Modified Neupert Effect

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9th RHESSI Workshop, Genova, 1-5 Sept. 2009

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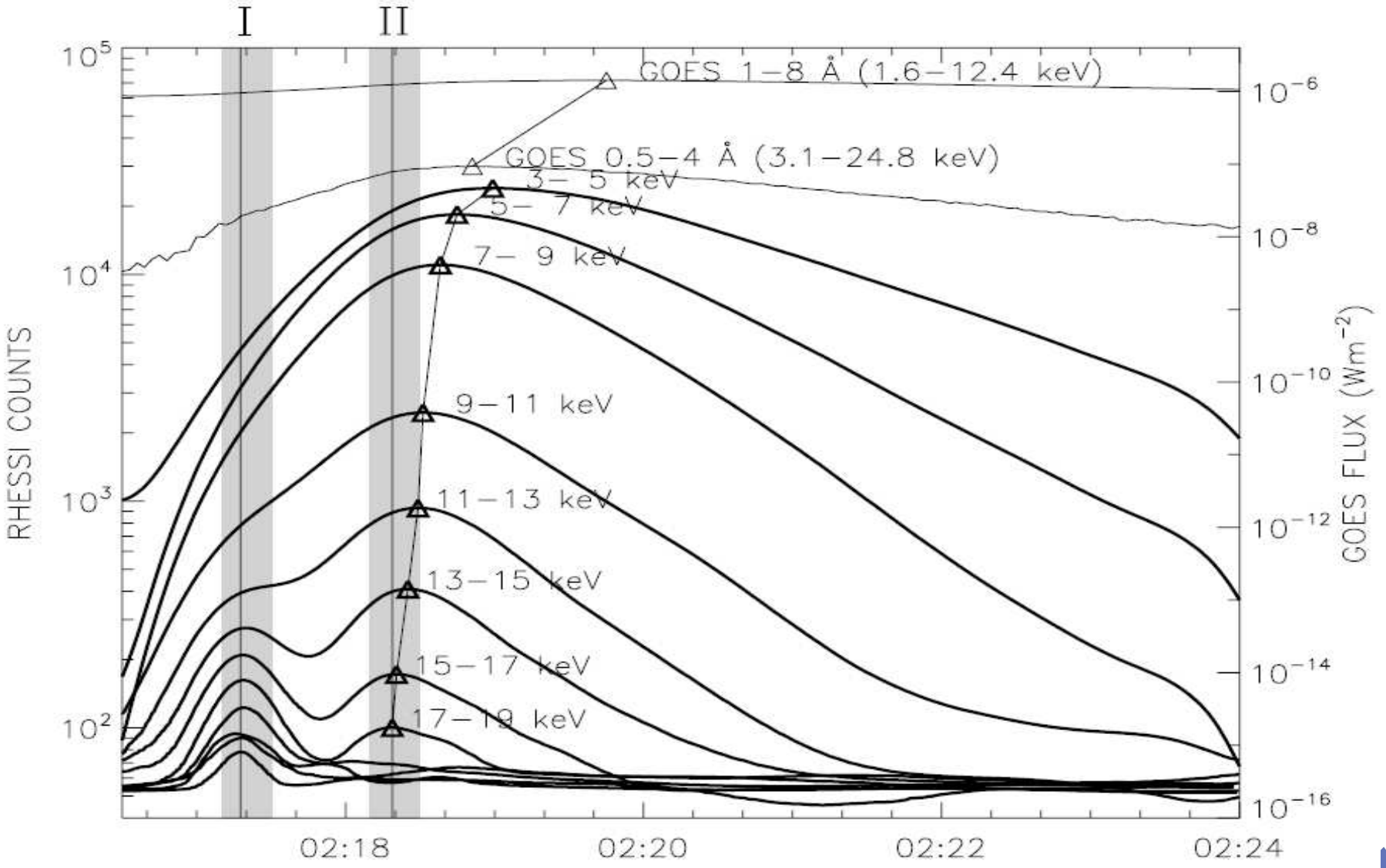
Motivation: SXR peaks are beyond the end time of HXRs. See also Veronig et al. (2002)



C1.3 flare on August 12, 2002 (Li & Gan 2009)

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How to explain the time delay?

Case study suggests a modified Neupert effect

$$F_{SXR}(t) \propto \int_{t_0}^{t} H_{HXR}(t' - \tau)dt'$$

$$\frac{d}{dt} F_{SXR}(t) \propto F_{HXR}(t - \tau)$$

τ, might be a comprehensive consequence of some complicated processes, including the filling of the loop by the evaporated material.

