

A multi wavelength study of the long duration May 9 2021 event: combined X-ray, radio and EUV observations: some update

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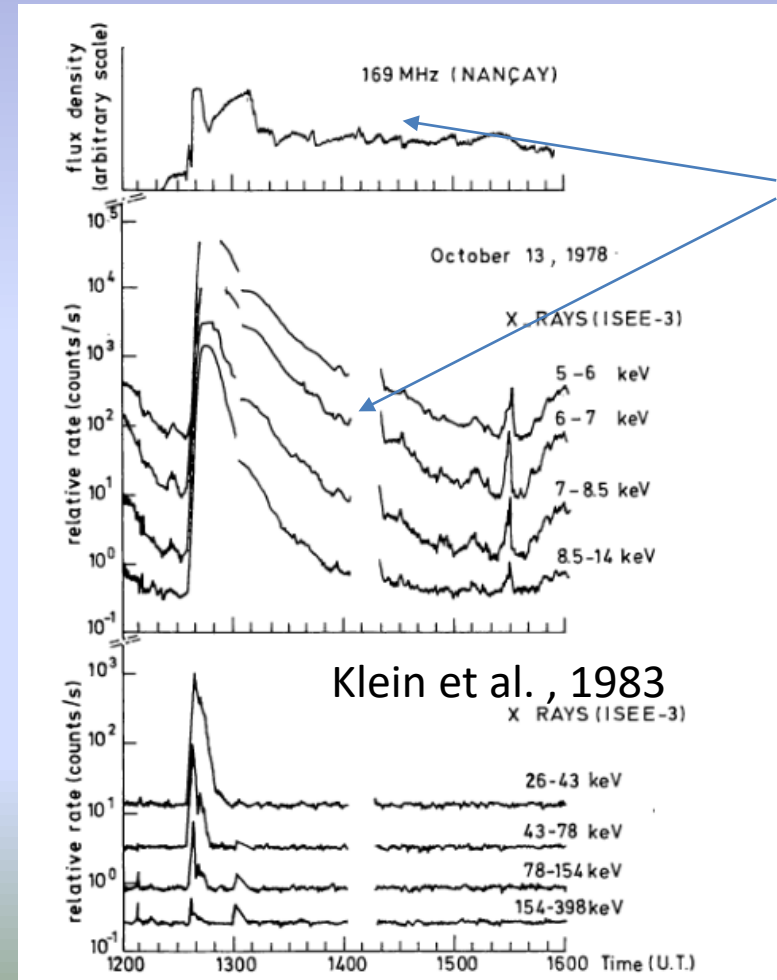
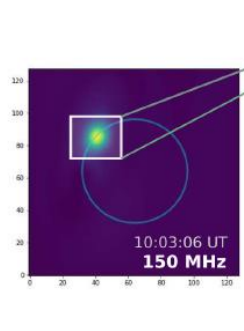
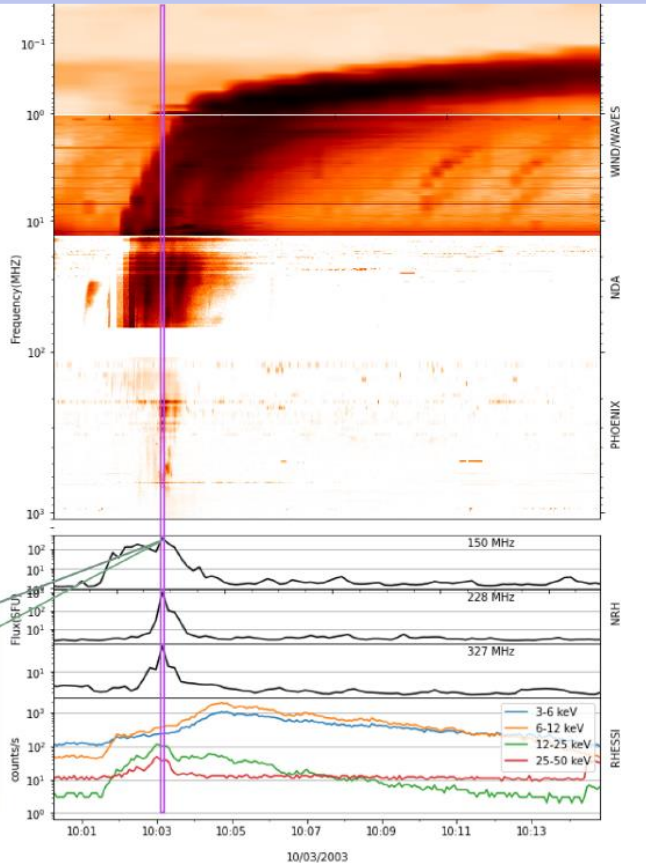
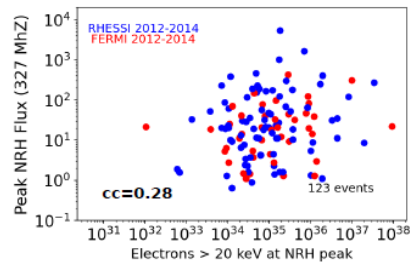
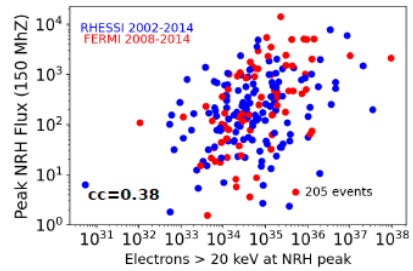


Radio and X-ray emissions: complementary diagnostics of energetic electrons in the corona

A lot of published statistical studies characterizing the correlation between HXR and radio emission intensities for type III bursts (e.g. Reid&Vilmer, 2017; James& Vilmer, 2023)

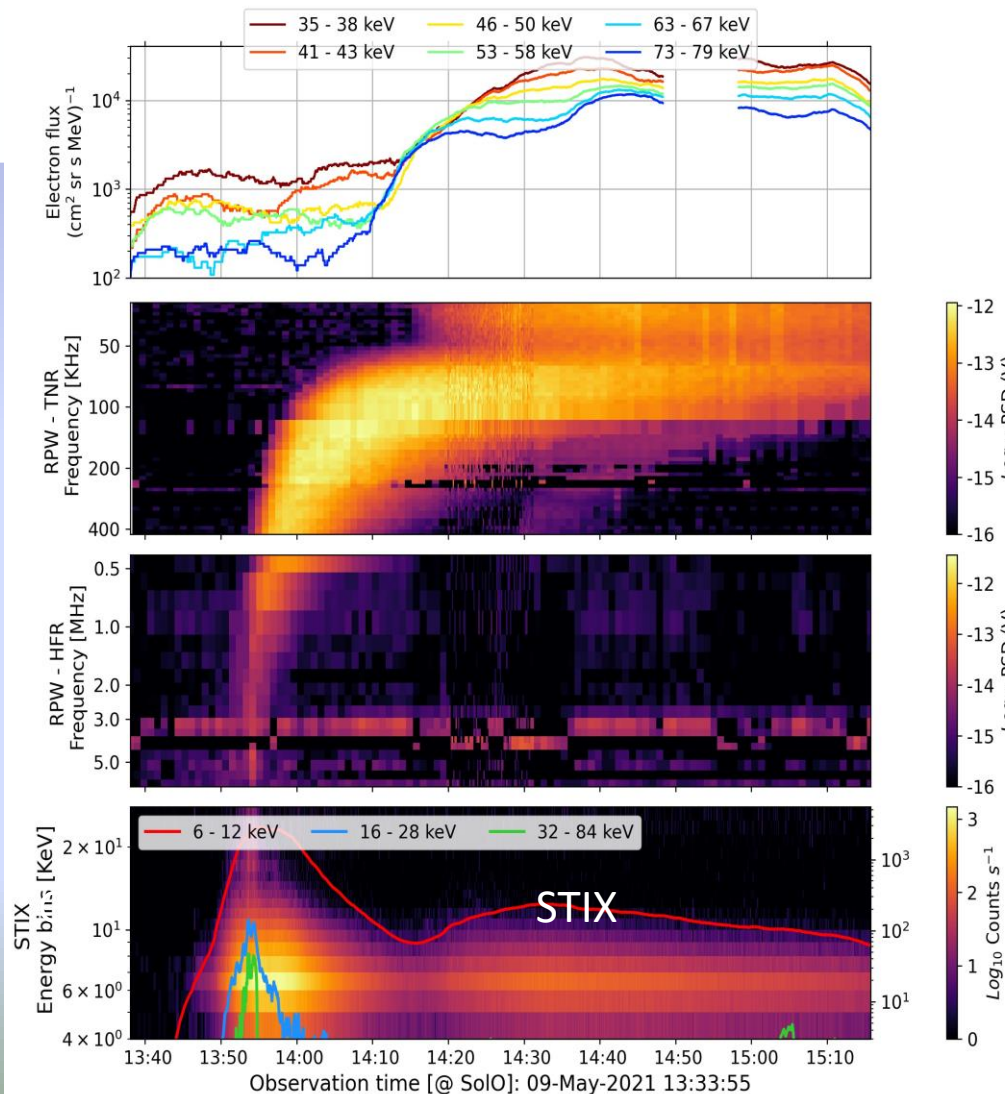
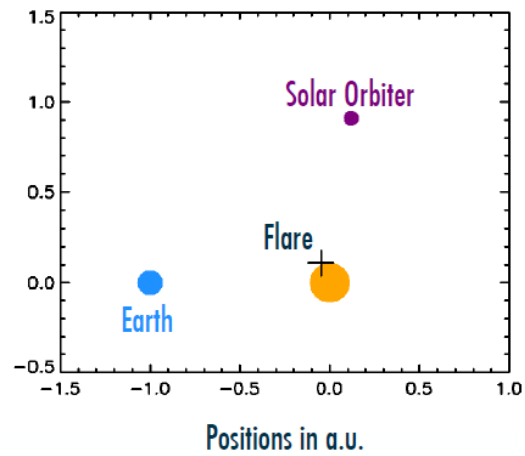
Correlation between non-thermal electron number with $E > 20$ keV at HXR peak vs. peak NRH flux at different frequencies

But much less is known about the correlation of X-ray emissions and radio emissions in long duration events



Metric continuum and X-ray emissions

The 9 May 2021 event: a long duration X-ray flare



Electron event EPD Solar Orbiter

Electron injection time UT@SOLO:

Time shift analysis: 13:58:05 UT@SOLO

Velocity dispersion analysis : 13:56:36 UT@SOLO

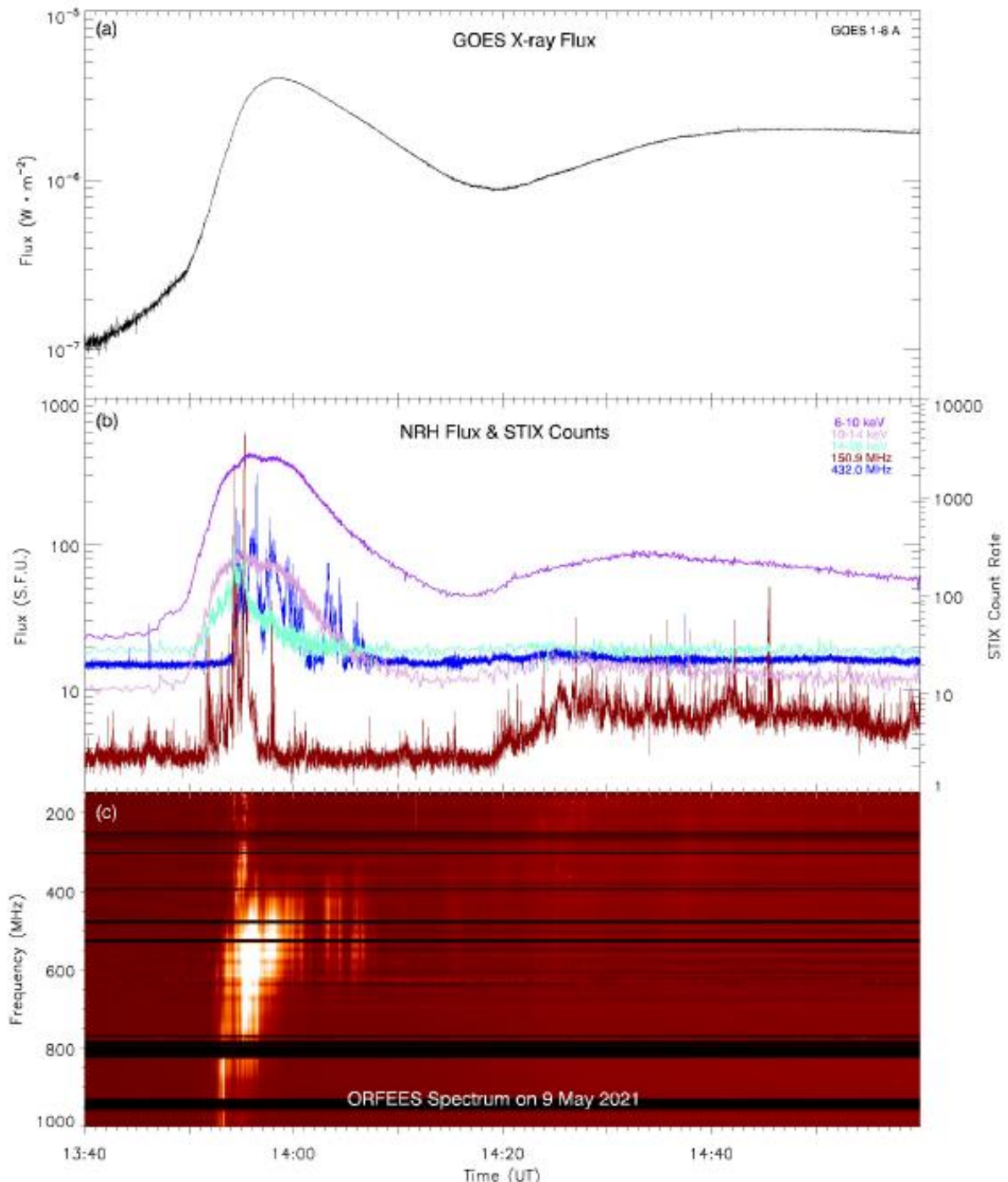
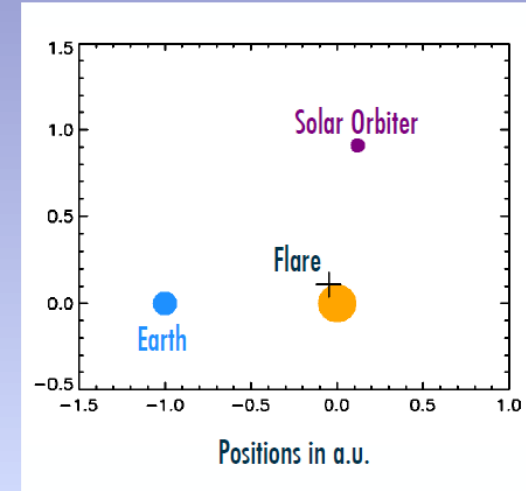
RPW observations

Interplanetary type III bursts

STIX observations

The 9 May 2021 event: a long duration X-ray flare

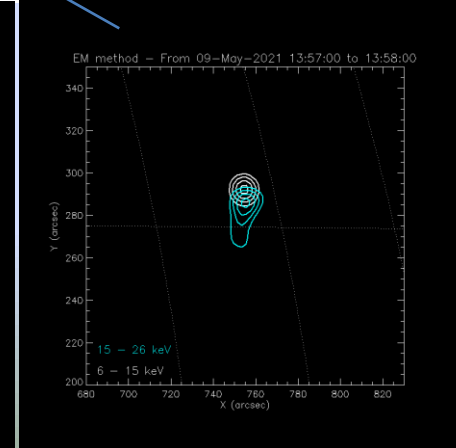
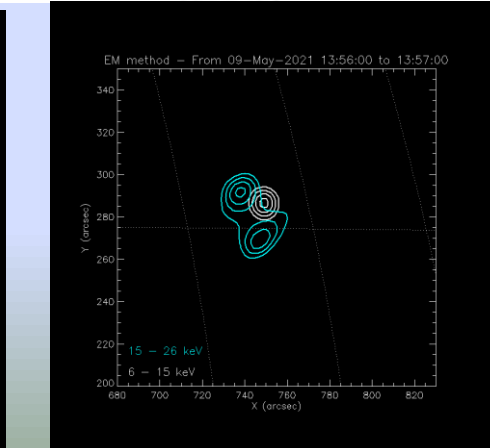
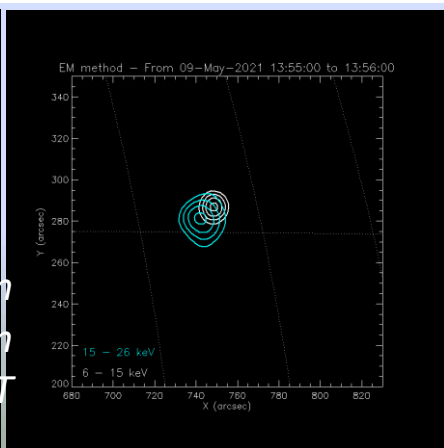
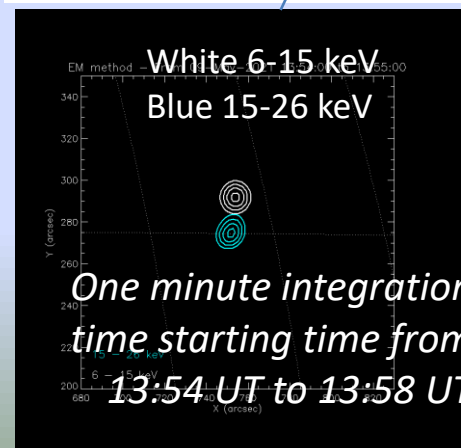
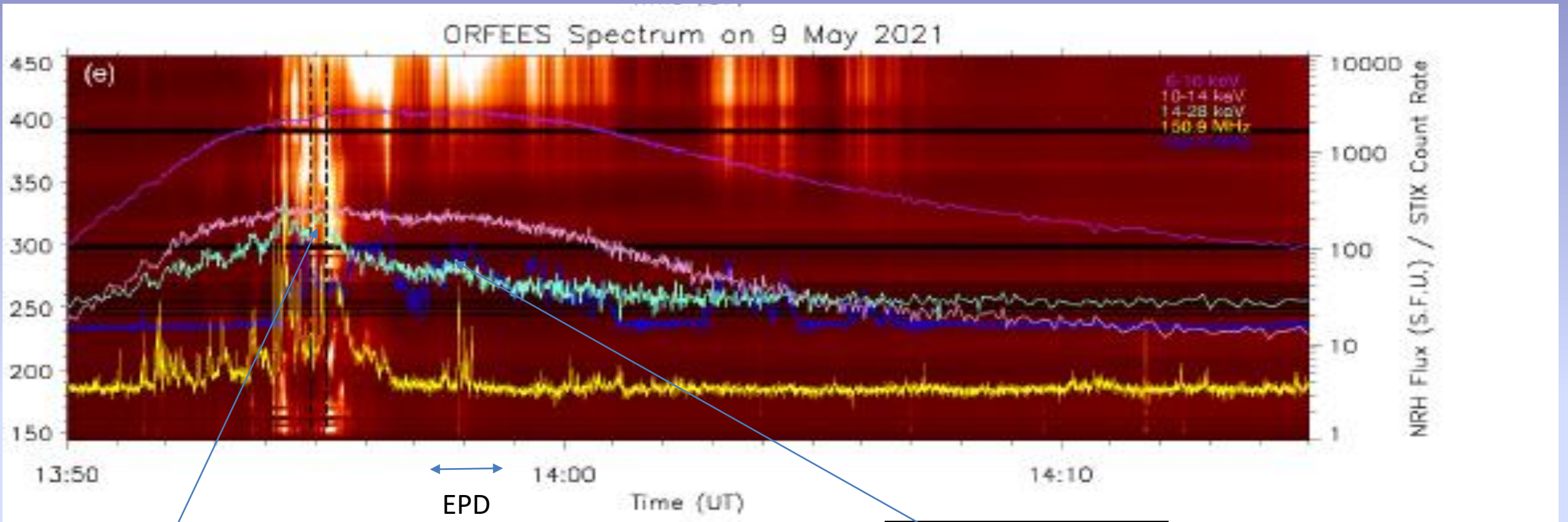
GOES C4.0 flare
(also detected by FERMI/GBM)



Ground-based observations
Impulsive phase: type III bursts
QPPs?

