STIX HXR sources of the Apr 2, 2022 eruptive flare Update

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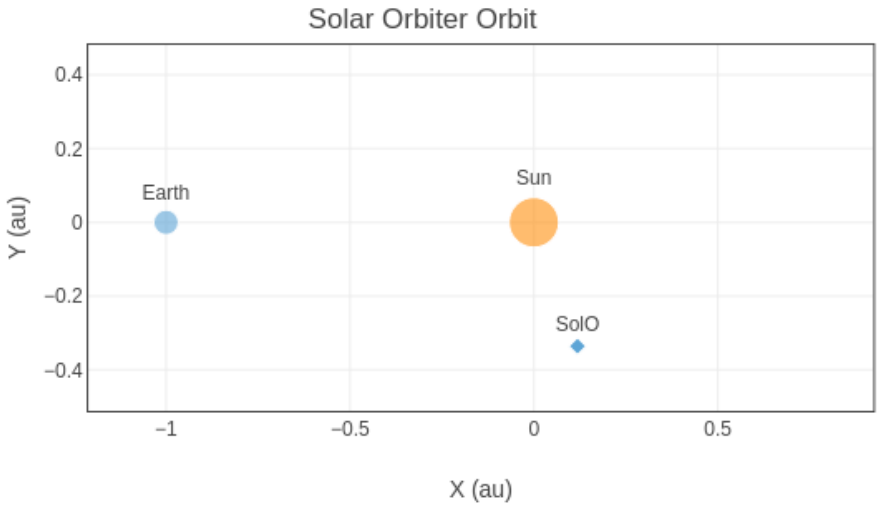
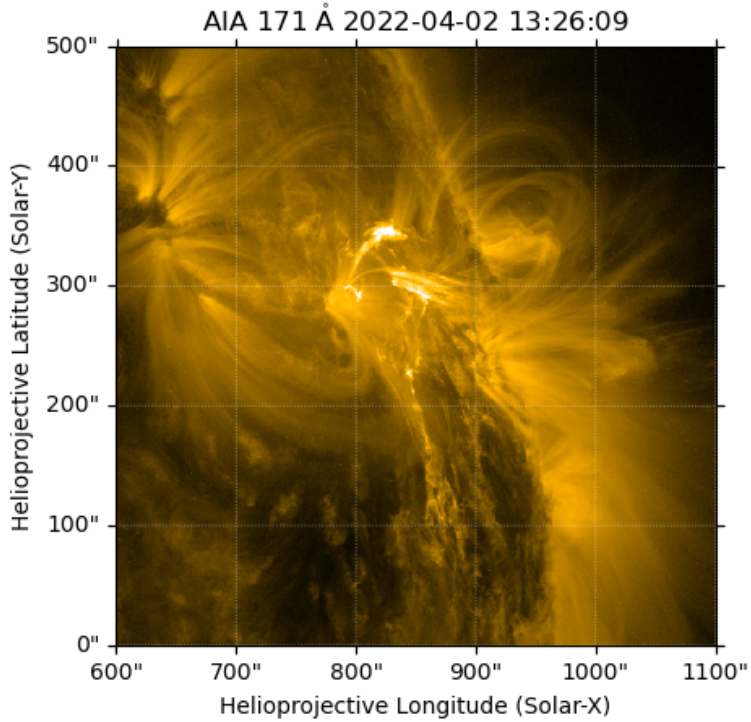
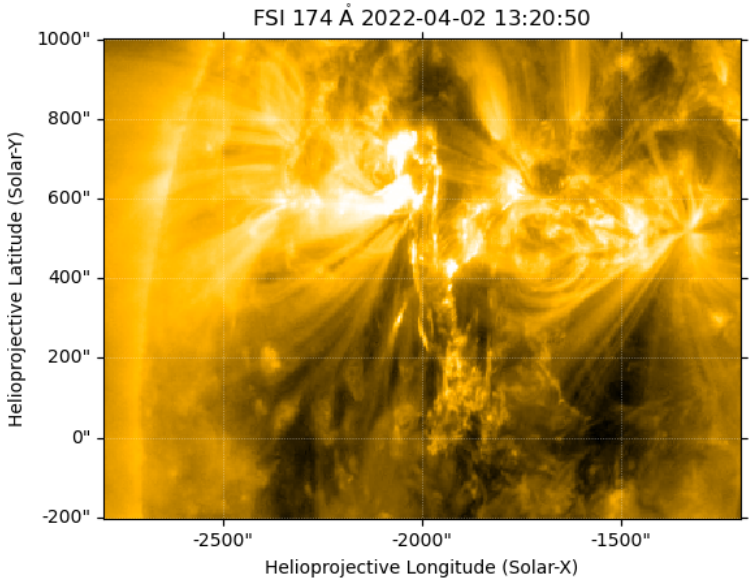
April 2, 2022 M 3.9 flare

- GOES peak at 13:55 UT
- long-duration event, Janvier et al. (2023)
- focus on impulsive phase
- Fermi, AIA, STEREO, EUI, radio
- different vantage points and distances
  - $\Delta t = 5$ min 21 s
  - $\measuredangle$ STIX - flare - Earth $\sim 110°$
  - STIX - Sun distance ~ 0.35 AU







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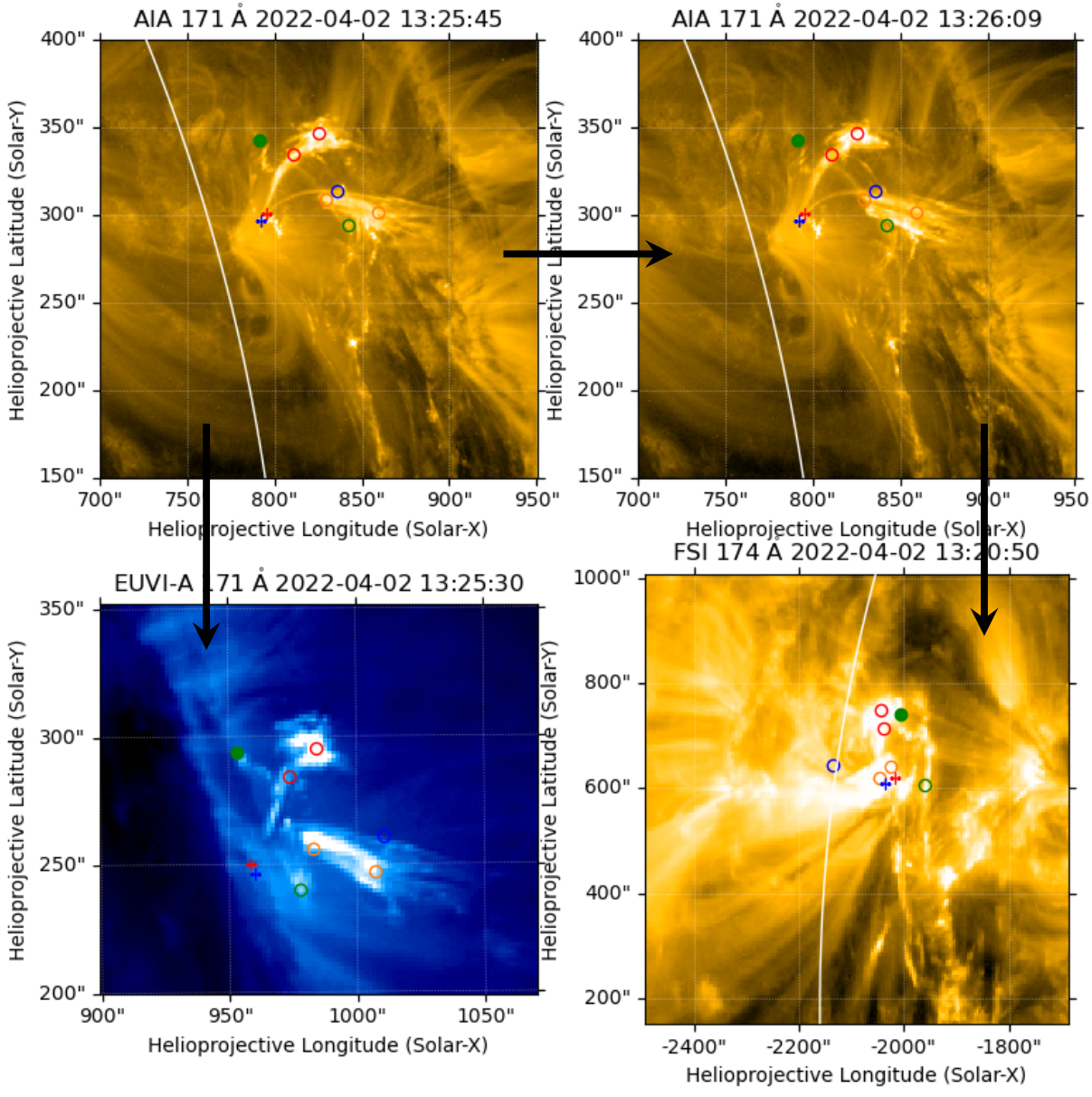
Multi-spacecraft view in EUV emission

