Statistical analysis of tiny SXR flares observed by SphinX

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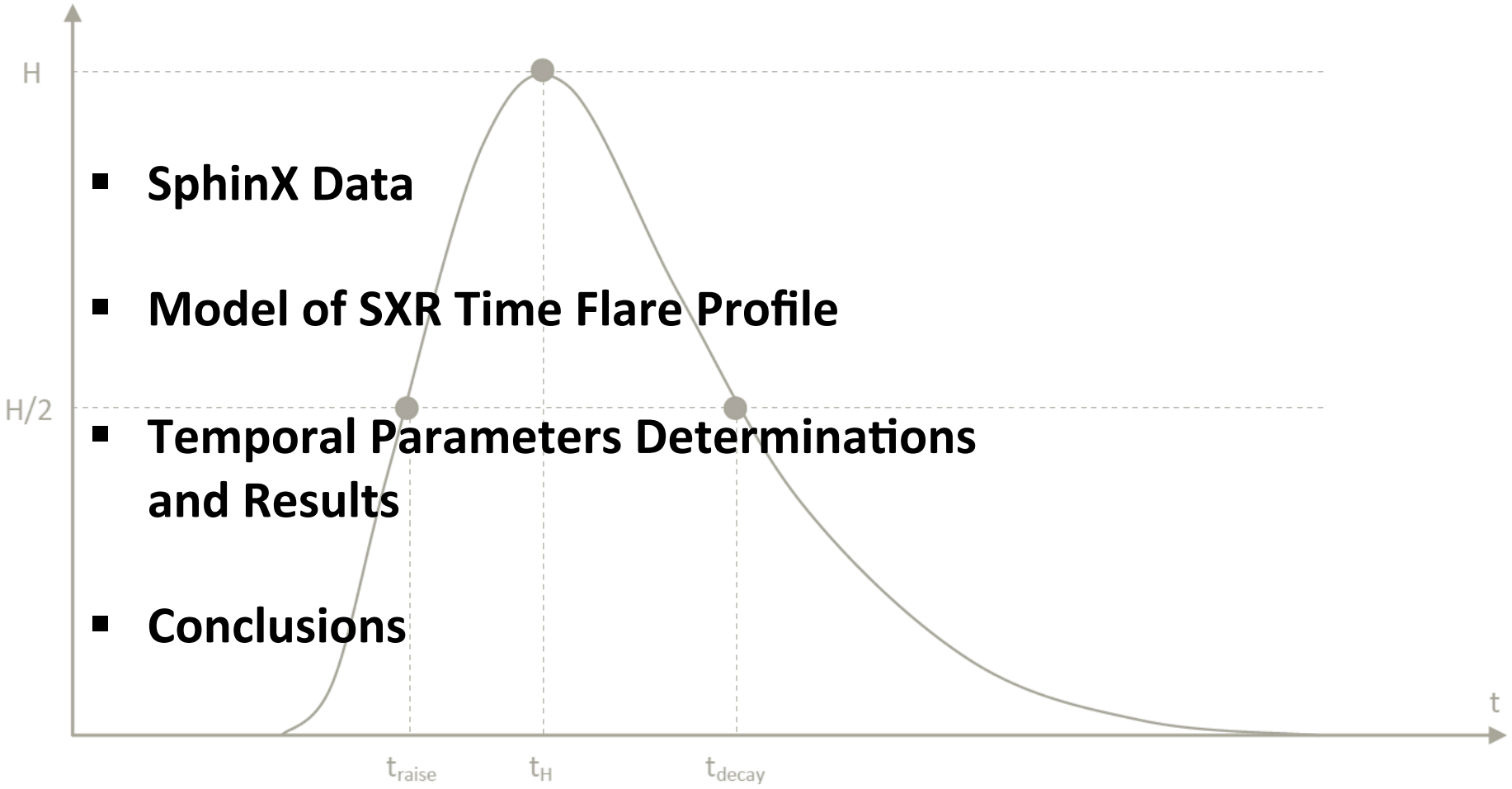
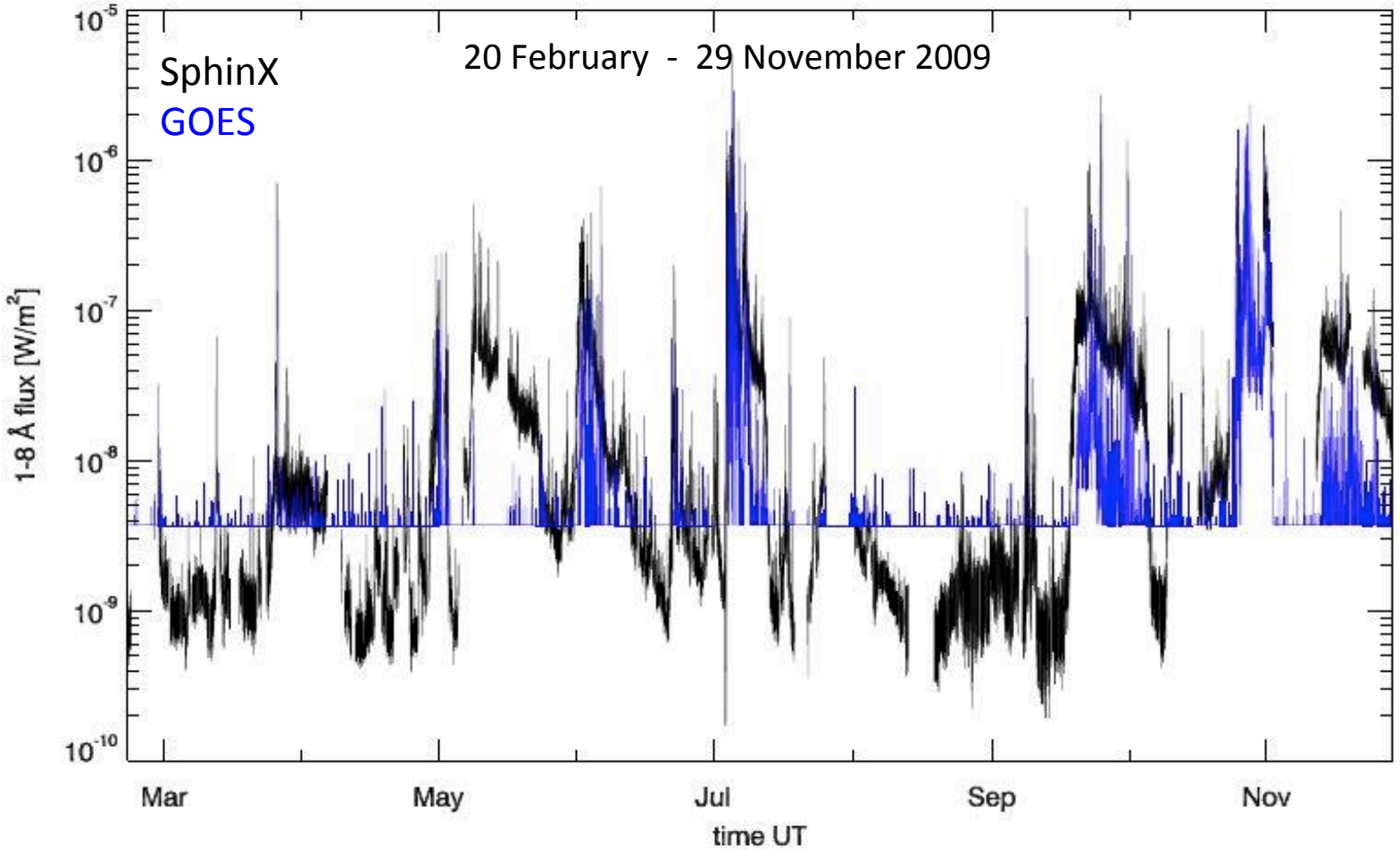
Outline



