DEM Temperature Analysis of Post-Flare Loops Using Hinode's X-Ray Telescope

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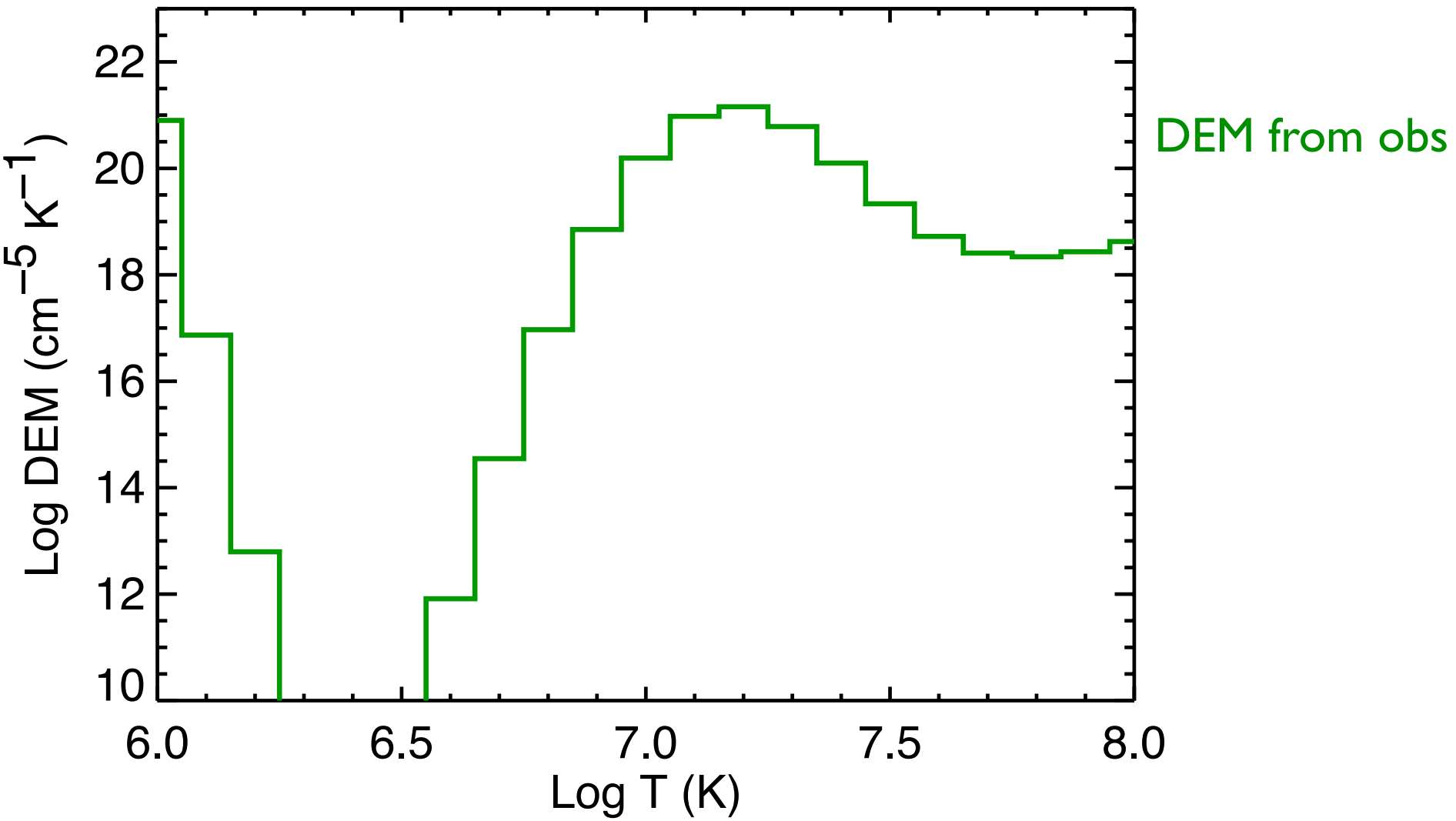
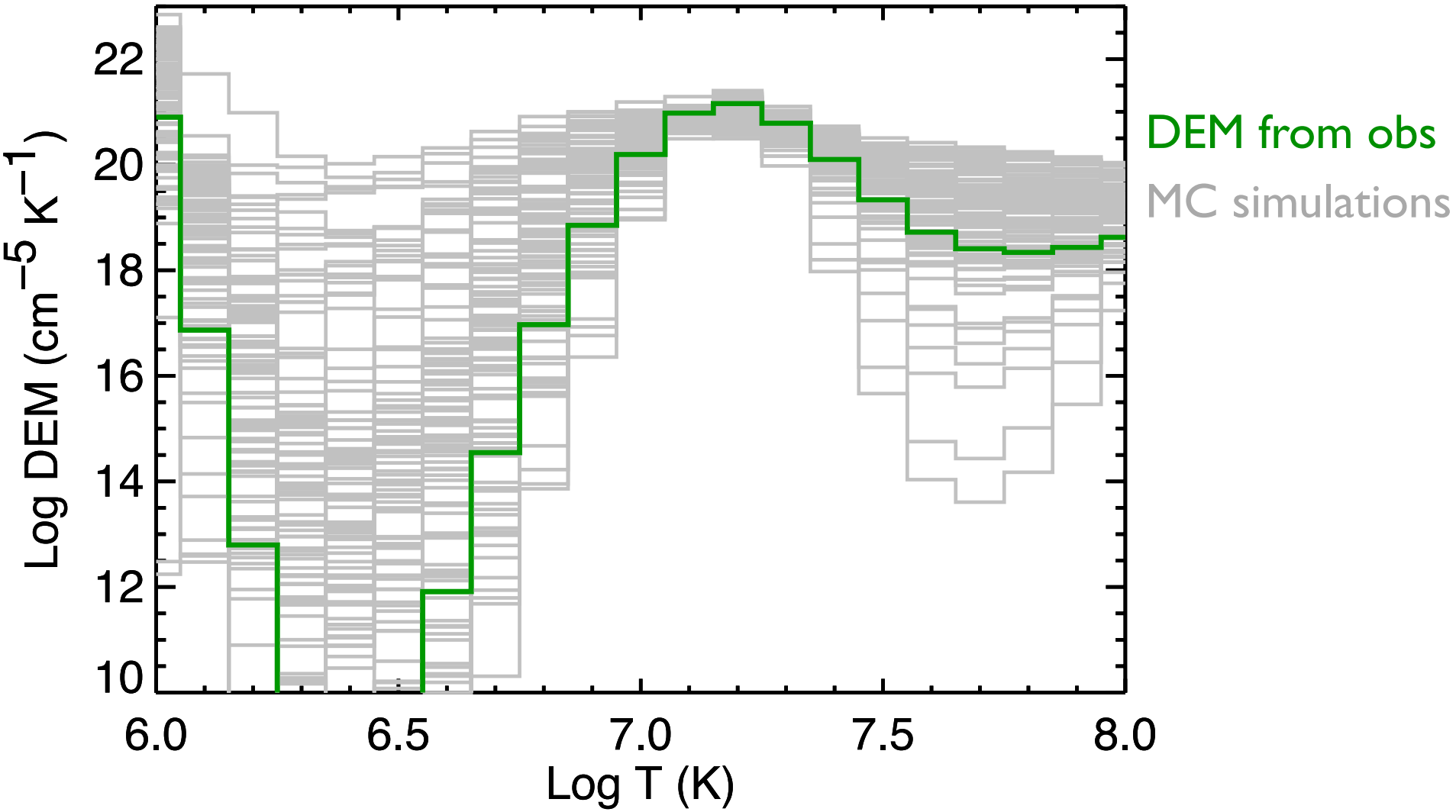
DEM Method

- SSW routine `xrt_dem_iterative`
- Forward fitting routine - a solution is guessed and iterated upon until the χ^2 between the actual and model observations is minimized.
- Monte Carlo runs on the data using values varied normally by the sigma error gives an estimate of the error in the DEM.

DEM Method


22
20
18
16
14
12
10
Log DEM (cm^{-5} K^{-1})
6.0
6.5
7.0
7.5
8.0
Log T (K)
DEM from obs