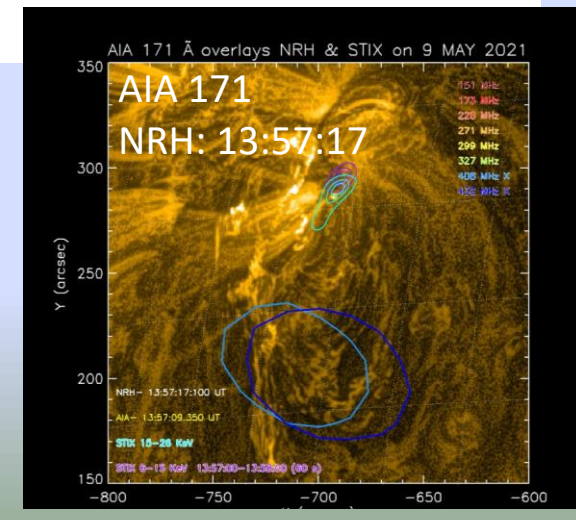
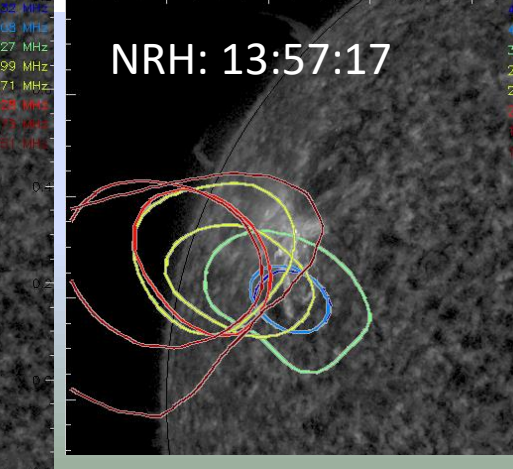
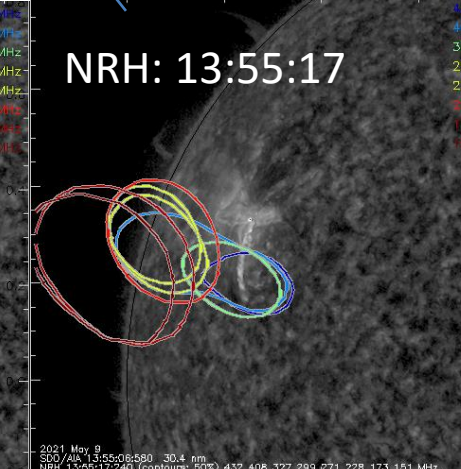
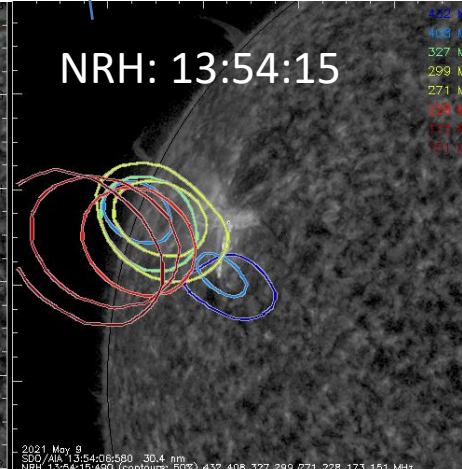
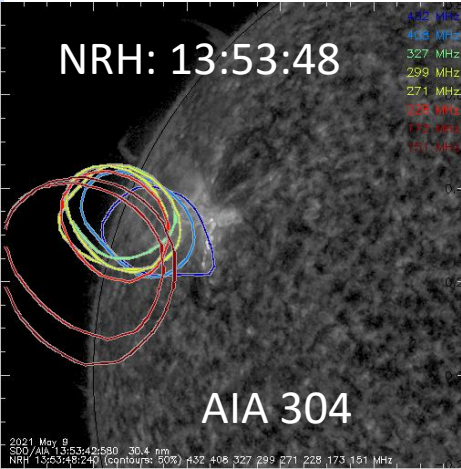
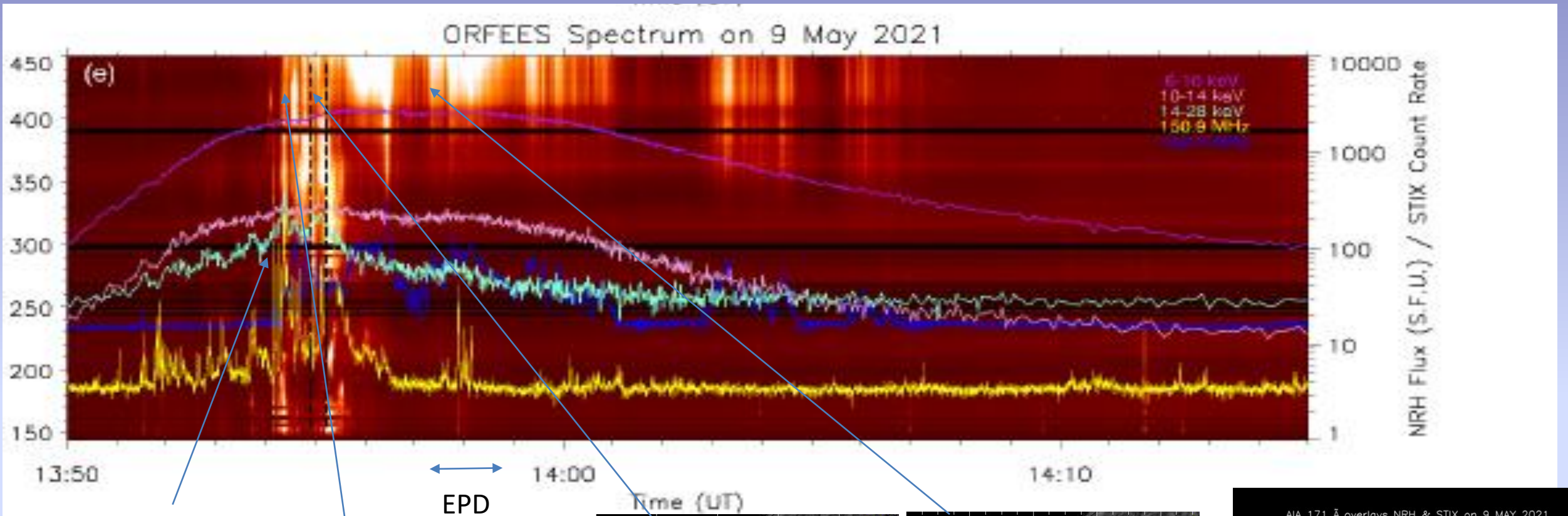
Long duration radio emissions
during the gradual X-ray phase

Evolution of X-ray sources during the impulsive phase

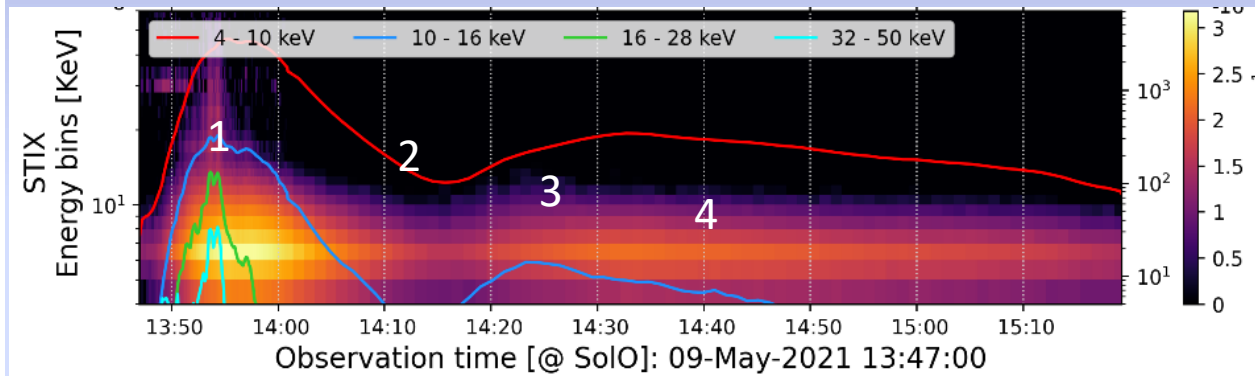
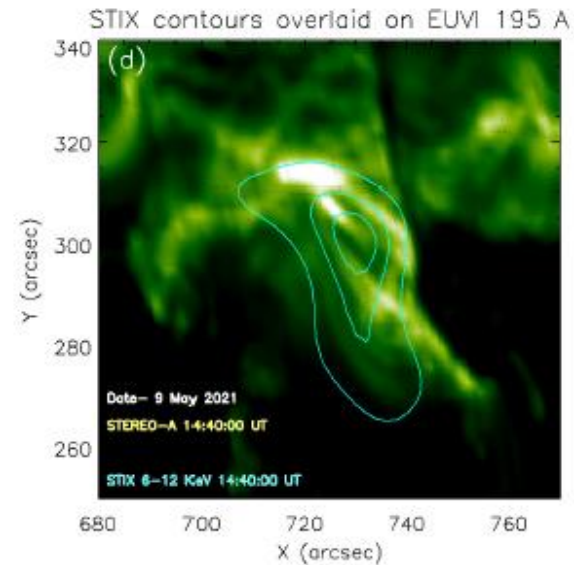
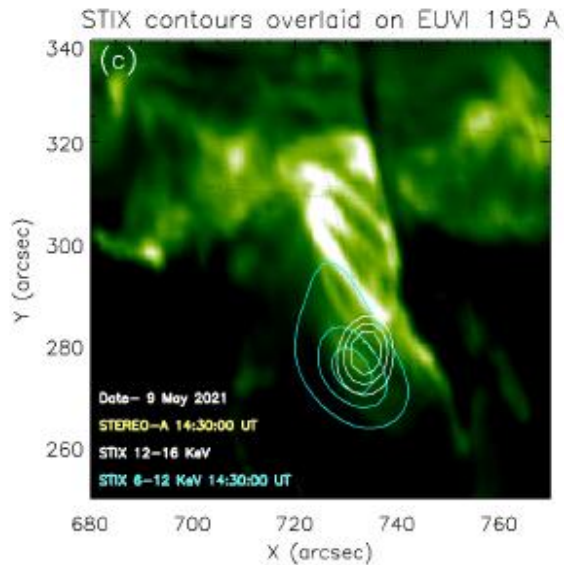
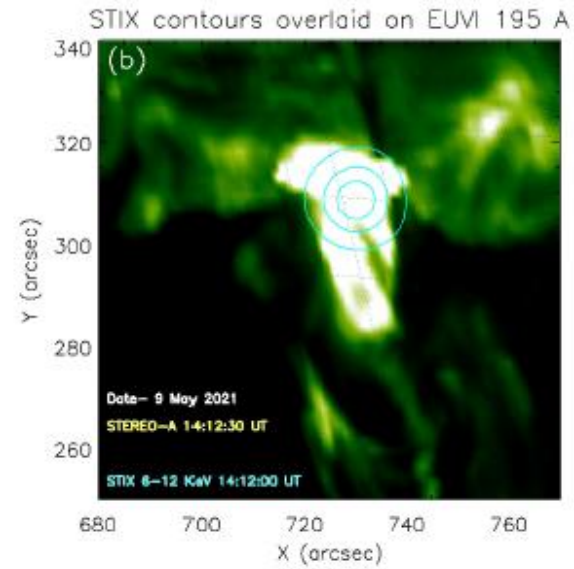
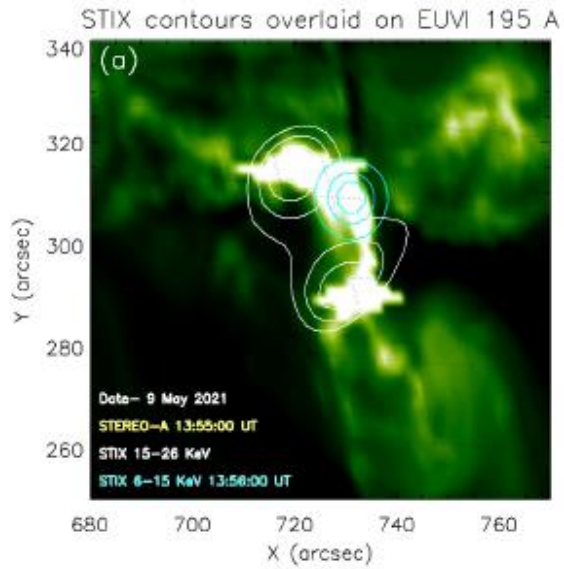