- SphinX Data
- Model of SXR Time Flare Profile
- Temporal Parameters Determinations and Results
- Conclusions

SphinX Data

minimum of solar activity, 23rd / 24th Solar Cycles



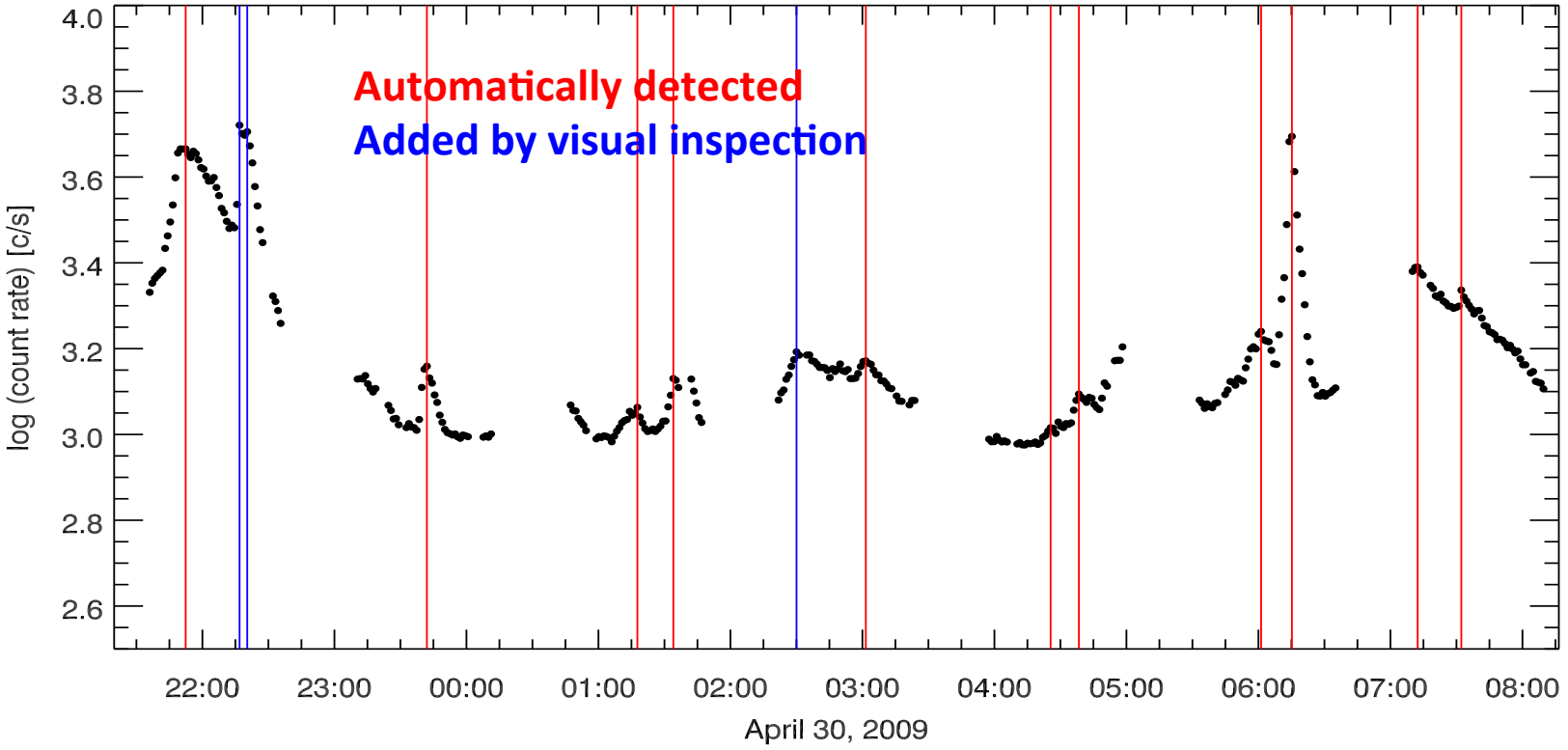
GOES threshold
3.726e-9 W/m²

Figure 1. Solar fluxes in 1-8 Å energy band calculated from SphinX data (black colour) compared with those observed by GOES (blue colour). The characteristic features of ARs and flares can be seen. It is also apparent that due to lack of sensitivity GOES did not observe any X-ray flux variability below 3.73×10^{-9} $[W/m^2]$.