DEM Method


Log DEM (cm^{-5} K^{-1})
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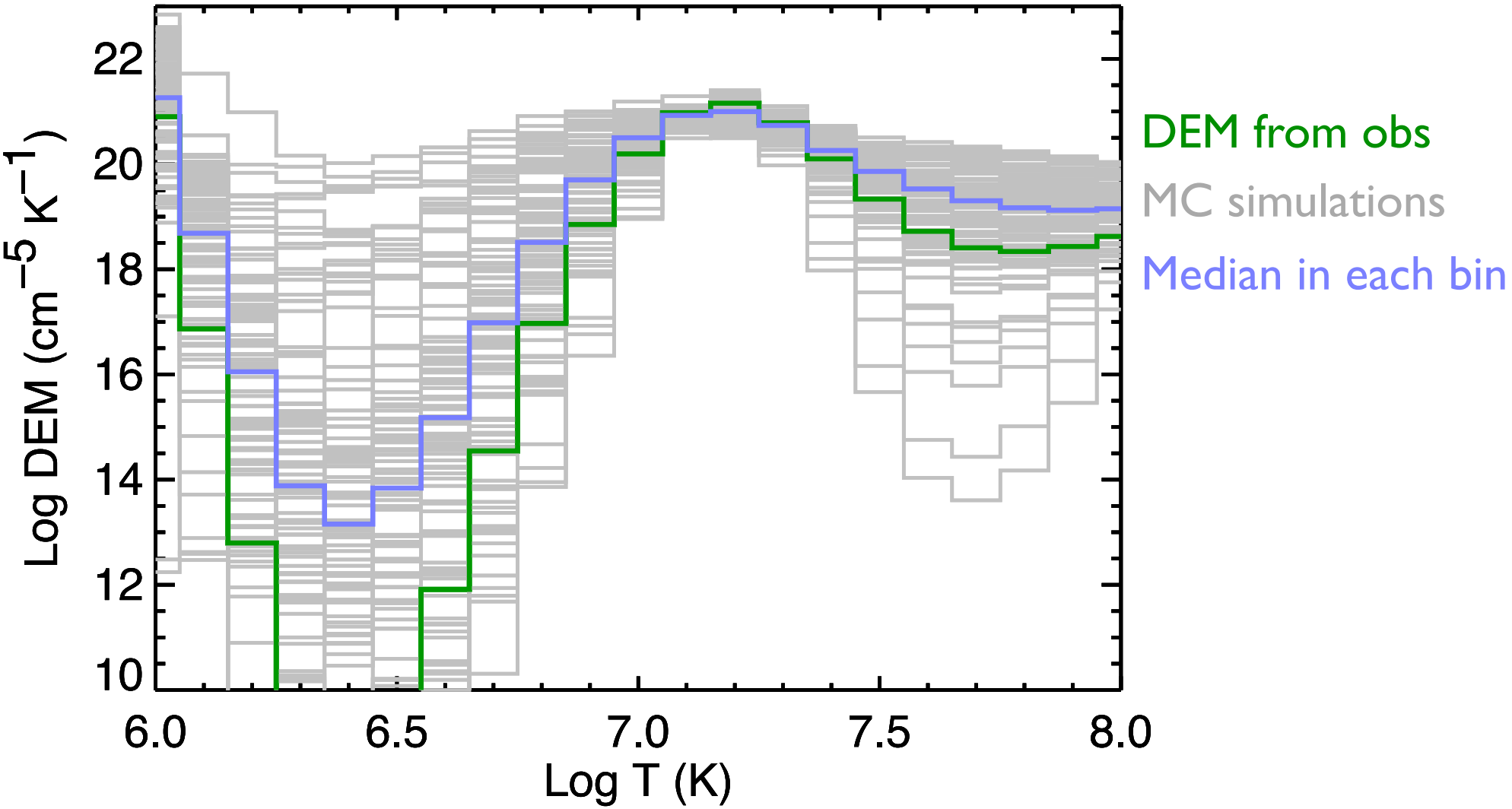
Log T (K)
DEM from obs
MC simulations

DEM Method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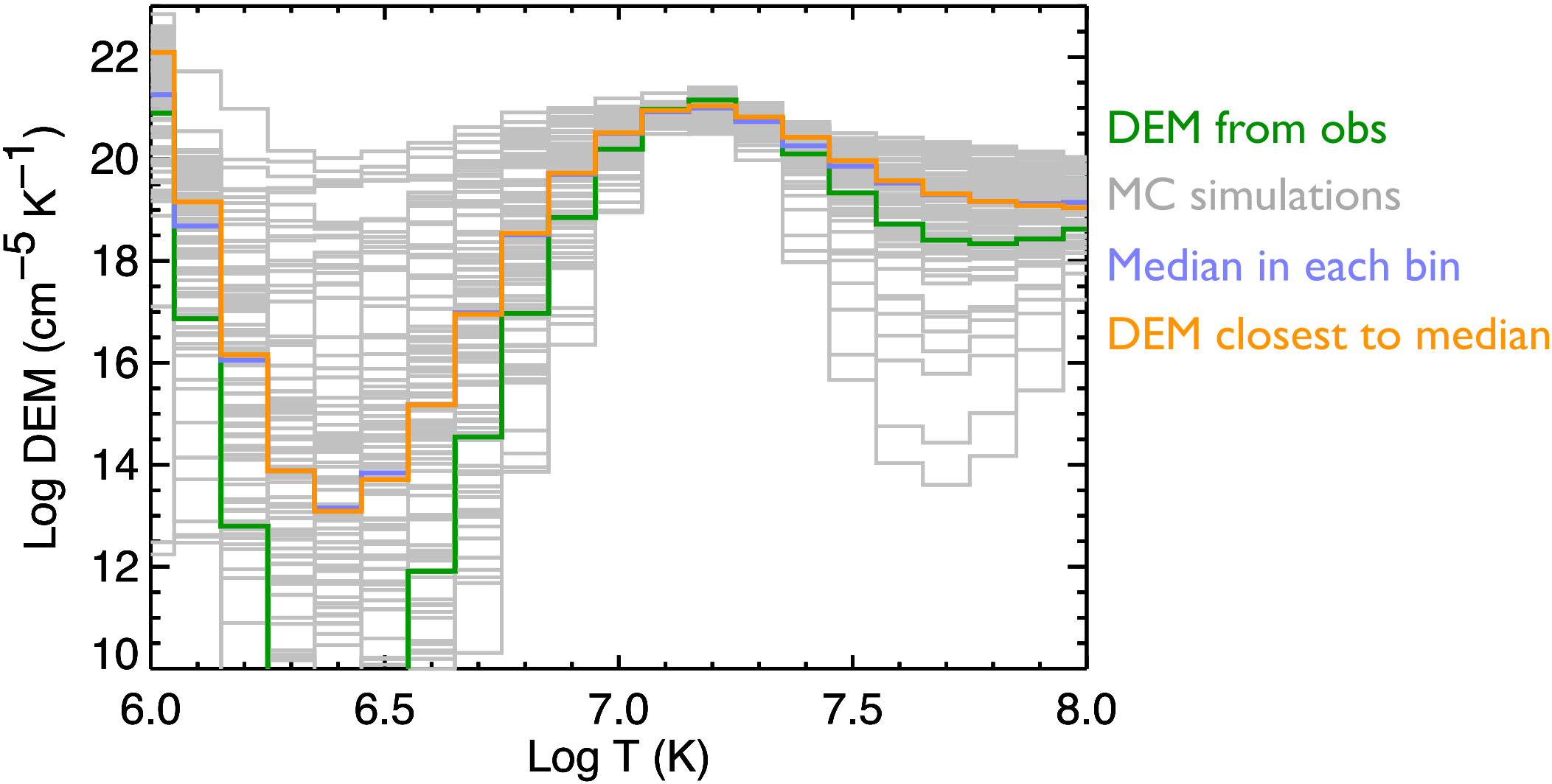
Log T (K)
DEM from obs
MC simulations
Median in each bin

DEM Method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20
18
16
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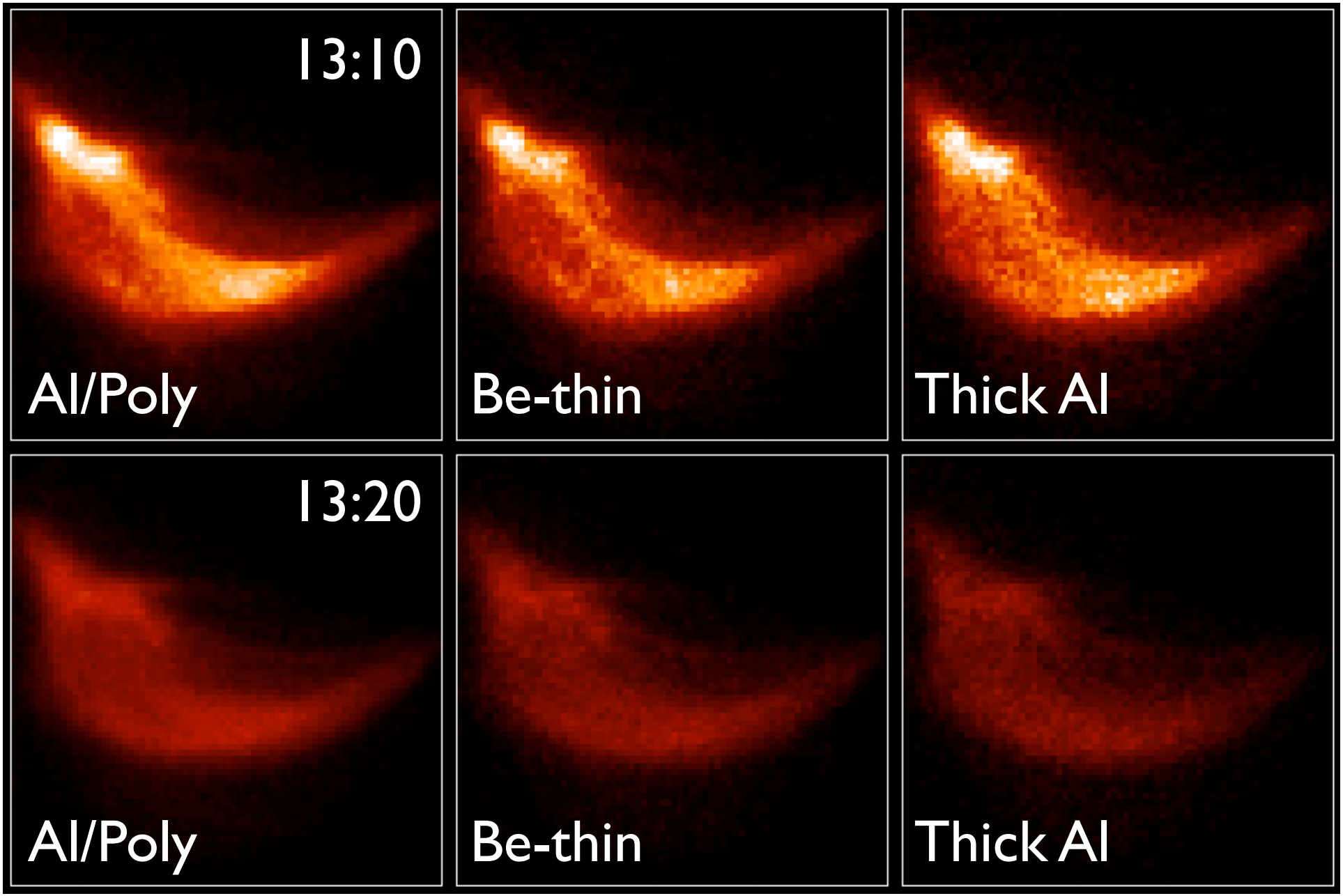
12
10
Log DEM (cm^{-5} K^{-1})
6.0
6.5
7.0
7.5
8.0
Log T (K)
DEM from obs
MC simulations
Median in each bin
DEM closest to median