- STEREO + AIA 171 Å
  - $\Delta t = 16$s, $\measuredangle \sim 33°$
  - behind the STEREO limb
- AIA 171 Å + EUI 174 Å
  - EUI 10min cadence
- identification of footpoints (+) and loop structures (o): height estimate and reprojection
- footpoints and some loops overlap in EUI
- long, narrow structure can be a loop (not a ribbon)



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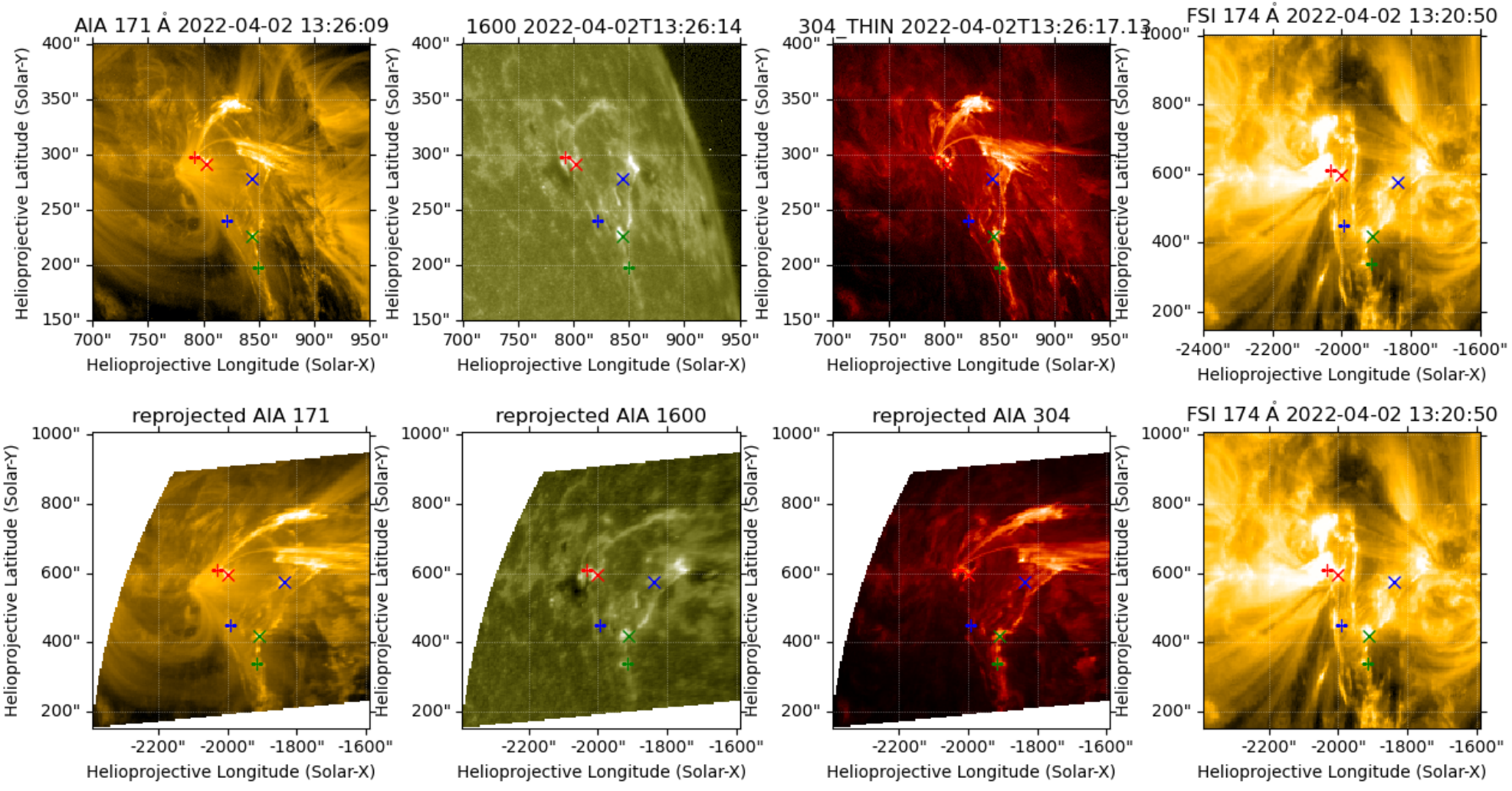
(E)UV emission - low atmosphere



- identification of (E)UV emission for co-alignment with HXR emision

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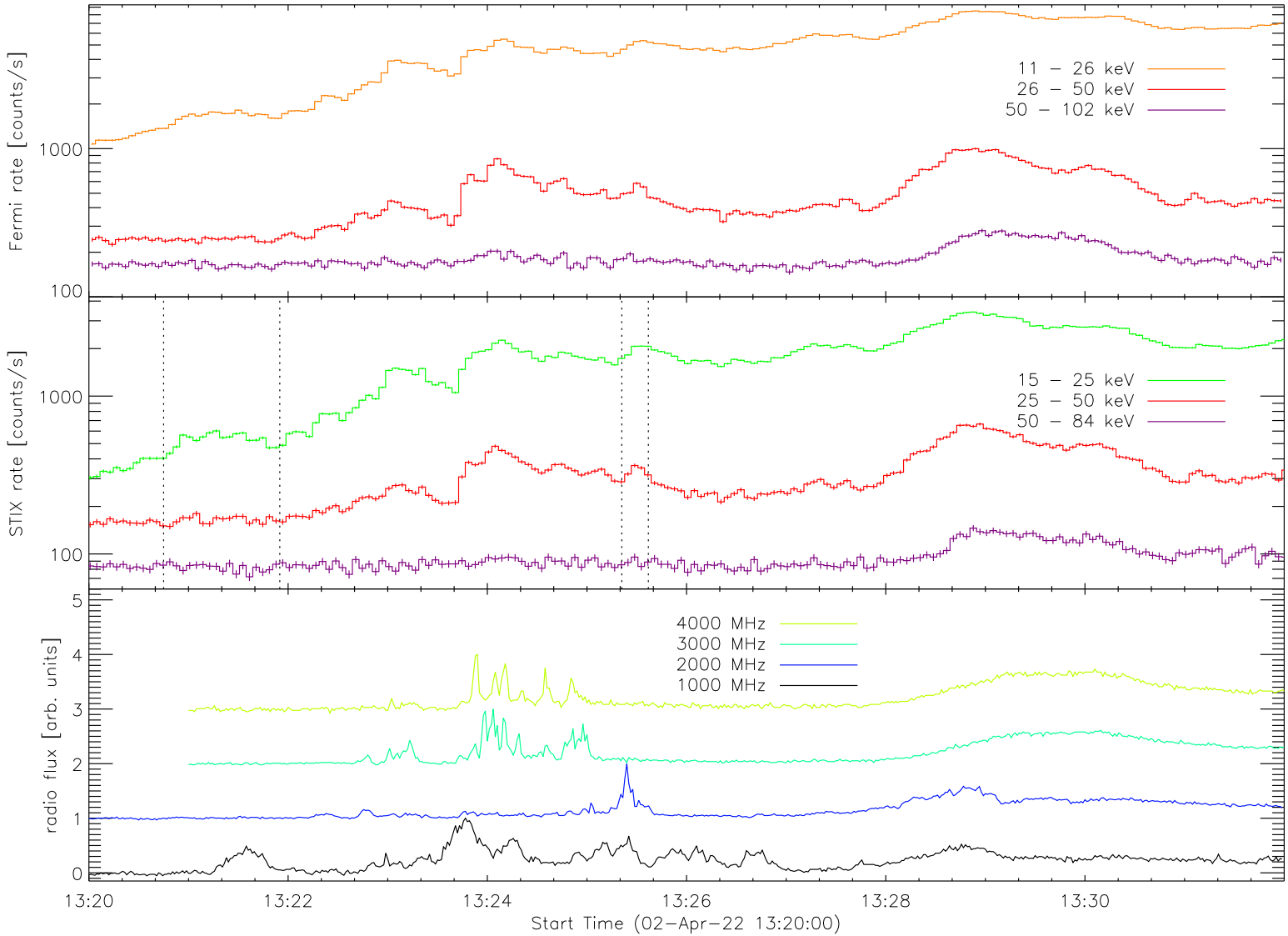
Impulsive phase in X-rays and radio



