**Master Class : data analysis**

Hard X-ray spectroscopy and imaging of solar flares

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**Evaluation of personal work**

Prepare the following report preferentially in pdf and send it before December 24 for evaluation before January 4 2022

**I « Quick look » time profiles**

* Using the document with programs in python from the second lecture, plot « quick-look » time profiles of the count-rates observed by STIX for the 7 June 2020 event between 21 :37 and 21 :41 UT. **(Note that there is a new version of the program, more user-friendly to help you !)**
* What is the highest energy band for which the signal from the solar event is significant ?
* Using your plots and the description of the event given in the paper Battaglia et al. (STIX X-ray microflare observations during the Solar Orbiter commissioning phase ; <https://ui.adsabs.harvard.edu/abs/2021arXiv210610058B/abstract>), can you explain why the temporal evolutions of the light curves at 4-10 kev and at 15-25 kev are different ?
* Integrate the light curves of the different energy bands on different time intervals and discuss the effects in term of the signal to noise ratio
* Is is interesting to integrate on time scales larger than one minute ?

**II Comparison of the count rates for different detectors**

* Select the energy band 6 to 10 keV
* For each detector, add the counts of all the pixels and plot the time evolution of the count-rate of each detector in this energy band
* Are all the time profiles strictly similar ? If not, does it make sense given the characteristics of the instrument ? Please explain. (You can have a look at the paper on the STIX instrument as well as at my second lecture)
* **Recommendation : the identification between detector numbers in the fits files and the subcollimator number used for imaging (see slide 25 of lecture 2) is given below**
* Sub coll [10a,10b,10c] detectors : 3,20,22
* Sub coll [9a,9b,9c] detectors : 16,14,32
* Sub coll [8a,8b,8c] detectors : 21 ,26,4
* Sub coll [7a,7b,7c] detectors : 24,8,28
* Sub coll [6a,6b,6c] detectors : 15,27,31
* Sub coll [5a,5b,5c] detectors : 6,30,2
* Sub coll [4a,4b,4c] detectors : 25,5,23
* Sub coll [3a,3b,3c] detectors : 7,29,1
* Sub coll [2a,2b,2c] detectors : 12,19,17
* Sub coll [1a,1b,1c] detectors : 11,13,18
* **Could you plot the light curves by grouping the detectors according to spatial resolution of the subcollimators (see slide 25) and comparing the three different light curves ? Please comment on what is measured on the different detectors ?**
* **Could you plot light curves from detector 9 and 10. Please comment using the description of the instrument.**

**III Comparison of the count rates for different pixels**

* Select now detectors 3, 20 and 22 and the energy band 6 to 10 keV . Plot the evolution of the count-rate for the different pixels.

Here is the correspondance between the pixel numbers in the fits files and the pixels on the detectors (see slides 14 and 25 of Lecture 2)

A : 0,4,8

B : 1,5,9

C : 2,6,10

D : 3,7,11

where 8-11 are small pixels and 0-3 and 4-7 are large top and bottom rows.

What are your conclusions on the different time profiles when plotting pixels corresponding to A,B,C,D ? Can you understand the differences and similarities of the count-rates on the different pixels ? What is the use of the different pixels ? (Here again, you can have a look at the paper on the STIX instrument as well as at my second lecture)

**IV Spectroscopy**

* **Plot the spectrogram (counts as a function of time and energy)**
* After selecting a time interval describing the background for the event, plot the count-rate spectrum between 21 :38 :59 and 21 :39 :19 AND between 21 :40 :39 and 21 :40 :59.
* Compare the two spectra with the ones published in Battaglia et al., 2021. **Note that the time used in the paper is the time of arrival of photons at 1AU, while the time of the plots are the time of arrival of photons at Solar Orbiter at 0.53 AU**. The time delay is 243s, so that you should compare similar spectra. Can you comment on the evolution with time of the count spectra as well as on the different components that can be seen in the count spectra ?