

# Active-region Loops

Working group report

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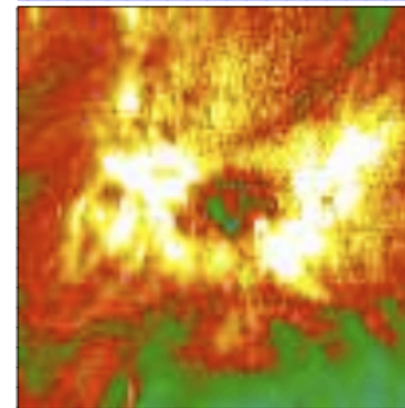
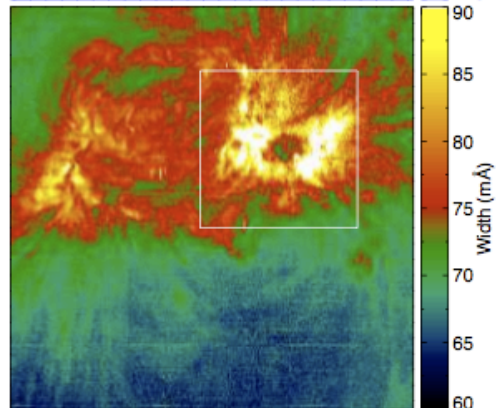
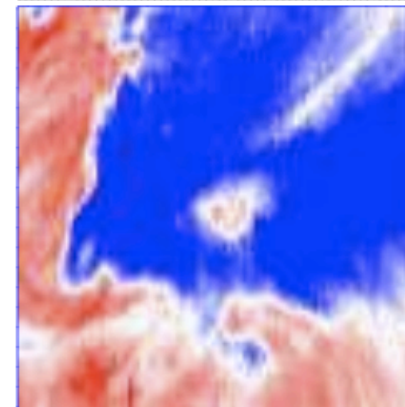
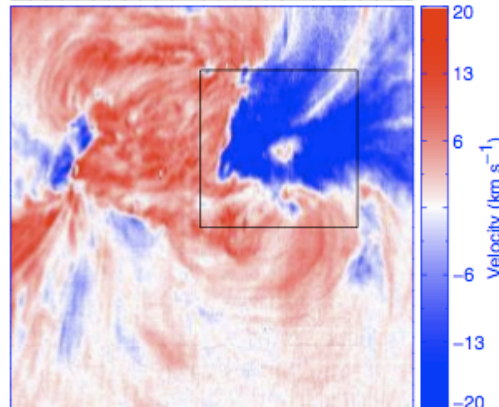
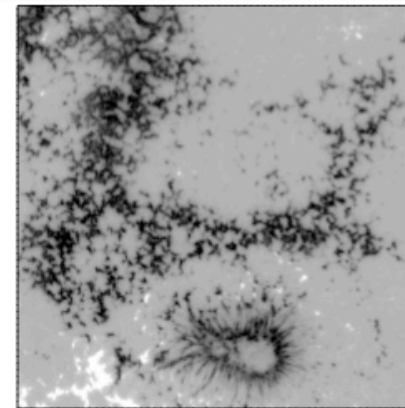
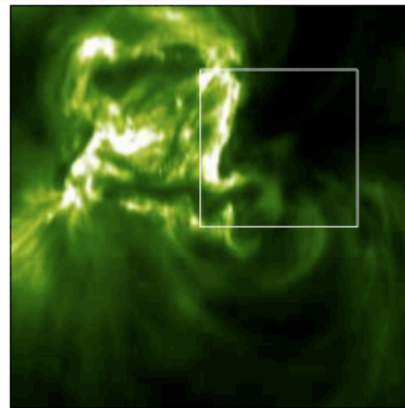
## Spatial structure

