Sixth RHESSI Workshop
4-8 April 2006
Meudon

Group 1:
Electron Acceleration and Propagation

Summary

Wednesday, 5 April

8:30–9:00	Coffee & Croissants
9:00–10:30	Plenary Session
10:30–11:00	Coffee Break
11:00–13:00	Working group session: Introductions Update on new spectral inversion and image reconstruction techniques (Piana, Massone, Scullion)
13:00–14:30	Lunch at the Observatory Cafeteria
14:30–18:00	Working group session: Albedo (Kasparova) X-ray polarization (Suarez, Emslie) Image forward fitting and X-ray footpoint areas vs. X-ray flux (Schmahl)

Regularized Inversions

- Contact Anna Massone for spectral inversion software
- Will add subroutine to software that determines thick-target F(E) and uncertainties
- Inversion to determine DEM(T) not useful
- Piana and Massone working on regularized inversion of RHESSI imaging data
- Eamon Scullion working on spectral inversion from *count* spectra

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Conclusions (Kasparova)

- centre to limb variation is found for γ_0, i.e. at energies $\sim$ 20 keV
  - no significant variation at higher energies
  - reason why it was not found e.g. by Datlowe (1974)
- dips in $\bar{F}(E)$ only for centre events, isotropic albedo correction removes them
- no dips in $\bar{F}(E)$ in limb events

$\Downarrow$

Photospheric albedo is responsible for the dips in $\bar{F}(E)$ below $E \sim 30$ keV
and
shows as a centre to limb variation of γ at $\varepsilon \sim 20$ keV

$\rightarrow$ Use isotropic albedo correction when fitting RHESSI spectra

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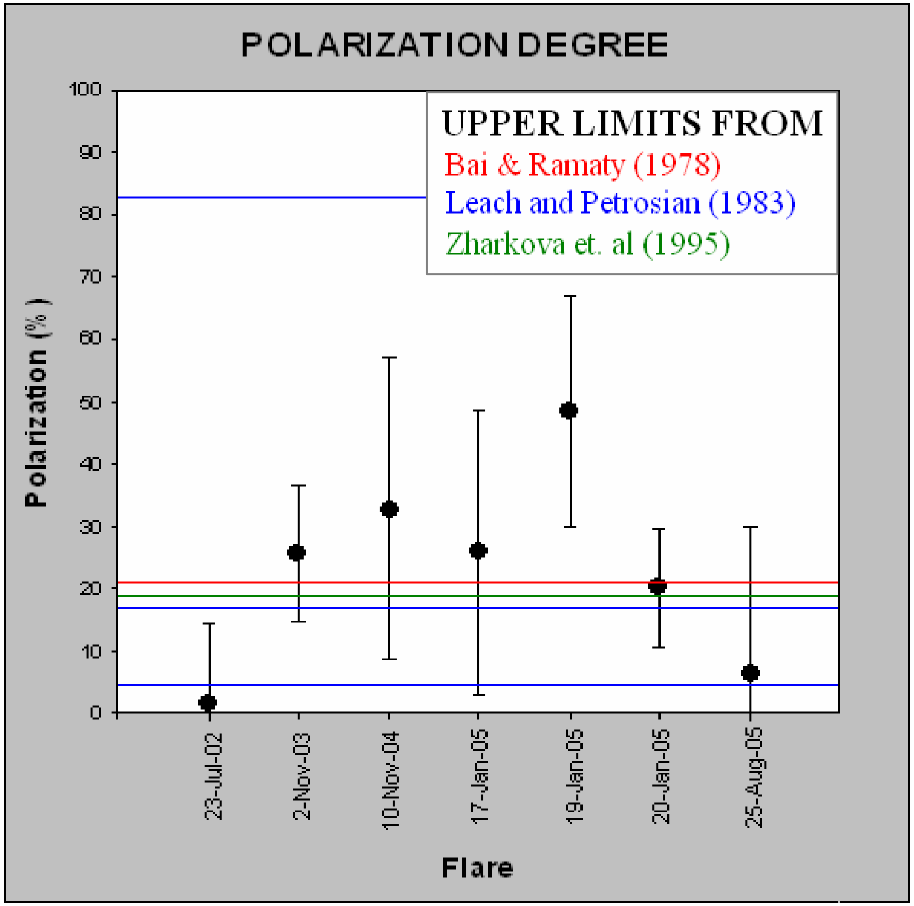
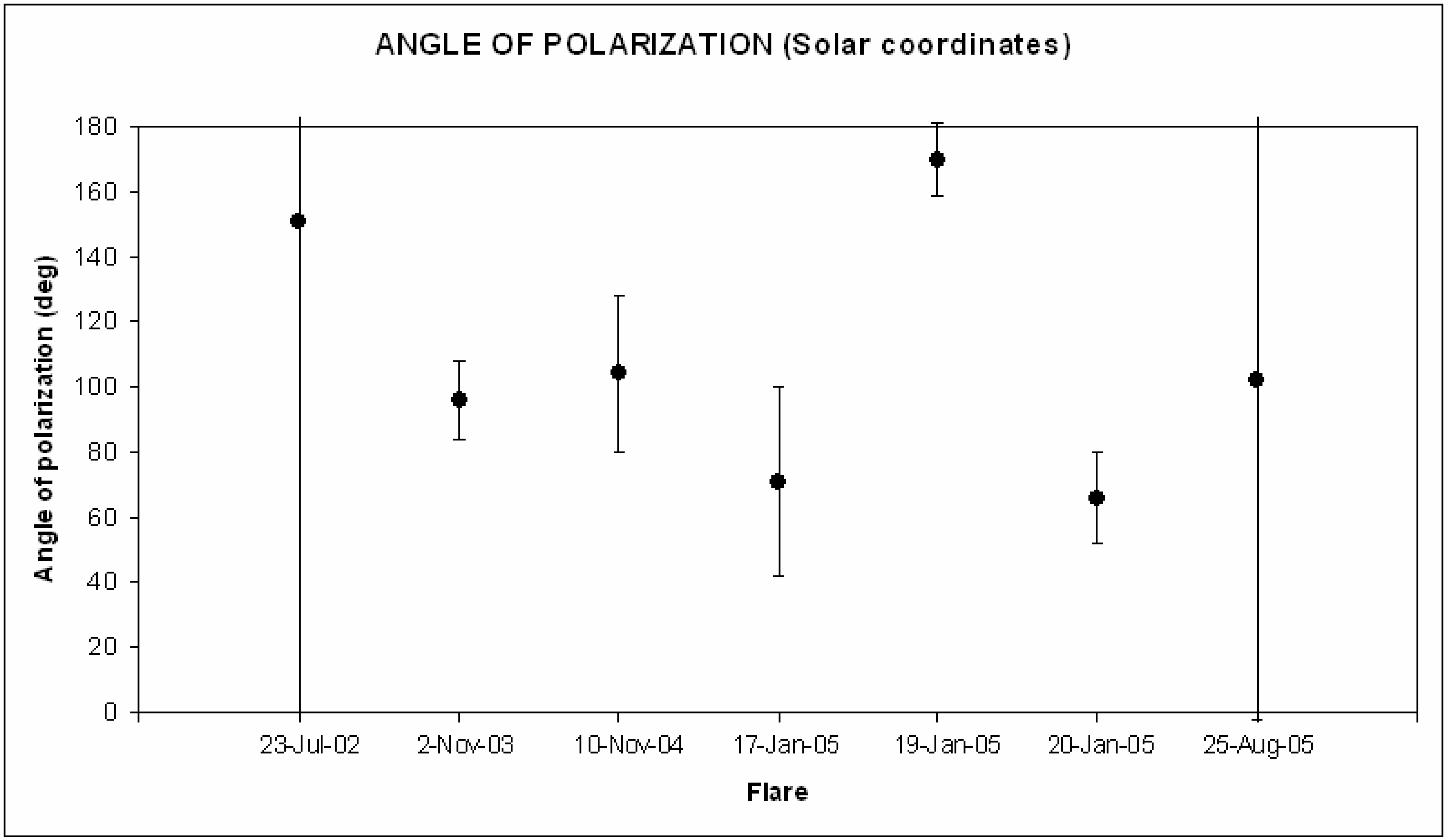
Polarization of Solar Flares (100keV–350keV): Conclusions

- 5 different models (including ‘zero-polarization’) are consistent with the data.
- Strongly rejected are models with emission from the top.
- No conclusions can be drawn about pitch angle distributions.
- We still need a better polarimeter.