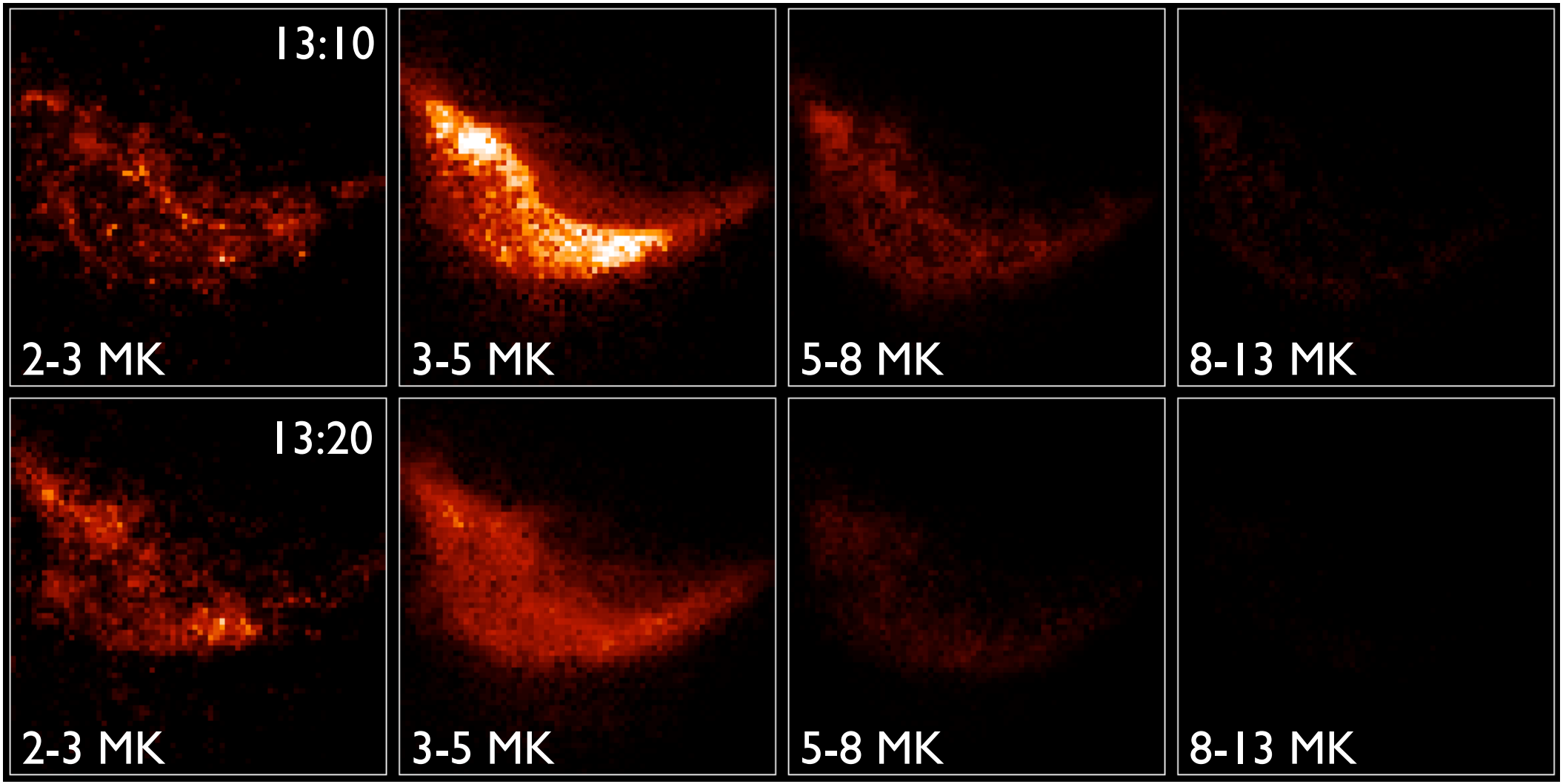
July 10, 2007 C8.2 Flare

- Flare peak at 12:40 UT.
- A total of 7 filter combinations were observed by XRT starting at 13:10 and 13:20 UT:
  - Al-poly
  - Ti-poly
  - thin-Be
  - med-Be
  - Al-poly/Ti-poly
  - thick-Al
  - C-poly/thick-Al

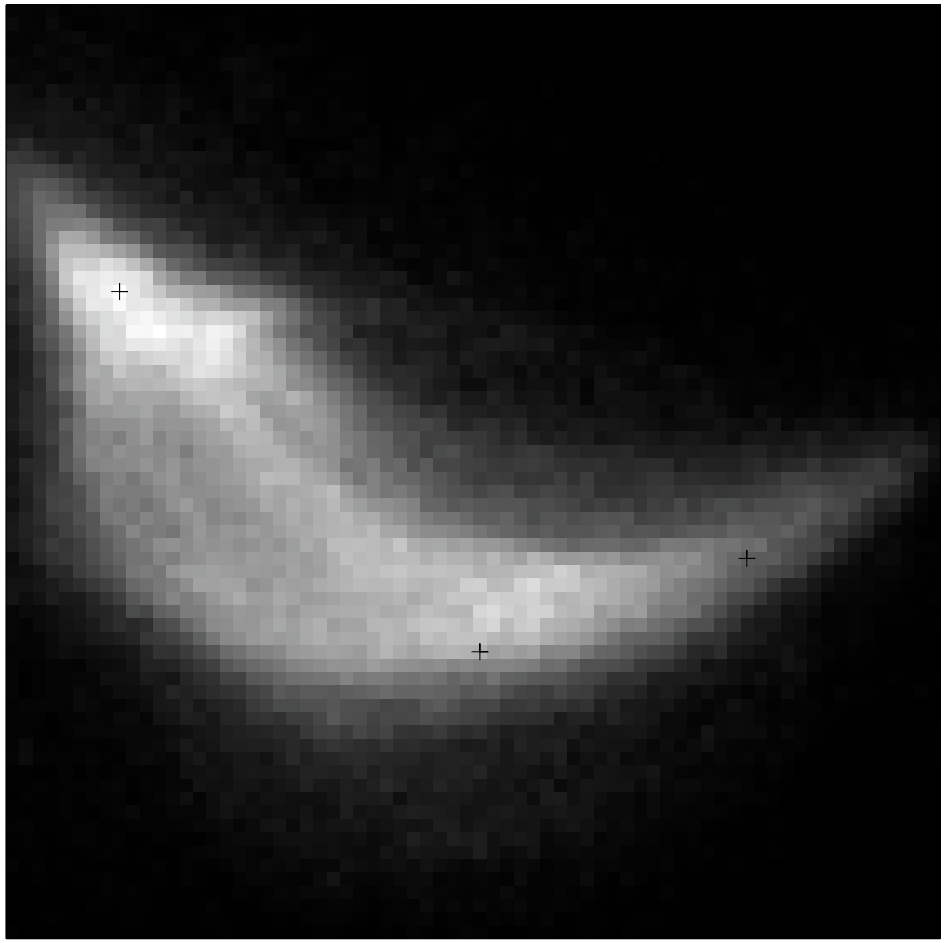
July 10, 2007 C8.2 Flare



Emission Measure Maps



Some Example DEMs



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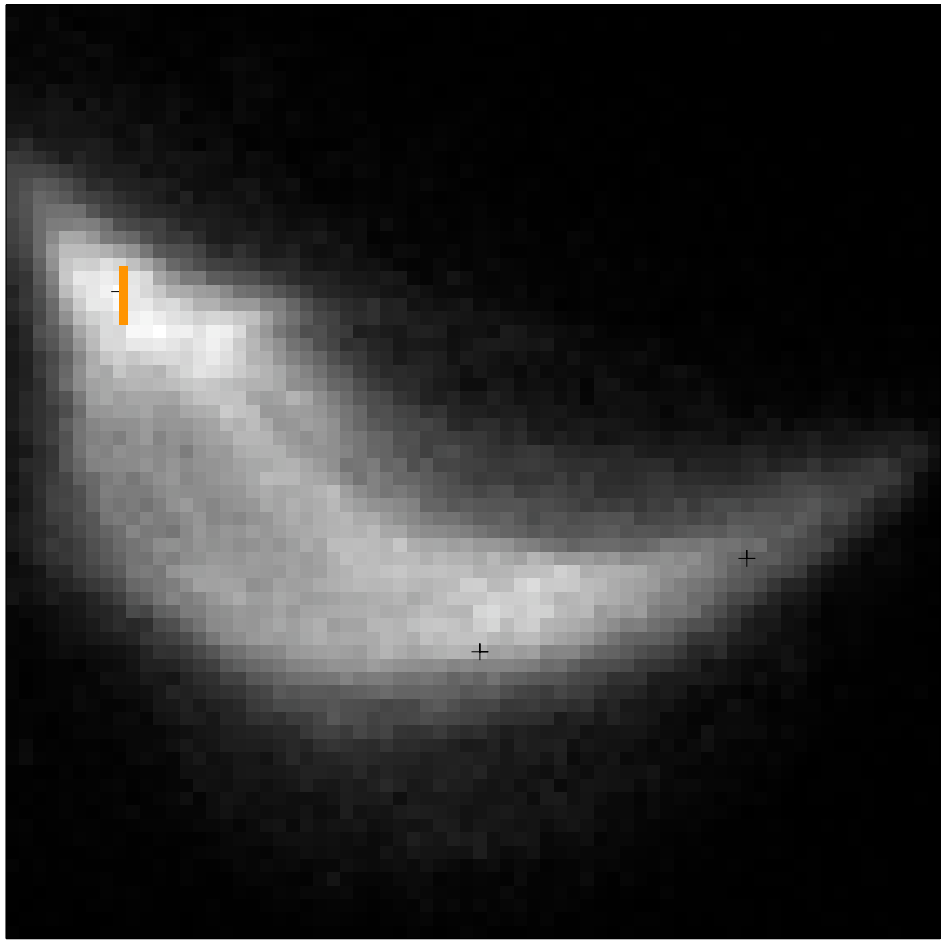