- How to define a loop?
  - Should we ignore the background?
- Are the thinnest loops seen in TRACE resolved?
- Monolithic or multi-stranded loops / single vs multi-temperatures
  - can models explain these narrow DEM? can a nanoflare-model do it?
  - is heating in AR loops predominantly at footpoints?
  - is heating asymmetric? (stronger in plane than above AR)
- Expansion of the loops (or strands)?
  - is this required by models, can we constrain this by observations?
- Hierarchy of loops
  - small hot dense loops at center of AR
  - cooler larger loops further out
  - fan-like structures (loops?) at periphery
  - dark areas surrounding AR (solar wind?)
- reconstructing 3D density & temperature structure (from STEREO)

# Outflow of the solar wind from the AR periphery

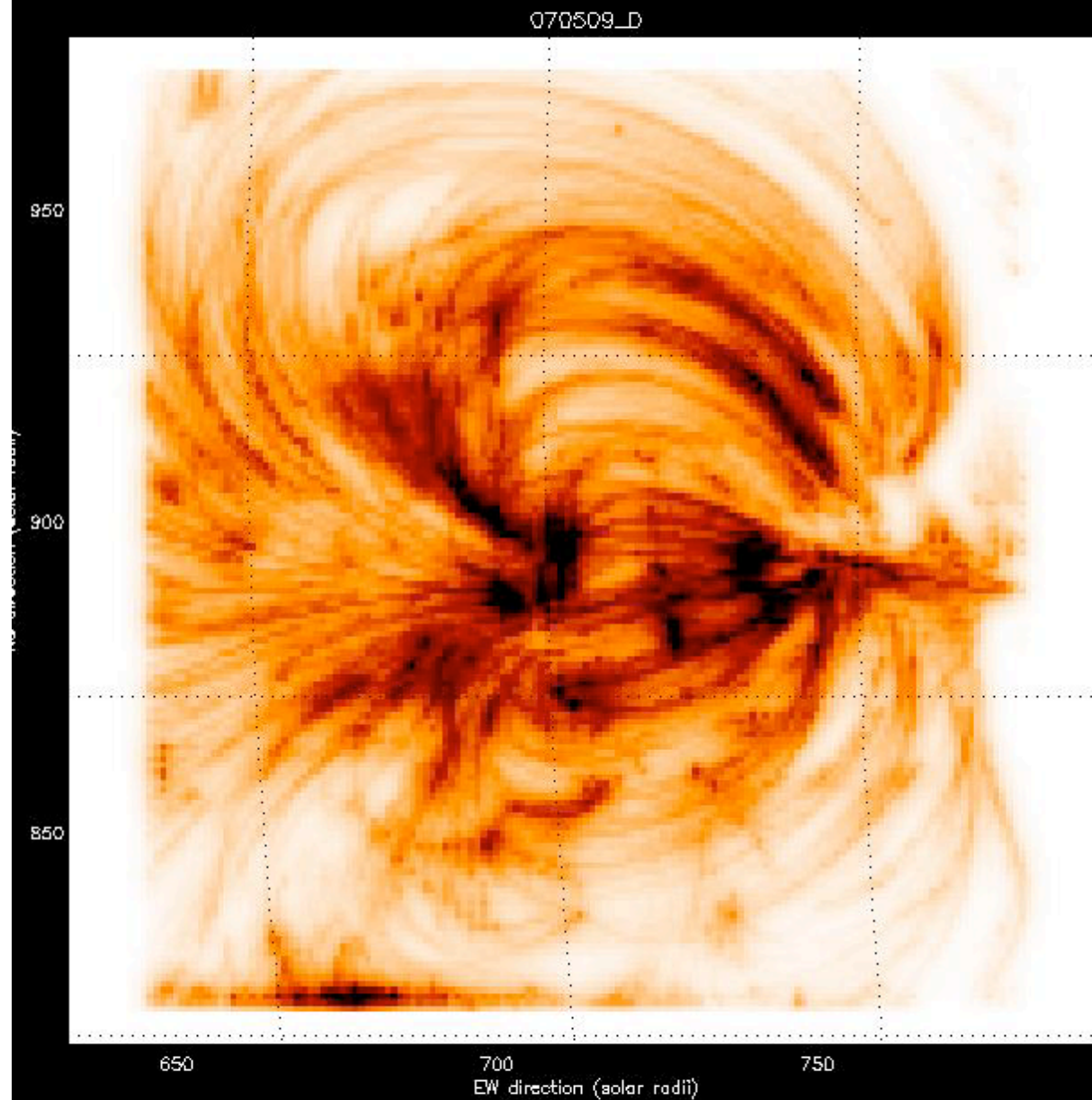
**Active Region**  
**11 Dec. 2007**  
**Fe XII 195.12 Å**  
**00:24:16 UT**  
**-178'', -144''**  
**60s exposures**  
**FOV: 256''x256''**