Scenario:

energetic electrons (assuming delta input function)

→ deposition in deep atmosphere

→ evaporation upward with kinetic energy (E_K)+ thermal energy (E_T)

→ collision at the looptop, kinetic energy converts into thermal energy

$$E_K / E_T \sim 25\%$$

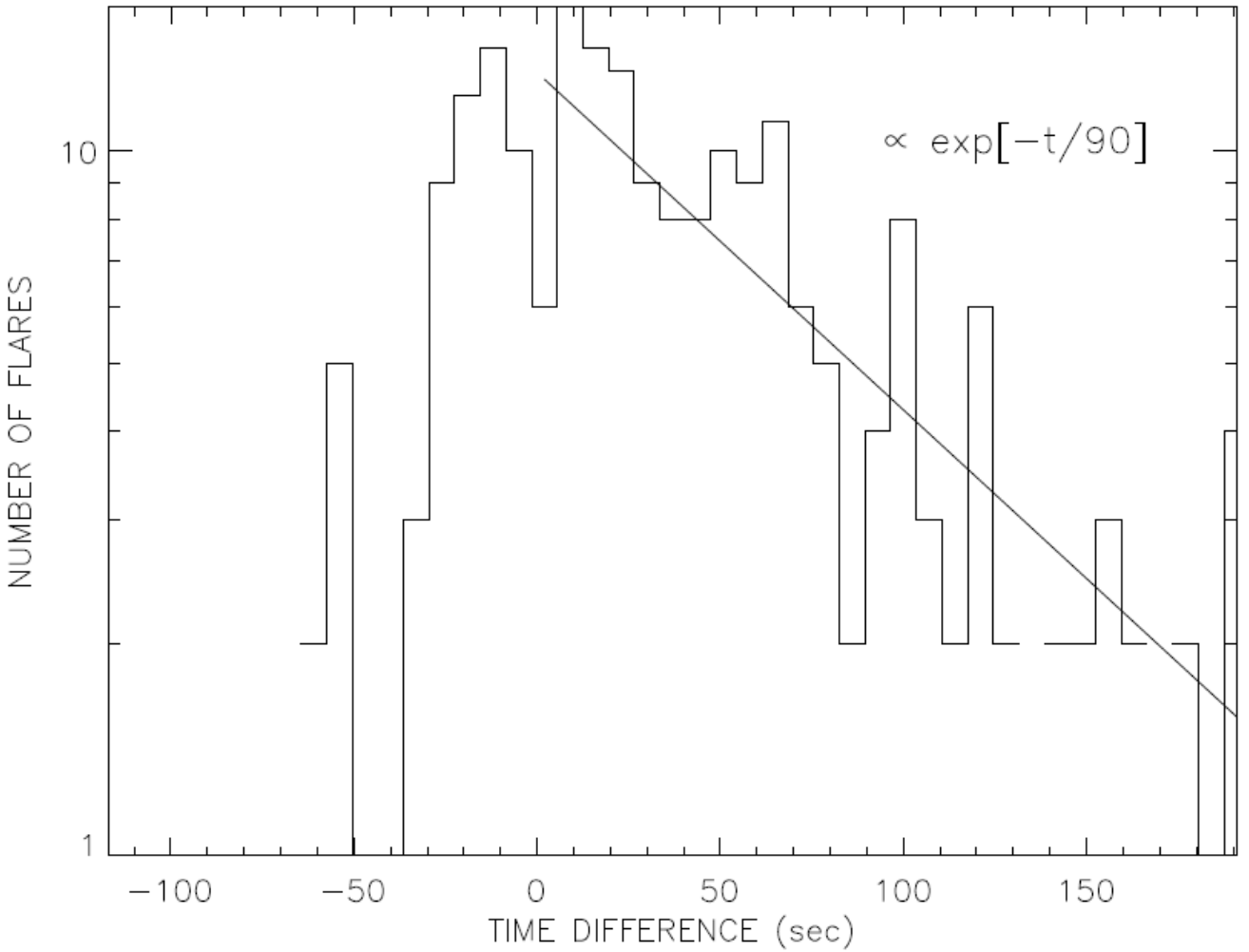
taking $V_p \sim 500$ km/s, $T=2\ 10^7$K

the time required: $L/ V_p \sim 60$ s

The time delay could be expected!

Statistical check:

Samples: up to the end of 2007, 219 RHESSI flares with >25 keV emission, simple 25-50 keV lightcurve, and also a simple GOES lightcurve