- similar Fermi (Det 4) and STIX lightcurves; HXR time intervals chosen by radio emission, HXR peaks used for co-alignment

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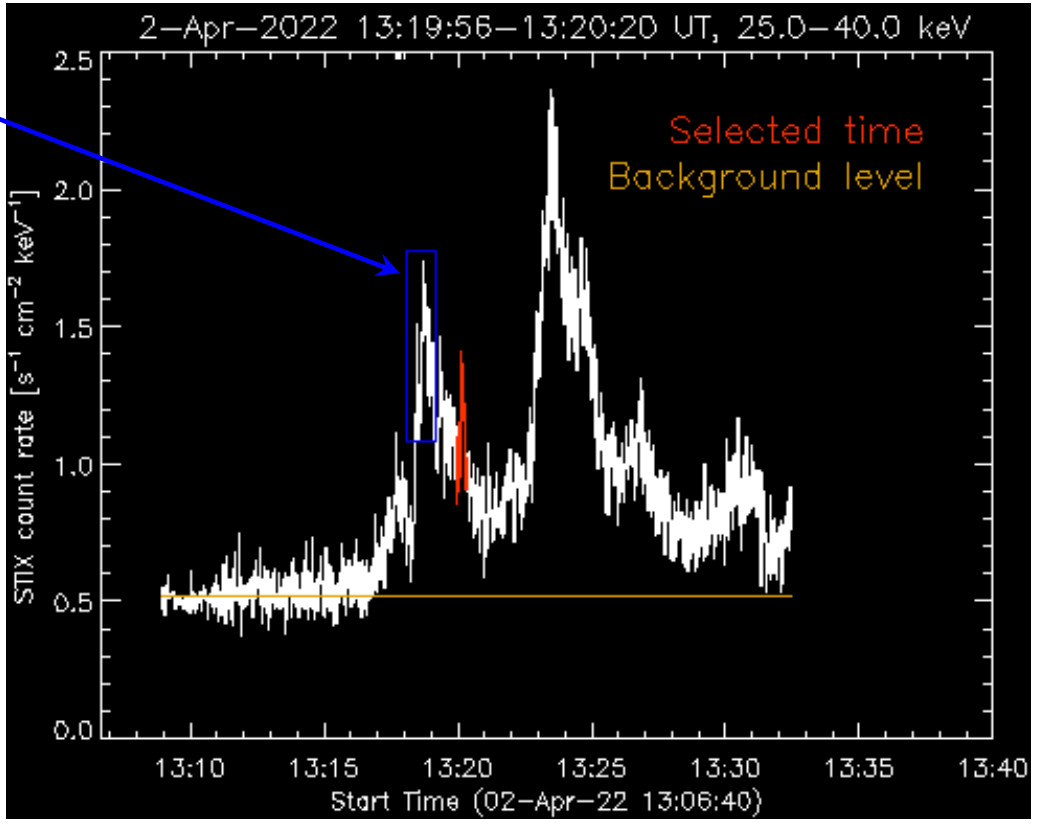
STIX HXR sources at 13:19 UT

- 1st significant peak above 25 keV
- modulation in subcoll. 3 - 10
- non-thermal emission above $\sim$ 20 keV
- co-alignment with AIA 1600 Å
  - assuming brightest emission corresponds to HXR source
- the same spatial shift applied to other, less bright STIX sources



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STIX HXR sources at 13:19 UT

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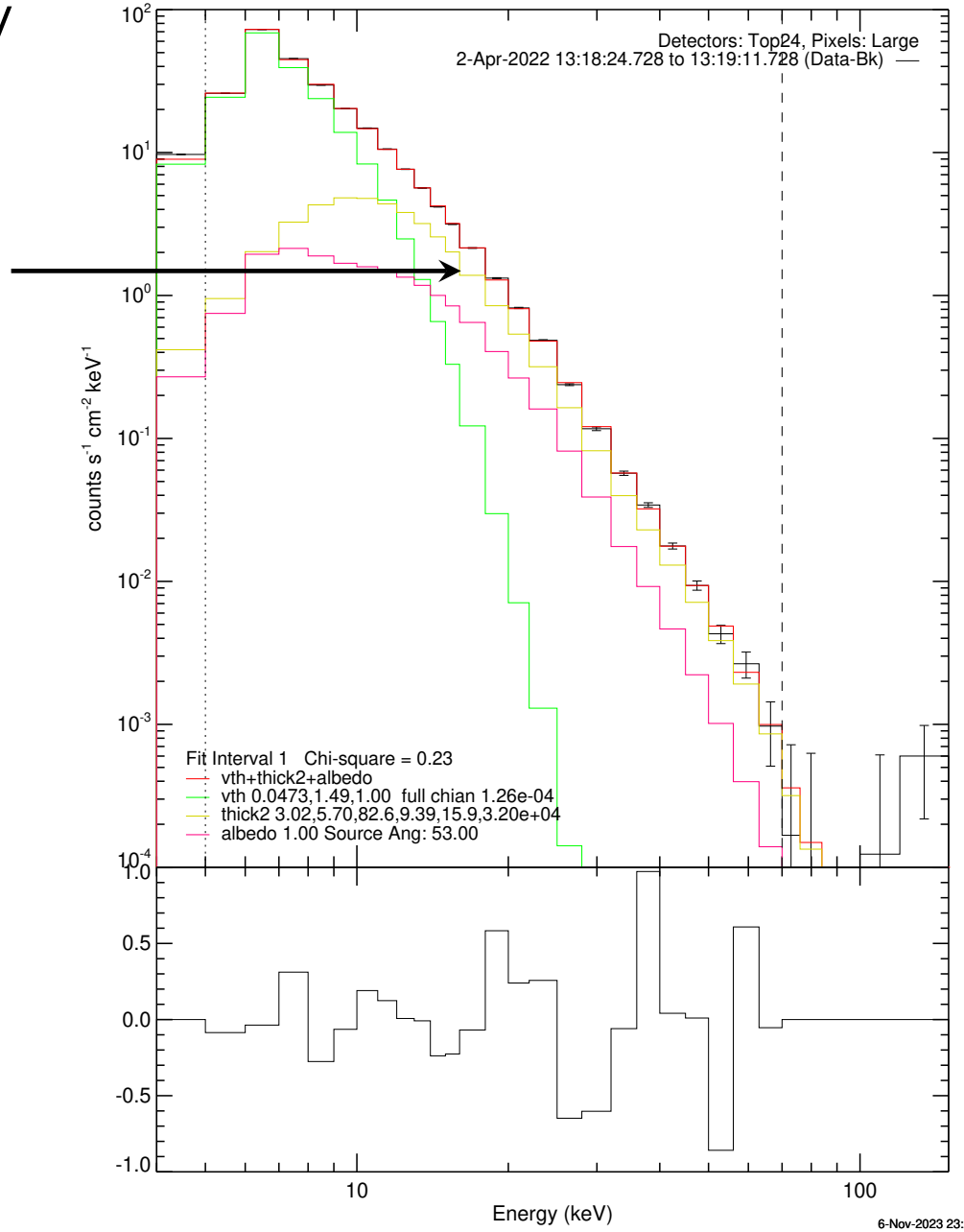