Suarez

Polarization Results



Suarez

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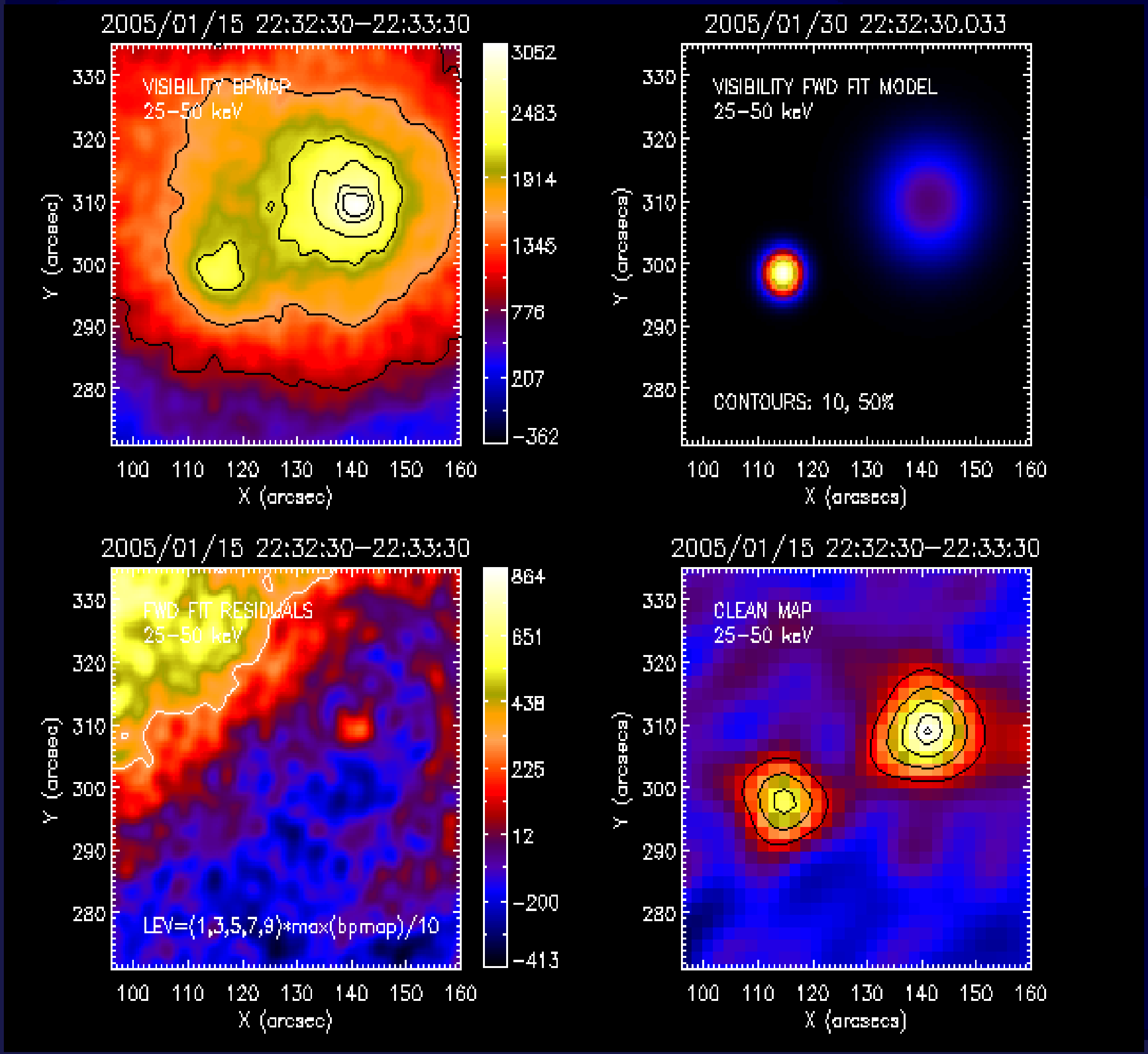
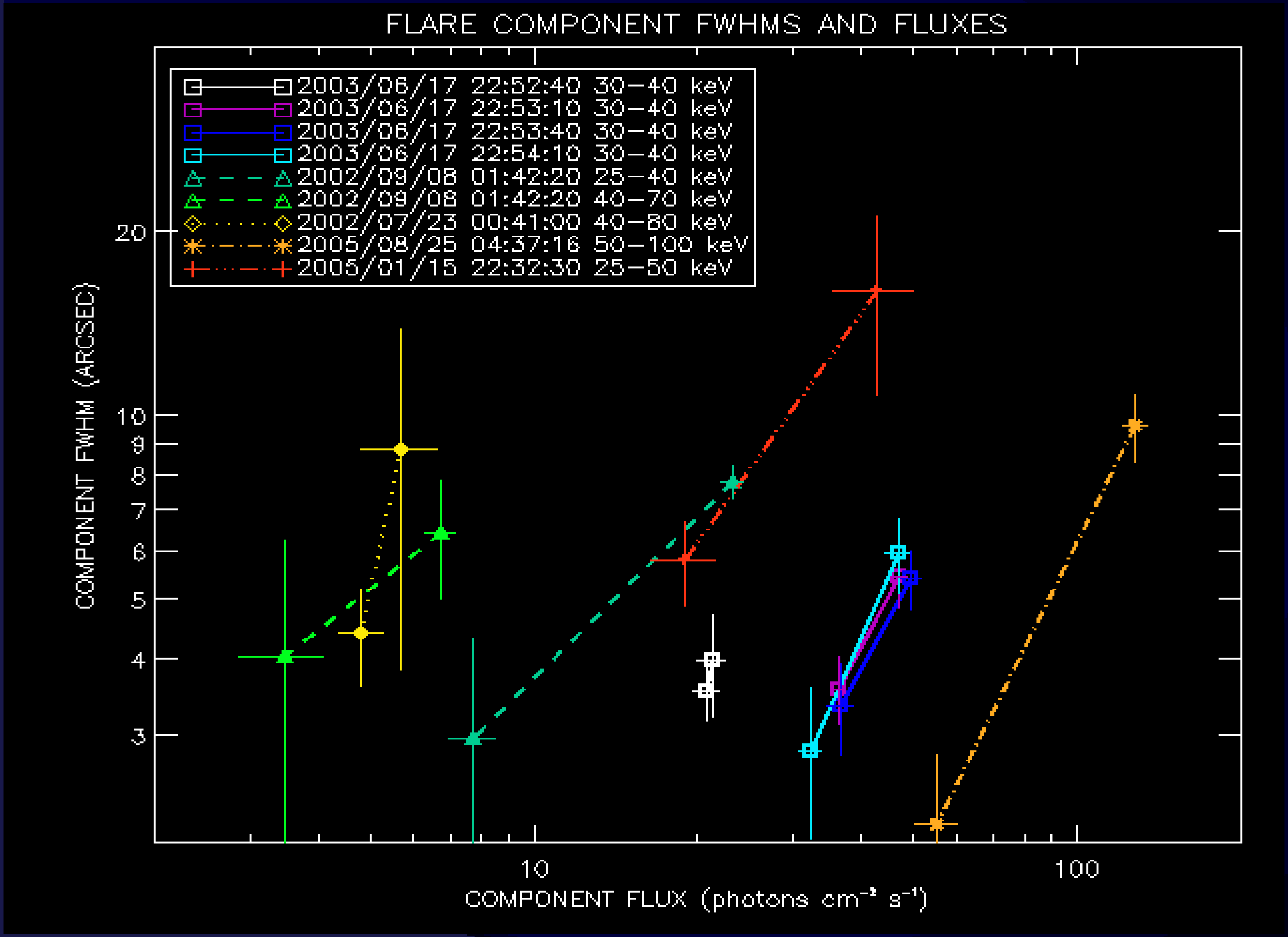
RESULTS (2): FLARE OF 2005/01/15



FWHM=
5.8, 15.

FLUX=
10.9, 43.