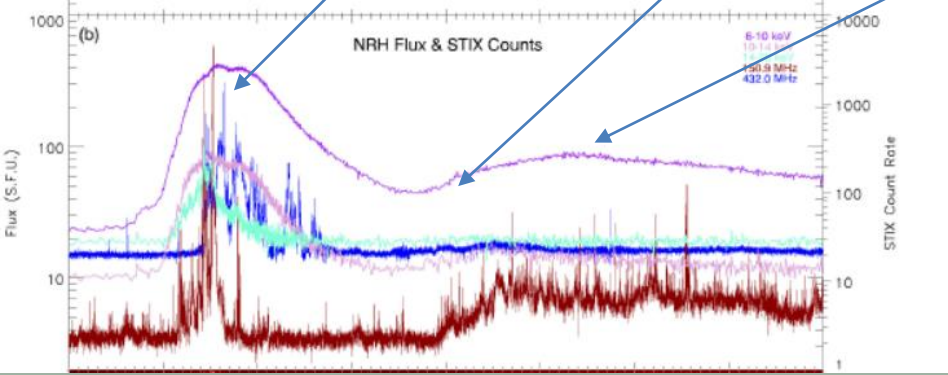
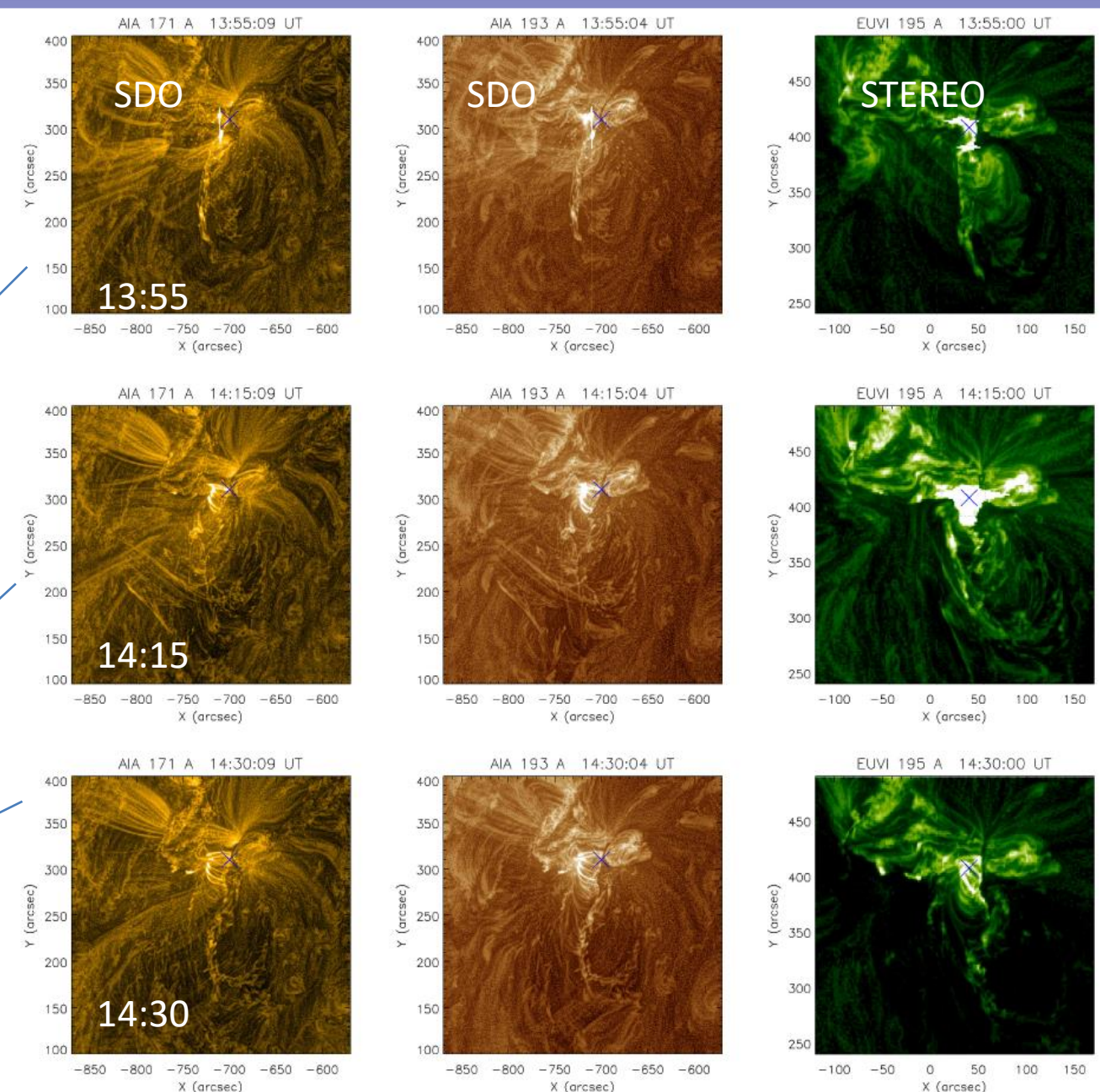
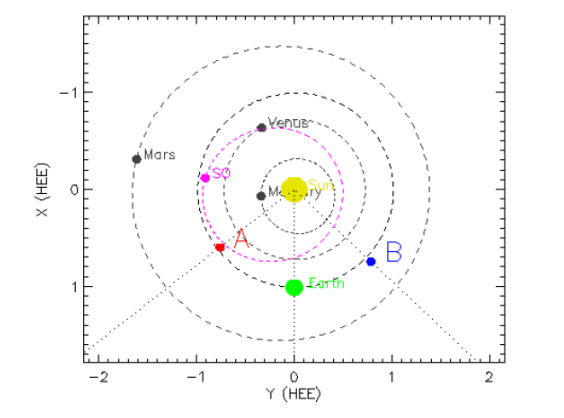
Electron injection time
UT@SOLO:
Time shift analysis: 13:58:05
UT@SOLO
Velocity dispersion analysis :
13:56:36 UT@SOLO
(+44 s for ground-based data
comparison)