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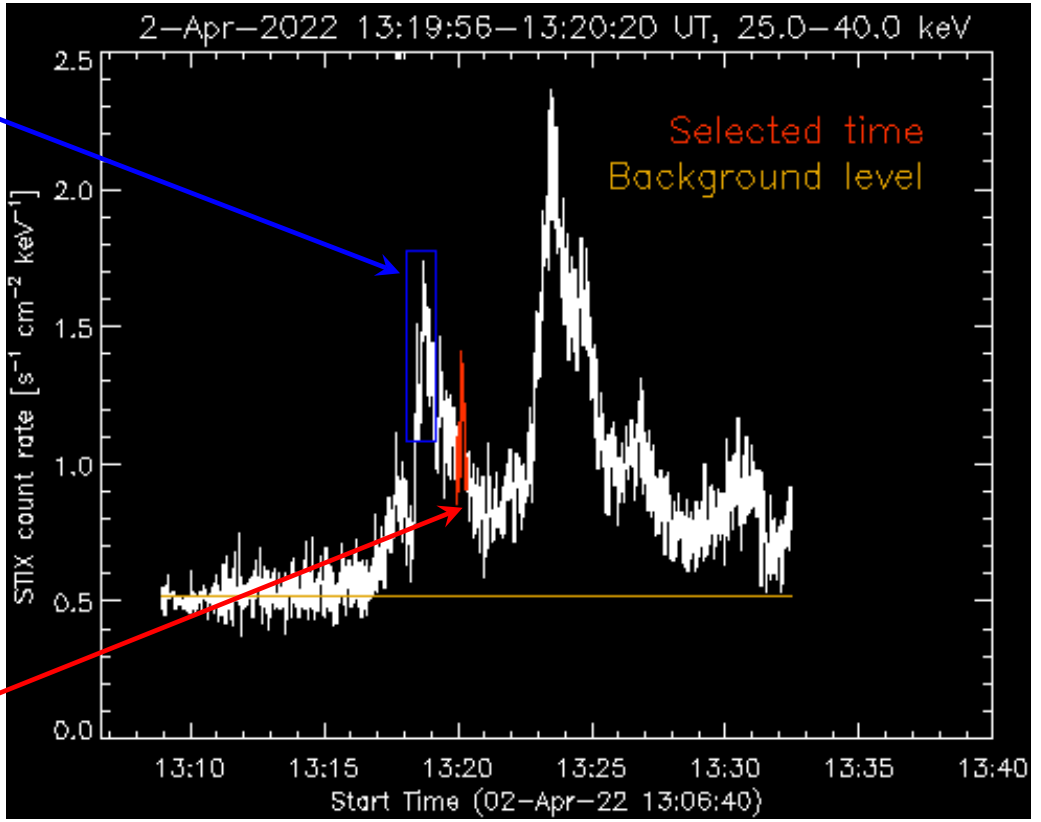

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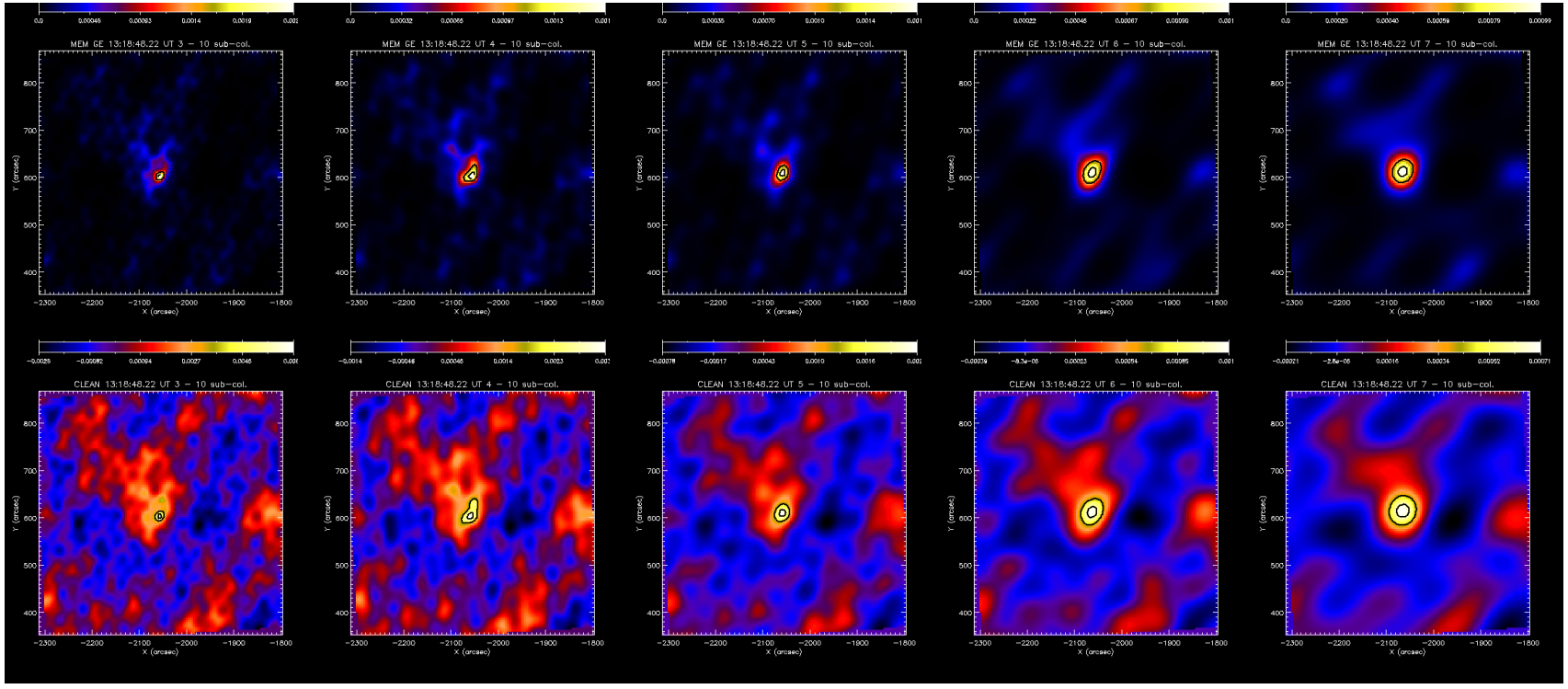
HXR peak image reconstruction



- subcoll. 4 - 10 used
- 2 energy bands: 25 - 28 keV, 32 - 45 keV to exclude high bckg from the calibration line

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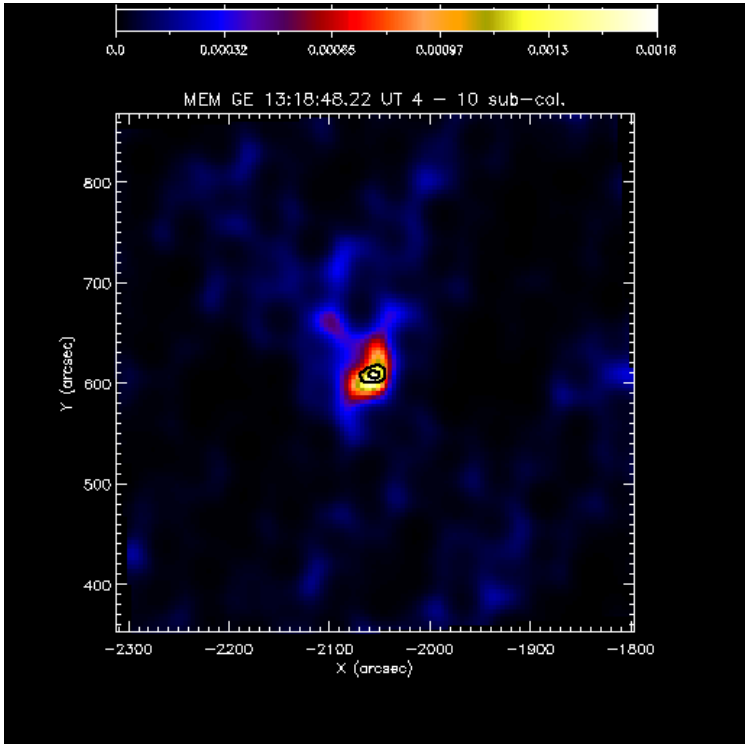

