

Particle Acceleration and Energy Release in Solar Flares

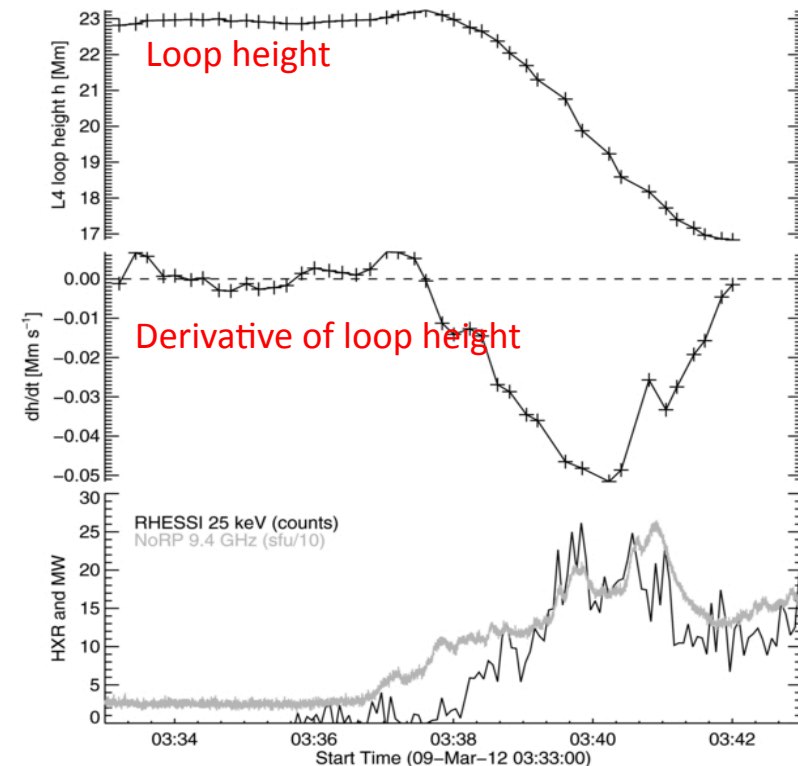
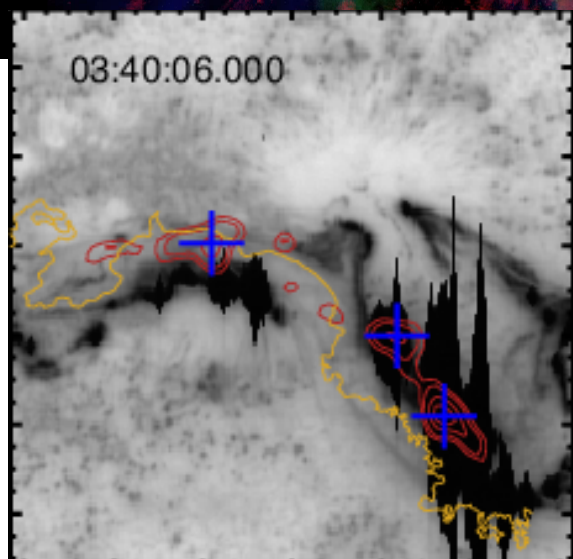
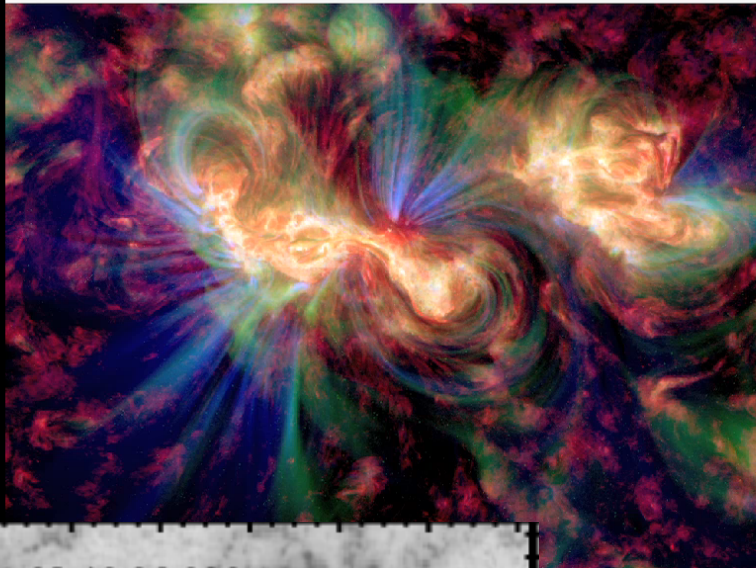
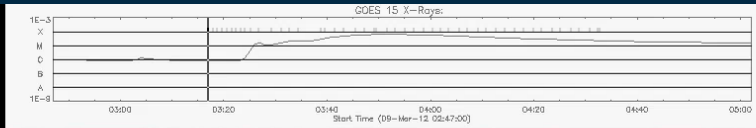
With HESPE people: Battaglia, Fletcher, Hannah,
Hudson, Graham, Kontar, Simões