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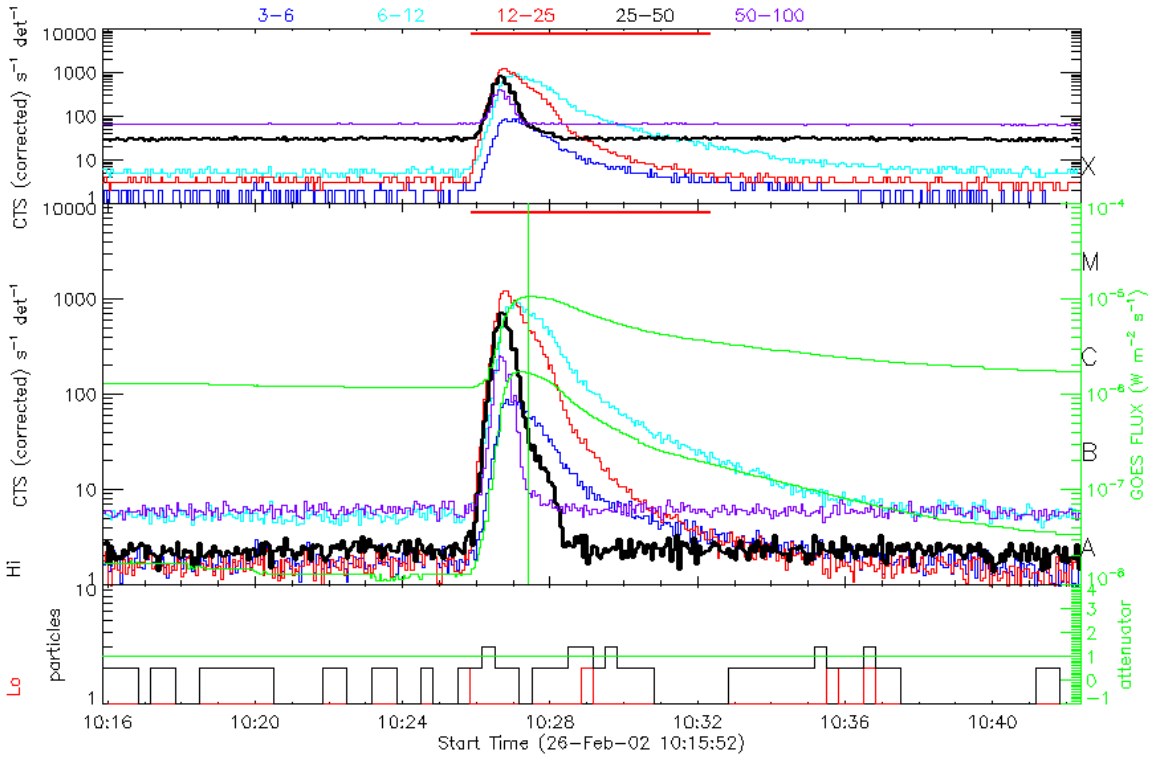
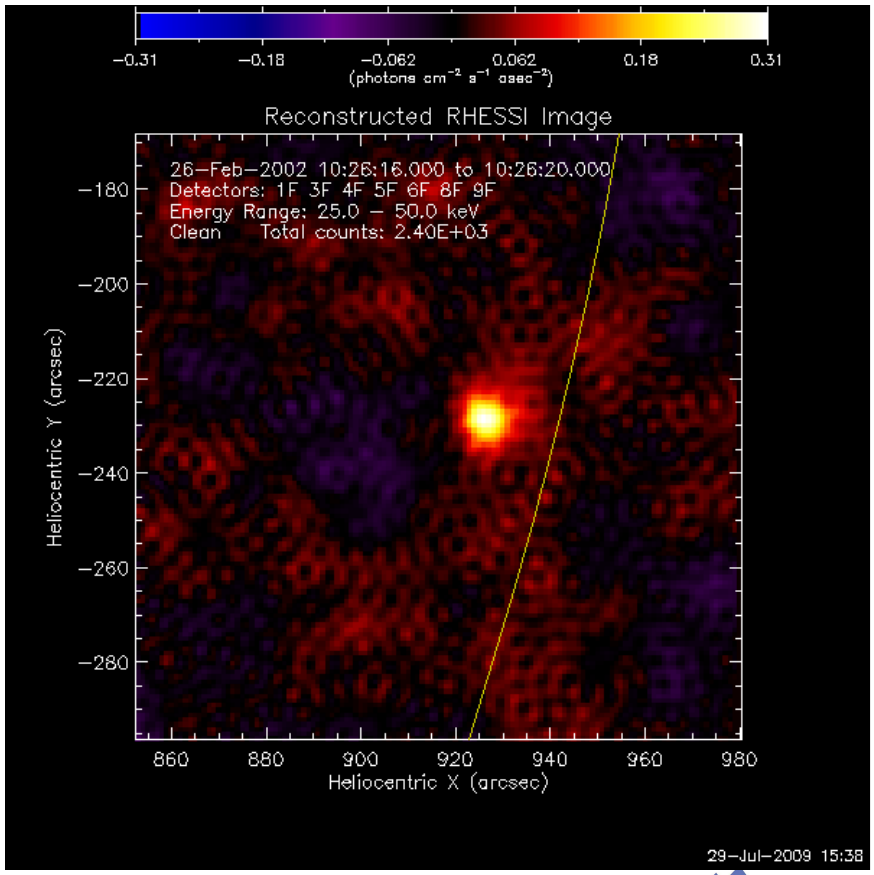
Events for τ <0