SphinX Flare List

1601 flares **20 February - 29 November 2009**

Semi-automated flare detection algoritm

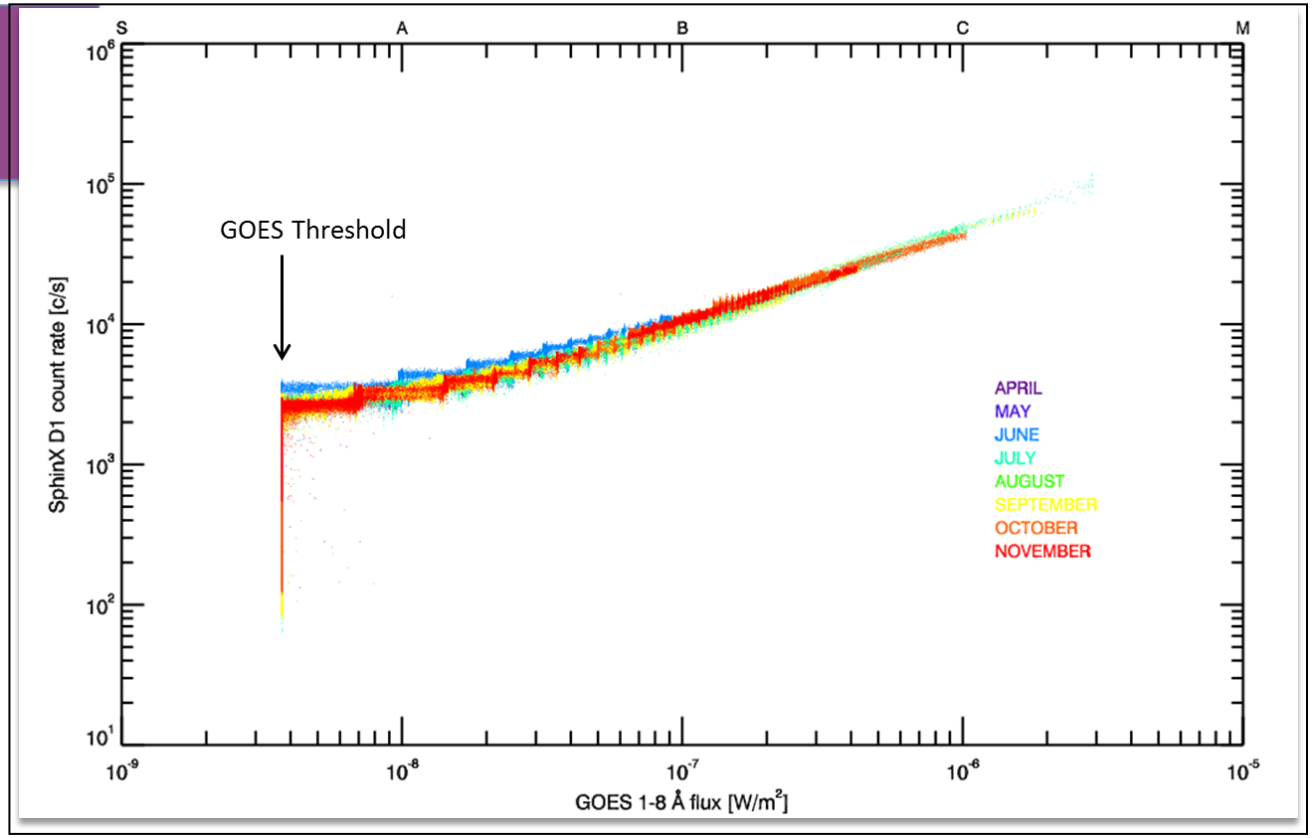


SphinX Flares List

1601 flares

20 February - 29 November 2009

NEW SXR FLARES CLASSES
S CLASS - S1 = 1. e-09 W/m^2
Q CLASS - Q1 = 1. e-10 W/m^2



Elementary SXR Flare Time Profile

$$F(t) = 0.5\ \sqrt{\pi}\ A\ C\ exp(D(B-t) + (C^2D^2)/4)\cdot$$
$$[erf((2B + C^2D)/2C) - erf((2(B-t) + C^2D)/2C)] +$$
$$+Et + F$$

