

Coronal Fuzziness modeled with pulse-heated multi-stranded loop system

Fabio Reale

*Dipartimento di Scienze Fisiche & Astronomiche, Università di Palermo, &
INAF/Osservatorio Astronomico di Palermo, Italy reale@astropa.unipa.it*

Massimiliano Guarrasi

*Dipartimento di Scienze Fisiche & Astronomiche, Università di Palermo &
INAF/Osservatorio Astronomico di Palermo, Italy guarrasi@astropa.unipa.it*

Giovanni Peres

*Dipartimento di Scienze Fisiche & Astronomiche, Università di Palermo, &
INAF/Osservatorio Astronomico di Palermo, Italy peres@astropa.unipa.it*

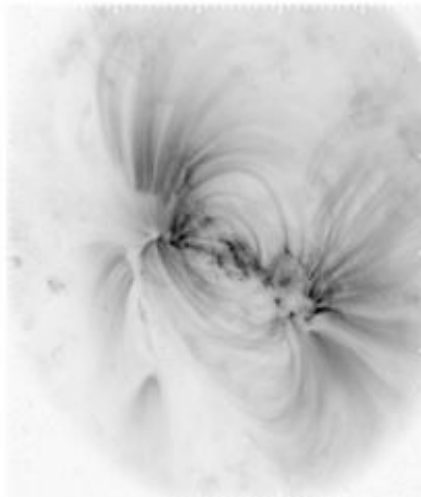
Coronal “Fuzziness”



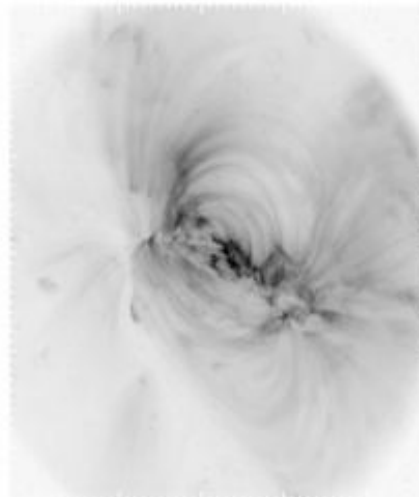
- Evidence: fuzziness increasing with band hardness (T)
- Long known (Skylab) but not addressed
- Loops/active regions better defined in cooler UV lines (e.g. Brickhouse & Schmelz 2006; Tripathi et al. 2009)

Brickhouse & Schmelz (2006): TRACE data, May 1998

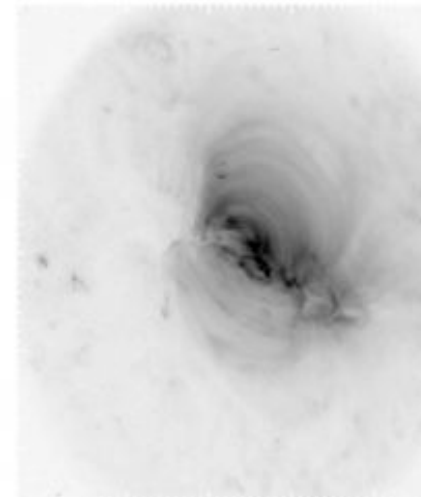
171 (~1 MK)



195 (~1.5 MK)