Focus on

- the flare environment and its evolution
- RHESSI sources in broader context



Loop implosion and HXR timing

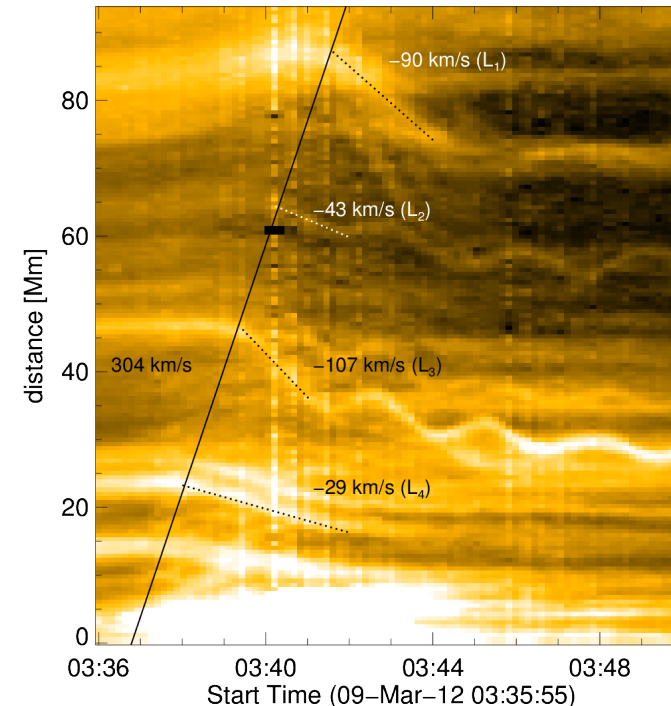
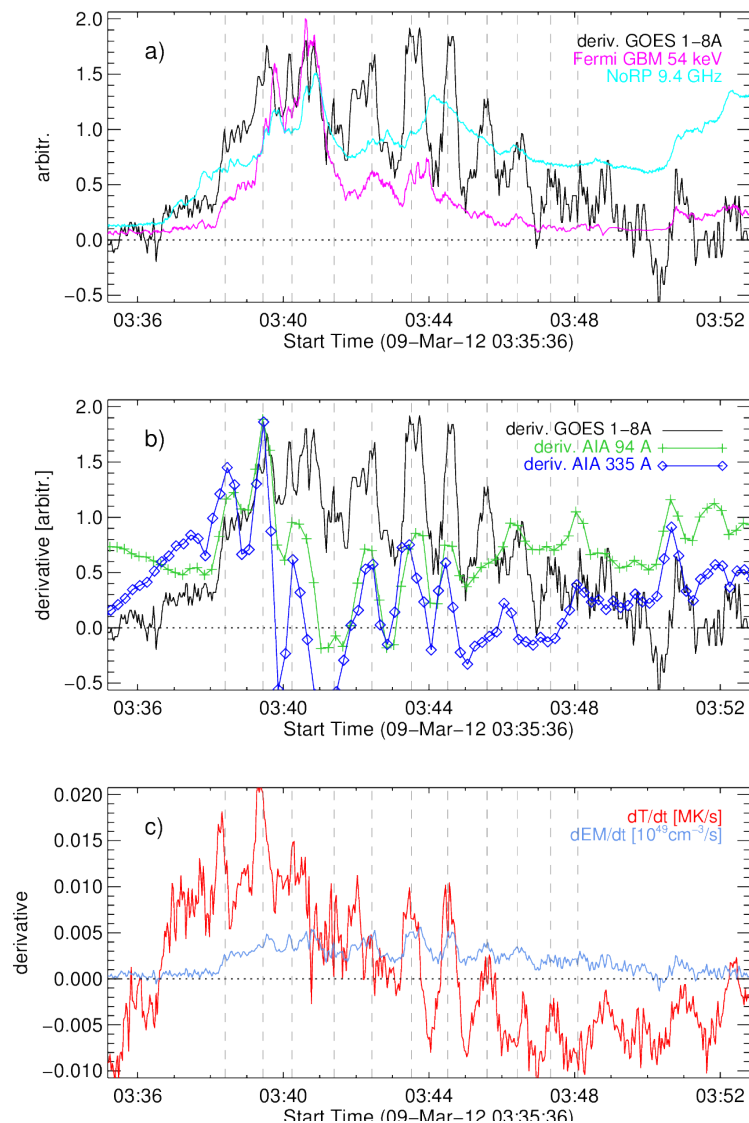