Convolution of two functions

Gauss function:

$$f(t) = Ae^{(-(t-B)^2/C^2)}$$

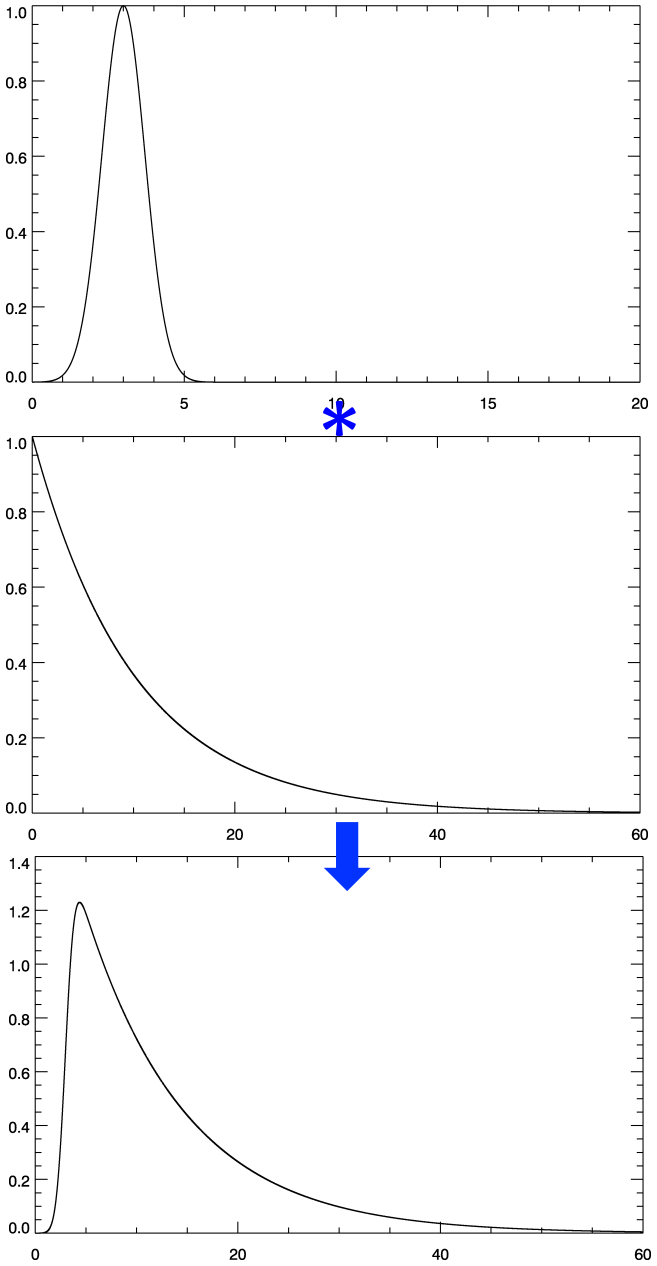
Exponential function:

$$f(t) = e^{(-Dt)}$$

Linear background

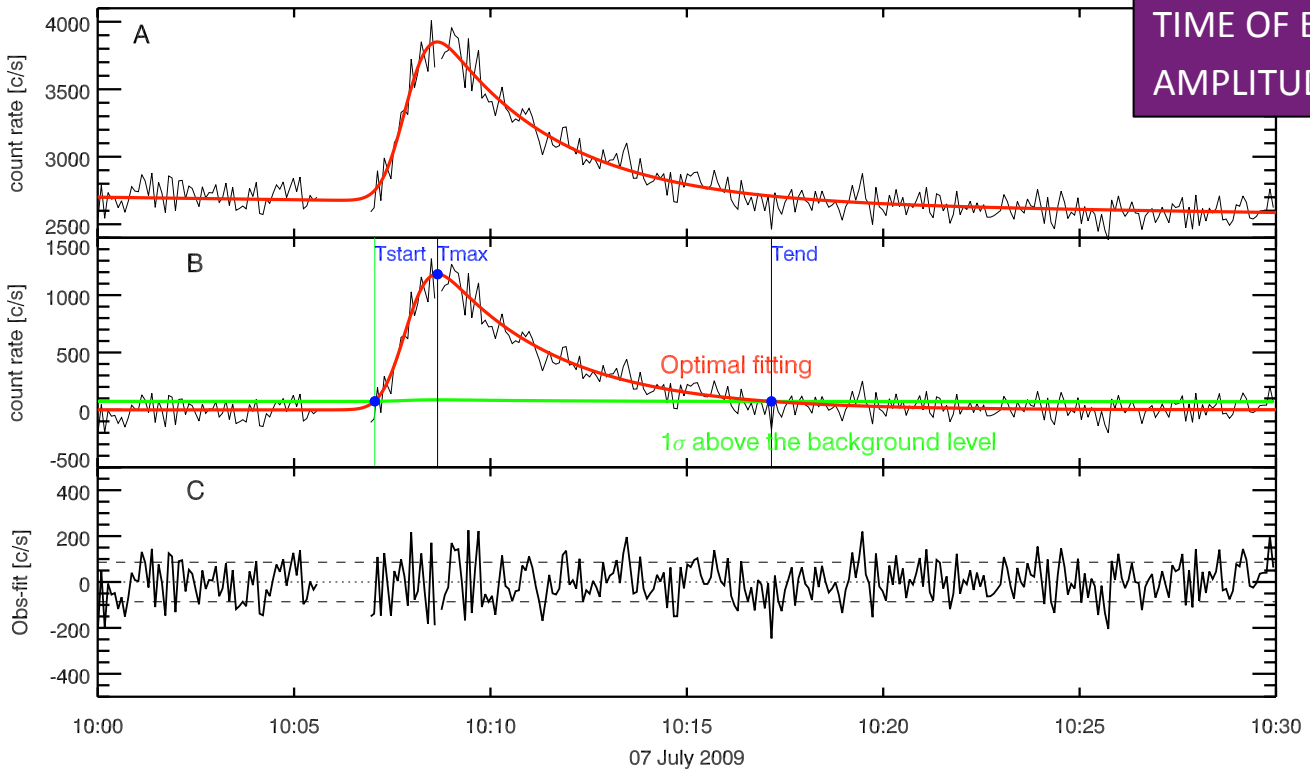
$$f_{bg}(t) = Et + F$$

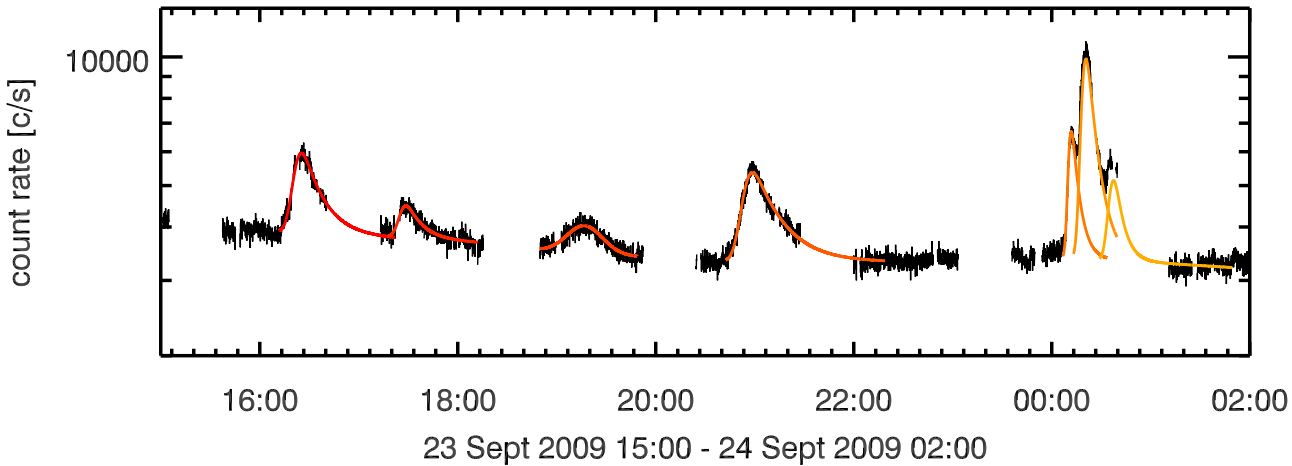
4 parameters (flare) +
2 parameters (linear background)
= 6 PARAMETERS