among events which can be well imaged, most present a compact source





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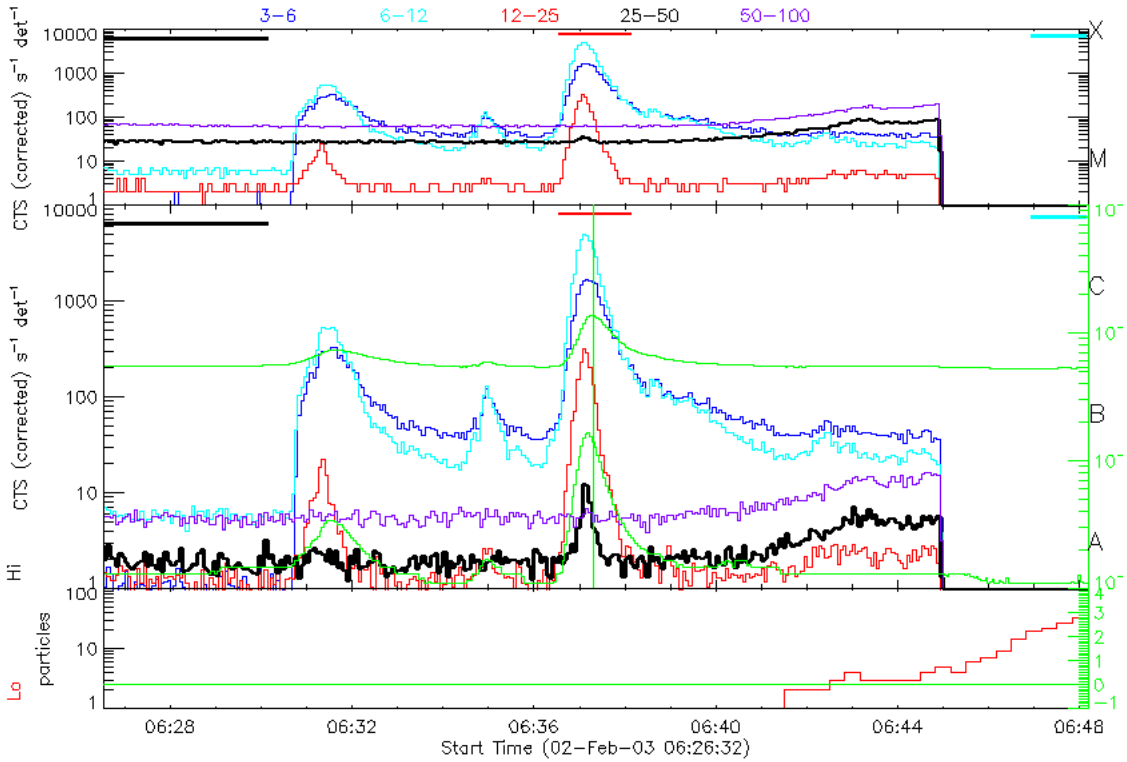