Early impulsive HXR & microwaves have nice correlation with loop shrinkage, indicating reduction of coronal magnetic energy

25-45 keV HXR
on 1600 Å

Simões et al. 2013, ApJ

Quasi-periodic pulsations



- Fluctuations in GOES SXR (T and EM) and EUV
- Persistent semi-regular compressions of the flaring core
- Association with HXR fluctuations
- Ongoing work to understand whether this (and other events) really show an oscillation

Pre-flare coronal X-ray source and its absent EUV footpoints

RHESSI/AIA observations of a steady preflare coronal source ($\sim 10\text{MK}$).

Full energetics can be calculated.

No accelerated electrons in this phase (RHESSI/Nobeyama).

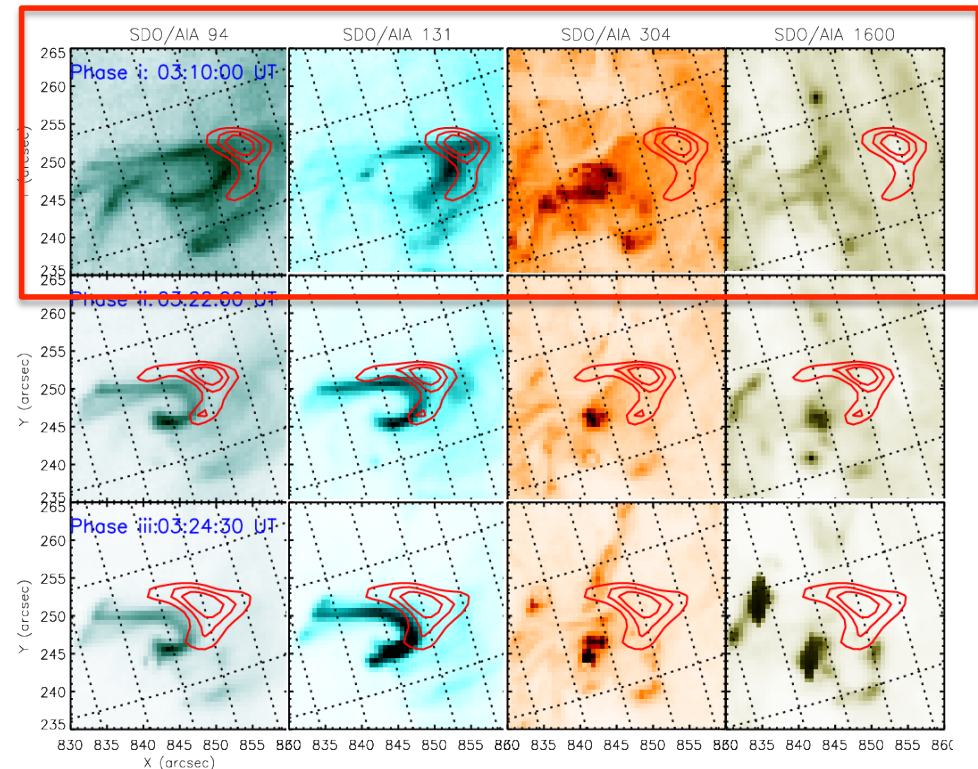
Estimated conductive flux to should give large preflare EUV chromospheric response – but none observed.