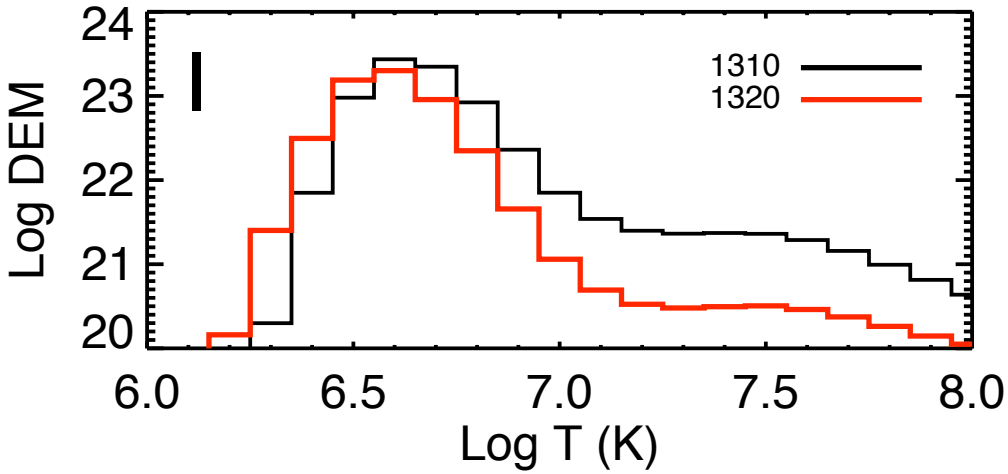

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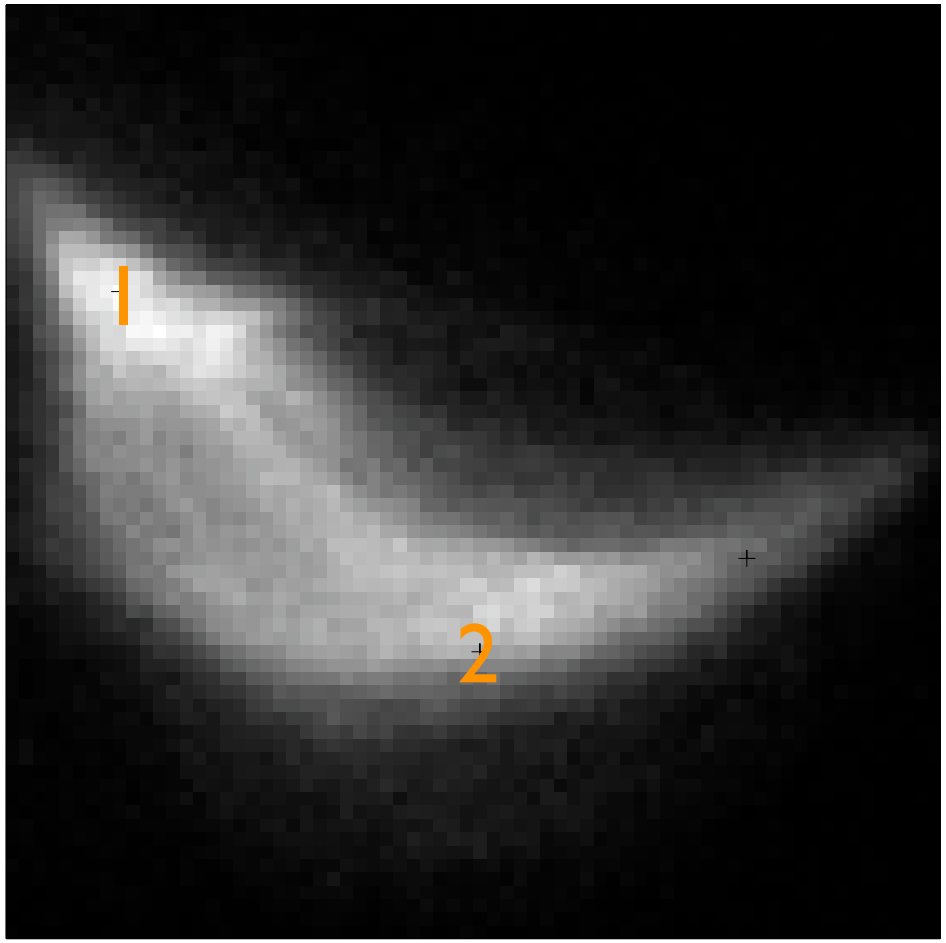