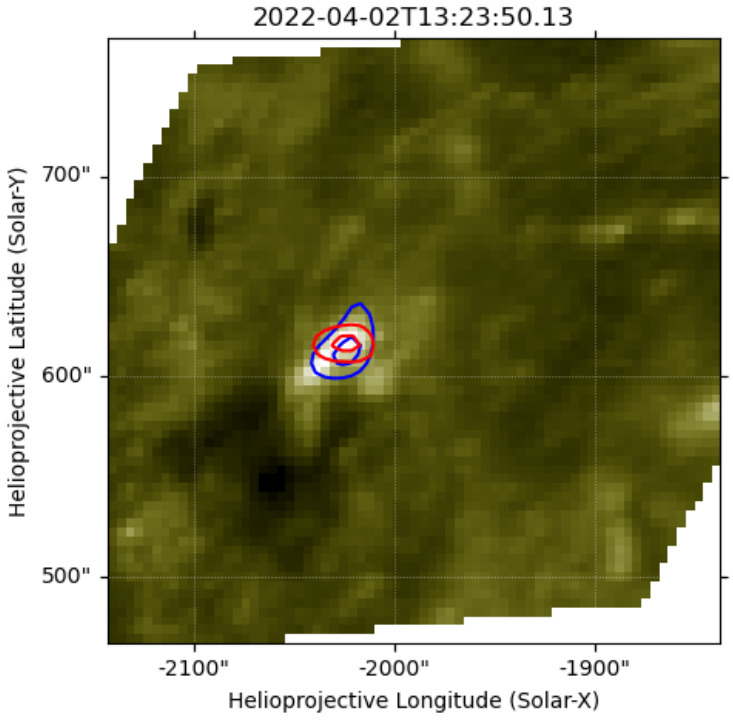

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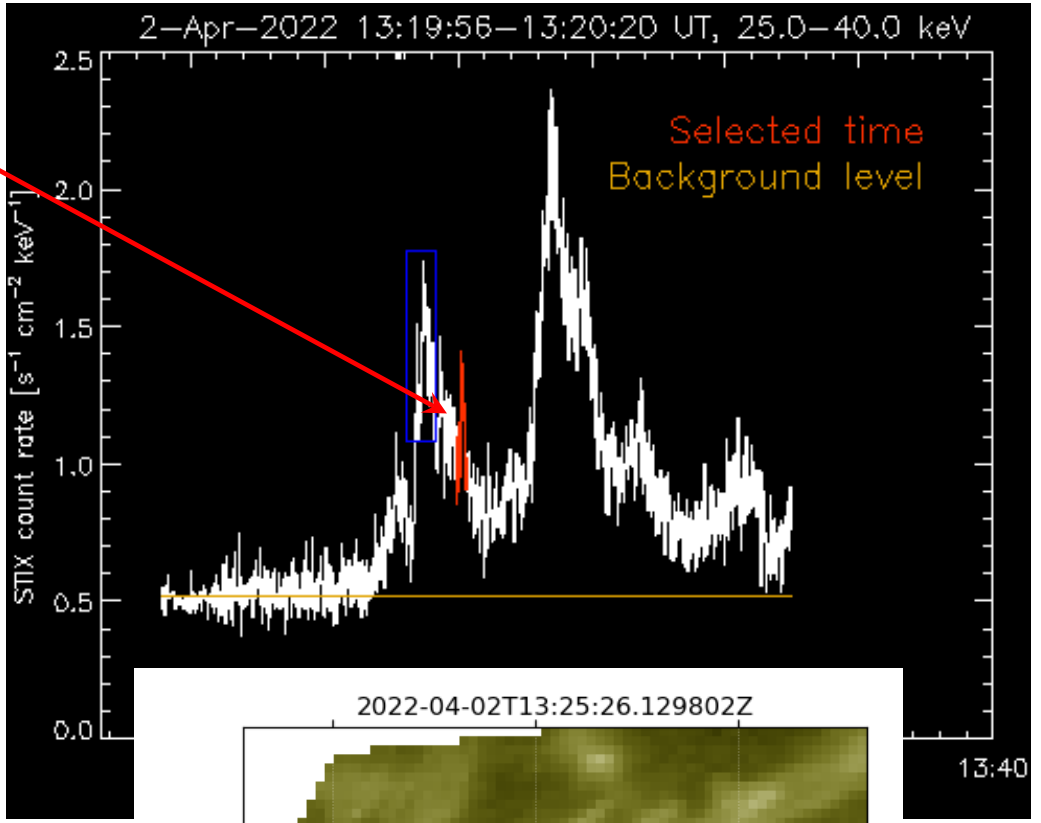
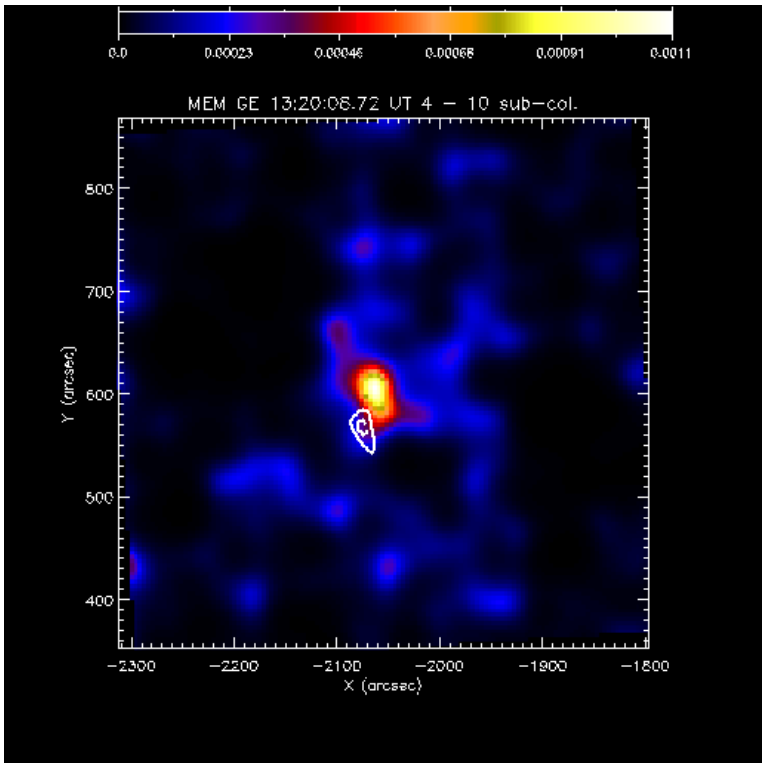
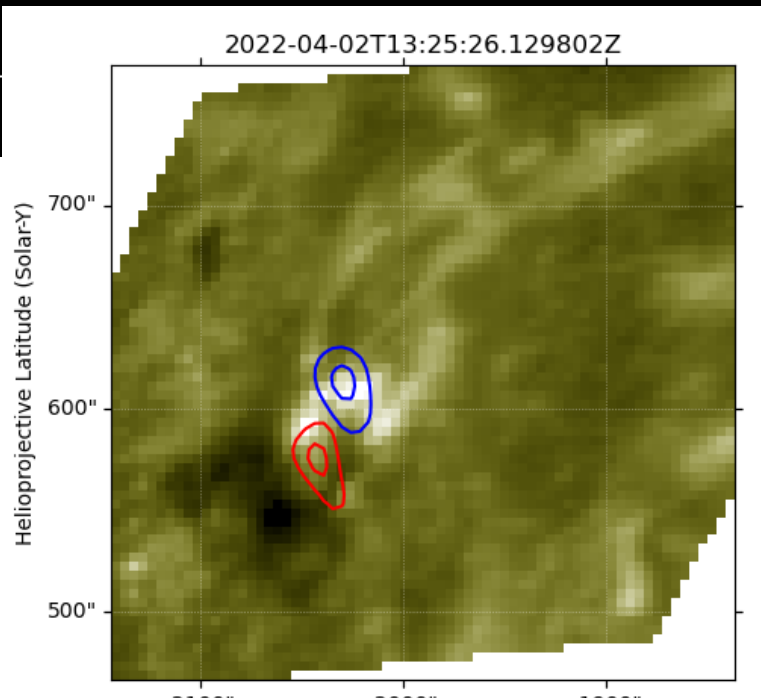
STIX HXR sources at 13:20 UT

- a narrow spike in the decay of 25 - 40 keV lightcurve and radio GHz emission
- subcoll. 4-10 used
- 2 energy bands: 25-28 keV, 32-45 keV: 2 different locations?