Evolution of radio sources during the impulsive phase

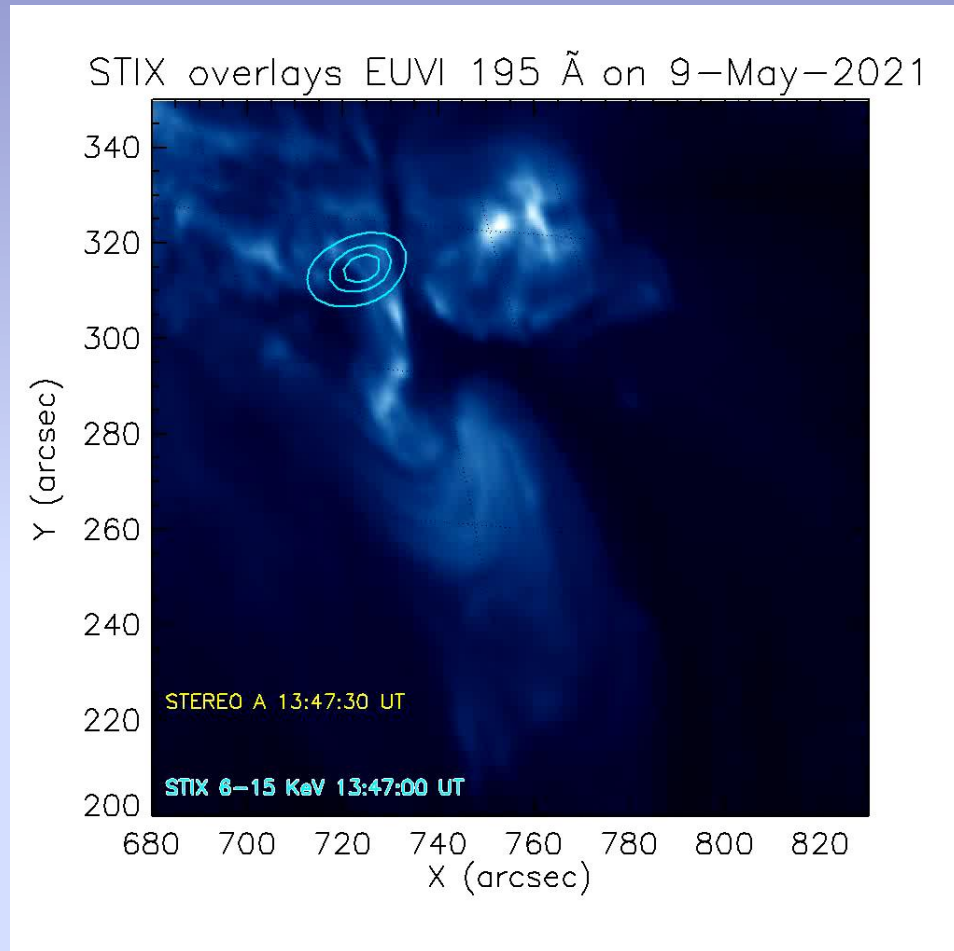


X-ray and EUV evolution



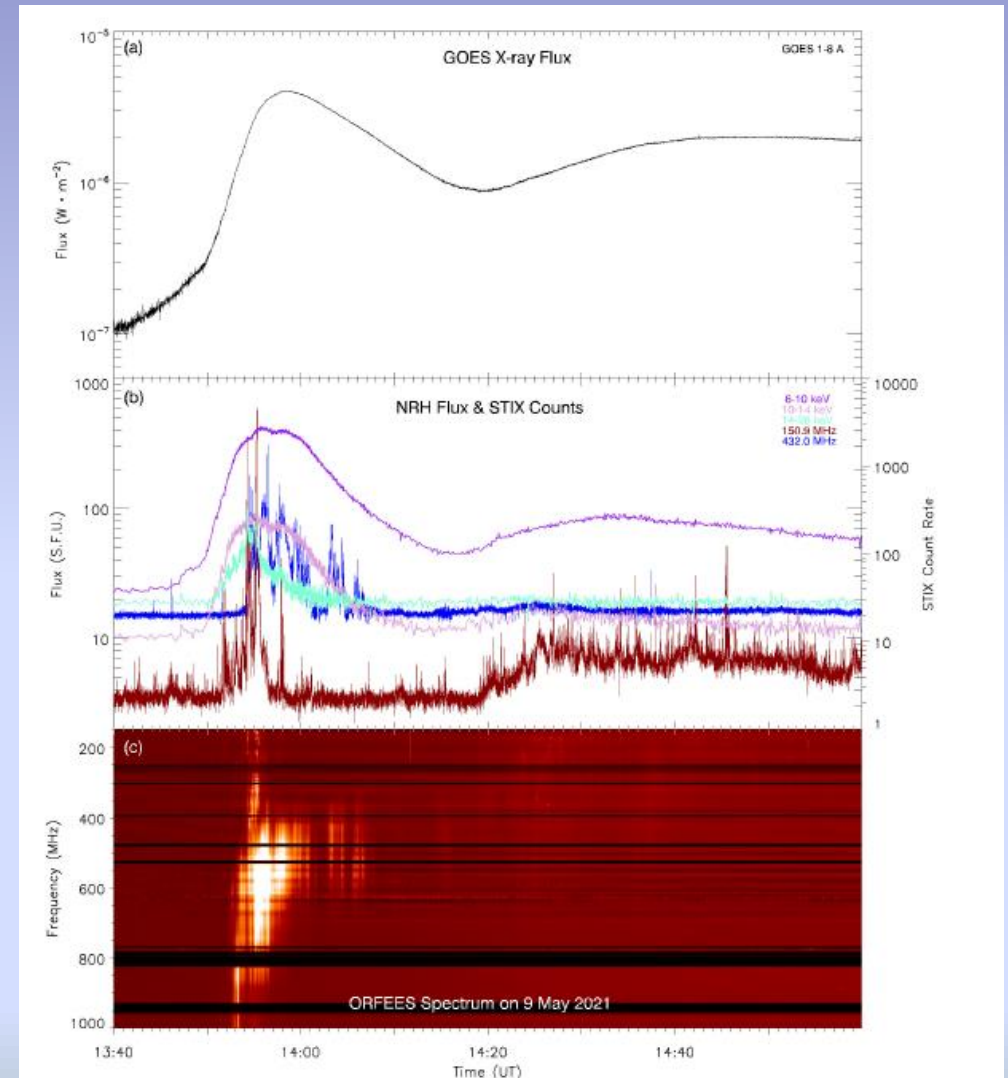


X-ray and EUV emissions



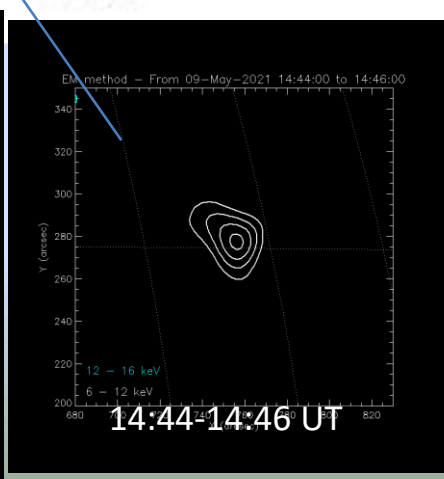
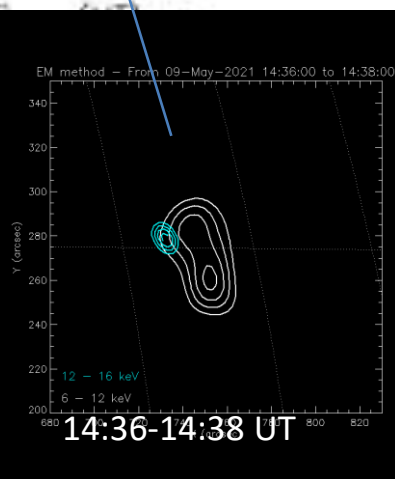
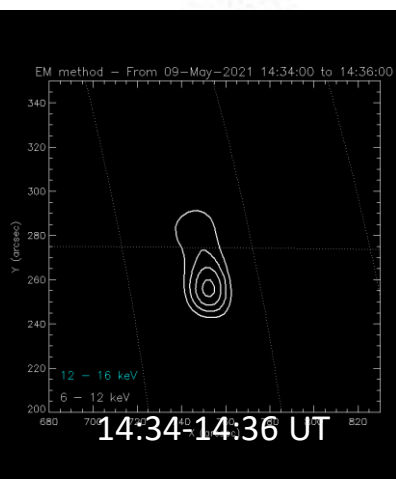
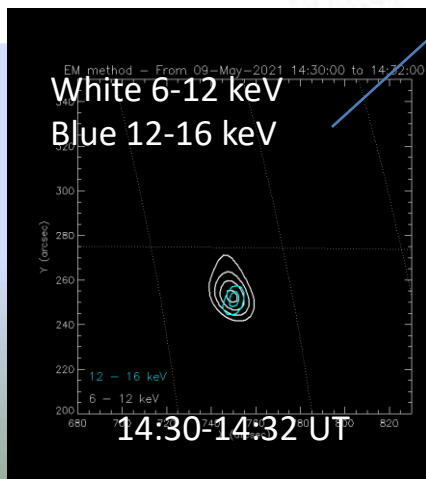
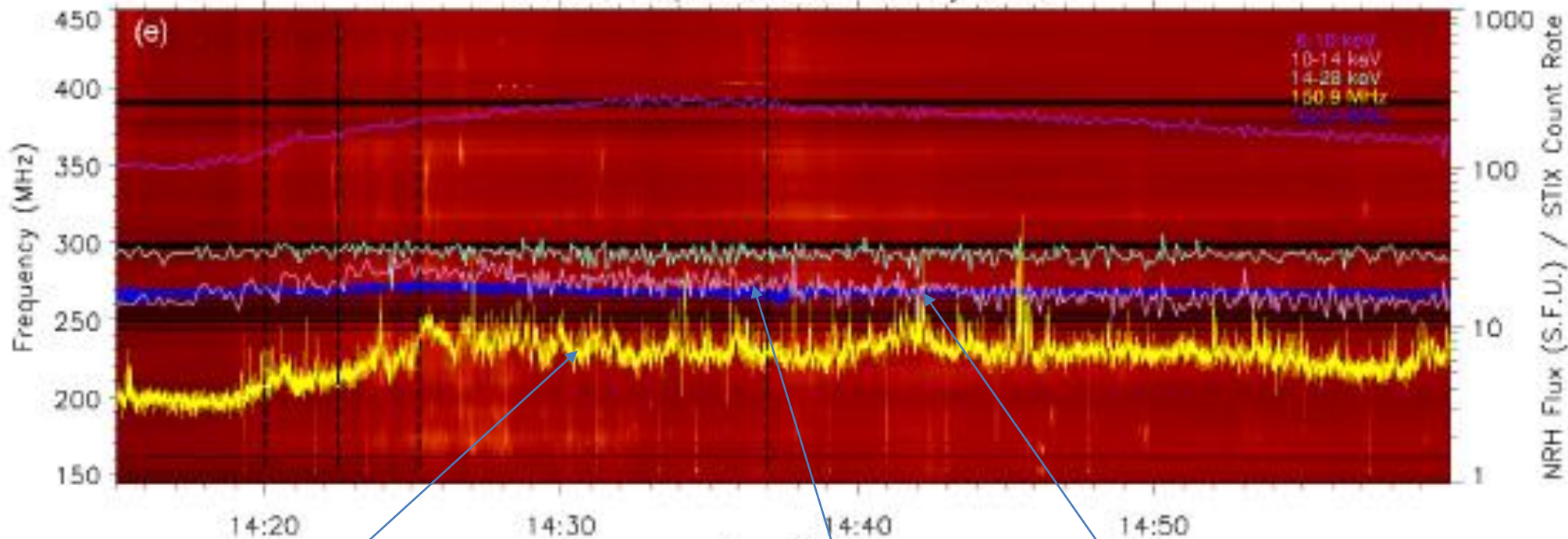
6-15 keV blue contours
15-26 keV white contours

SO point of view



Evolution of X-ray sources during the gradual phase

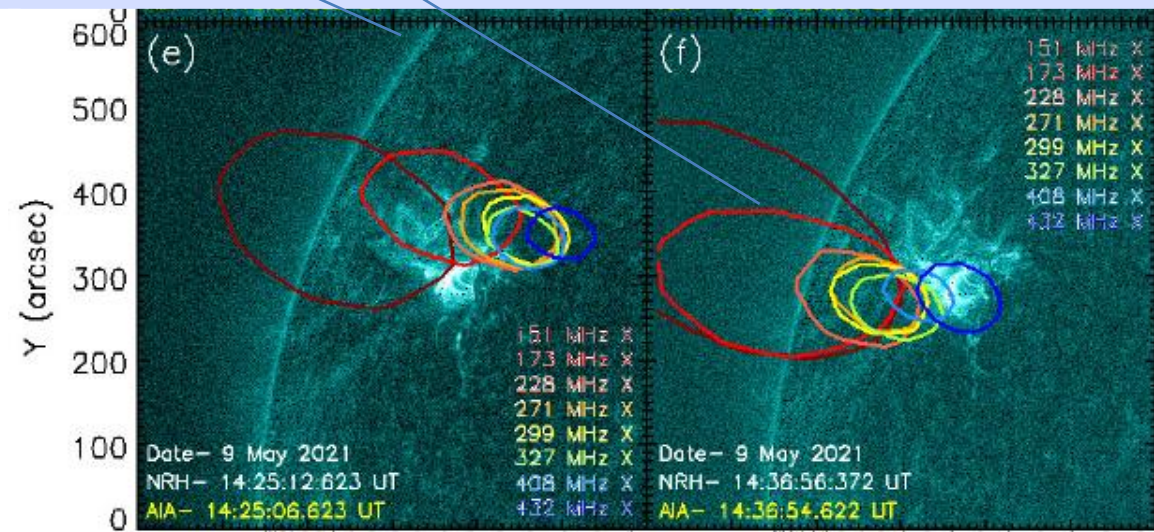
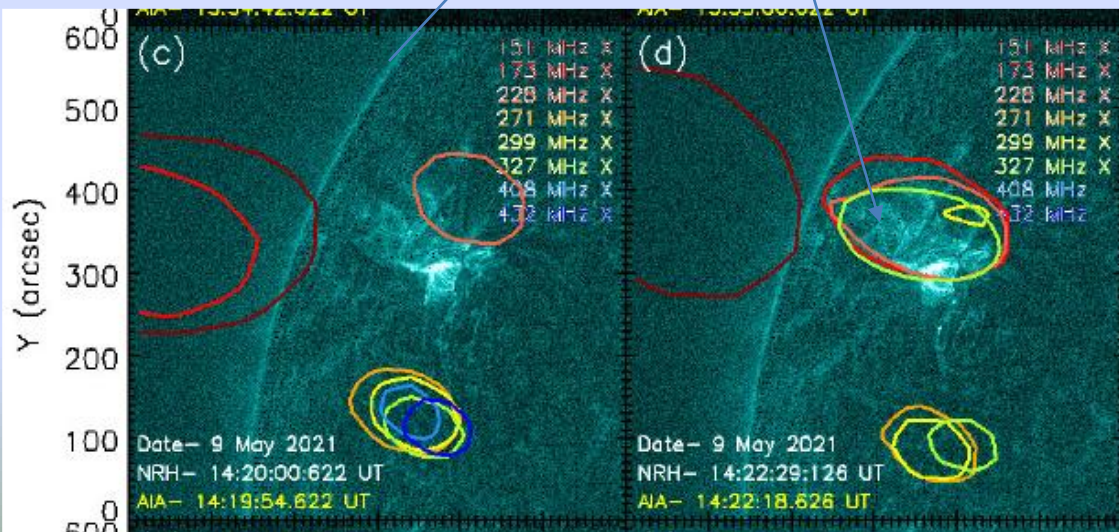
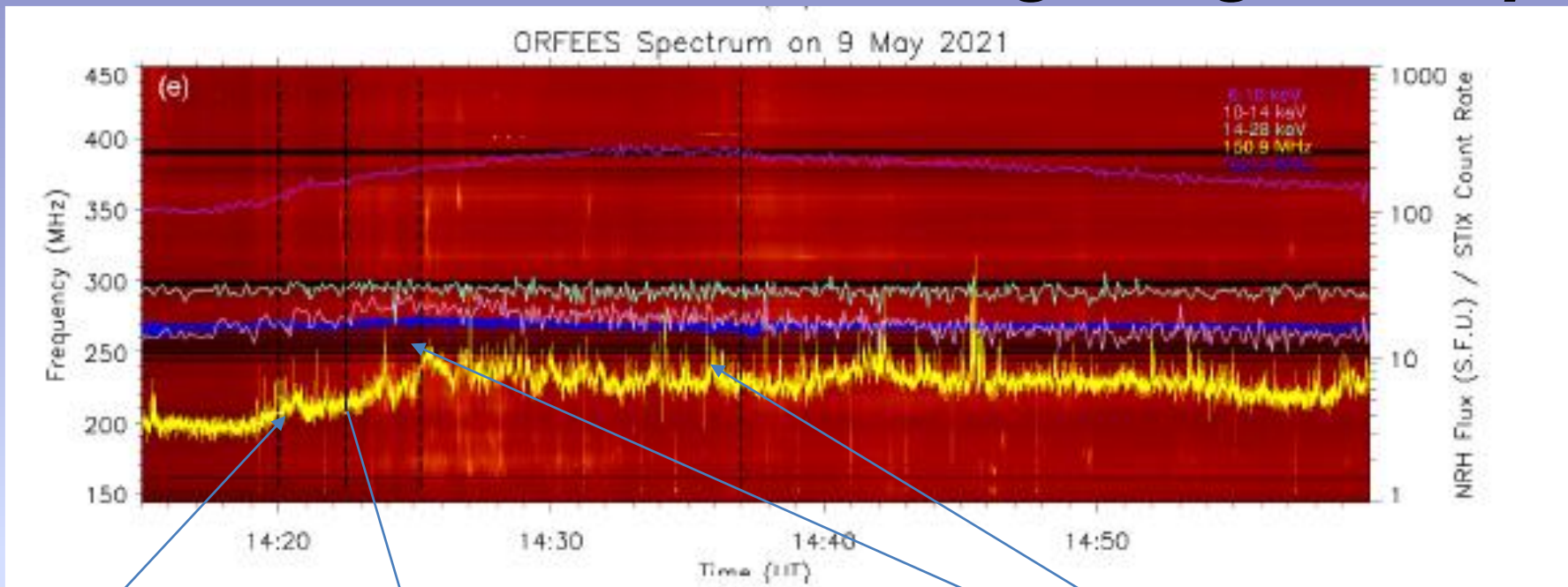
ORFEES Spectrum on 9 May 2021