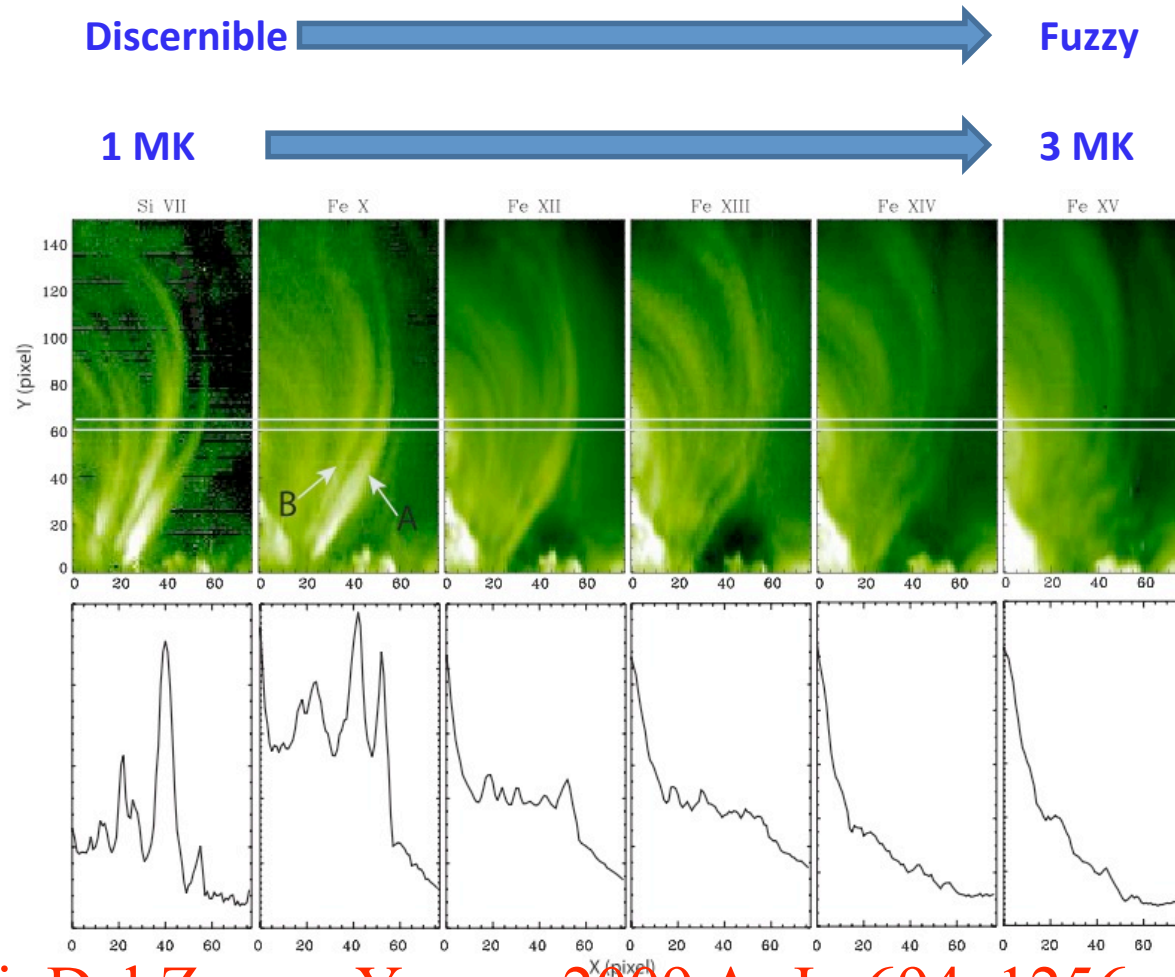
284 (~2 MK)



How do we define fuzziness?



- Active region (May 2007)
- Hinode/EIS lines: 1-3MK
- Fuzziness: capability to resolve single loops/strands (loop contrast, presence of interloop gaps)



Tripathi, Mason, Dwivedi, Del Zanna, Young, 2009 ApJ, 694, 1256

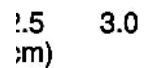
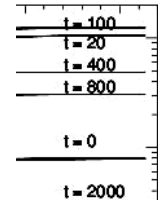
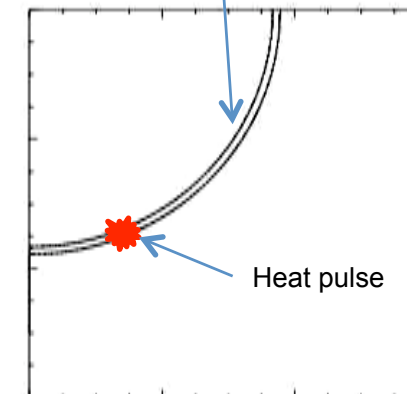
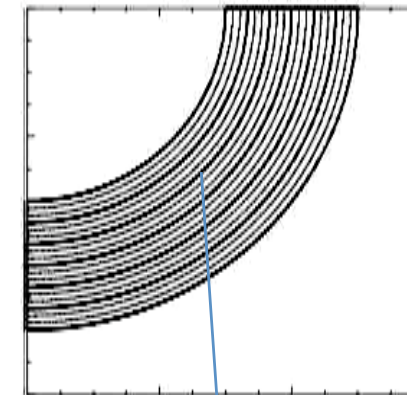
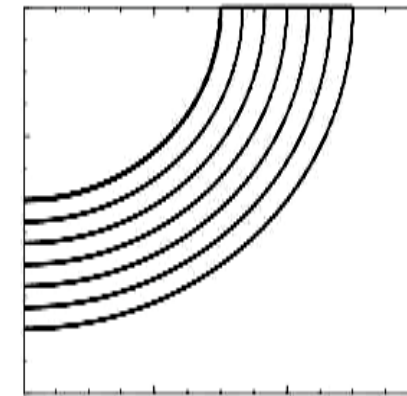
The model