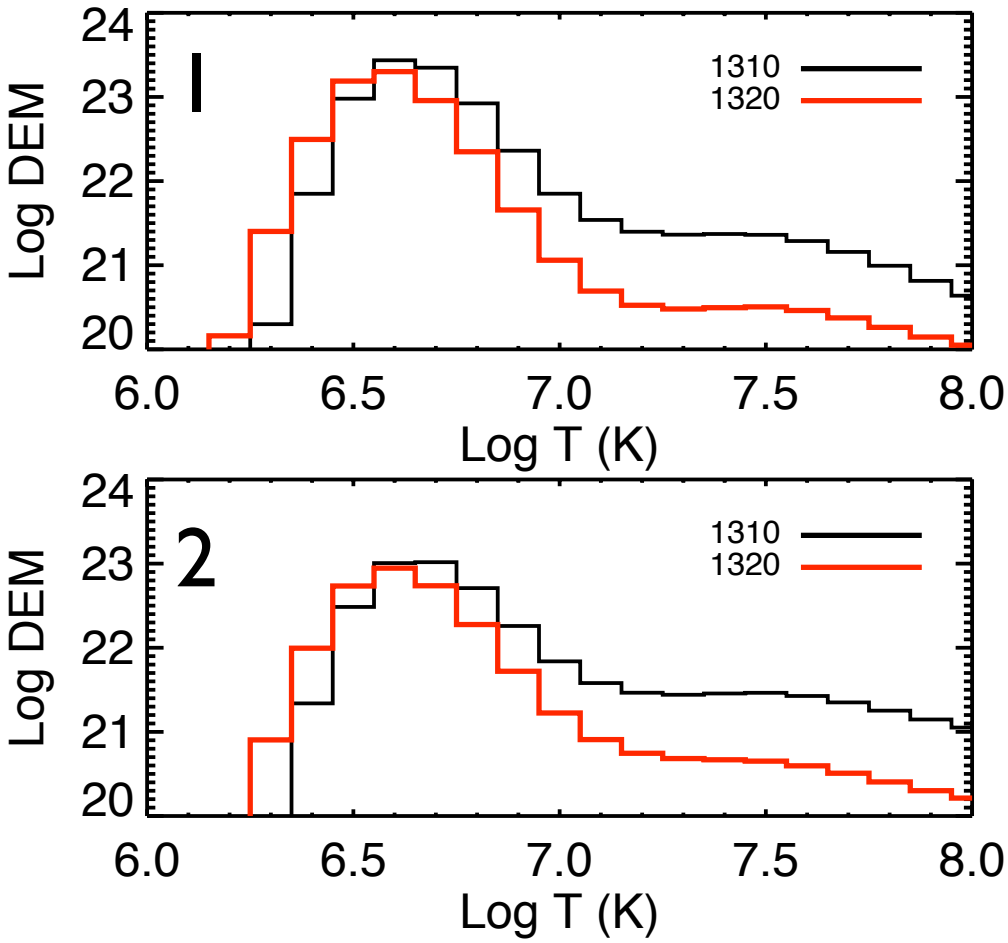

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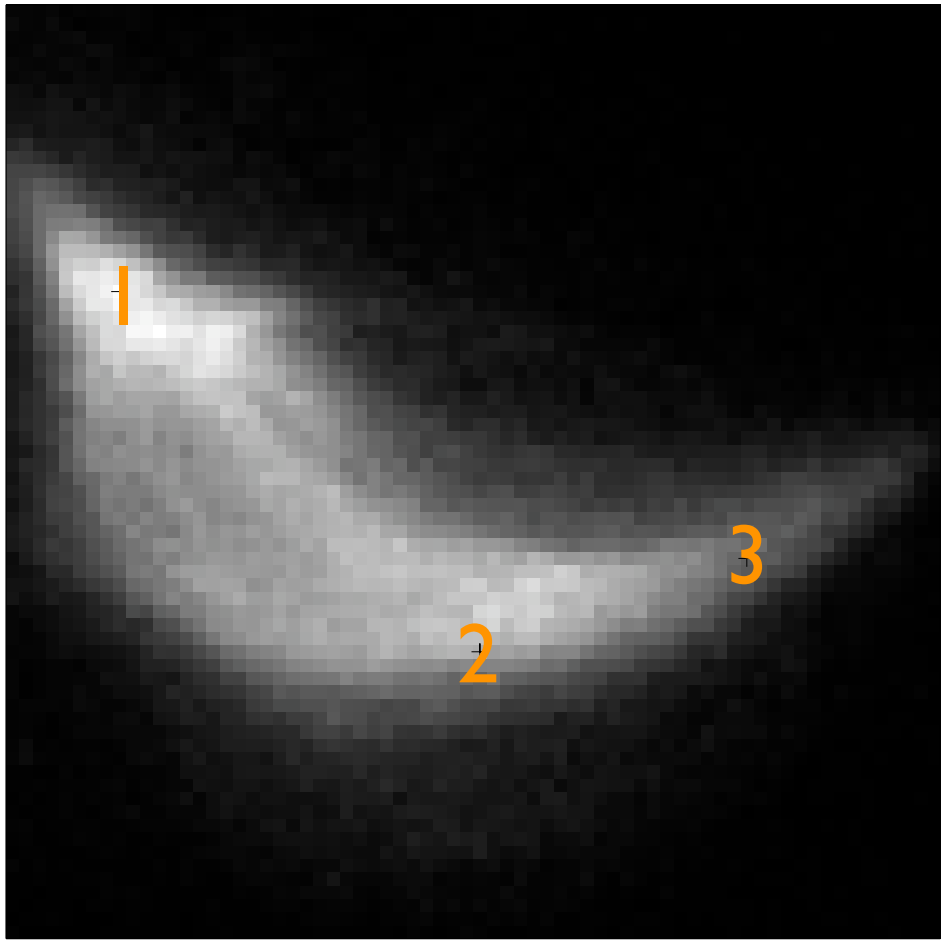
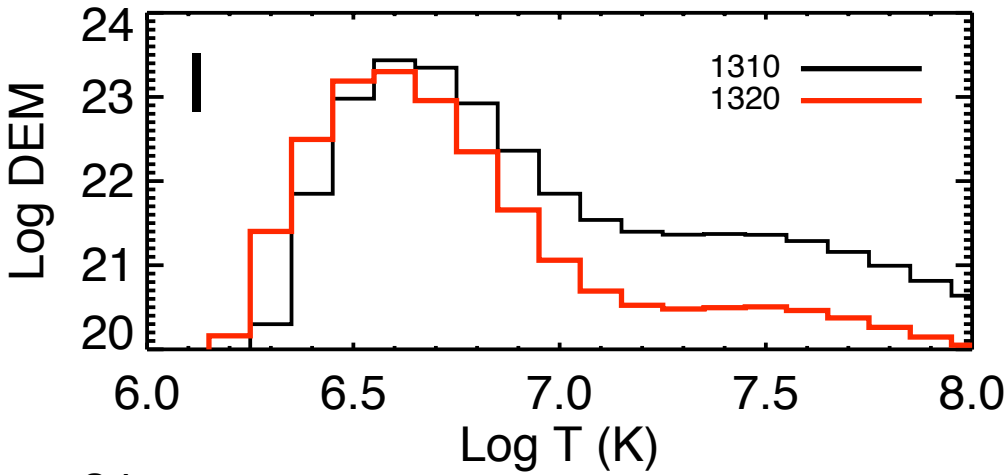
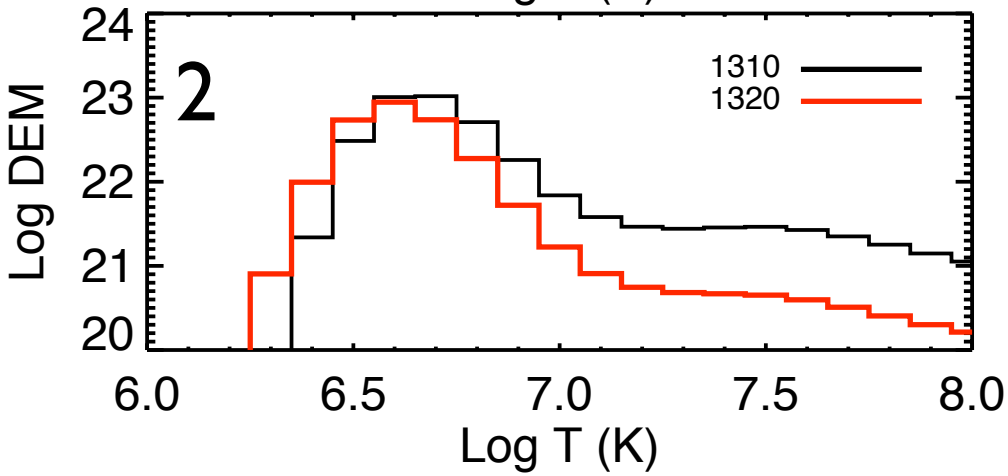
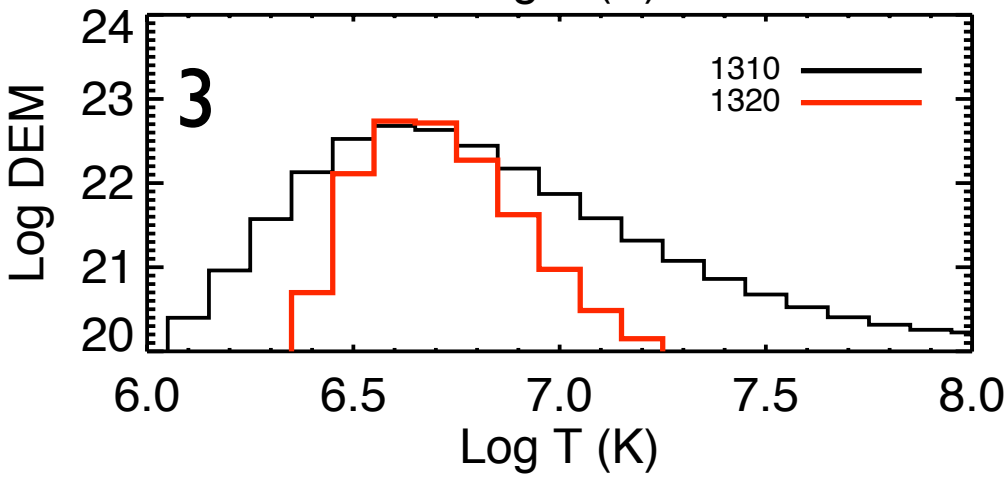
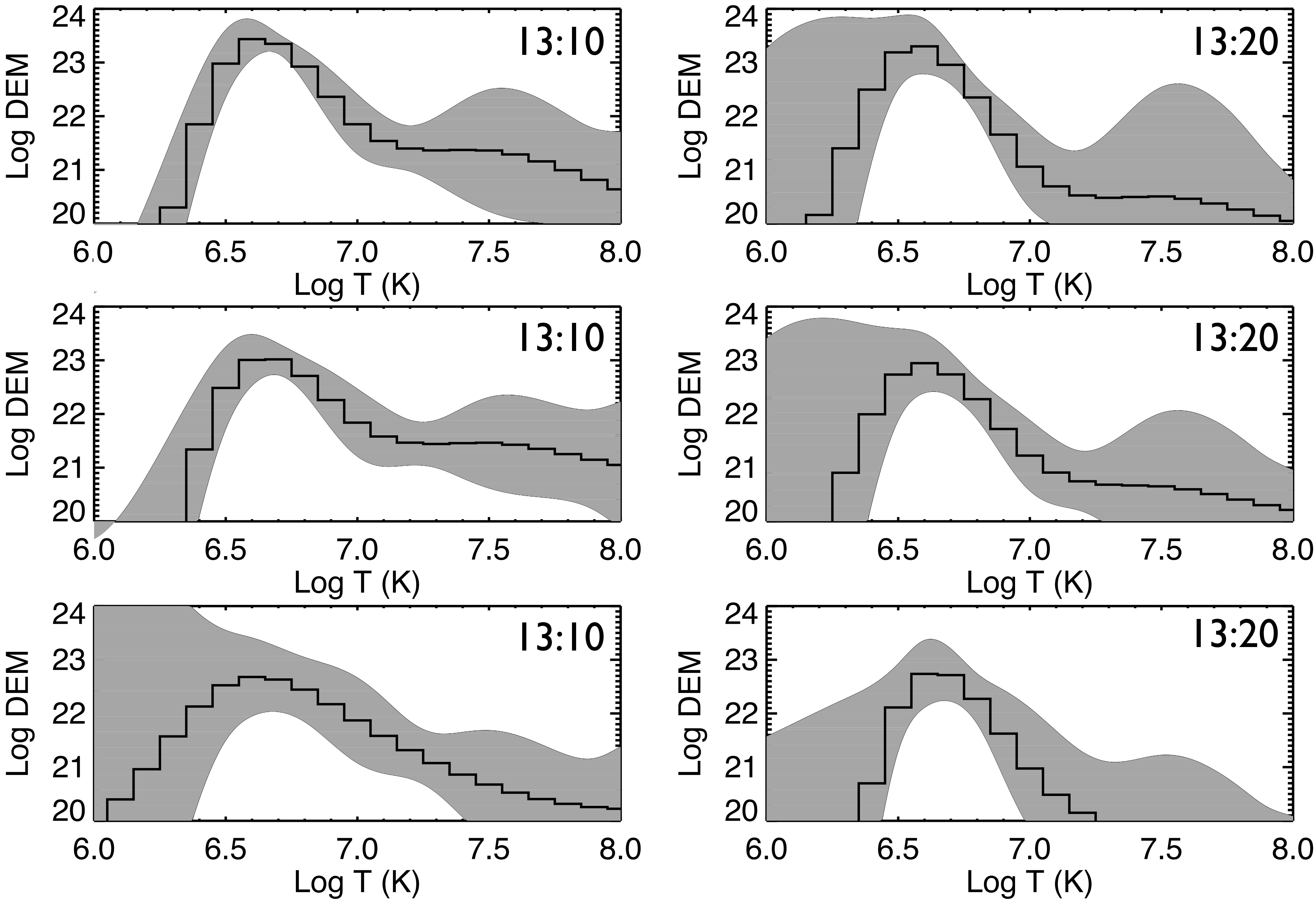