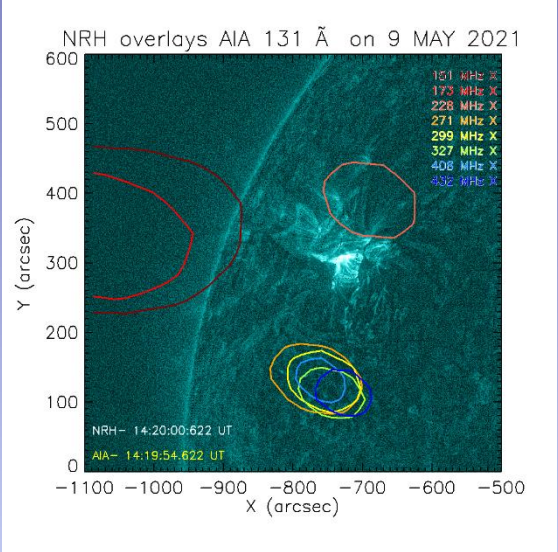


*Change of positions
between 14:30 and 14h36*

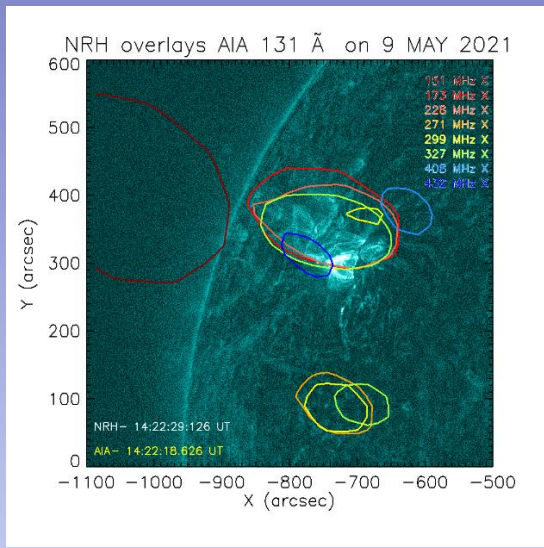
*Some non-thermal
emission ?*

Evolution of radio sources during the gradual phase

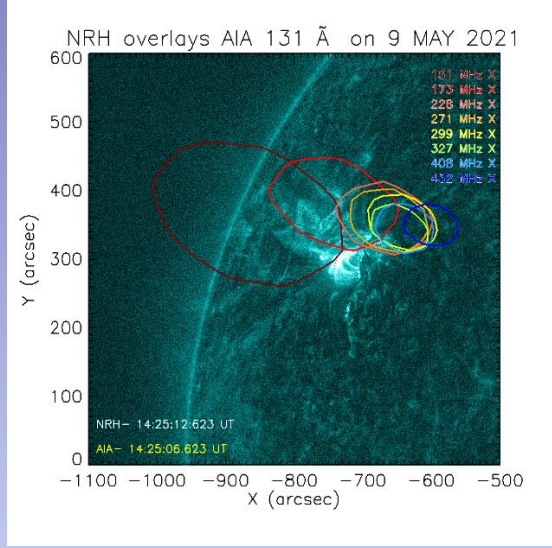




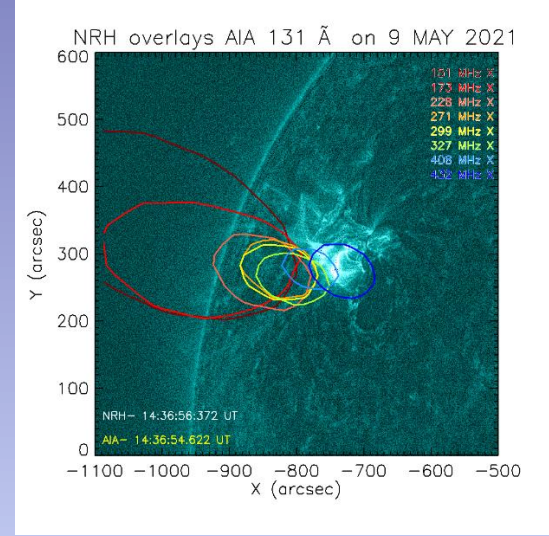
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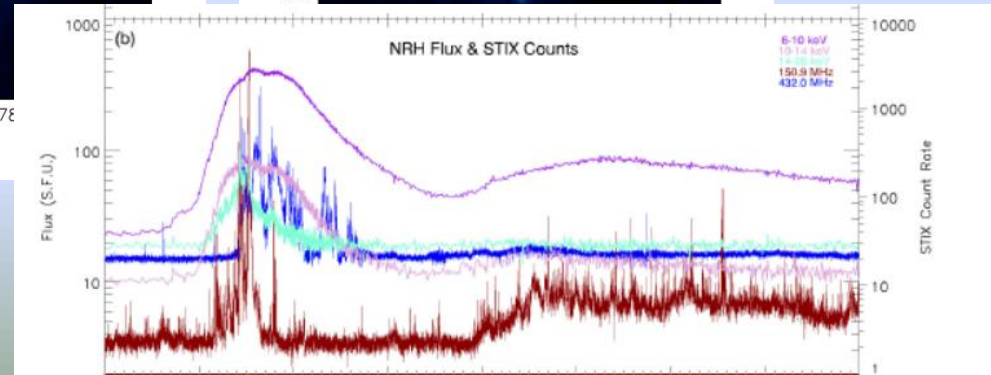
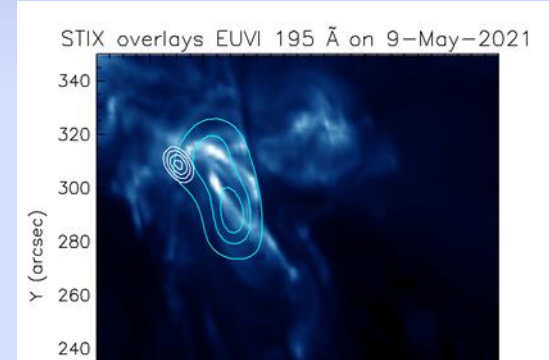
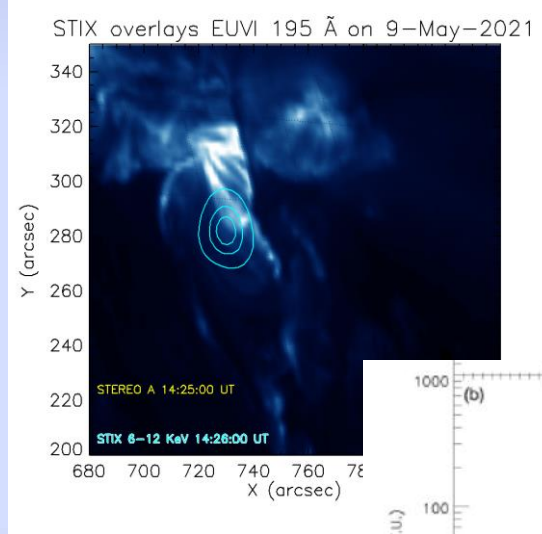
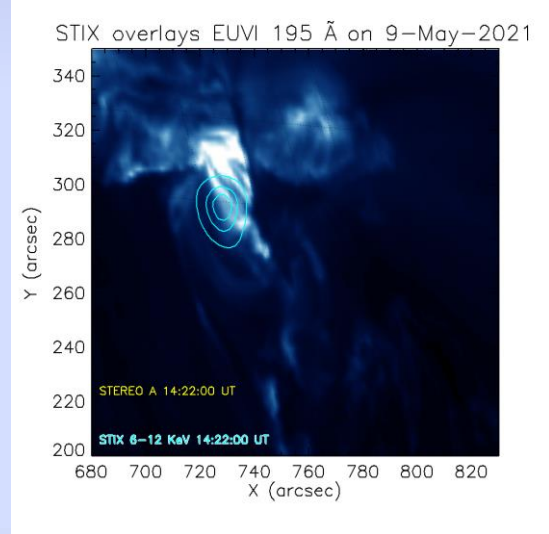
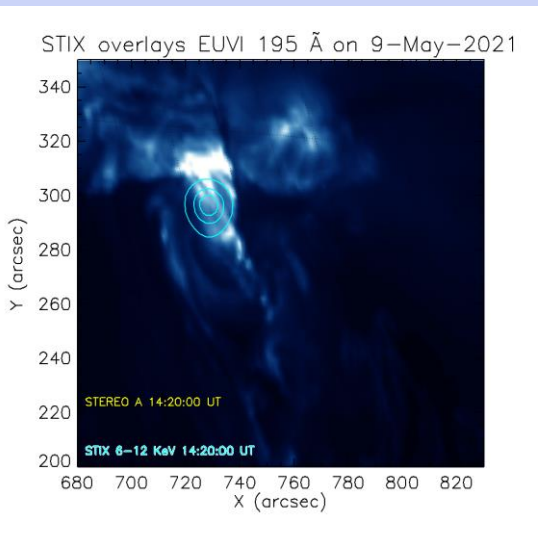
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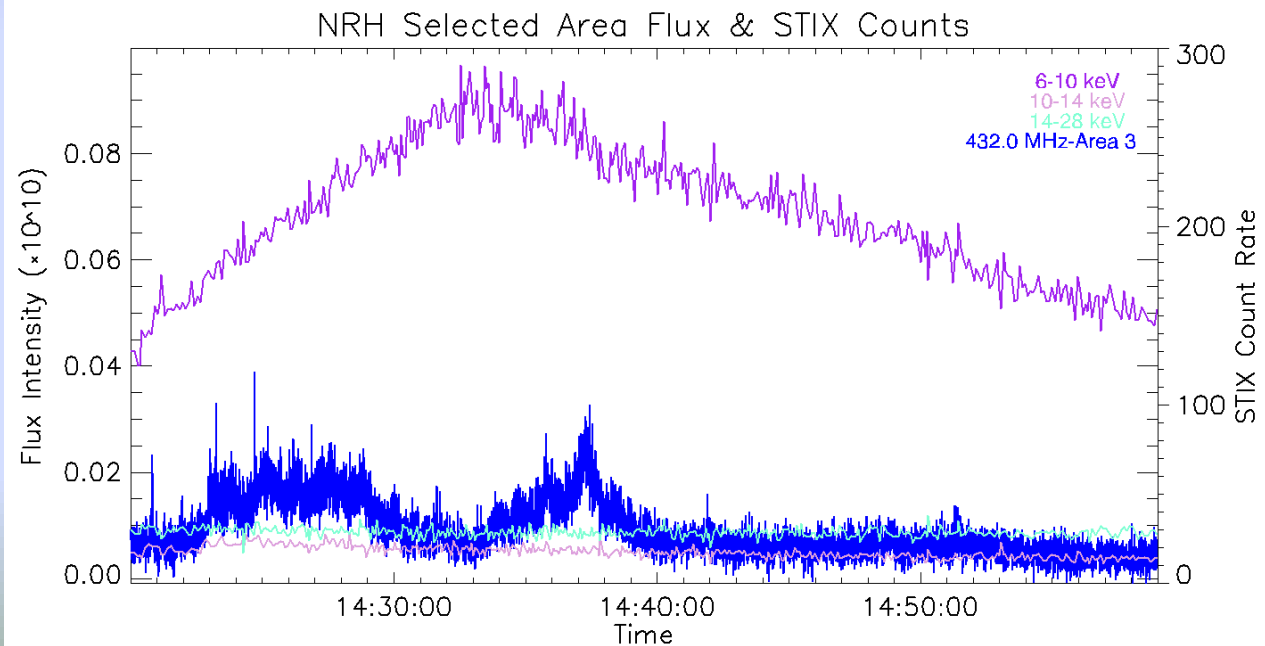
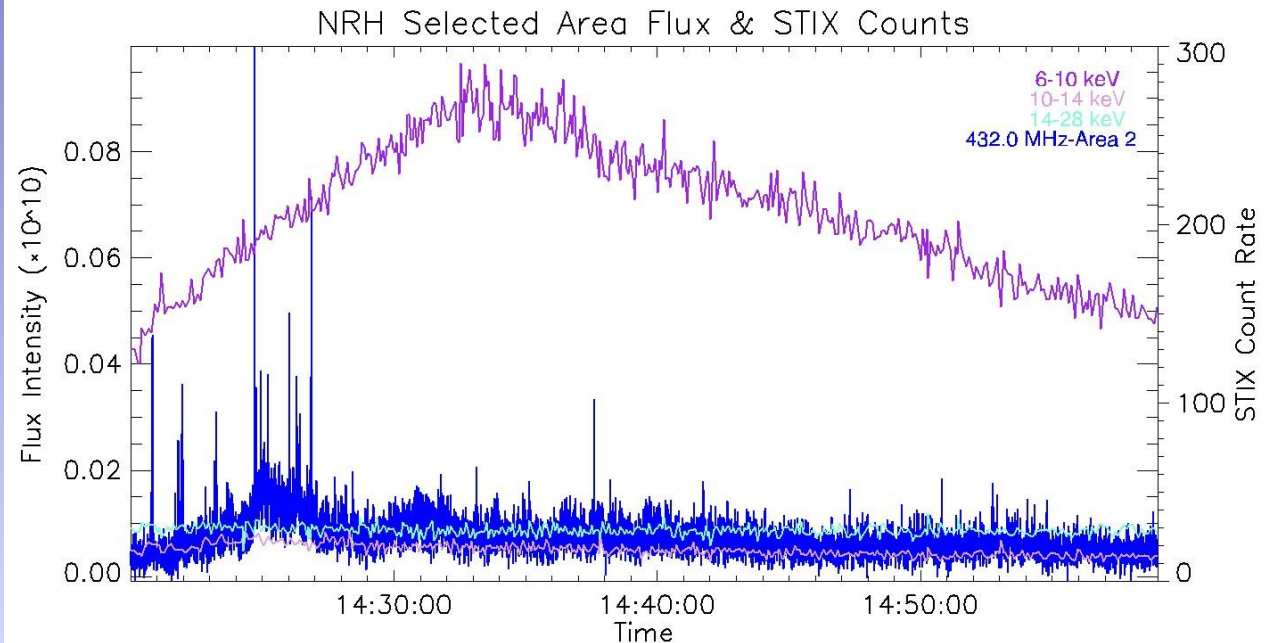
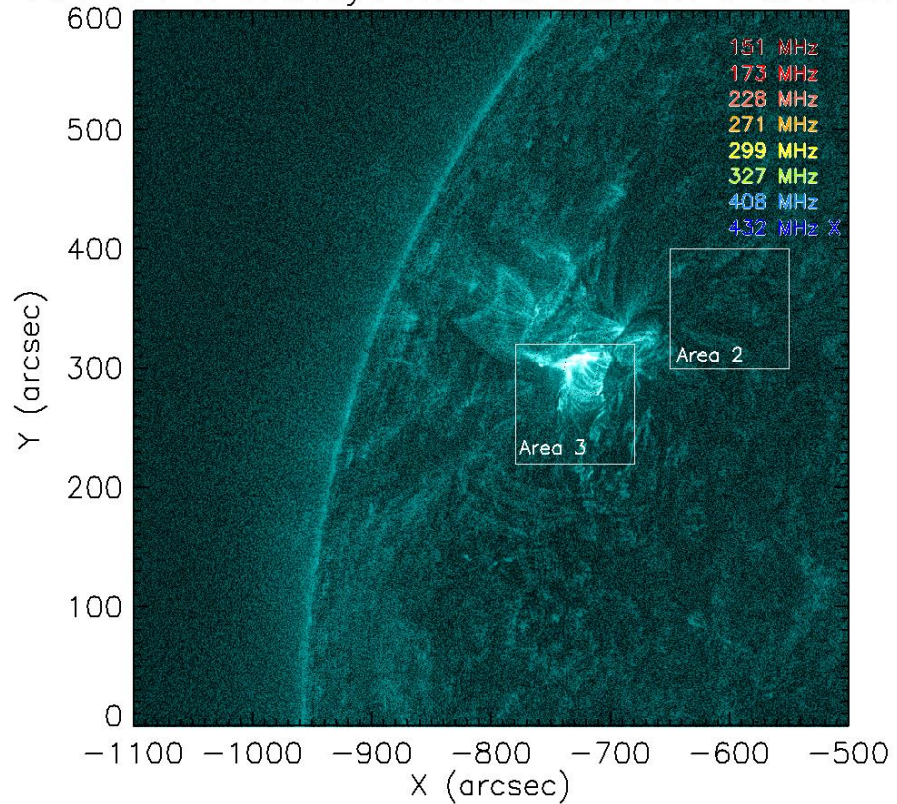
14:25