FWHM VS FLUX (WITH ERRORBARS)



Schmahl

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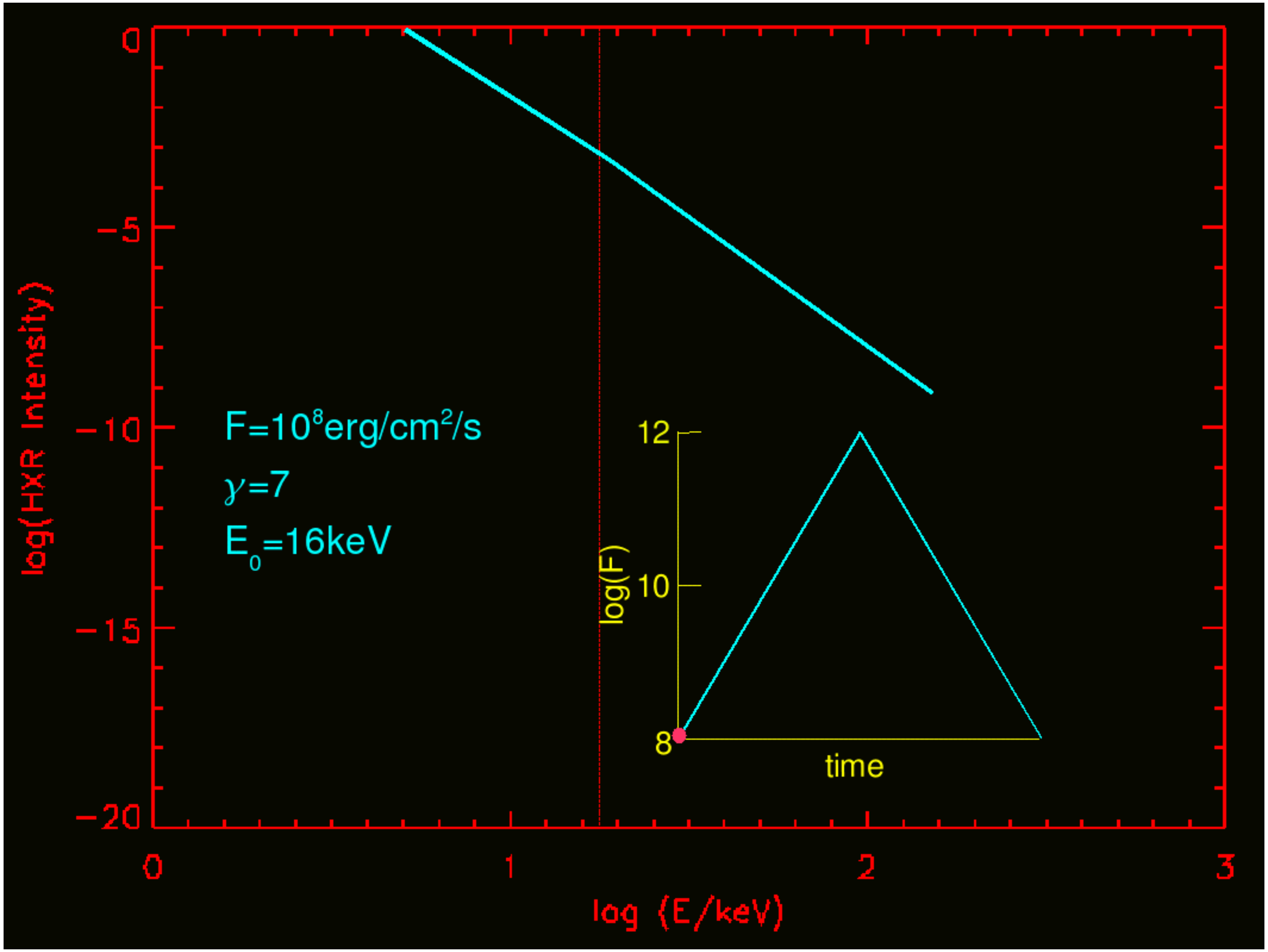
Return Current Energy Losses and Spectral Evolution



Zharkova

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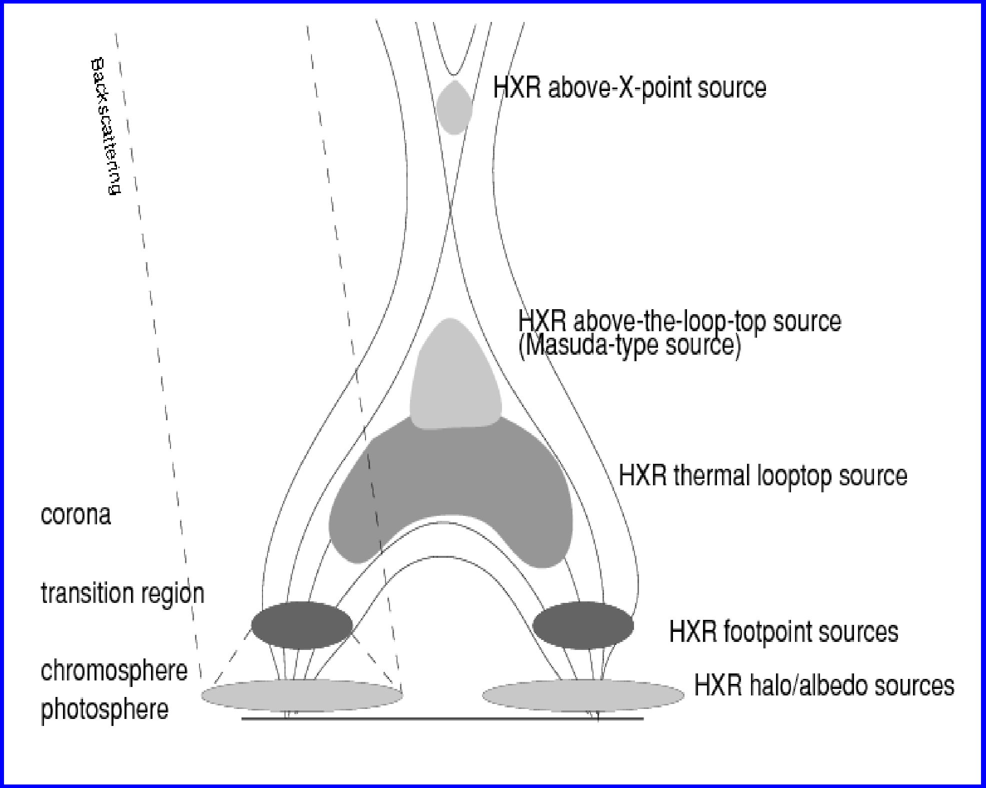
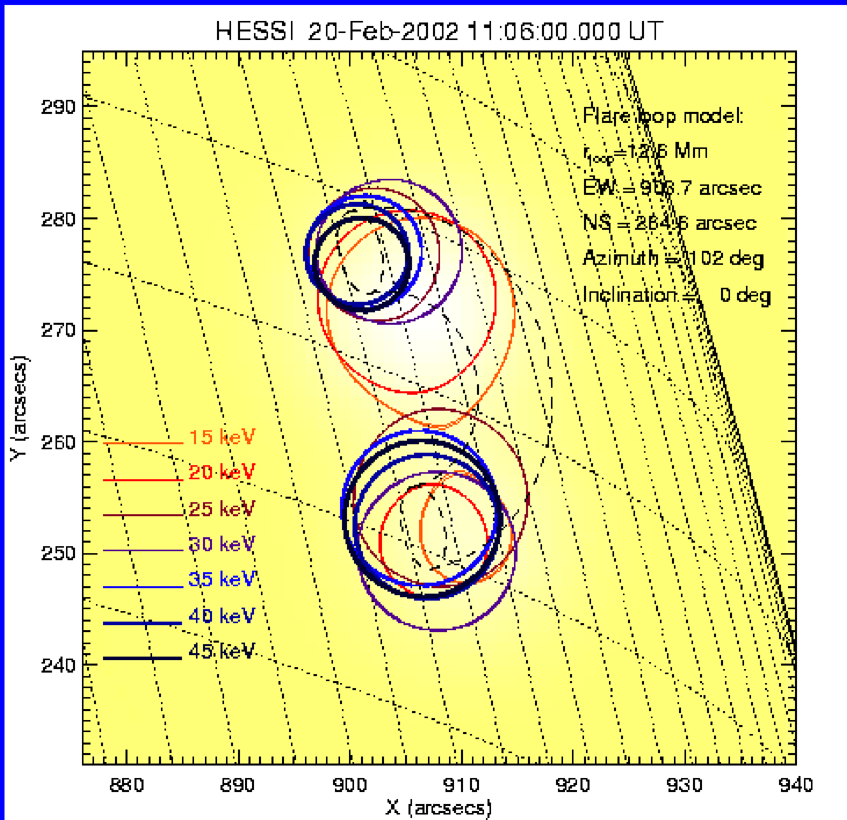
Height Dependence of Hard X-ray Sources