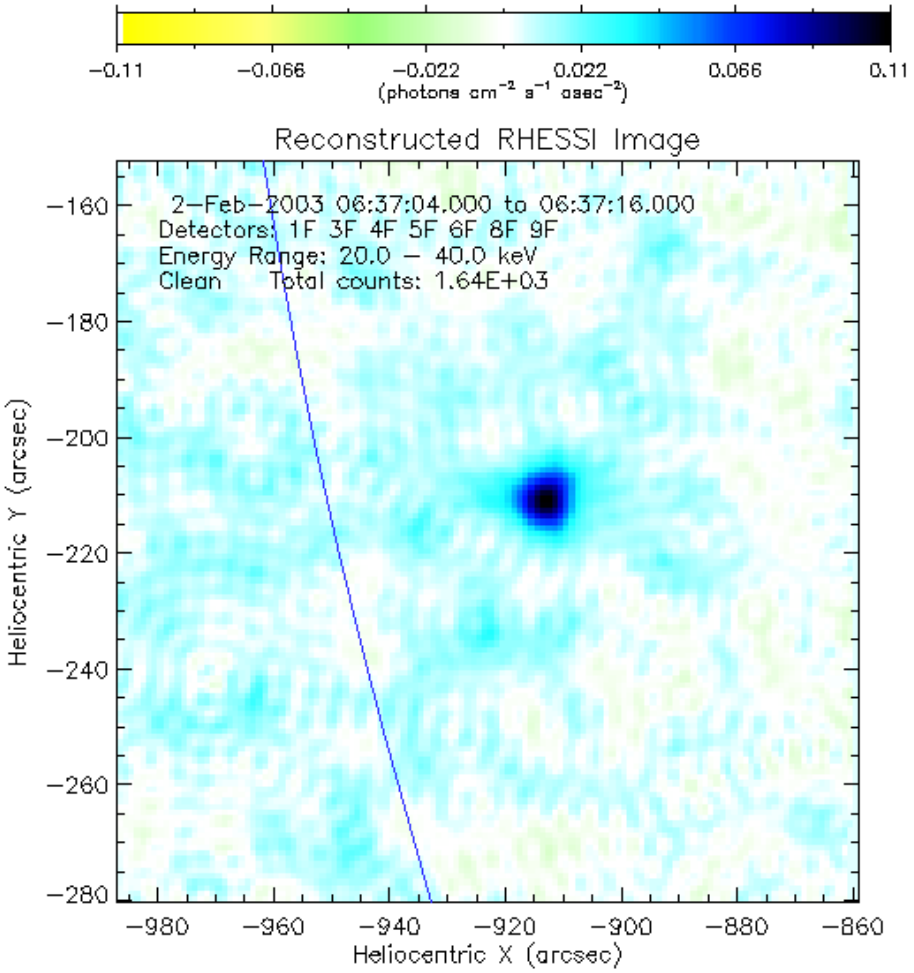
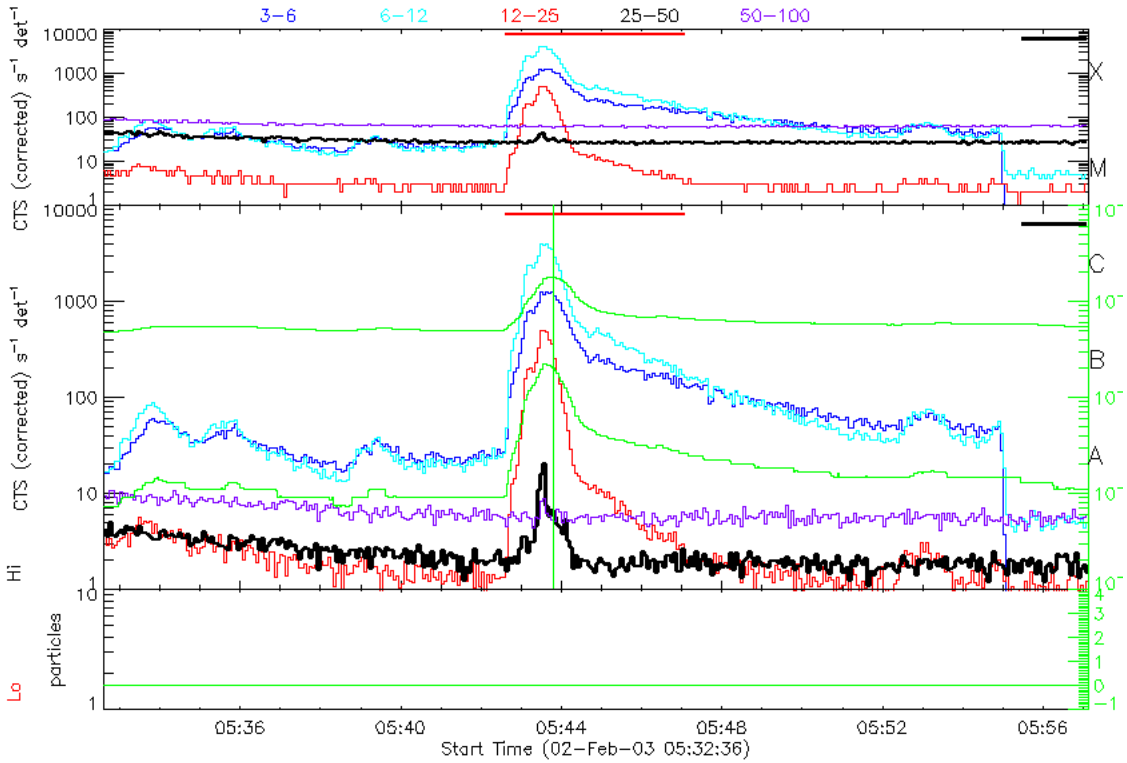
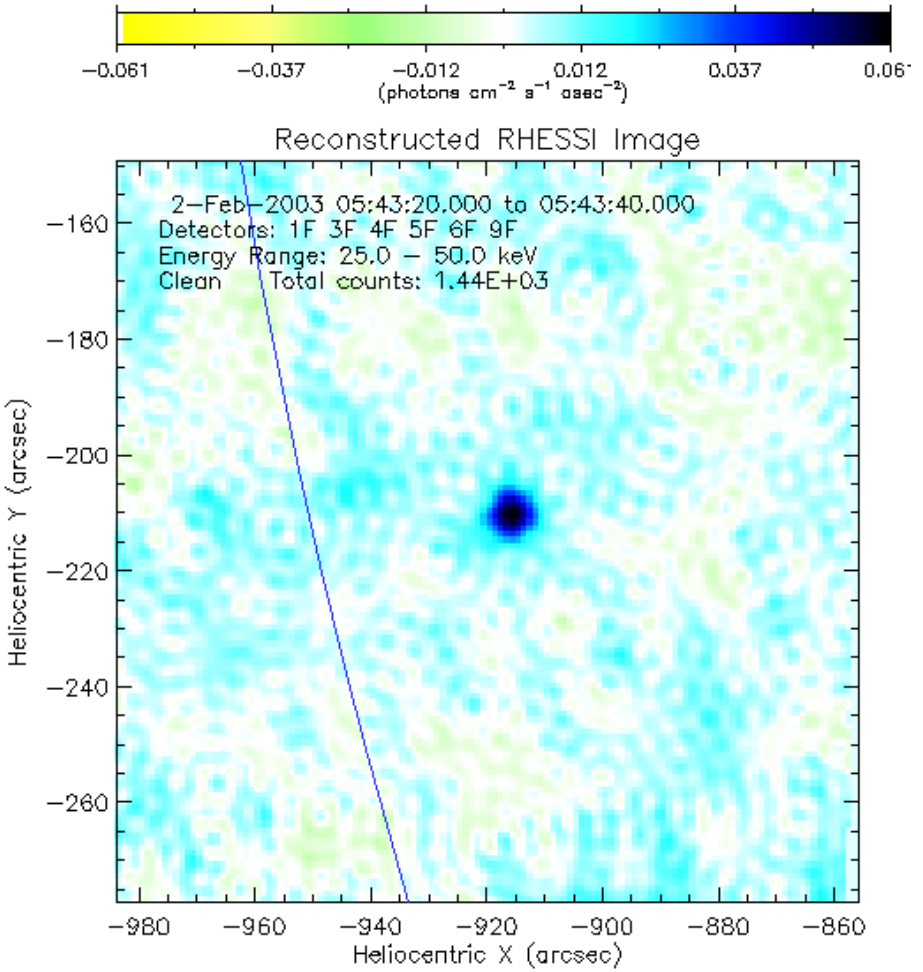