Flare Temporal Parameters

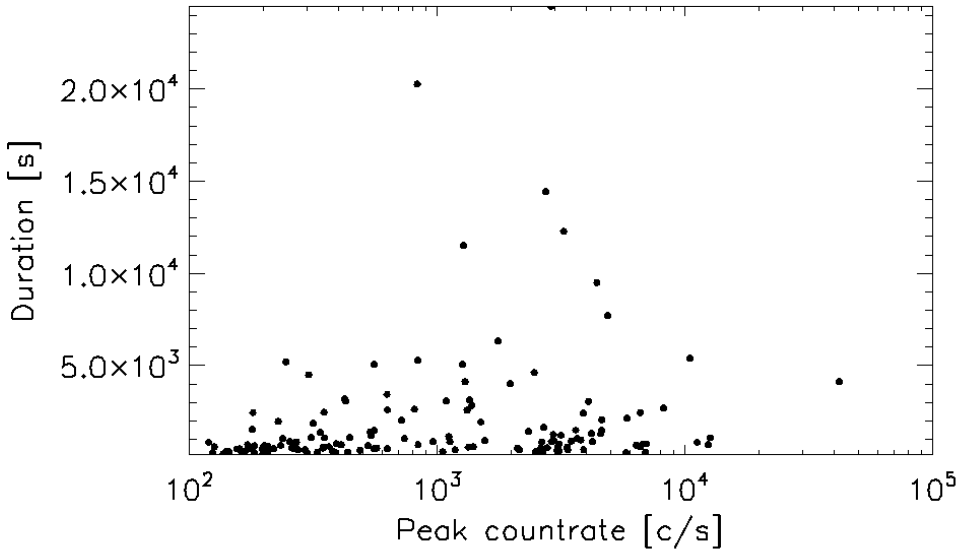
TIME OF START
TIME OF MAXIMUM
TIME OF END
AMPLITUDE (INCREMENTAL CLASS)





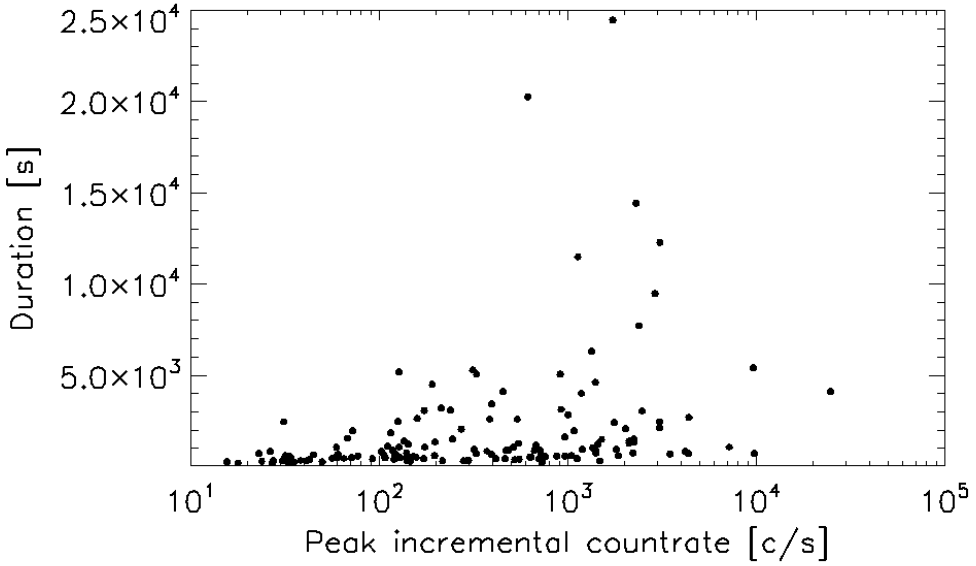
Sample of SphinX observations and fitted flare time formula