(Guarrasi, Reale & Peres, 2010, ApJ, 719, 576)

- System of similar loops, each with many unresolved strands
- All strands have the same pulsed heating (60 s duration)
- Approach: collection of single "loop" simulations
 - All strands have the same evolution..
 - ... but they are out of phase
 - One 1D loop simulation (Palermo-Harvard code)
 - Shuffling
- Average heating rate tuned for a 3MK loop system (peak ~ 10 MK, e.g. Reale & Orlando 2008)

Temperature (K)

Density (cm^{-3})



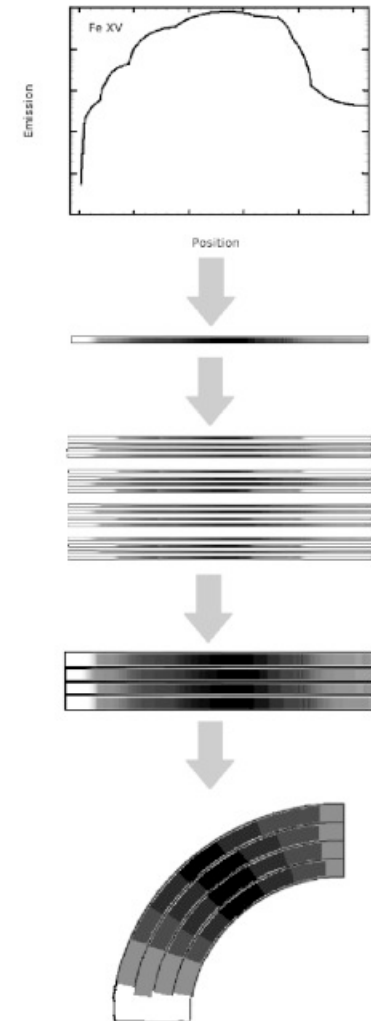
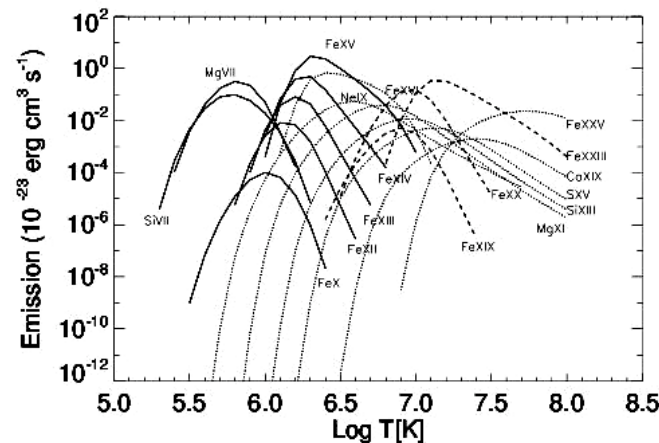
Loop system emission

(Guarrasi, Reale & Peres, 2010, ApJ, 719, 576)



- From temperature and density, calculate lines emission (CHIANTI) along a loop strand
- Put strand emission side by side (2D image)
- Group the strands to degrade down to current instrument resolution
- Bend the image to obtain a loop-like shape

- Lines from $\text{Log} T = 5.8$ to $\text{Log} T = 7.5$
- 60 strands per pixel

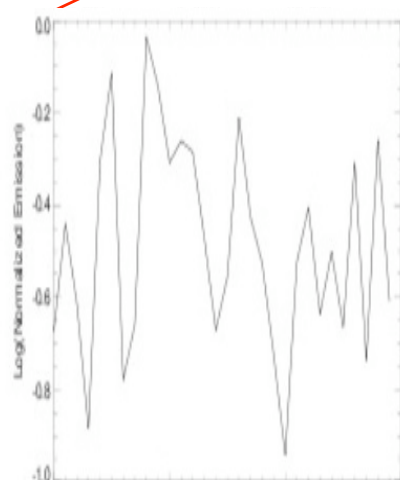
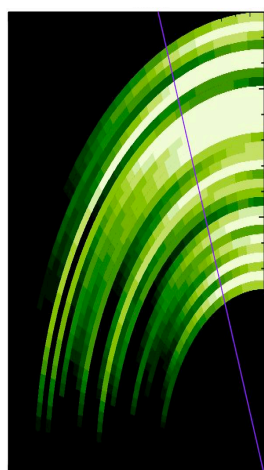