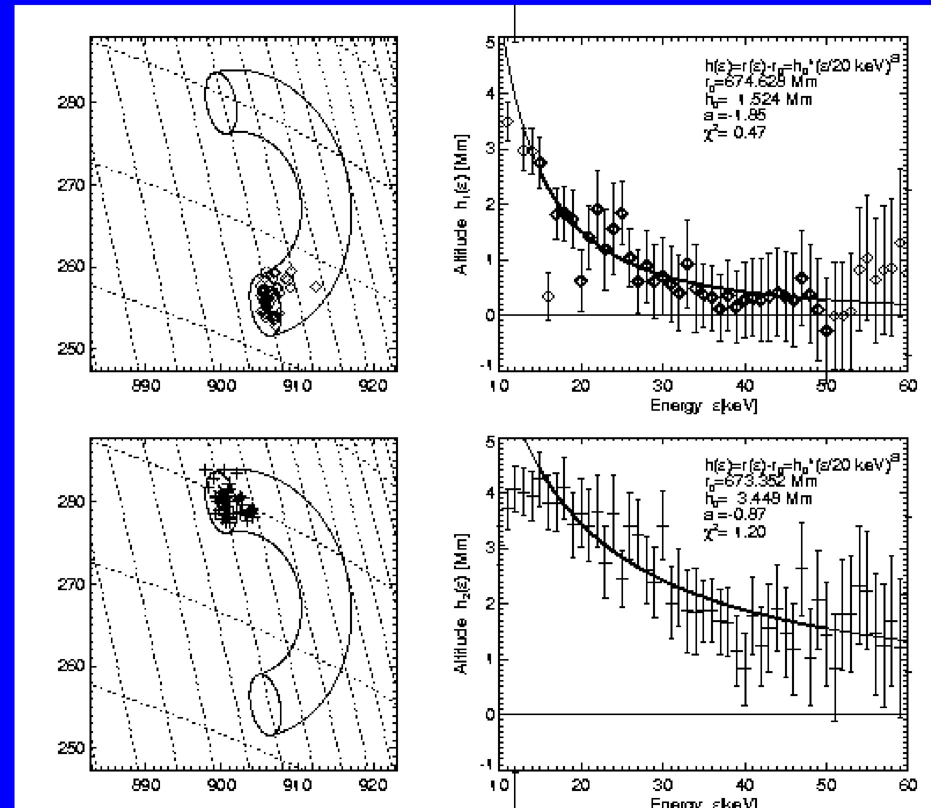
Observation



Model

Aschwanden

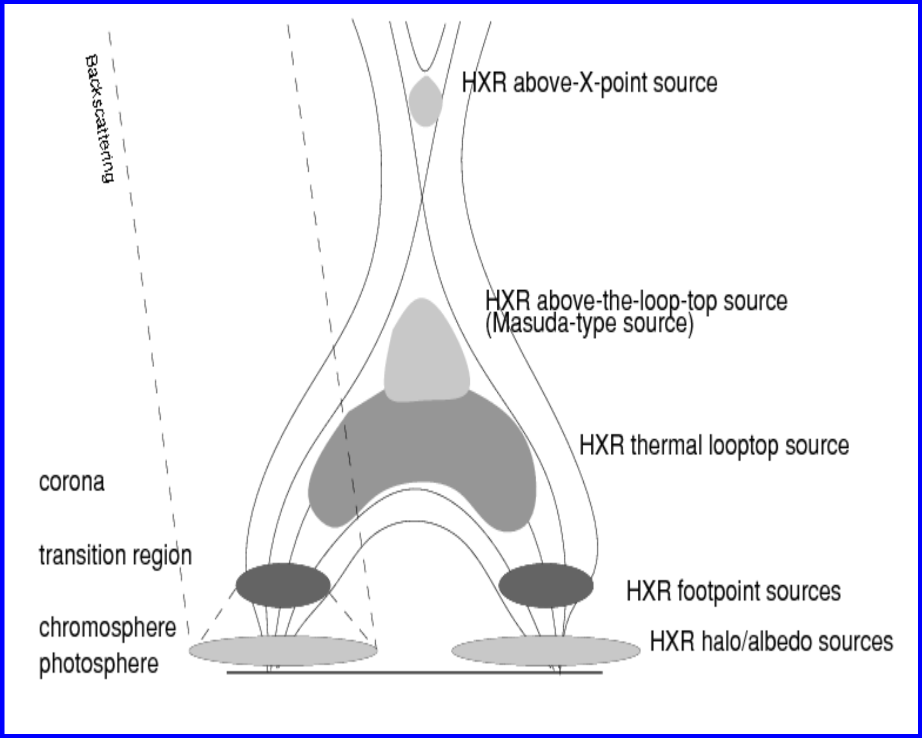




The height of hard X-ray footpoint sources is consistent with the thick-target model: The altitude of the centroid of 10-60 keV footpoint sources decreases in the altitude range of h(E=10 keV)=5000 km to h(E=60 keV)=1000 km

(Aschwanden, Brown, & Kontar 2002)

Observation



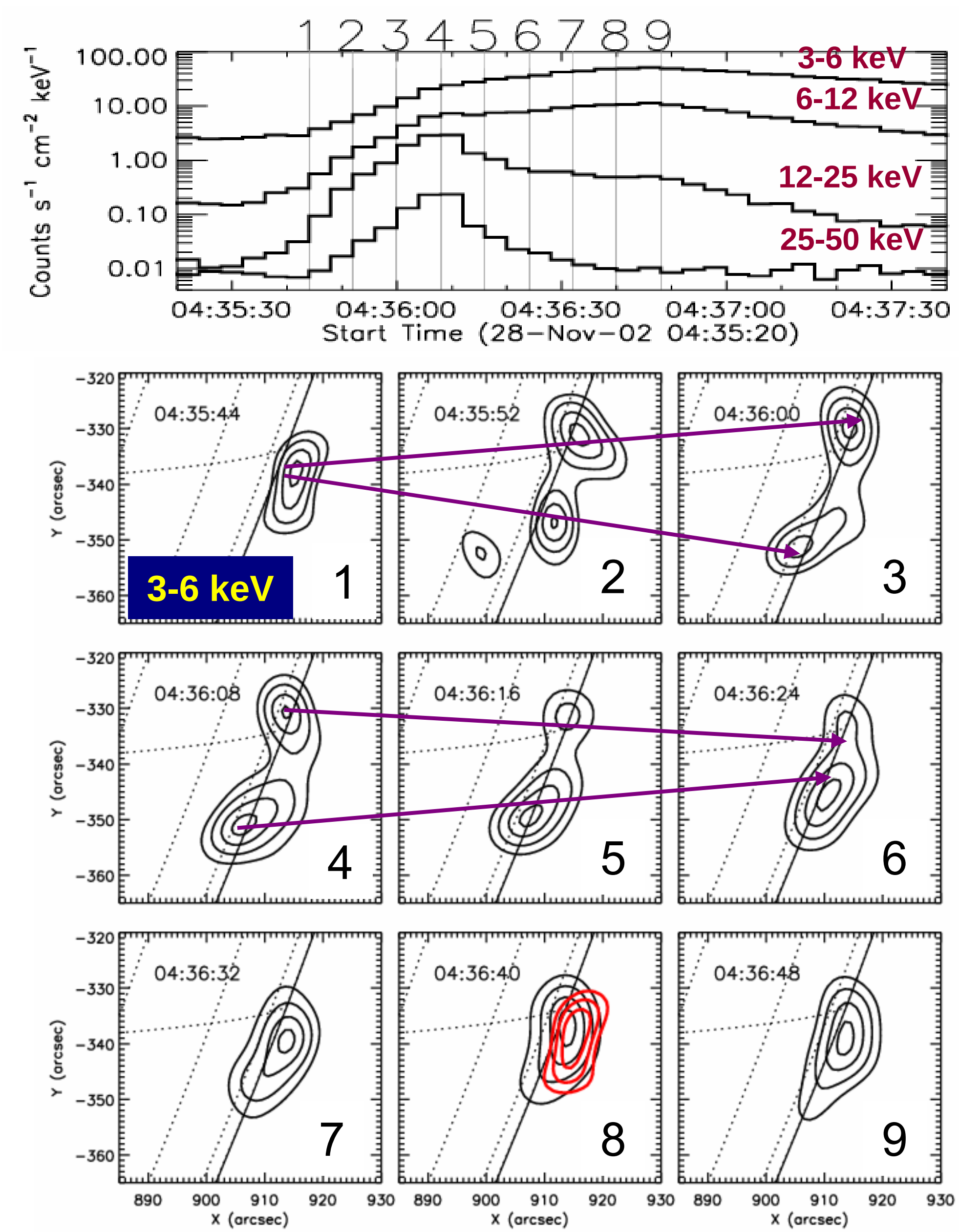
Model

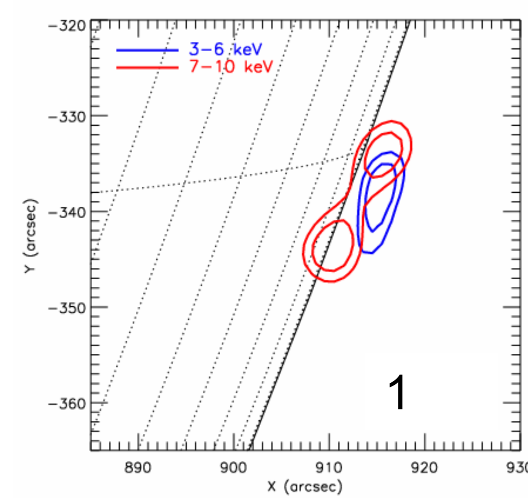
CONCLUSIONS :