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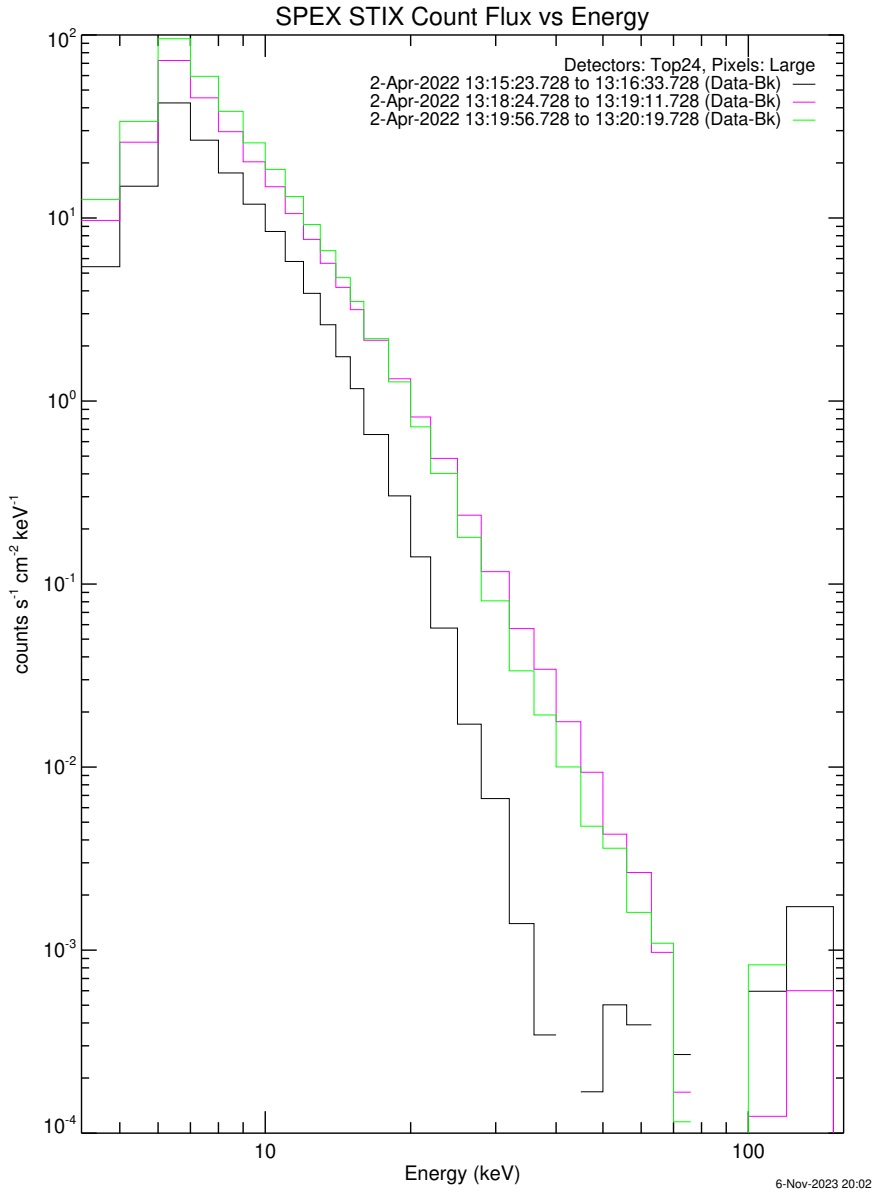
STIX spectra fitting

- spectra at 3 times of interest
- software version 0.5
- (2) vth + thick-target + albedo components
- broken electron spectrum needed
- break energy $E_b \sim 25$ keV for HXR spike
  - 2 different electron distributions at 2 different places?
- double thermal fit consistent with the data for the earliest time
  - hot component?, no footpoint emission above 20 keV?



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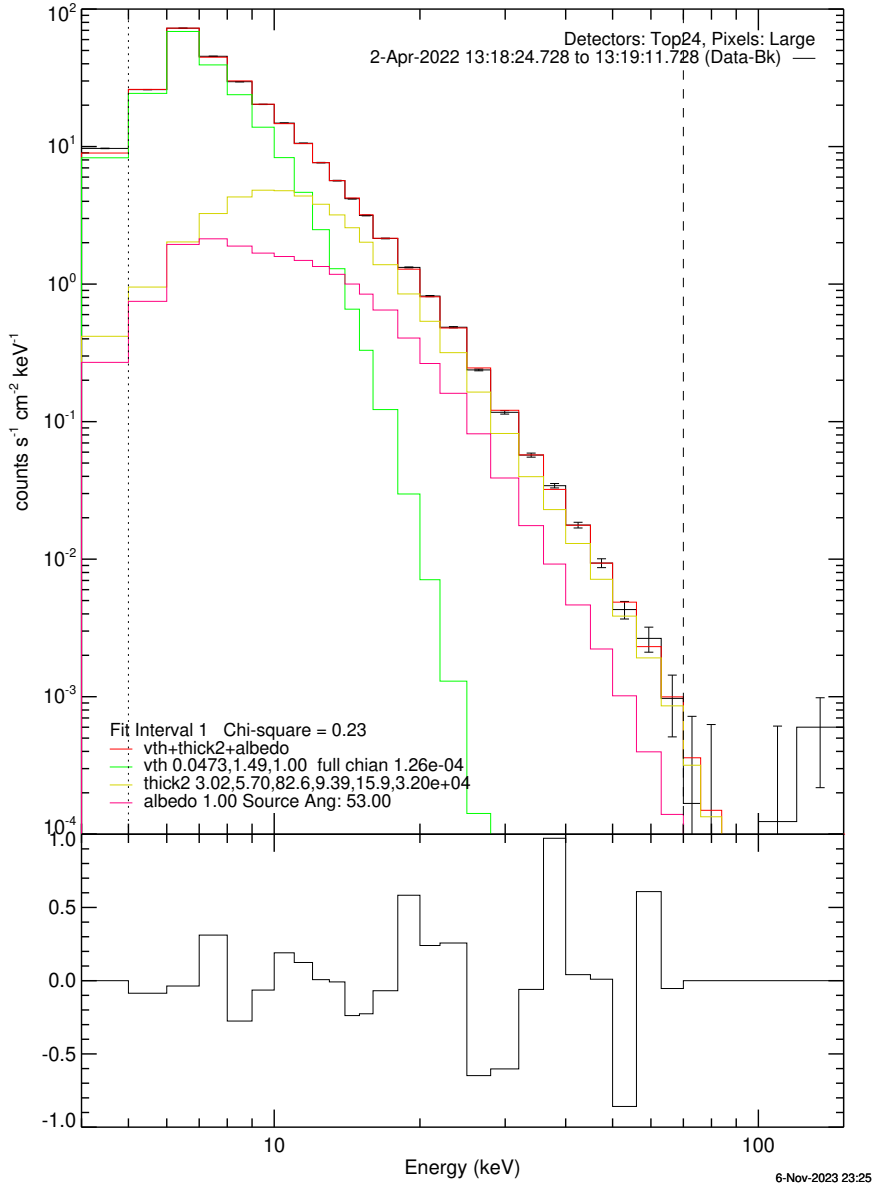