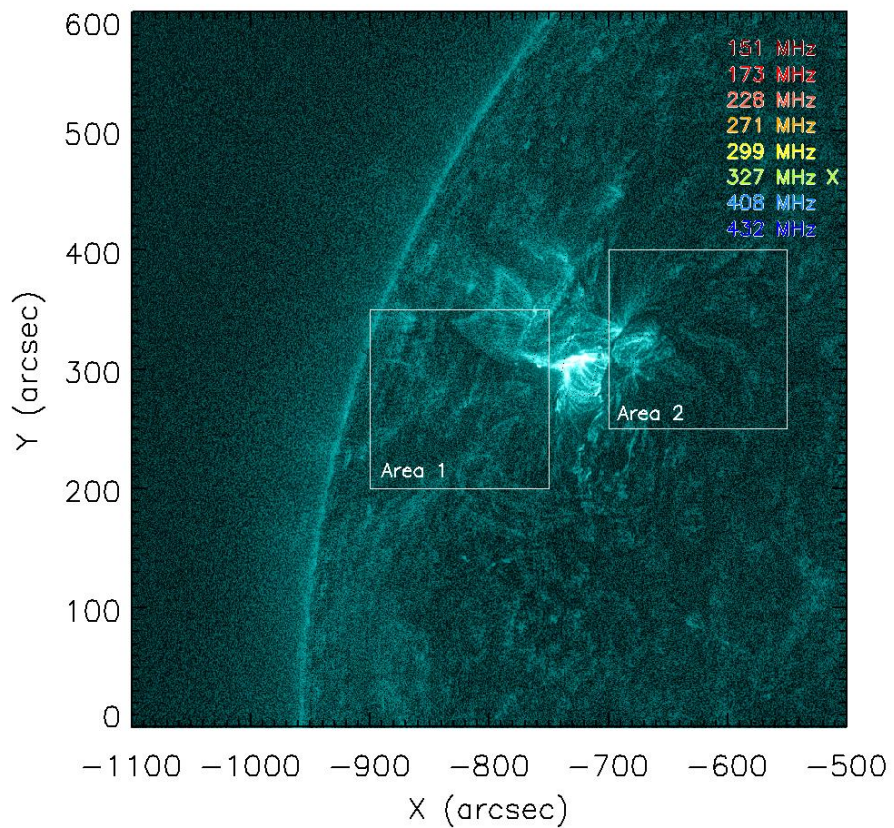
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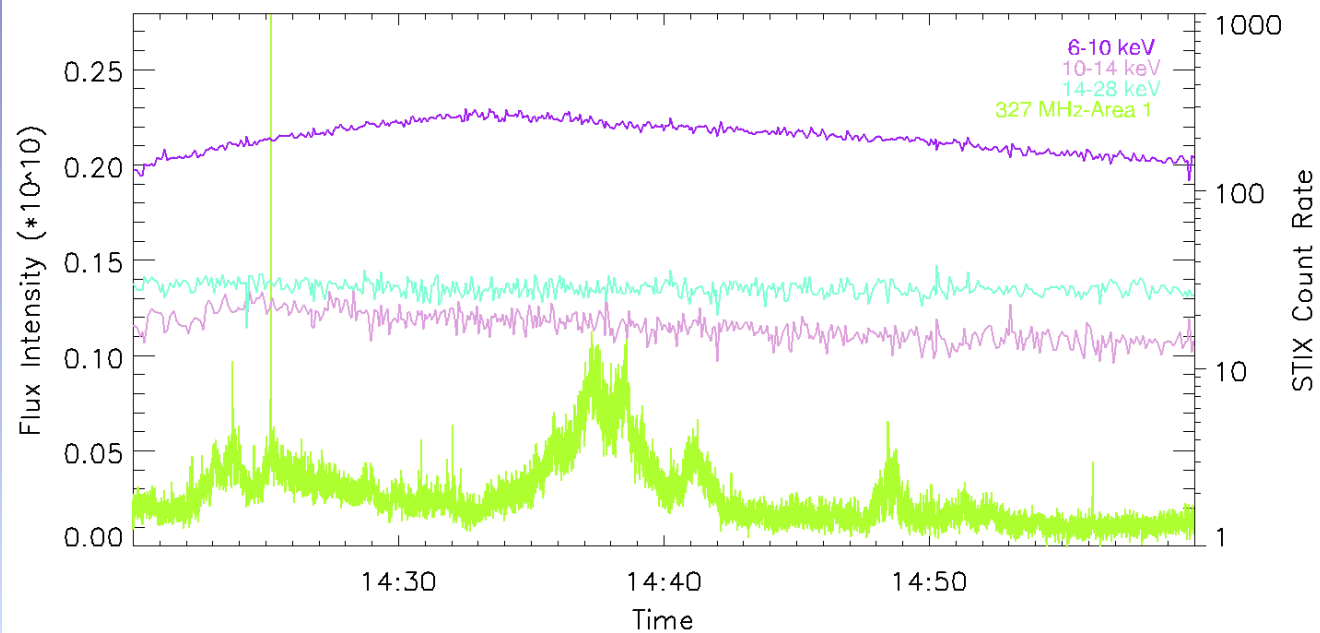
AIA 131 Å overlays NRH & STIX on 9 MAY 2021