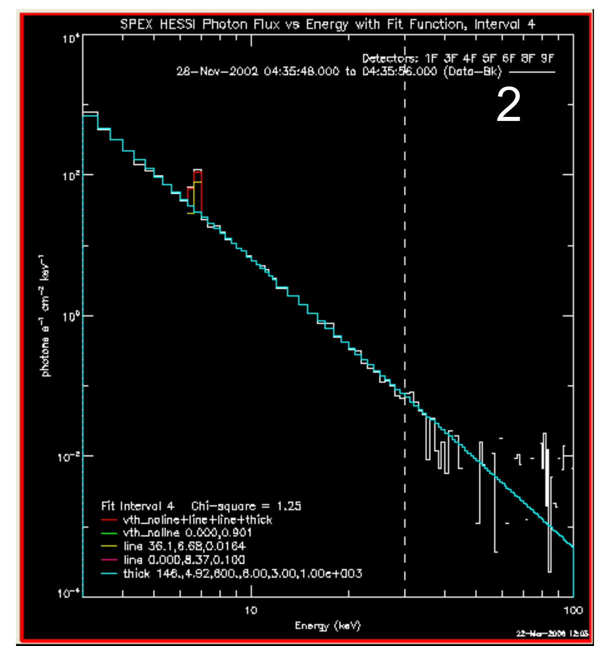
The model is consistent with the observation !!!

Aschwanden

Source Motion Along Flare Loops (Sui)