DEM errors


13:10
13:20
13:10
13:20
13:10
13:20
Log DEM
Log T (K)
6.0
6.5
7.0
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8.0
20
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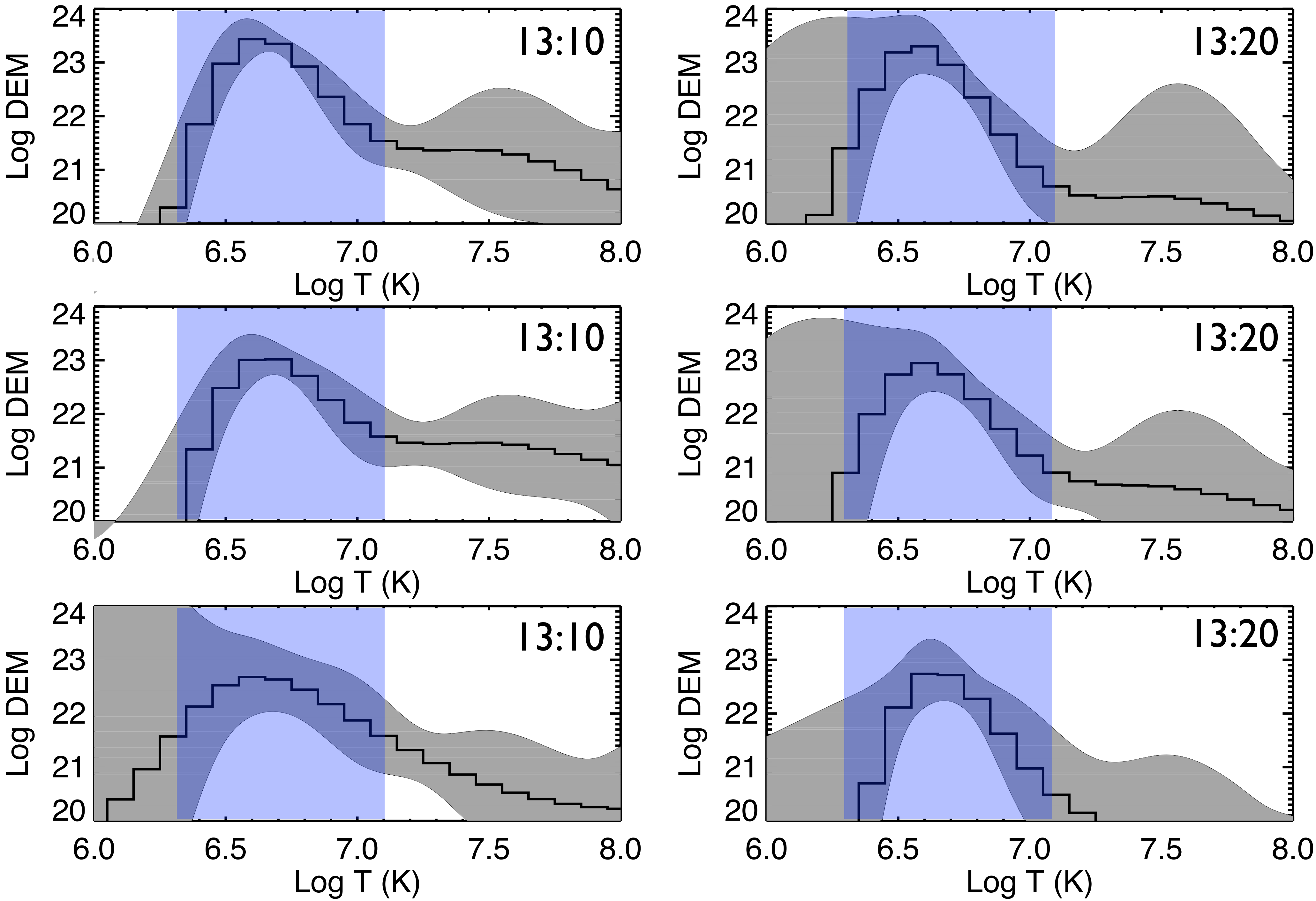
24

DEM errors



13:10
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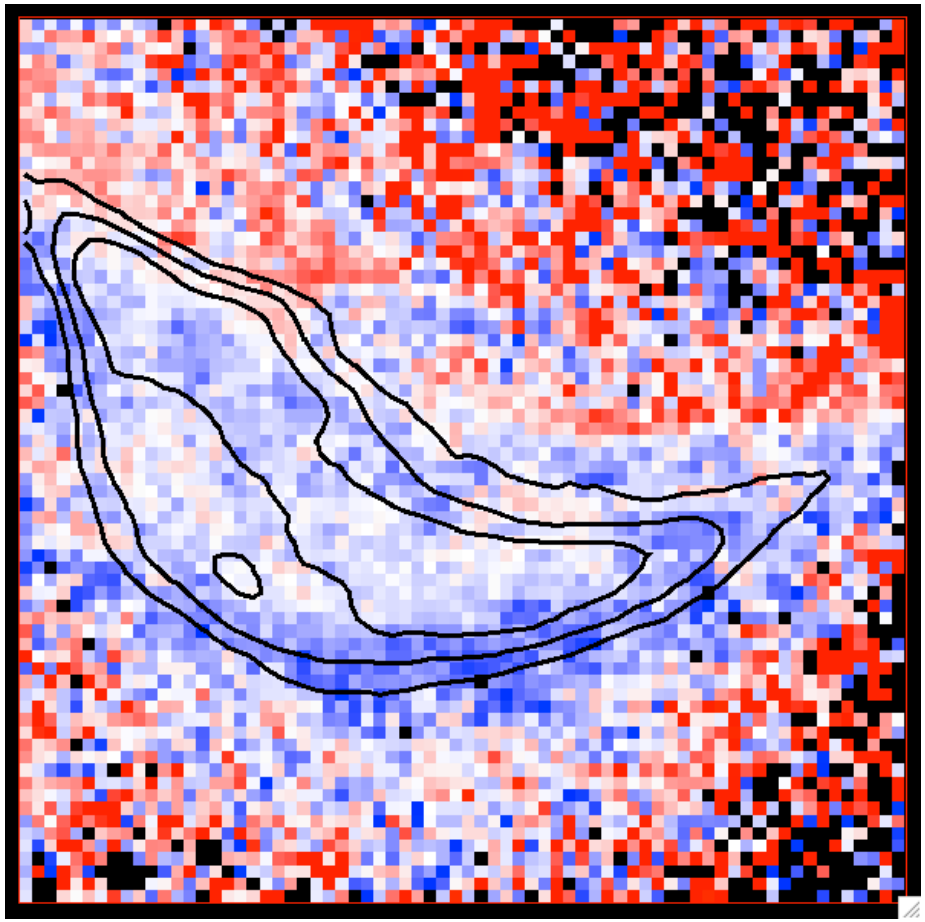
Emission measure: 2-13 MK



- Loop characterized by emission measure loss
- Decrease in intensity in XRT images due to decreasing emission measure, not decreasing temperature