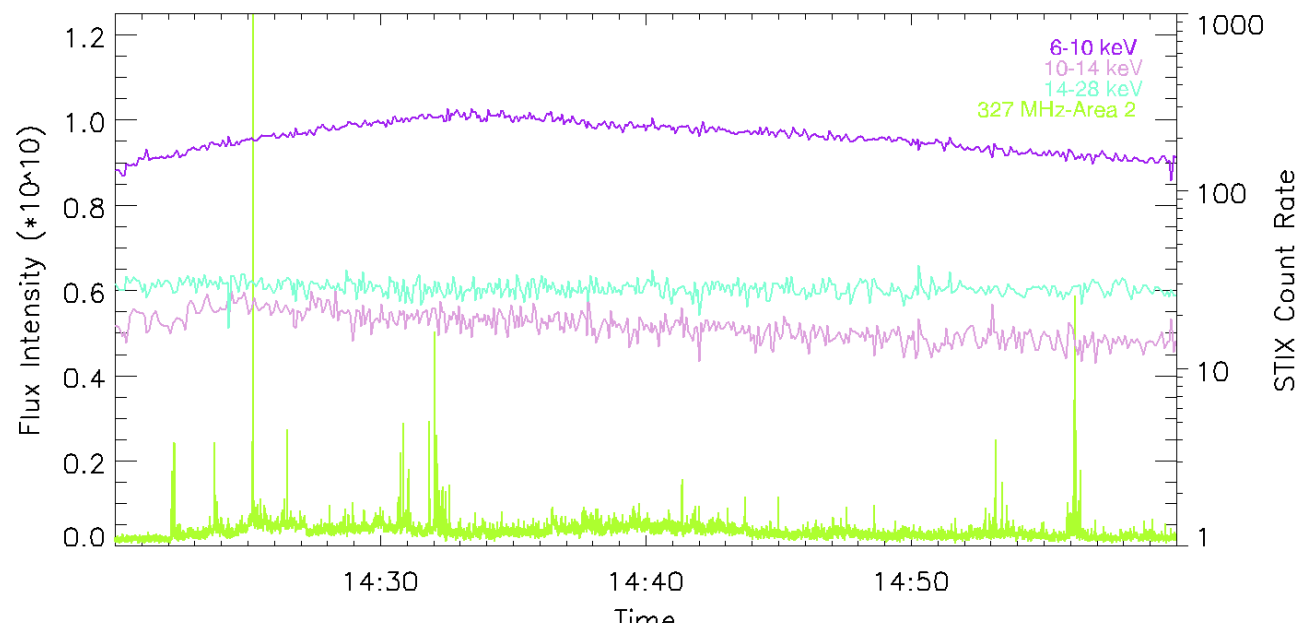
NRH contours overlaid on the AIA 131 A



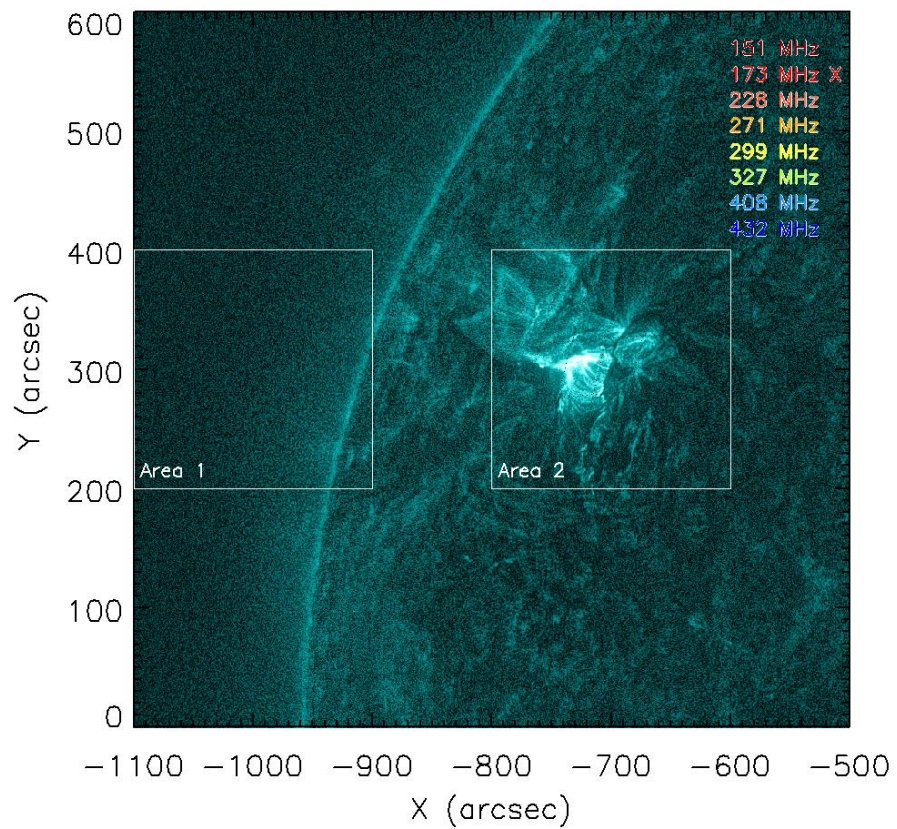
NRH Selected Area Flux & STIX Counts



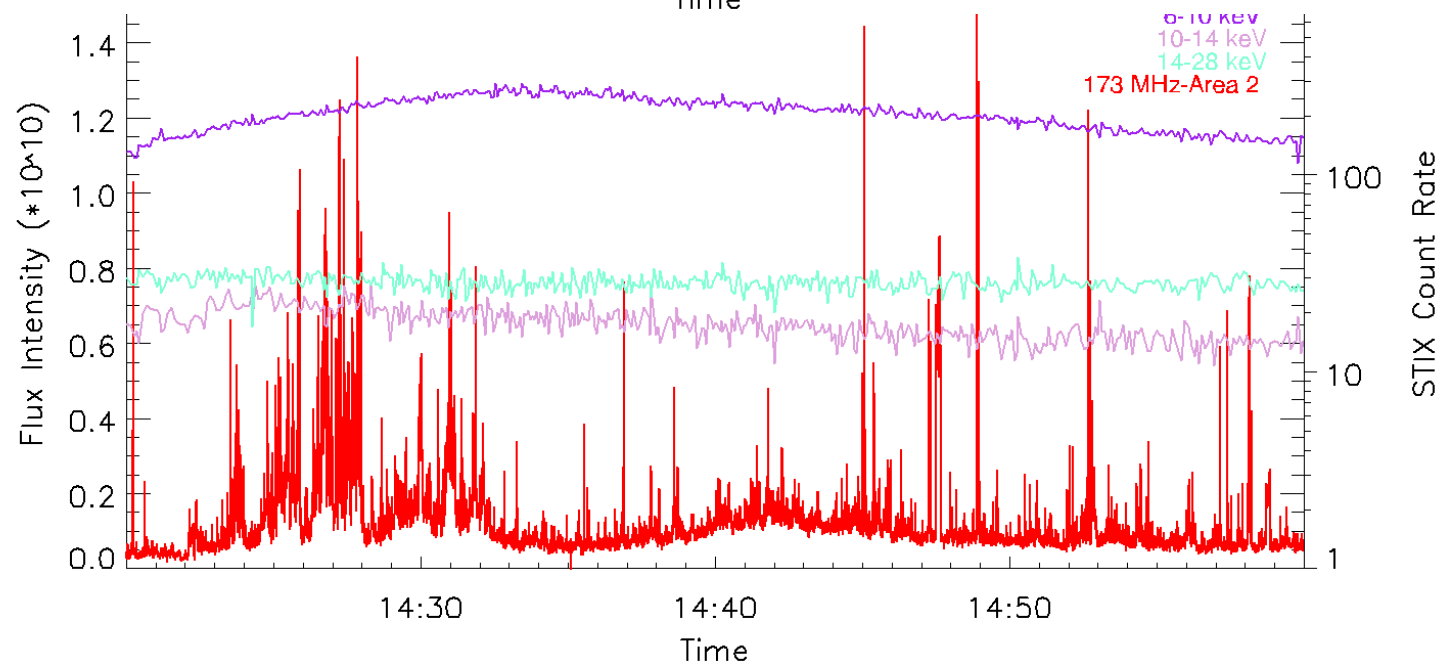
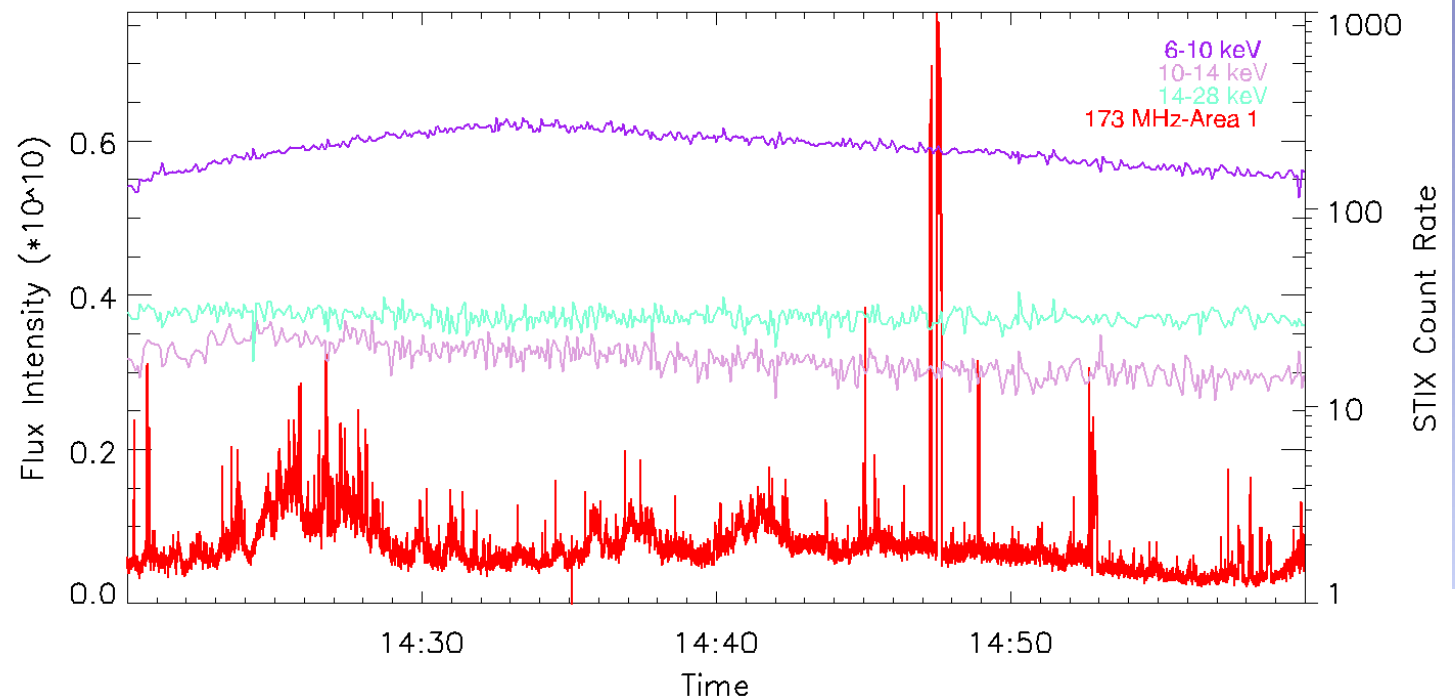
NRH Selected Area Flux & STIX Counts



NRH contours overlaid on the AIA 131 A



NRH Selected Area Flux & STIX Counts



A multi wavelength study of the long duration May 9 2021 event: combined X-ray, radio and EUV observations: some update

- **An interesting event to study the association of X-ray and radio (dm/m) emissions for both impulsive emissions *but also for gradual X-ray phase***
- **Combination of data from many wavelengths but also different view-points**
- **Some preliminary results:**
 - HXR sources in the deka-keV range can be imaged during the long duration « gradual » emission. Slightly different positions compared to the first part
but may be a second « related » flare in a close by region? That is consistent with EUV observations
 - Association between HXR sources and radio sources in the « gradual phase » should be examined in details, but also radio sources at different frequencies with EUV
 - Non-thermal HXR electrons can be measured by STIX during some parts of the long duration phase. *what about the X-ray spectra?*
 - *More to be learnt about the number of electrons in the long duration phase , but radio emission is not really a continuum (especially at low frequencies...)*
- *Work in progress... More at the next workshop??*