What is going on?

Thermal conduction is strongly inhibited?

Energy conducted to deep chromosphere, radiated in UV without any EUV emission?

Energy is conducted elsewhere?



Hot EUV and X-ray footpoints

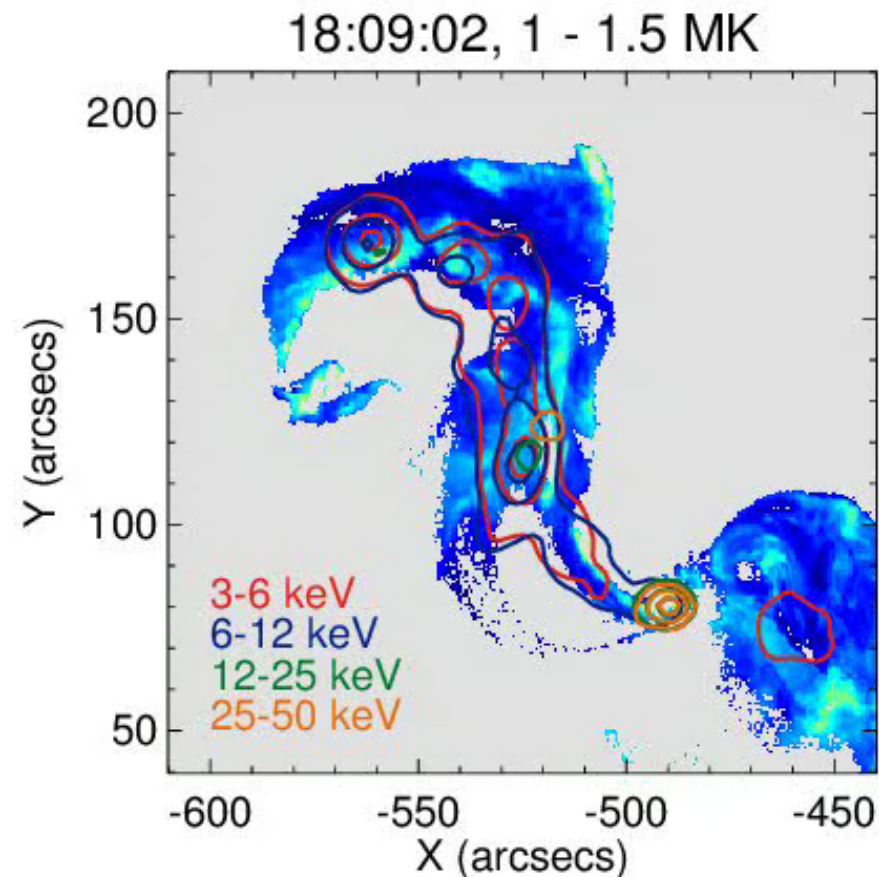
Energetics of flare footpoints examined with RHESSI, GOES, AIA