Results

(Guarrasi, Reale & Peres, 2010, ApJ, 719, 576)



- EIS-like images
- Cut at 2/3 of loop length
- Fuzzy $6.0 < \text{LogT} < 6.4$

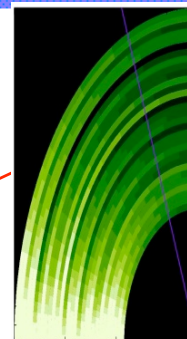


(g) Fe XXIII

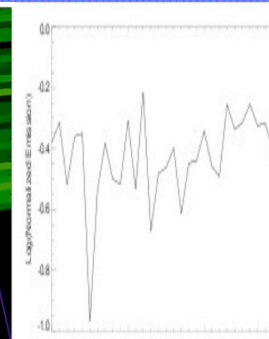
From Tripathi et al. 2009

(h) Fe XXIII

LogT = 7.1

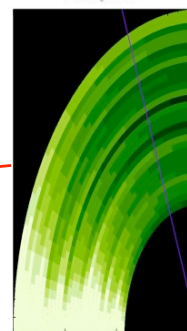


(a) Mg VII

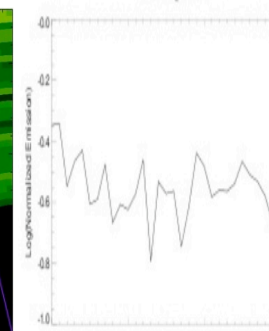


(b) Mg VII

LogT = 5.8

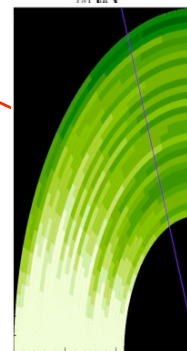


(c) Fe XV

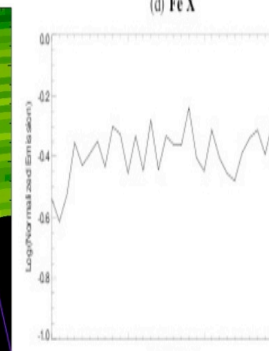


(d) Fe XV

LogT = 6.0



(e) Fe XV



(f) Fe XV

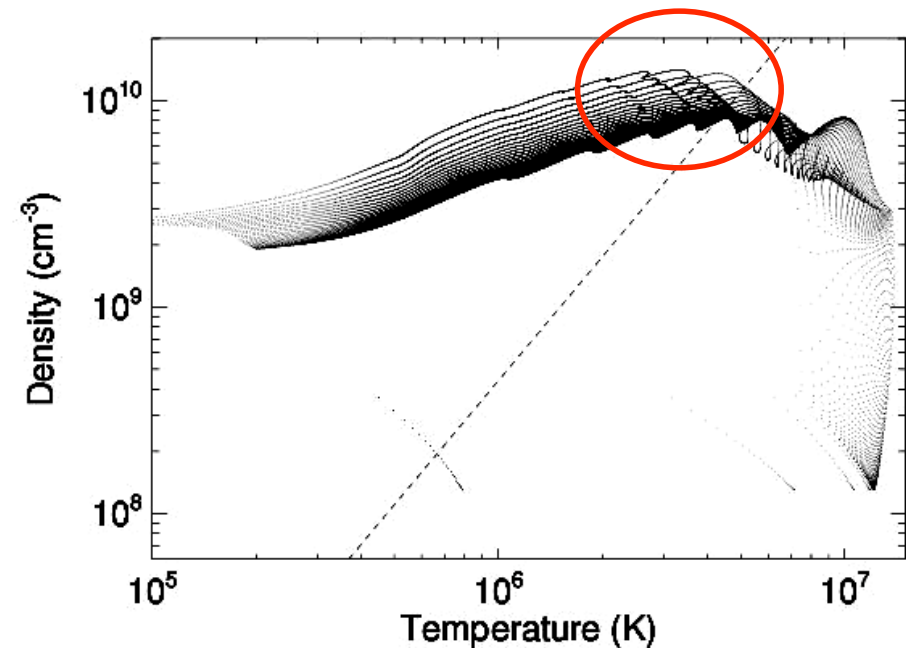
LogT = 6.4

Why?