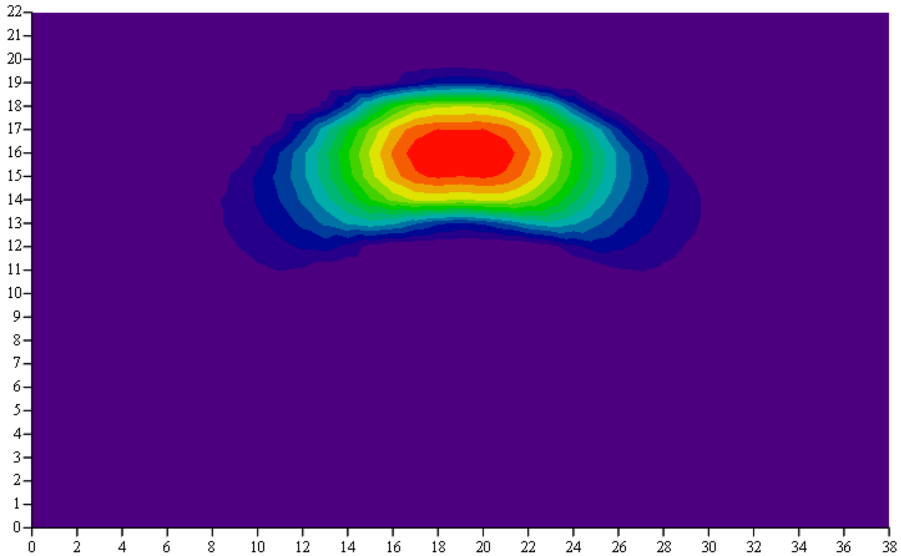




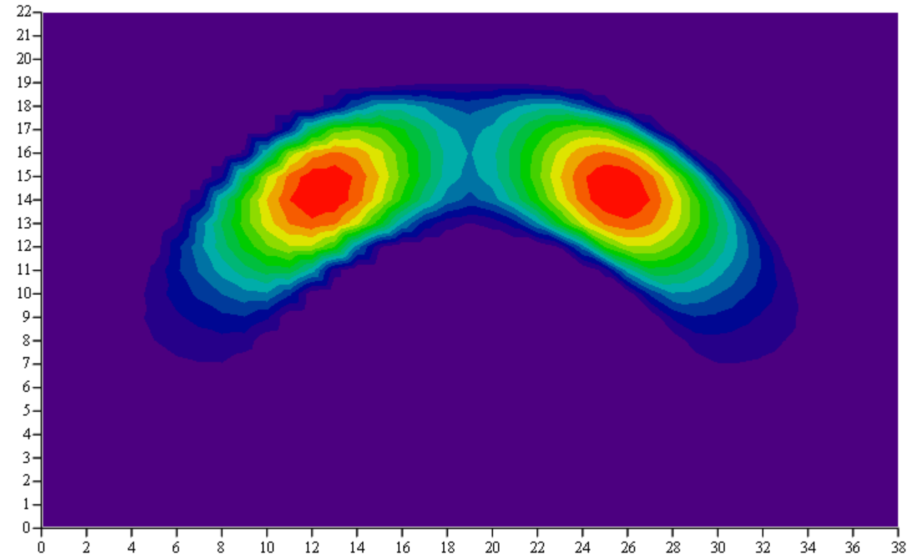


Early Rise (04:35:44 UT): Model

Thick-target electron spectral index = 5.7



3 keV

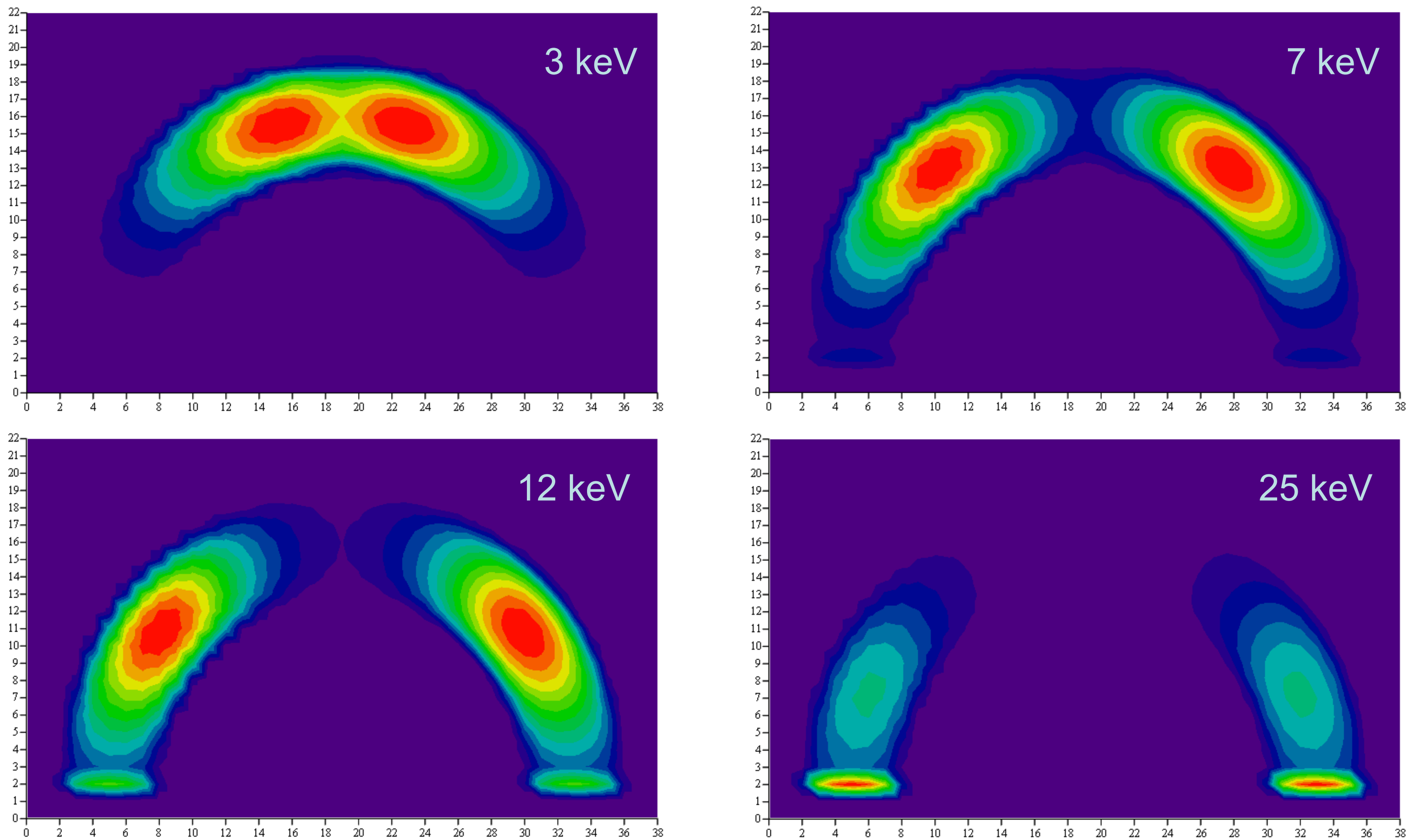


7 keV

Holman

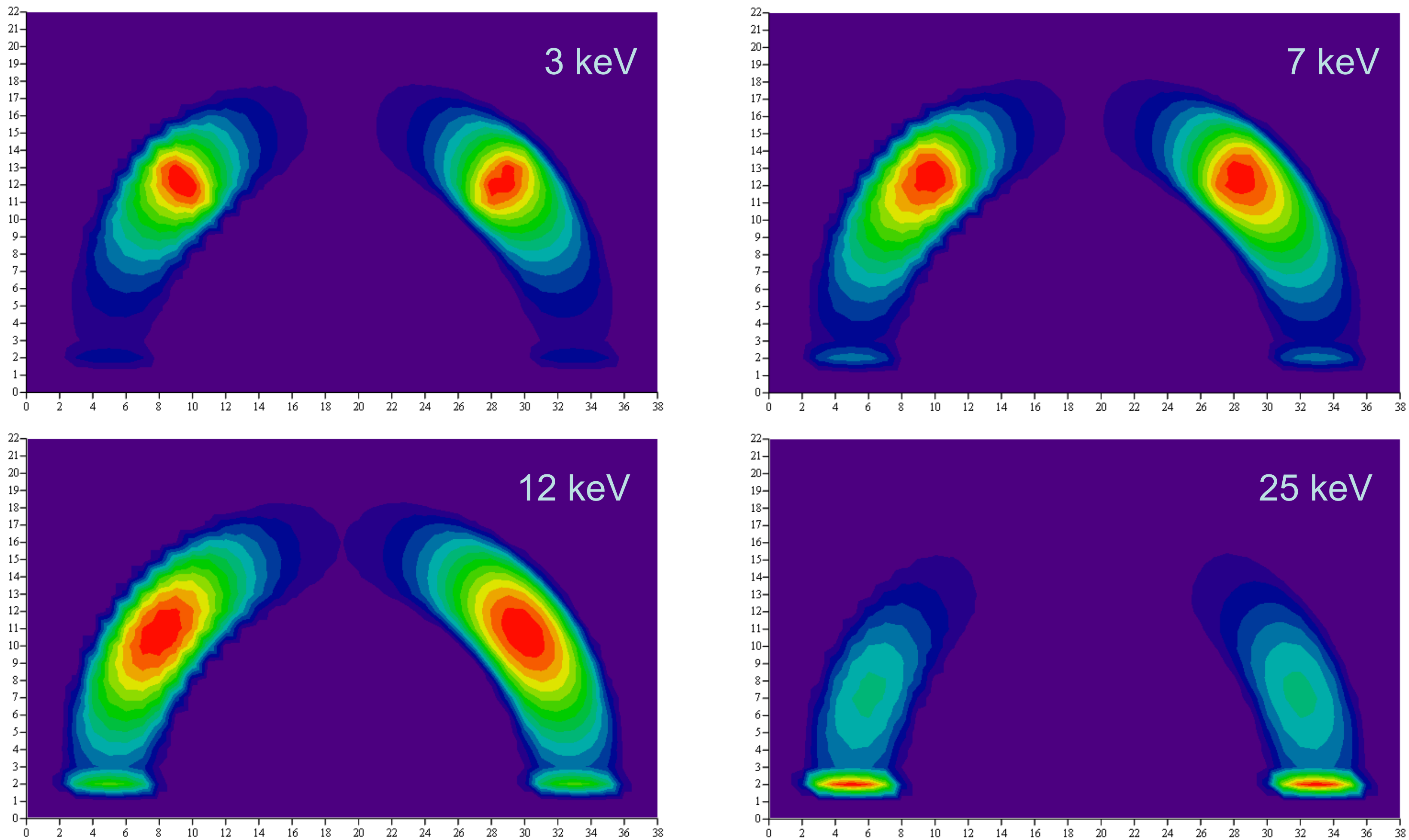
Hard X-Ray Peak (04:36:08 UT): Model

Thick-target electron spectral index = 4.2



Hard X-Ray Peak (04:36:08 UT): Model

Low-energy cutoff at 12 keV



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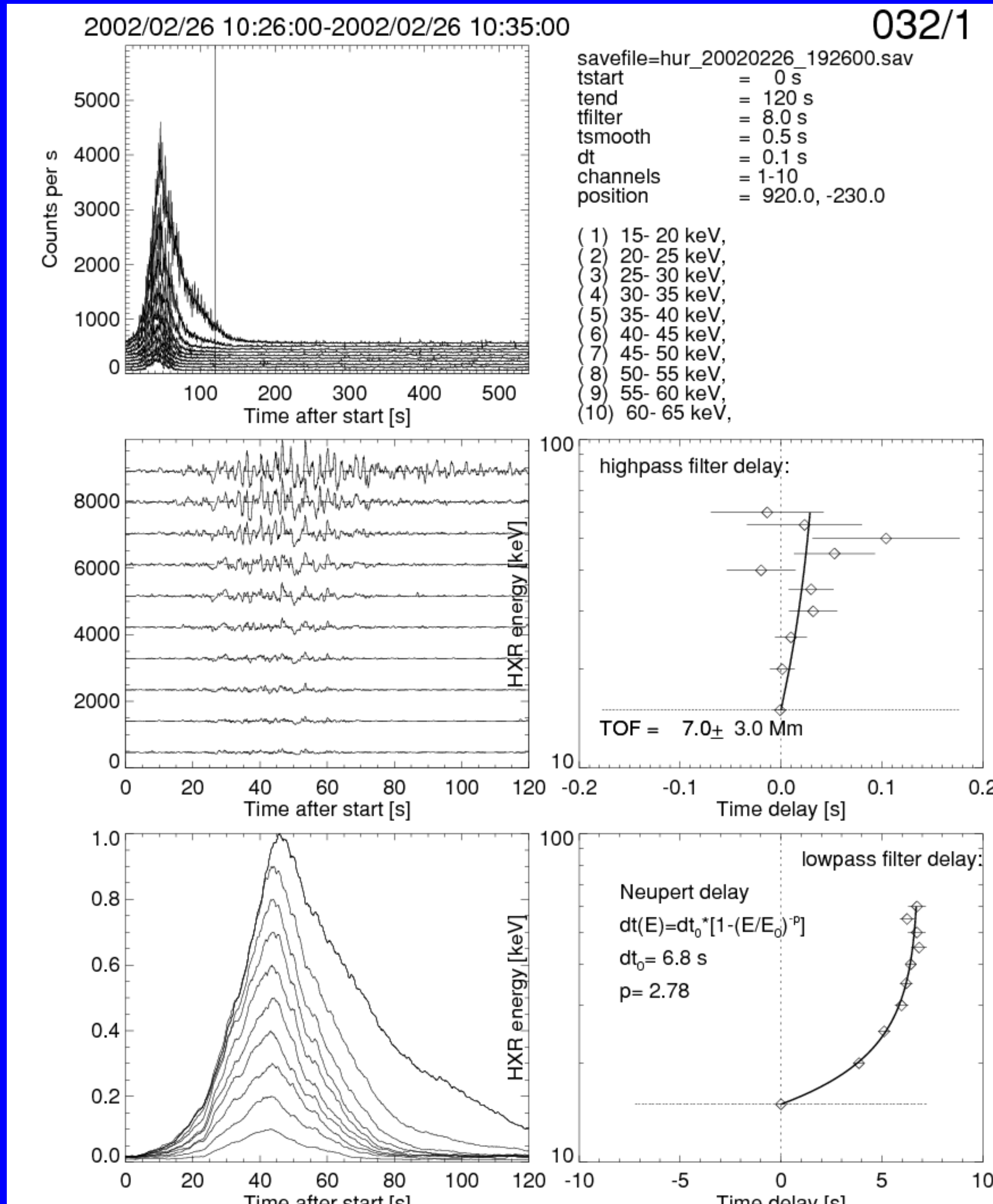
2002/02/26 10:26:00-2002/02/26 10:35:00
032/1
savefile=hur_20020226_192600.sav
tstart = 0 s
tend = 120 s
tfilter = 8.0 s
tsmooth = 0.5 s
dt = 0.1 s
channels = 1-10
position = 920.0, -230.0
(1) 15- 20 keV,
(2) 20- 25 keV,
(3) 25- 30 keV,
(4) 30- 35 keV,
(5) 35- 40 keV,
(6) 40- 45 keV,
(7) 45- 50 keV,
(8) 50- 55 keV,
(9) 55- 60 keV,
(10) 60- 65 keV,
Counts per s
Time after start [s]
highpass filter delay:
TOF = 7.0± 3.0 Mm
HXR energy [keV]
Time delay [s]
lowpass filter delay:
Neupert delay
dt(E)=dt0*[1-(E/E0)^-p]
dt0= 6.8 s
p= 2.78