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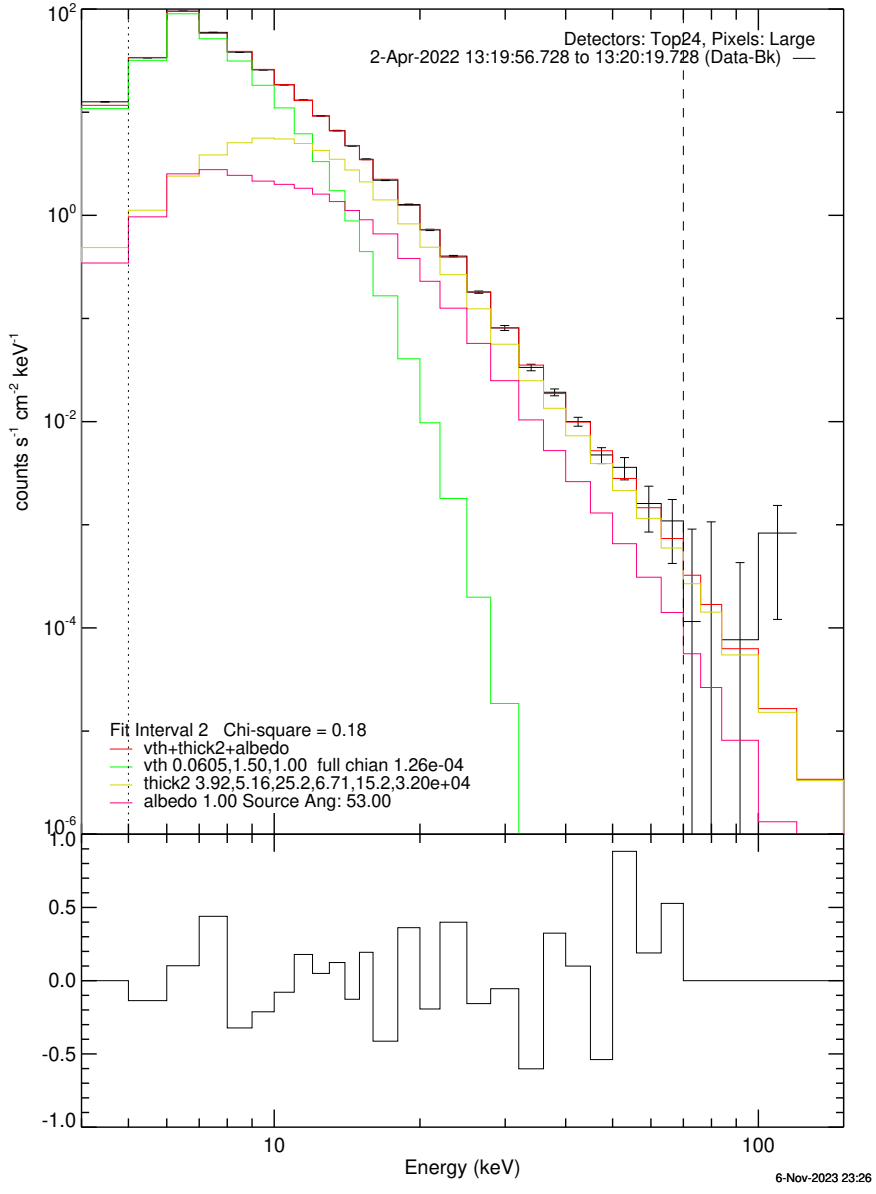

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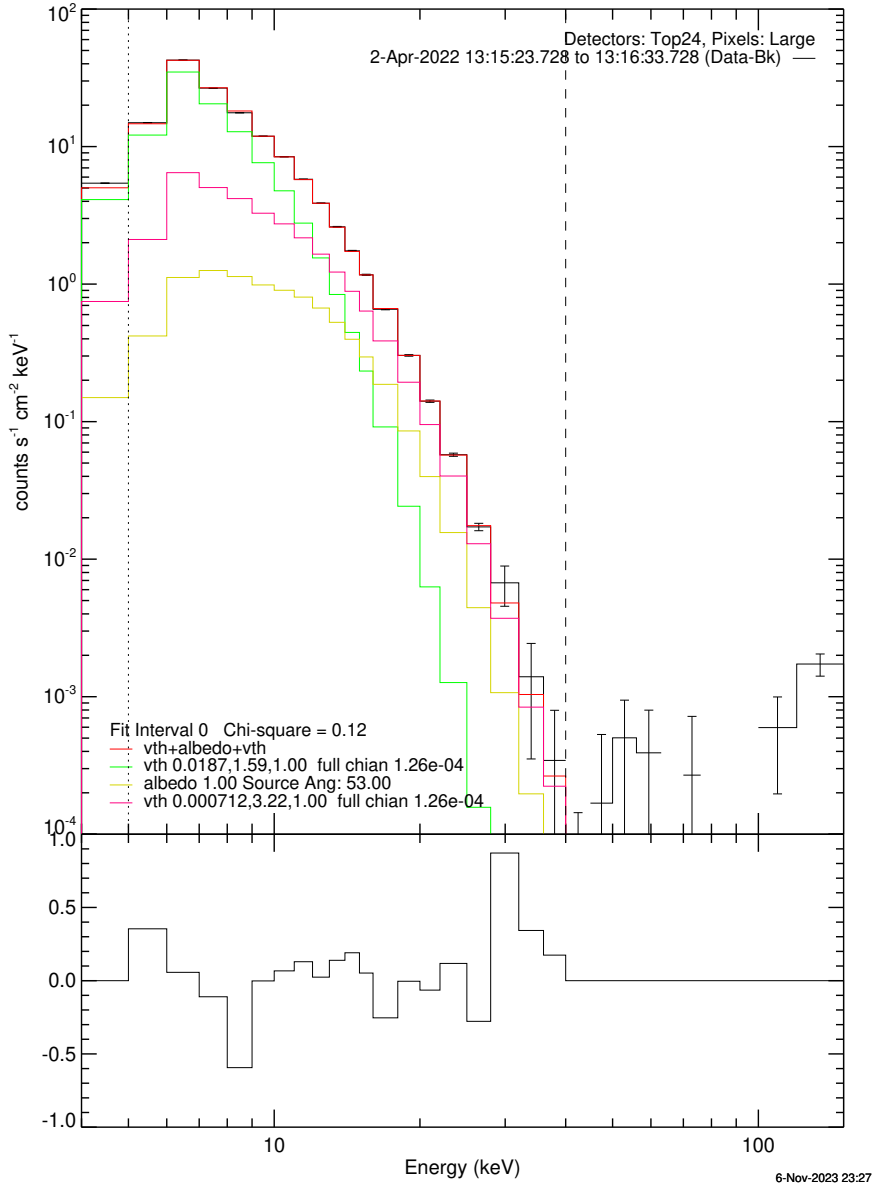

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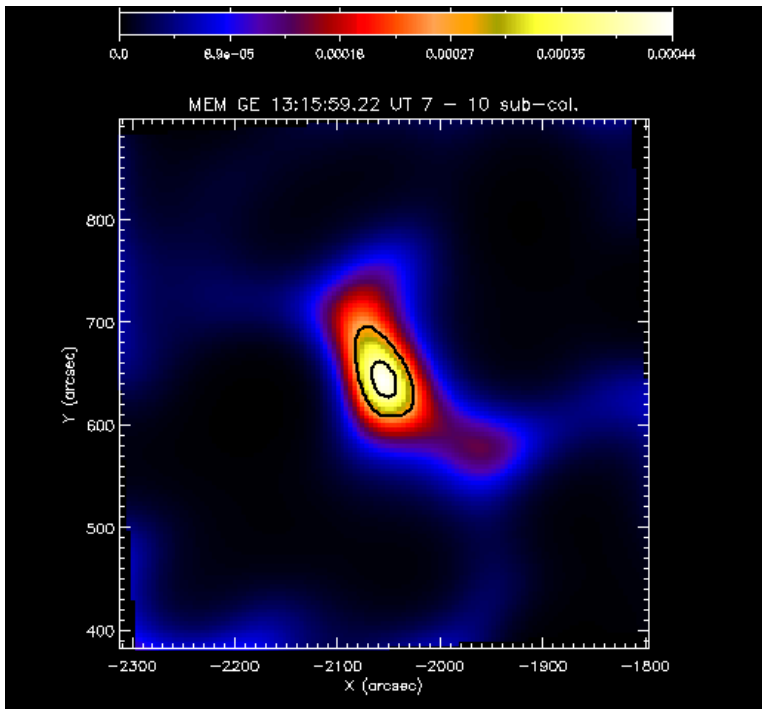
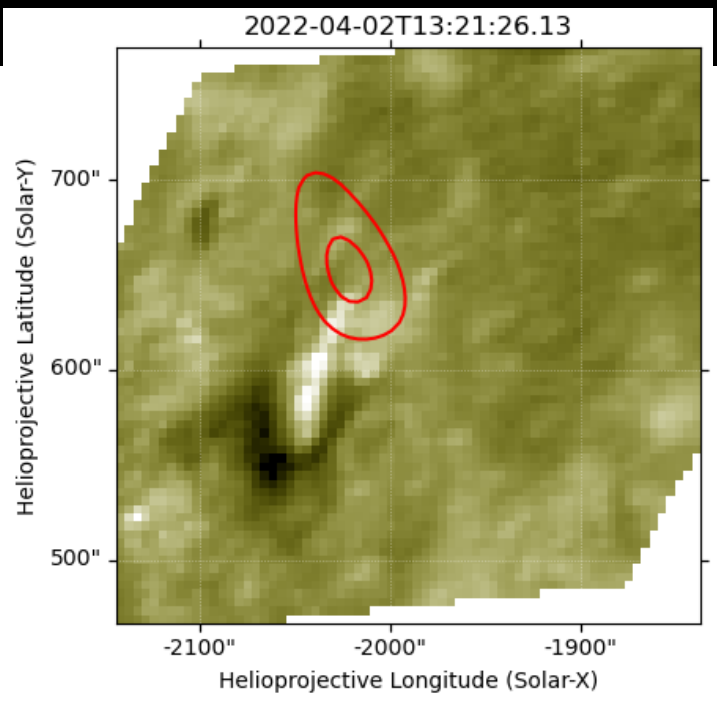
STIX source at 13:16 UT