Scatter plot of all strands:

- Each strand stays longer (*higher density of points*) around 3 MK and at high density
- -> we expect a higher "filling factor" at 3 MK
- -> more fuzziness.



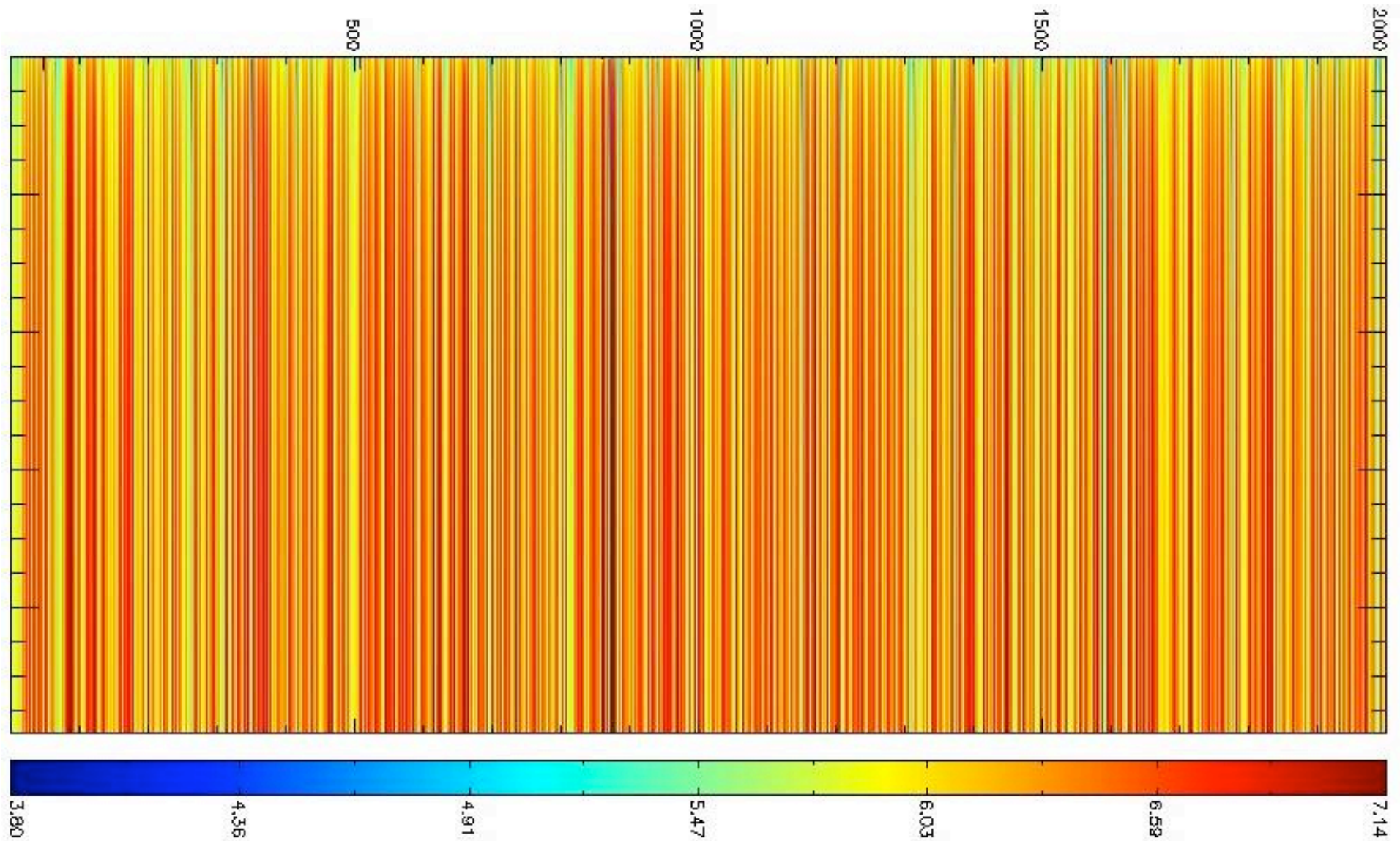
Conclusions



- Our explanation for fuzziness:
 - fine substructuring + Pulsed heating
- Equal heat pulses, 1 min duration, 10 MK (location unimportant)
- Check: SDO? X-rays?

Unfolded loop!

(temperature)





Thank you,
Helen