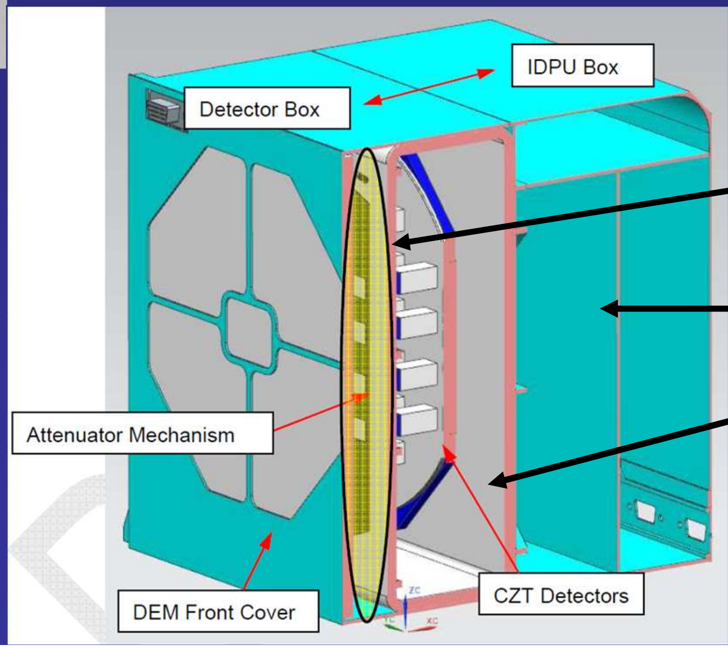
STIX Spectrometer



- 32 10x10x1 mm thick CdTe detectors
- Mounted on 32 ‘Caliste’ ASICs
- Passively cooled to -20C
- 12 pixels per detector

  + guard ring

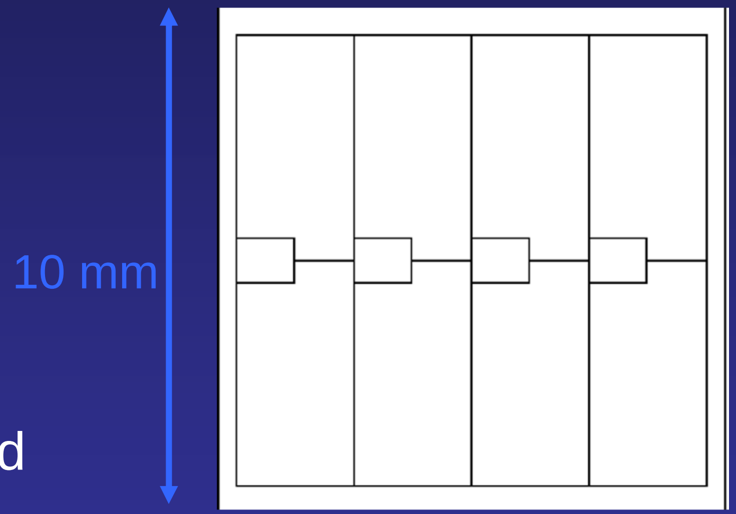




- Moveable attenuator
- IDPU
- Cryostat

High-Rate Handling

- STIX sensitivity helped by 1/r2 and low detector background
- Can electronically reduce effective area of pixelated detectors during high rate conditions



- Observations of intense events are throughput limited (~10^6/s), not flux limited
- Moveable attenuator enhances ratio of high energy to low energy counts in large events
- Combination of pixelated detectors and attenuators
  - ➔ STIX can image A1 class flares.
  - ➔ STIX can image thermal and nonthermal x-rays in X30 class flares.

STIX Data Handling

an evolving issue

- Current allocation = 25 Bytes/second
- STIX data is flare-dominated, not background-dominated
- On board conversion of native energy channels to 32 science-optimized detector-matched energy channels

  ➔ Instrument flash memory can store many months of ‘raw’ data
- Data selection options range from:
  - Onboard flare identification and time/energy bin selection
  - Post facto requests from ground?
- Data compression options range from:
  - Accumulator-based pseudo-RHESSI-like flexibility
  - Transmission of 30 visibilities per time/energy bin

    ➔ 60 bytes/image

    ➔ ~1000 statistically significant images/hour x N years

Current STIX Status

- July 2010 – Began STIX Phase B
- Oct 2011 - Solar Orbiter mission confirmation?
- Nov 2011 - STIX Preliminary Design Review
- Jan 2012 - Begin Phase C,D
- Jan 2017 - LAUNCH
- 2020 - Main science phase begins