Aschwanden

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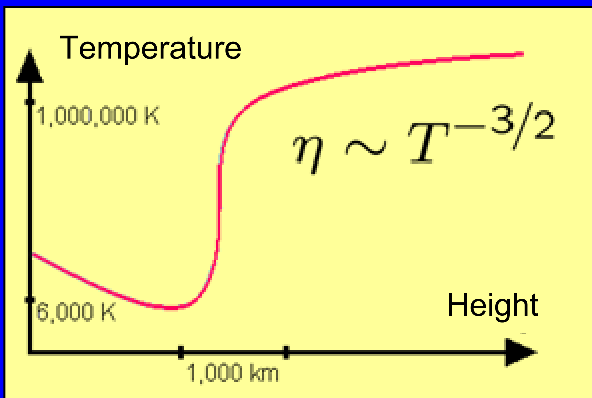
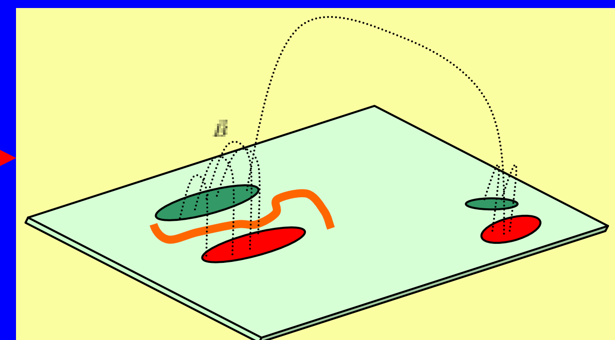
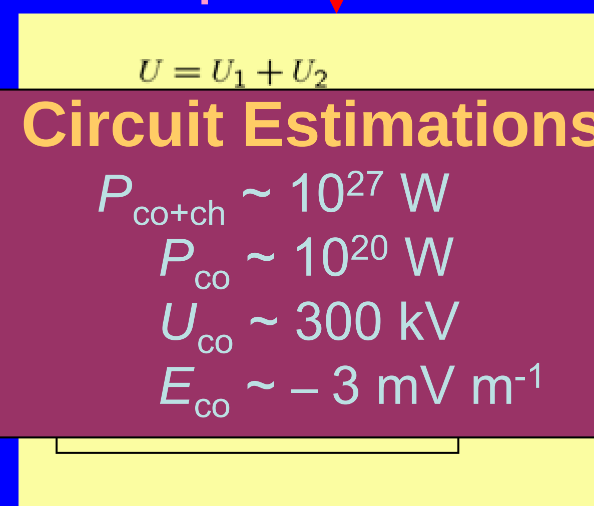
Summary
Electron Acceleration by DC Fields



short circuited



electric field induction by Photospheric footpoint motion



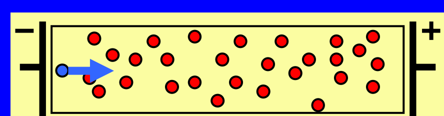
Circuit Estimations

$P_{co+ch} \sim 10^{27}$ W

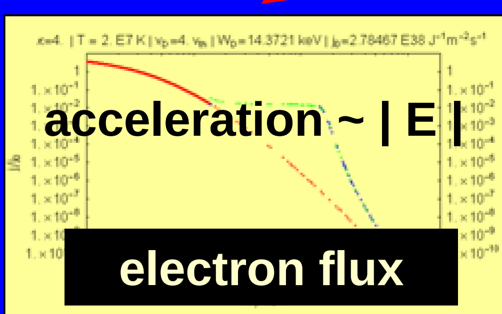
$P_{co} \sim 10^{20}$ W

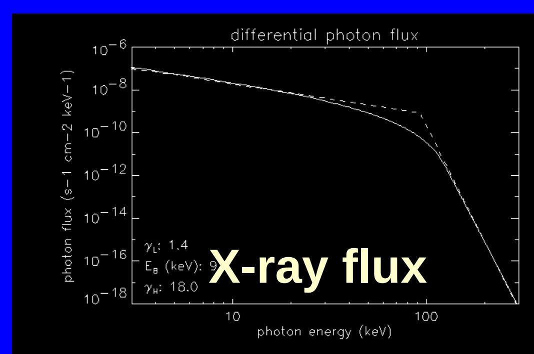
$U_{co} \sim 300$ kV

$E_{co} \sim -3$ mV m^{-1}



acceleration by DC field





Friday, 7 April

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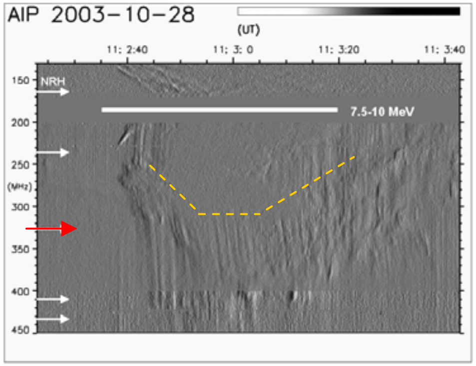
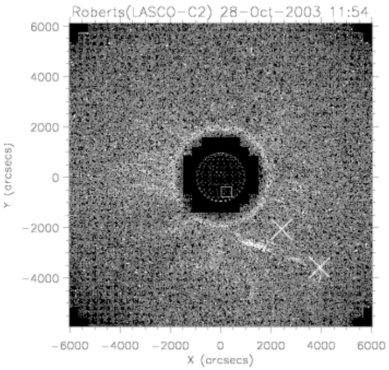
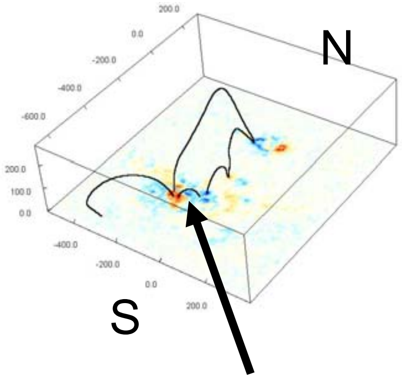
Summary 28 Oct. 2003

Impulsive electrons	Termination shock (TS)
Relativistic protons	TS and post-accel. in large loops ? A separatrix source ?
Gradual electrons	Post- Flare / CME current sheet







Main flaring arcade

H. Aurass

Discussion IV

AIP

Solar event on October 2003

basic coronal parameters at 150 MHz

$N_e = 2.8 \cdot 10^8 \, \mathrm{cm}^{-3}$ (→ 160 Mm for 2 x *Newkirk (1961)*)

$B_o = 4.7 \, \mathrm{G}$ (*Dulk & McLean, 1978*)

$T = 40 \, \mathrm{MK}$ (flare plasma)

$\rightarrow \; v_{th,e} = 12.300 \, \mathrm{km/s}$

$v_A = 610 \, \mathrm{km/s}$

$A \sim 10^{19} \, \mathrm{cm}^{-3}$

shock parameter

$$N_{down} / N_{up} \approx B_{down} / B_{up} = 2 \quad \rightarrow \quad M_A = 2.32 \quad \rightarrow \quad v_s \approx 1500 \, \mathrm{km/s}$$

comparison: theory ↔ observations

$F_e = 1.5 \cdot 10^{37} \, \mathrm{s}^{-1}$ (→ $5 \cdot 10^{36} \, \mathrm{s}^{-1}$ observed by RHESSI)

$P_e = 7.3 \cdot 10^{29} \, \mathrm{erg \, s}^{-1}$ (→ $5 \cdot 10^{29} \, \mathrm{erg} \cdot \mathrm{s}^{-1}$ observed by RHESSI)