- early flare phase
- 1st peak in 16 - 25 keV
- modulation in subcoll 4 - 10 but only for some orientations
  - elongated source, thermal ?
- subcoll. 7 - 10 used
- difficult co-alignment with AIA





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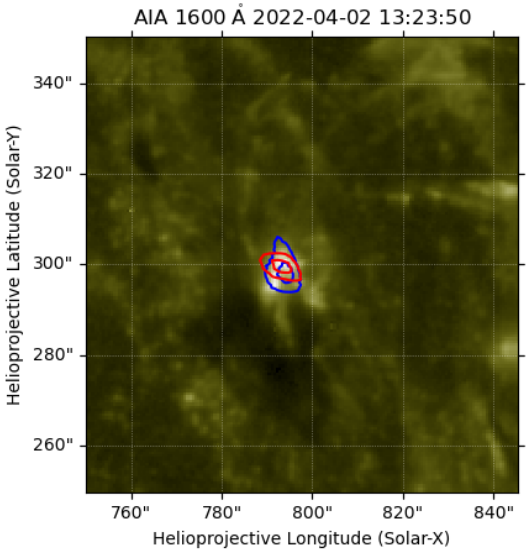
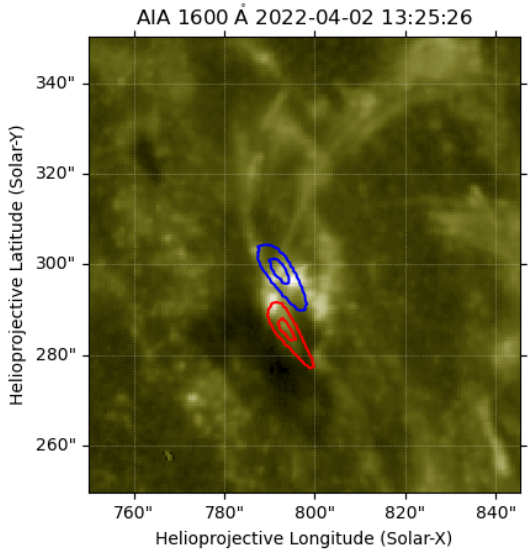
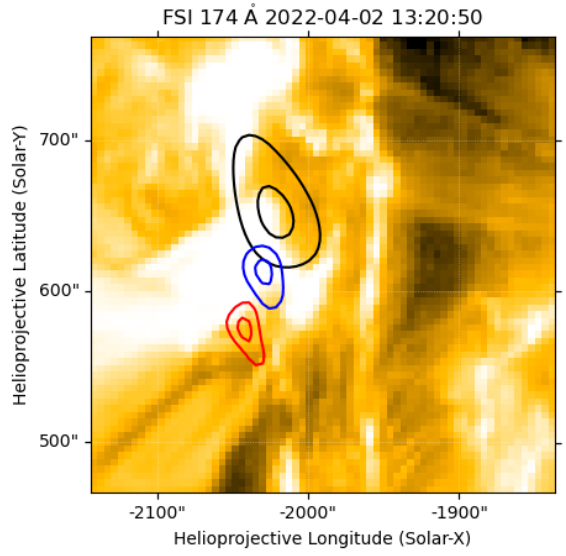
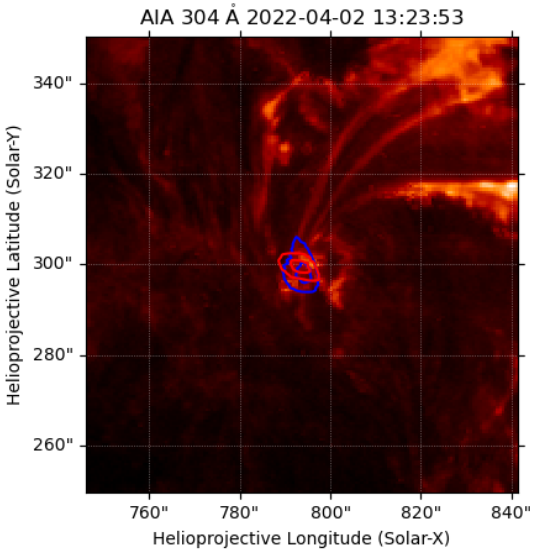
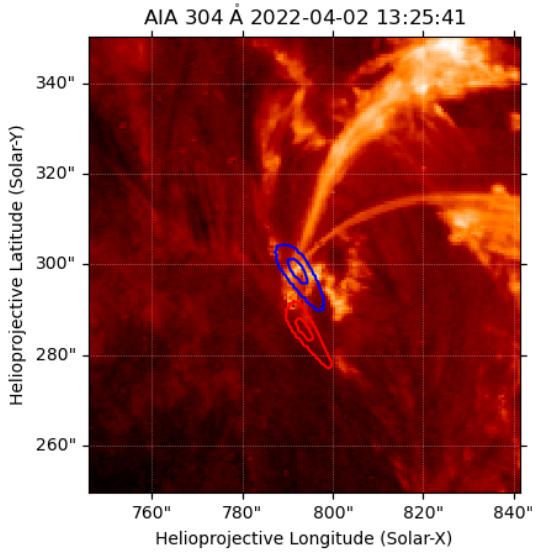
STIX and EUV sources

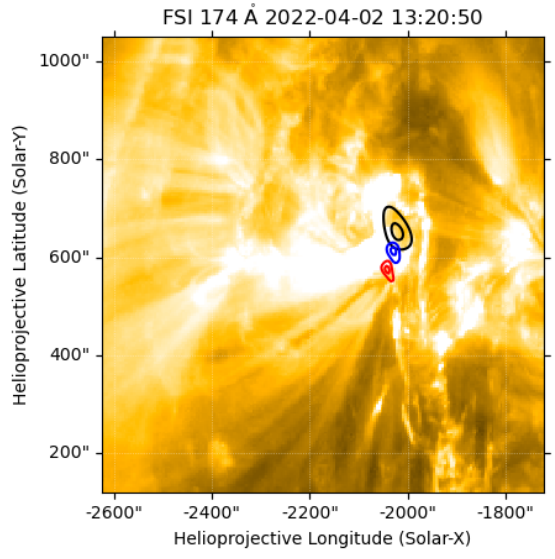












Summary

- we try to reconstruct and understand STIX sources in the early impulsive phase and their relation to EUV structure and radio emission
- remaining issues in imaging
  - check spatial offset between 25 - 28keV and 32 - 45 keV sources using Forward Fit and/or MARLIN (?)
  - further tests to understand why CLEAN sources do not reproduce visibility amplitudes
  - adjust energy range for imaging the source at $\sim$ 13:16 UT