Flares Temporal Parameters



Probe of **208** flares observed by SphinX

Duration vs Peak



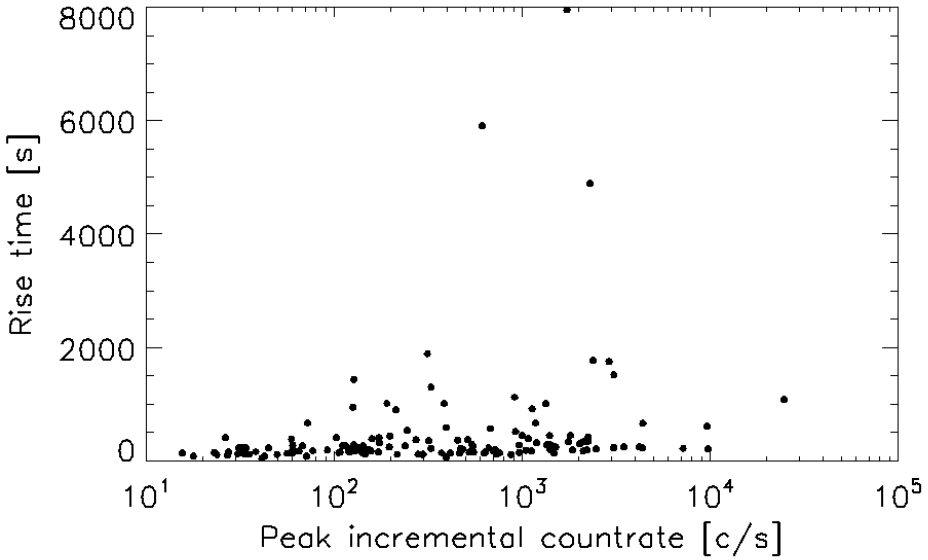
Duration vs Peak incremental

Linear background

$$f_{bg}(t) = Et + F$$

Peak incremental = Peak - Background

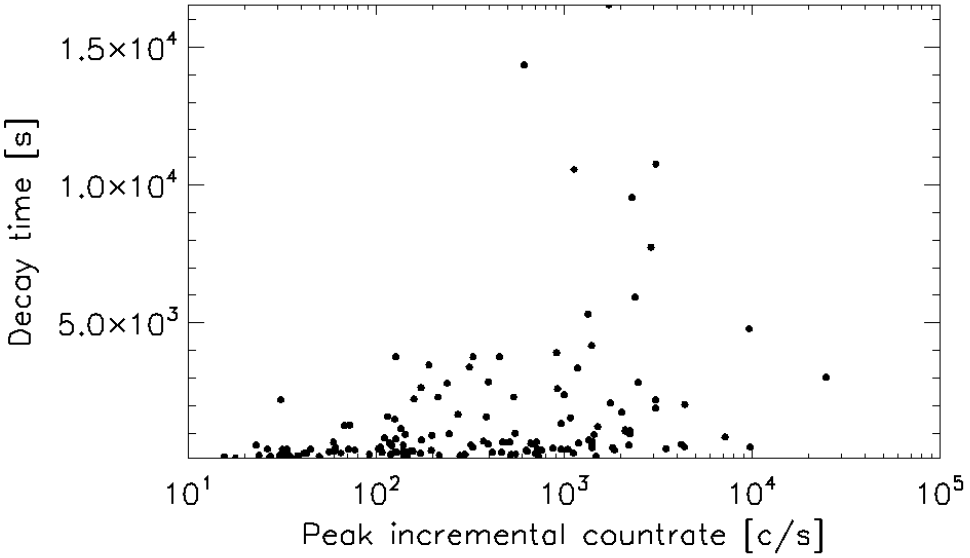
Flares Temporal Parameters



Probe of **208** flares observed by SphinX

Peak incremental = Peak - Background

Rise time vs Peak incremental



Decay time vs Peak incremental

Linear background

$$f_{bg}(t) = Et + F$$

Peak incremental = Peak - Background

Conclusions

- SphinX provide large data base of flares and brightenings observed during very deep solar minimum of activity

- We have proposed a model of time flare profile, which is usefull tool for SXR flares parameters analaysis
- More precise and homogeneous method of time parameters estimations
- Analysis of multi-picked flares (time covered events)
- Method can be apply with other SXR data as well

- Parameters catalogue as plenteous material of statistical analysis

SphinX data are available on the webpage of Solar Physics Division, Space Research Centre Polish Academy of Sciences (SRC PAS): http://156.17.94.1/sphinx l1 catalogue/ SphinX cat main.html.

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Thank You

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