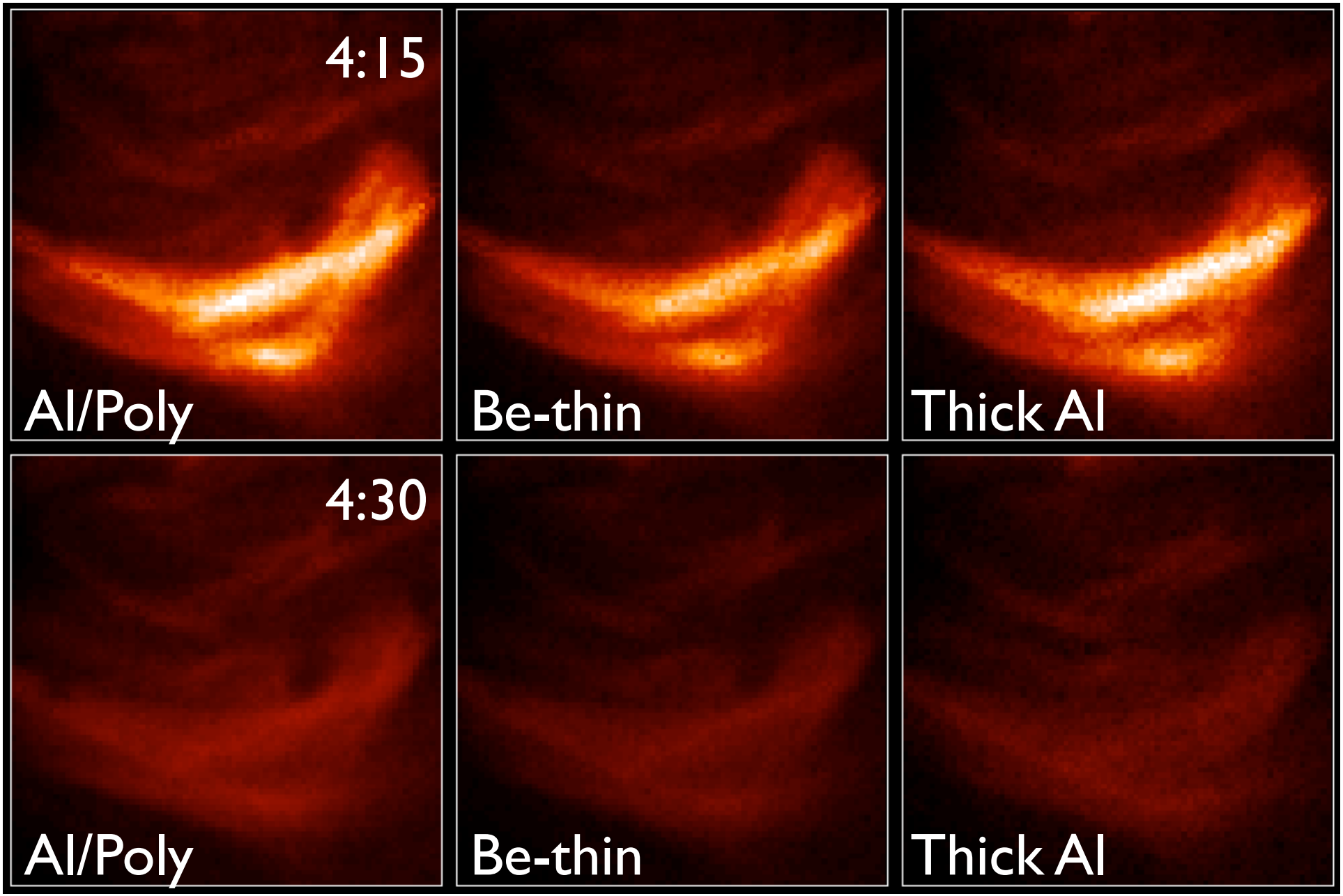
Red = EM gain

Blue = EM loss

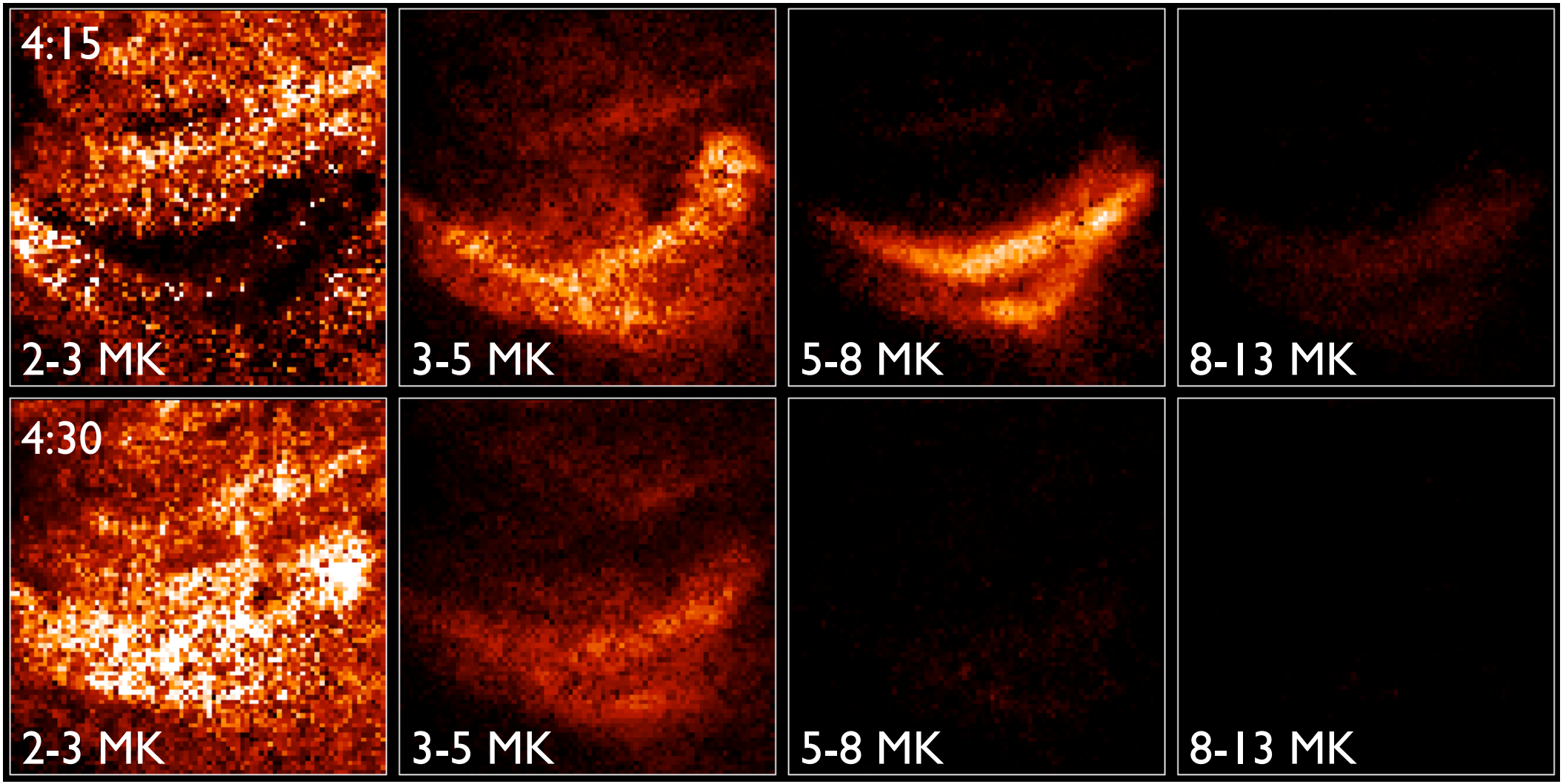
Dec 13, 2007 B8 Flare

- Flare peak at approximately 4:04 UT.
- A total of 8 filter combinations were observed by XRT starting at 4:15 and 4:30 UT:
  - Al-poly
  - Ti-poly
  - thin-Be
  - med-Be
  - C-poly
  - Al-poly/Ti-poly
  - thick-Al
  - thick-Be