G. Mann

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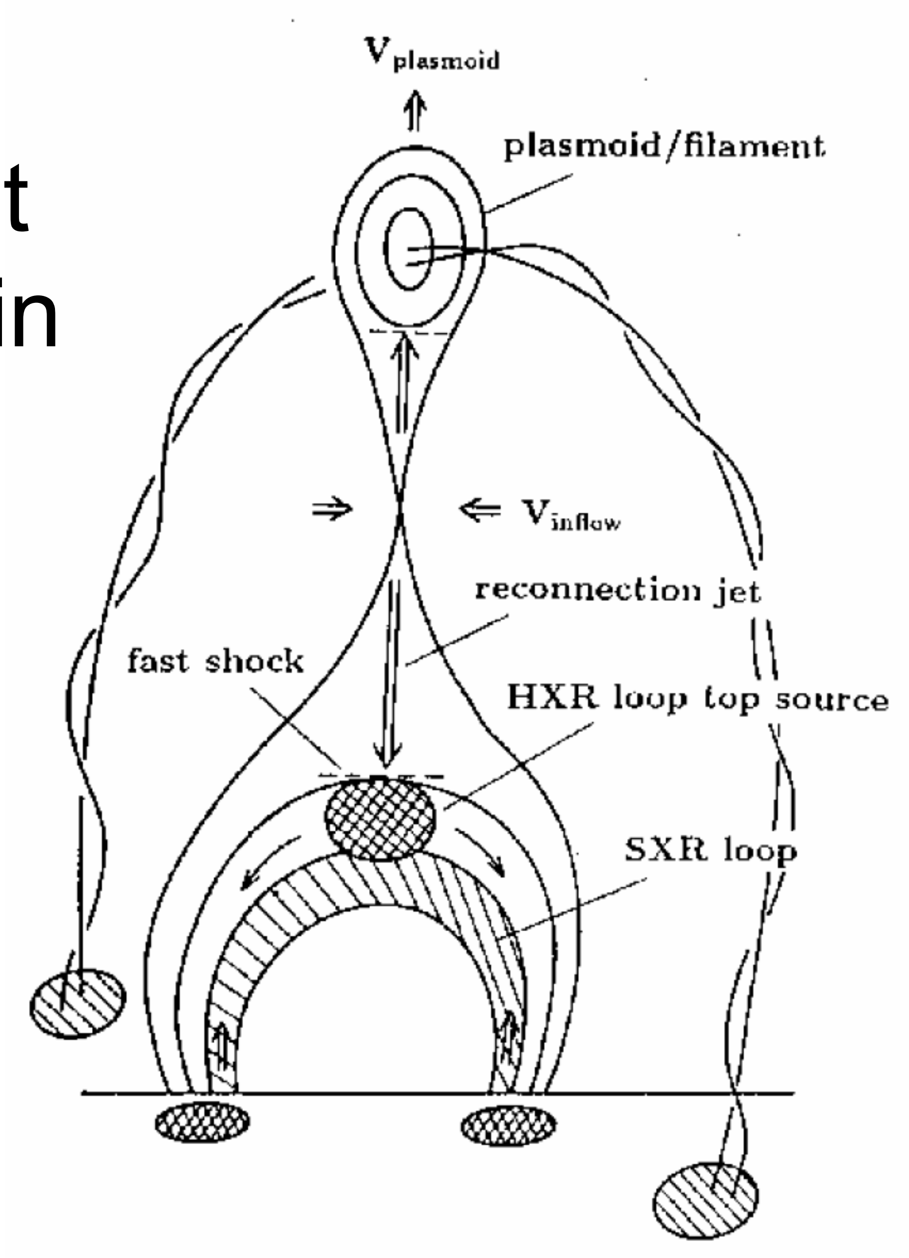
Is a large-scale, reconnecting current sheet really present in solar flares?



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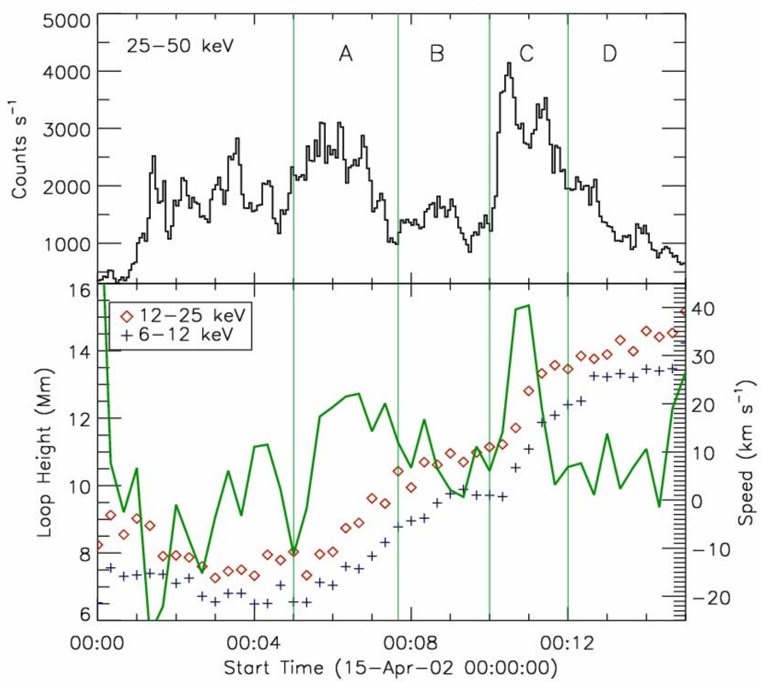

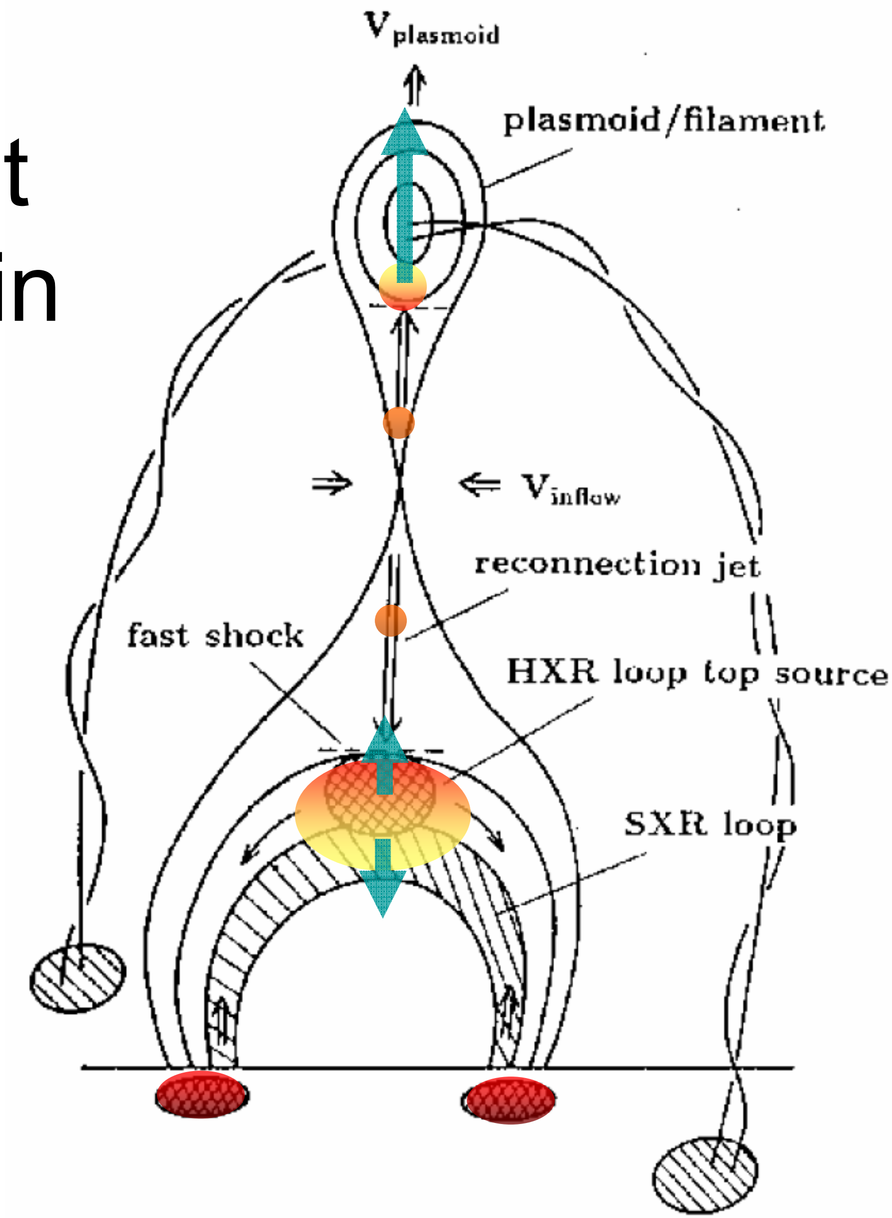

Is a large-scale, reconnecting current sheet really present in solar flares?

If it walks like a duck and quacks like a duck …