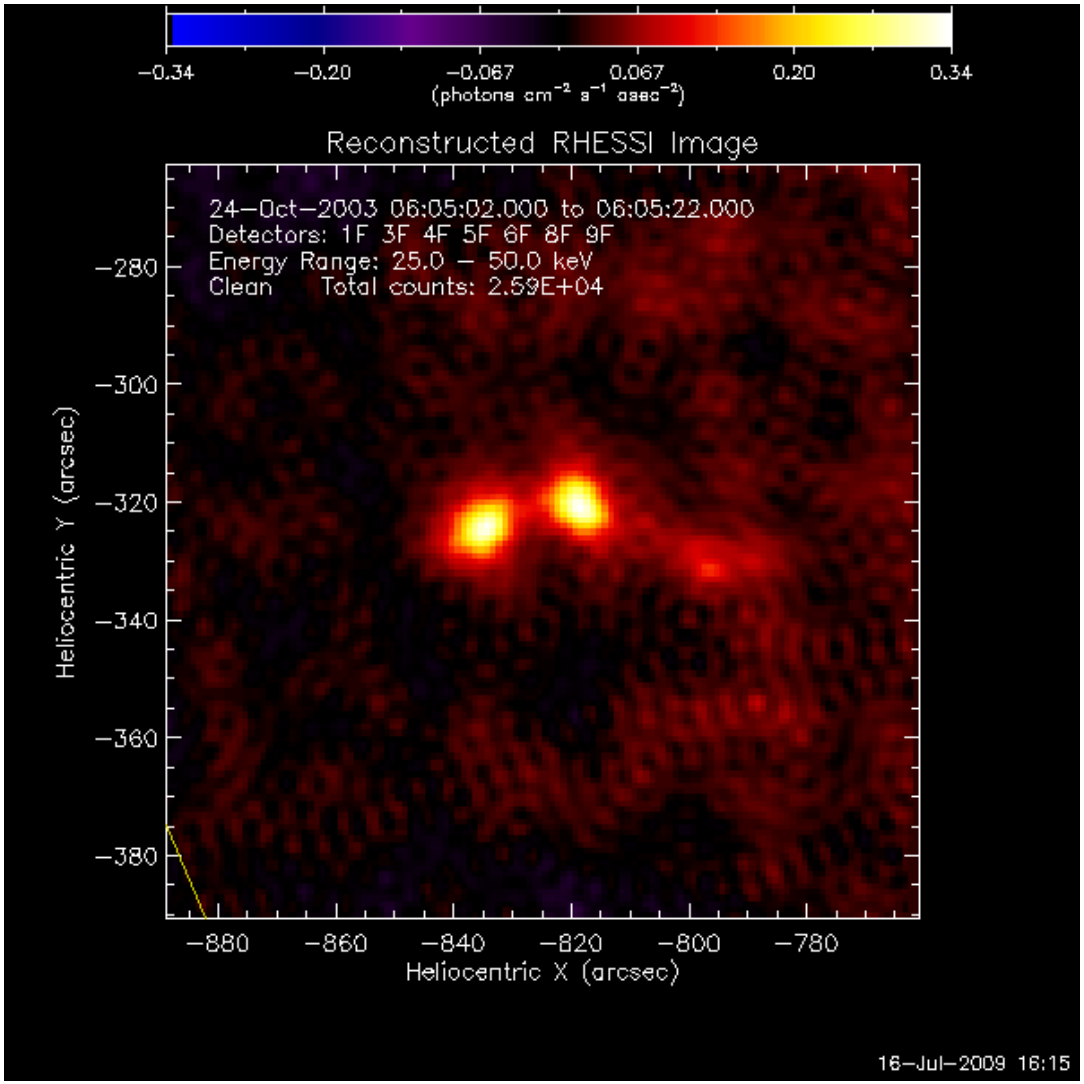
26–Aug–2

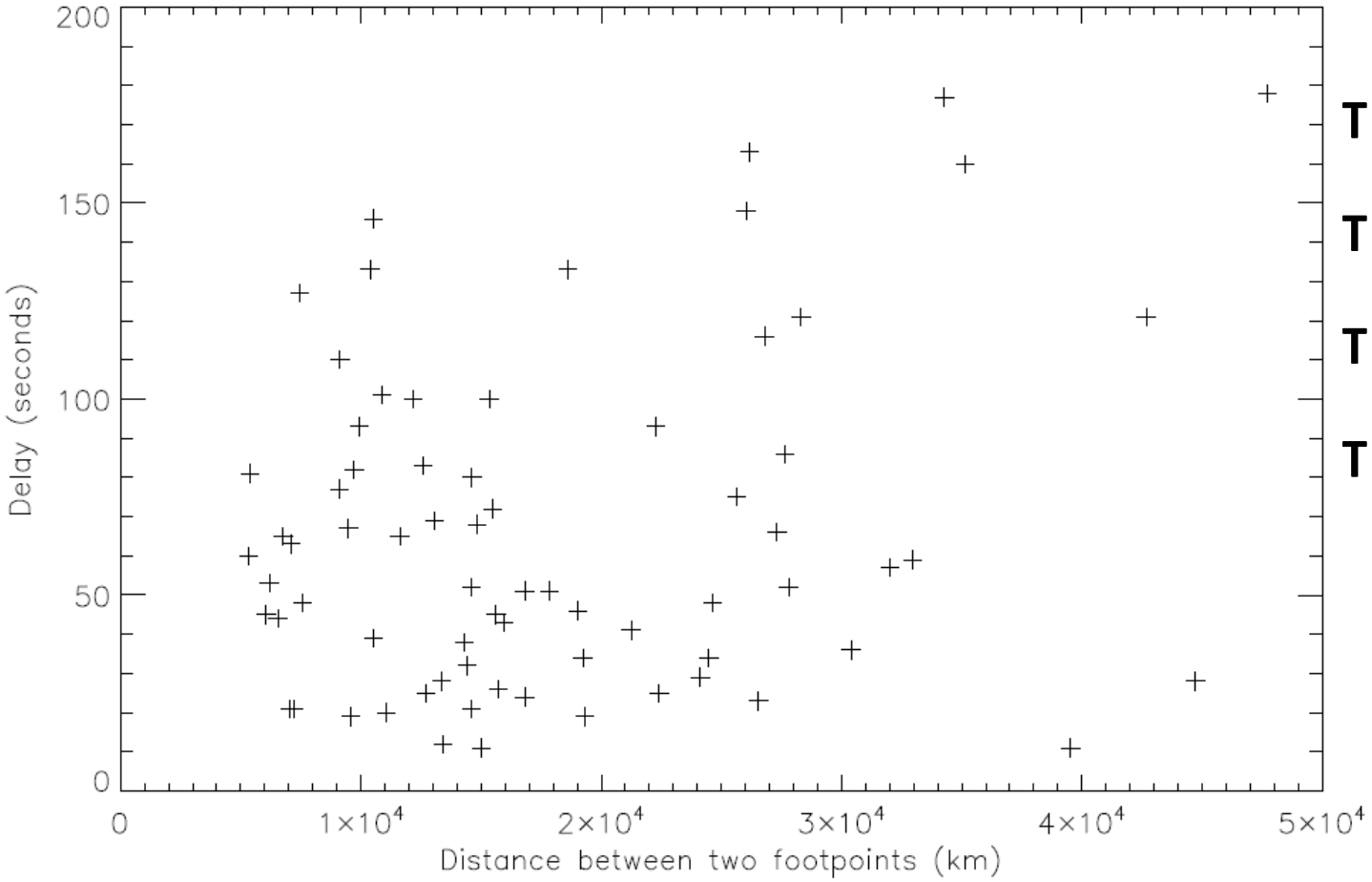




6–Jul–2

Events for τ >0: most present two fps





τ >10 s, r=0.25

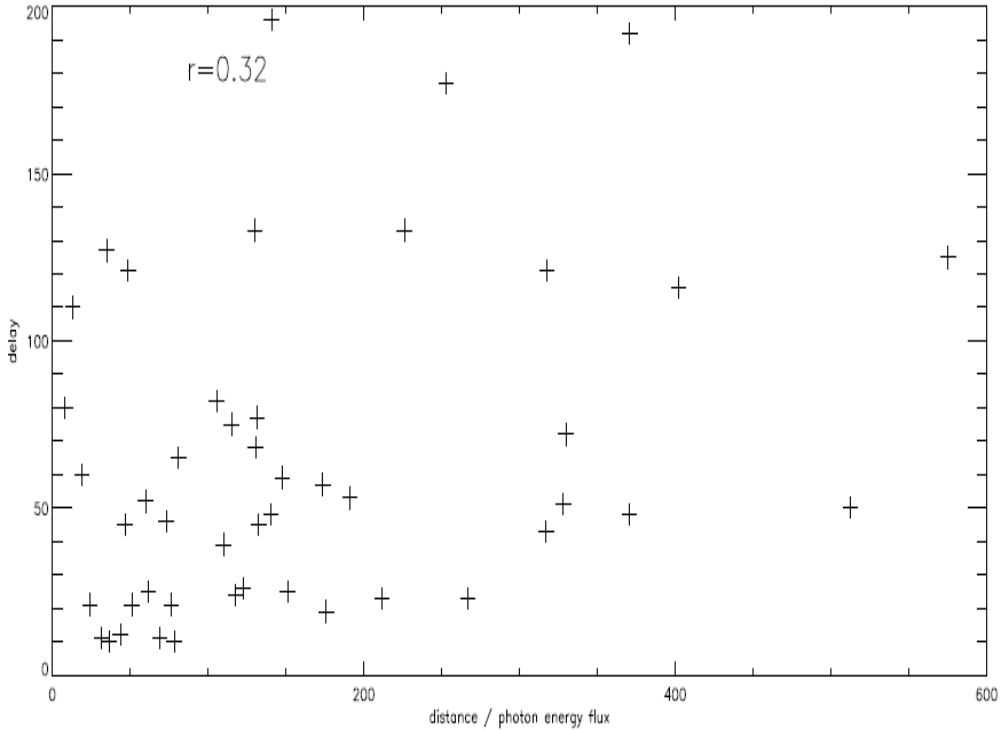
τ >30 s, r=0.37

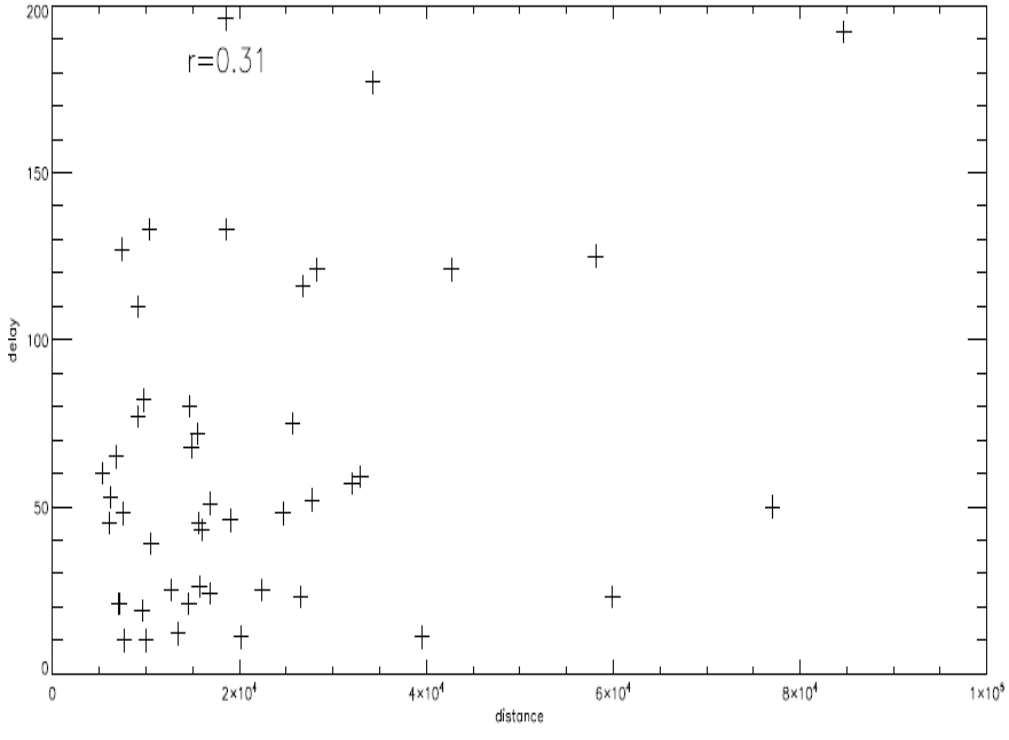
τ >50 s, r=0.43

τ >60 s, r=0.58

The delay versus the loop length does not seem to be as simple as we expected.

Taking into account the weight of flare importance, manifested with the peak flux of 25-50 keV, we have not seen any improve-ment of correlation between the time delay and the loop length





Conclusion

The physical meaning of τ has not yet been clarified.

Statistically, more studies should be done in order to check the modified Neupert effect!

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Thank you!

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