SOT magnetogram



from Doschek et al. 2008, ApJ, 686, 1362

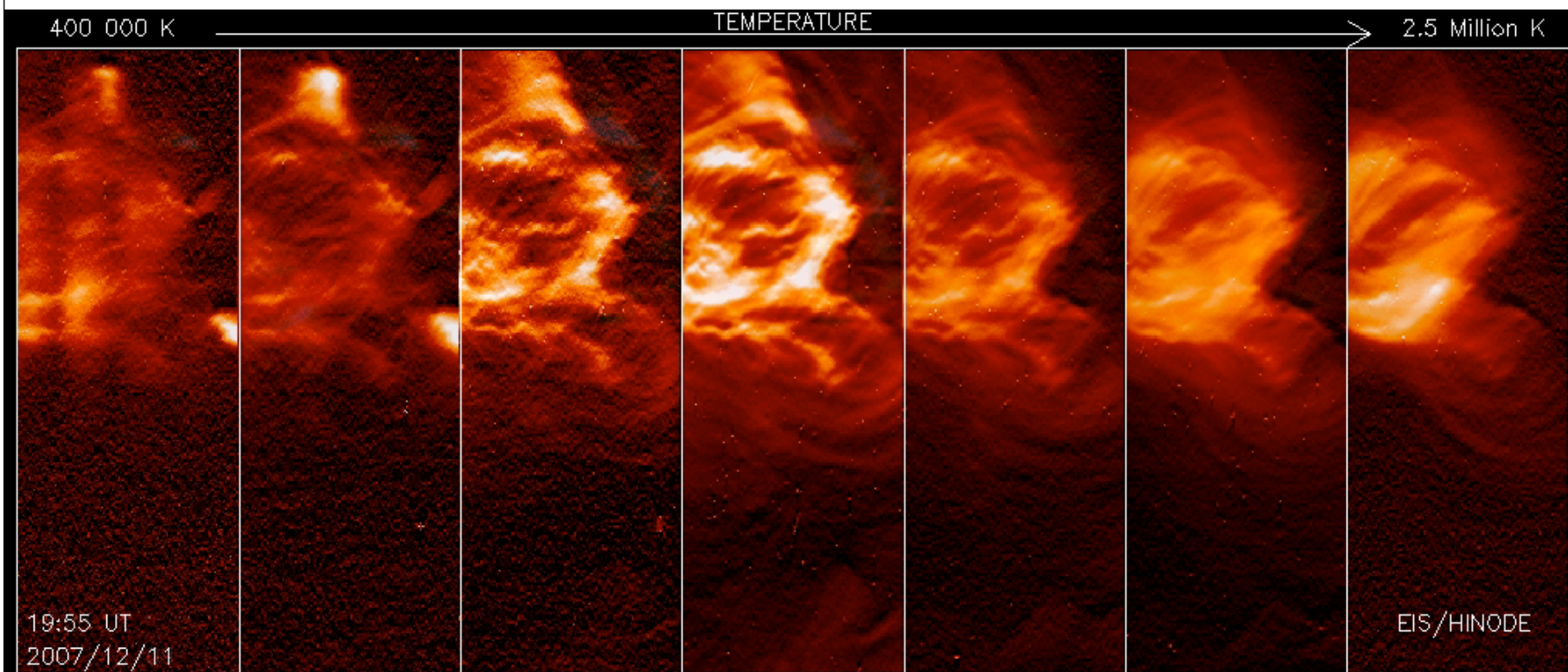
# 3D coronal rendering using STEREO



Aschwanden et al (2008)