DEM method of Hannah & Kontar

Flare footpoint temperature ~ 10 MK

Non-thermal emission weak, but present

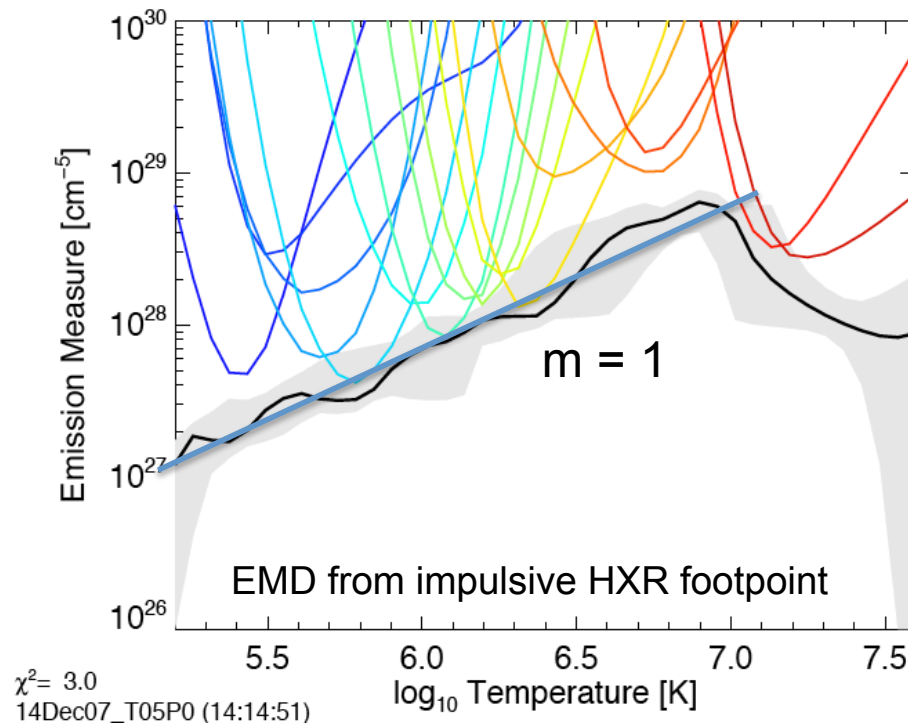
To support the 10MK plasma against radiative/conductive losses requires electron low-energy cutoff ~ 5 keV



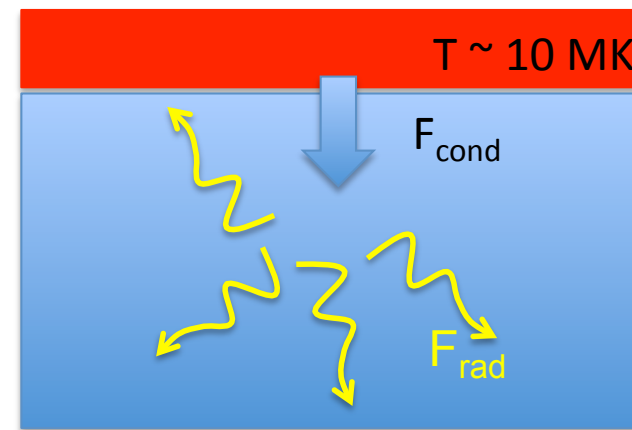
Fletcher et al (2013)

Hannah et al in prep

EIS spectroscopic observations of 6 RHESSI C-class flares
Spectra taken at RHESSI footpoint location in impulsive phase
Emission measure distribution produced - slope provides information on energy loss and input.