# Temporal Evolution

- evolution of AR loops: heating-cooling cycle
  - overheating
  - Doppler shifts
  - EM
- dynamic evolution of hot loops (3-5 MK) ?
  - could these loops be steady? (i.e. lifetime longer than cooling)



# Modeling

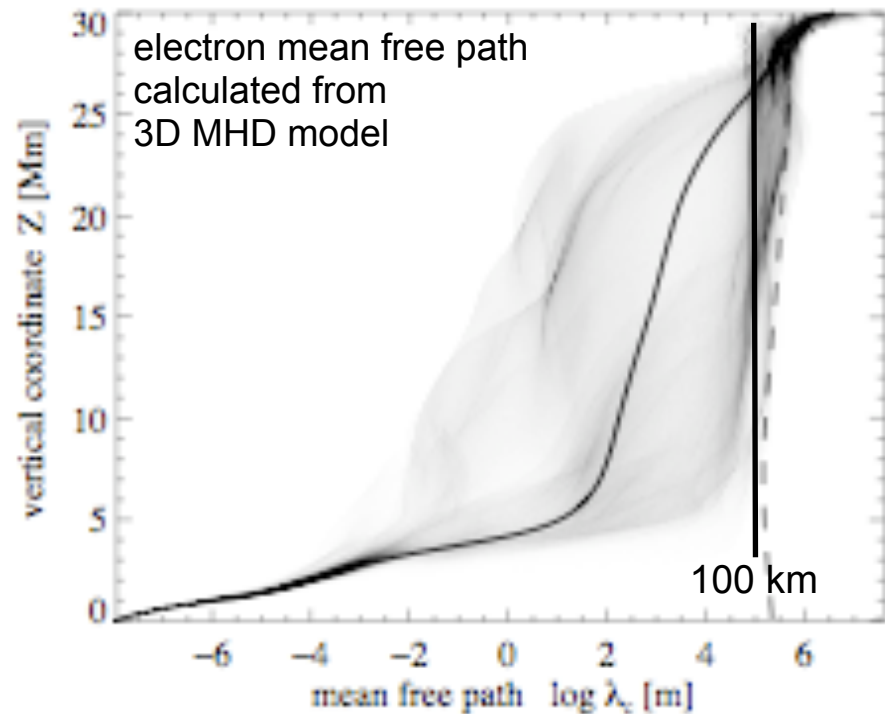
- forward model: include synthesis of observables
  - line profiles
  - broadband filtergrams
  - what about non-equilibrium ionization ?
- location of the heating:
  - footpoint-dominated → is this settled now?
- intermittency of heating:
  - impulsive → one (or few) events over (cooling) time scale
  - quasi-static → many smaller events / quasi-continuous
  - waves
  - ...
- connection to chromospheric modeling
  - corona/AR loops → large scale (up to 200 Mm)
  - chromosphere: → high resolution preventing large FOV
- publicly available data cubes from complex numerical models

## (New) Observations (existing instruments)

- can we rule out straylight (20%) → how does this influence results
- background effects from EUV observations
- combine observations sequences for dynamics and flows with EIS:
  - small rapid scans of parts of ARs or undersampling
  - about 5 minutes time cadence
- increase multi-instrument usage: XRT, EIS, TRACE
  - important to get temporal evolution of heating-cooling process
  - STEREO data to get 3D reconstructions
- make better use of SOT
- temporal resolution of AIA/SDO will greatly help for loop evolution

# Future

- what kind of temporal, spatial and spectral resolution do we really need?
  - how do we measure coronal magnetic fields?
    - EUV spectro-polarimeter (in addition to coronagraphic instruments)
  - imaging spectroscopy of AR field-of-view within cooling time
    - 200" x 200" maps with spectral resolution within <5 minutes
    - spatial resolution 0.1"
    - cover lines from  $1e^4$  to  $10^7$  K
- remember:  
this should be complimentary  
to the chromosphere/TR observations  
which need higher temporal and  
spatial resolution  
(at a smaller field-of-view)



Peter et al. (2008)