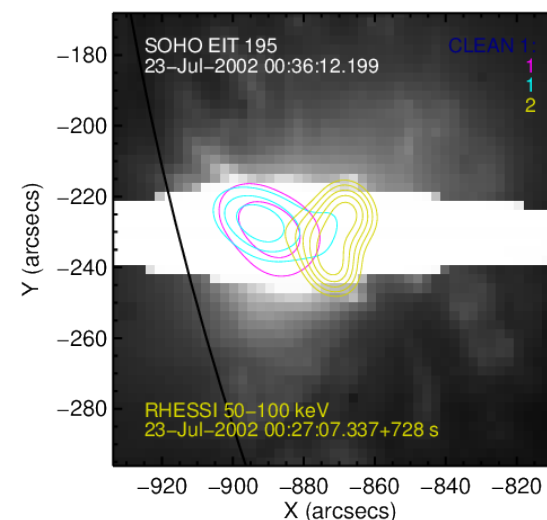
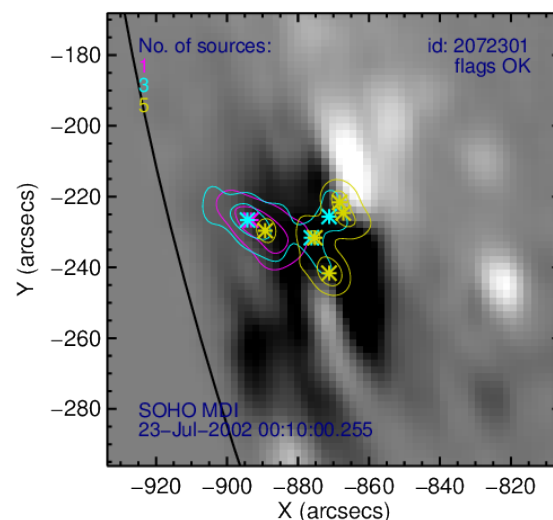
$m = 1$ consistent with conductive heating balanced by radiative cooling (Shmeleva & Syrovatskii 1973)



207 RHESSI flares having 50 – 100 keV images during impulsive phase
CLEAN reconstruction (beam factor width 1 and 2), detectors 3 to 8
Catalogue at <http://www.astro.gla.ac.uk/users/paulo/rhessi/>

Investigations:

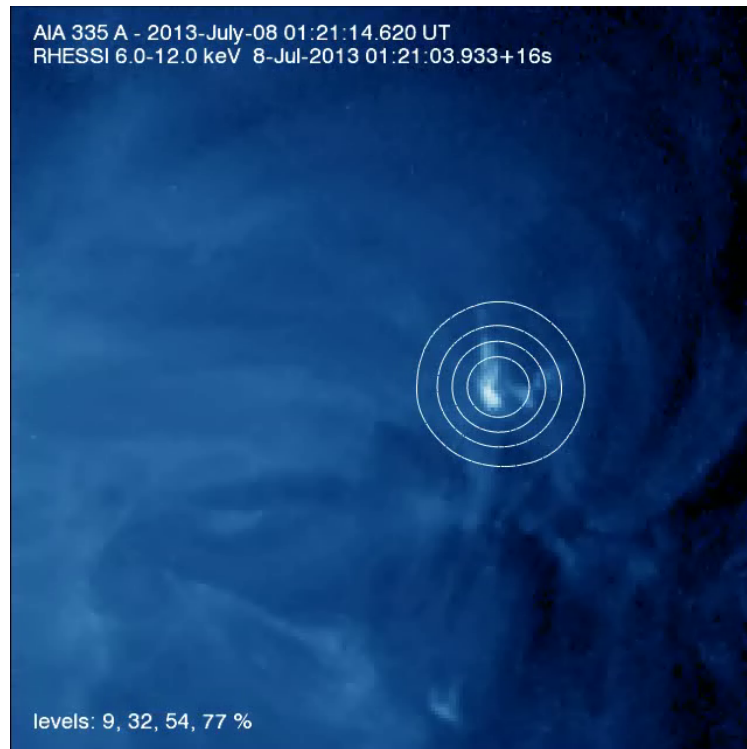
- Number and location of footpoints (e.g. Sakao et al. 1995 - Yohkoh)
- Asymmetry and photospheric magnetic field (e.g. Yang et al. 2012)
- Association with “high-gradient magnetic polarity-separation” regions – strong shear and upwards Poynting flux transport through photosphere.



Simoes et al
(in prep)



Development of a flare with flows



Topology reminiscent of fan-spine
flare reported by Masson et al.
2009, Reid et al. 2012