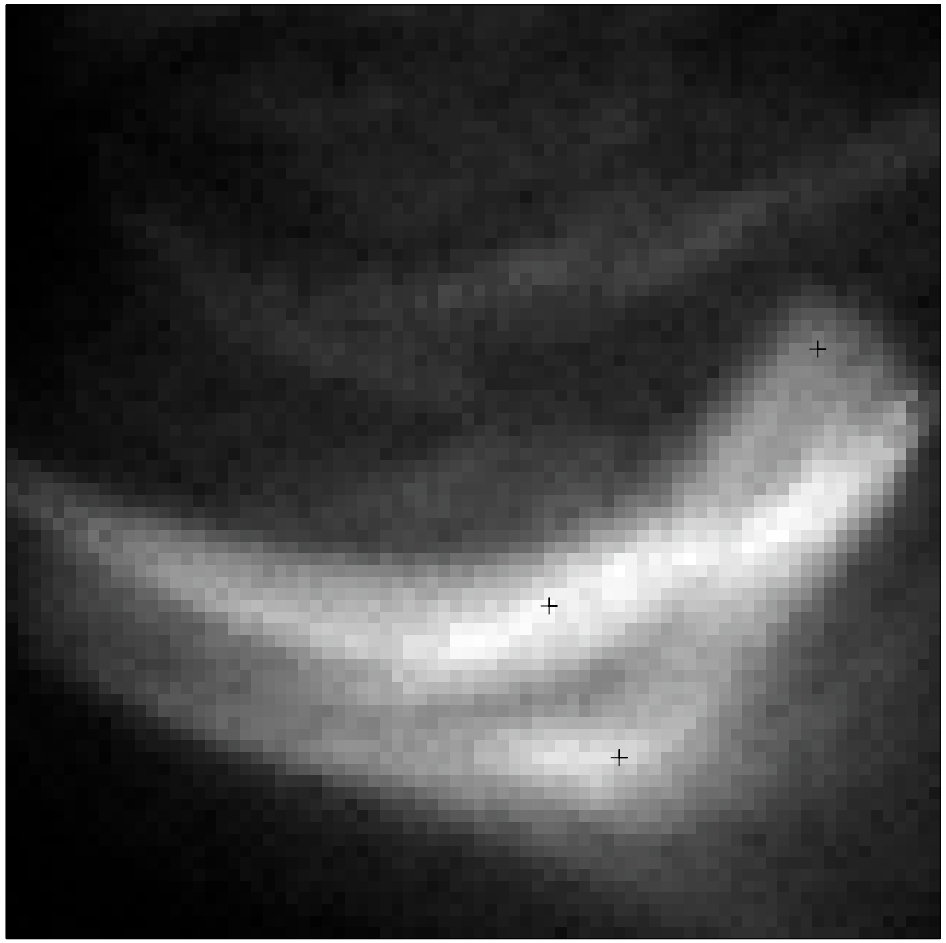
Dec 13, 2007 B8 Flare



Emission Measure Maps



Some example DEMs



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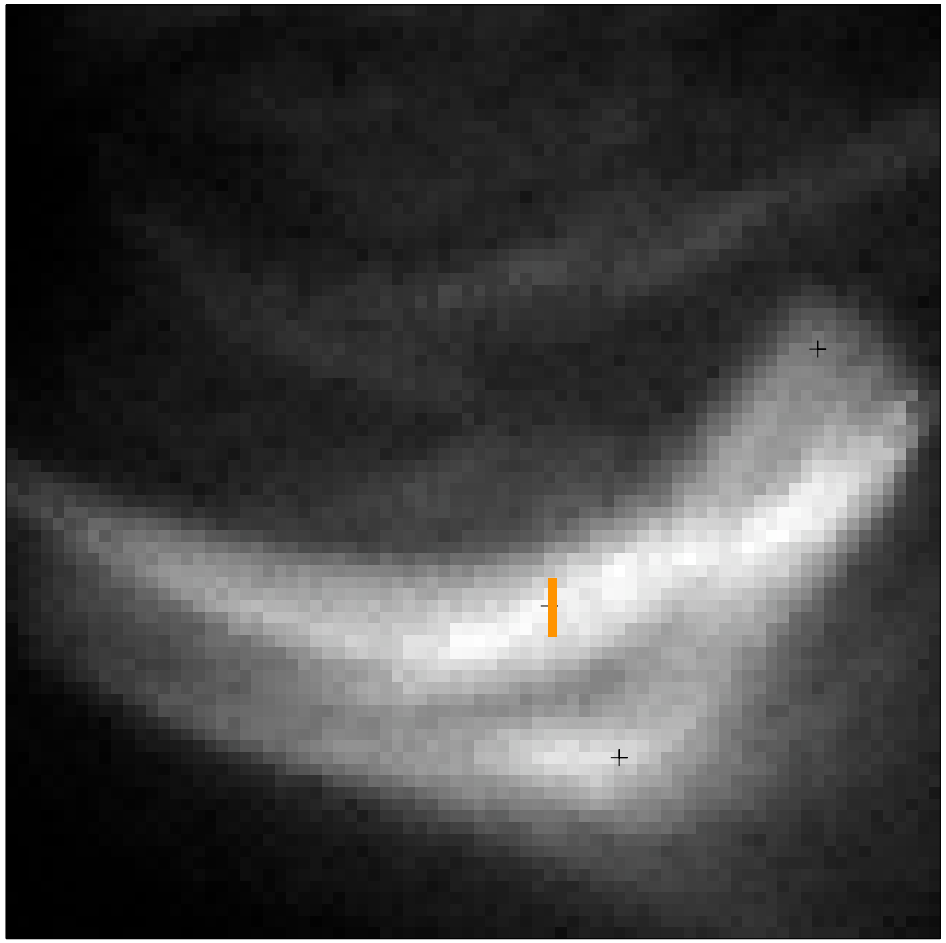

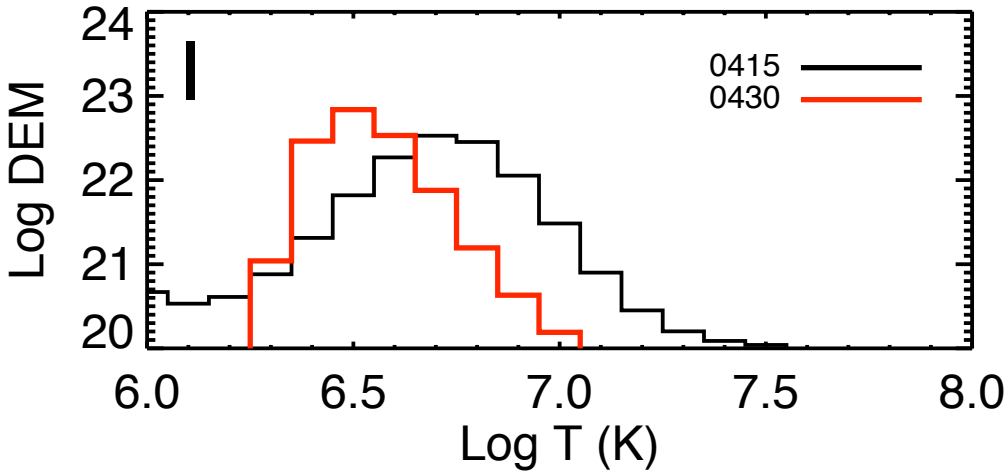

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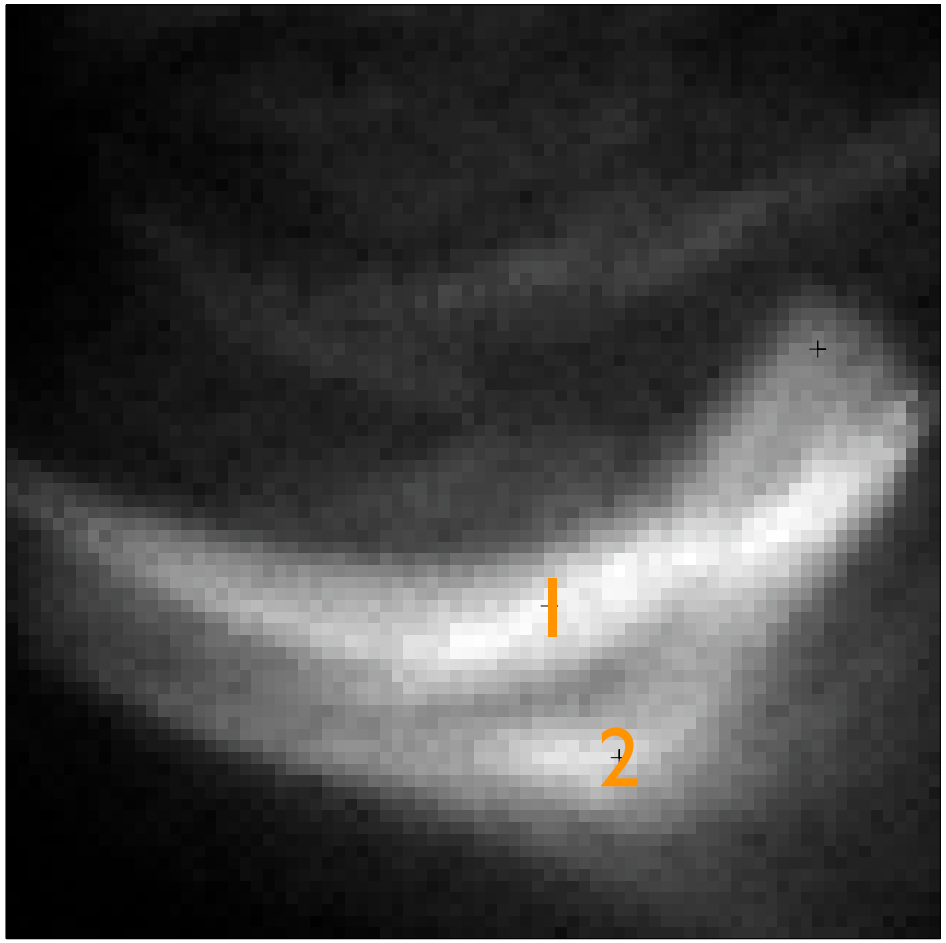

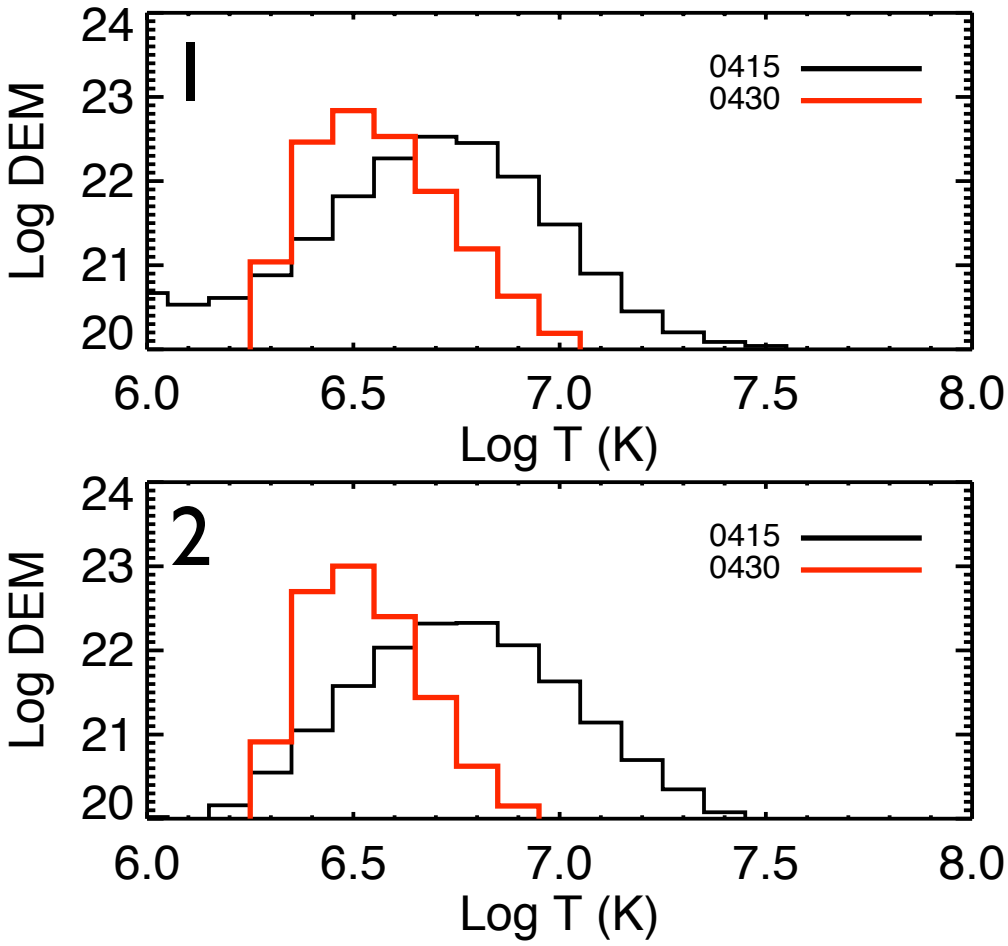

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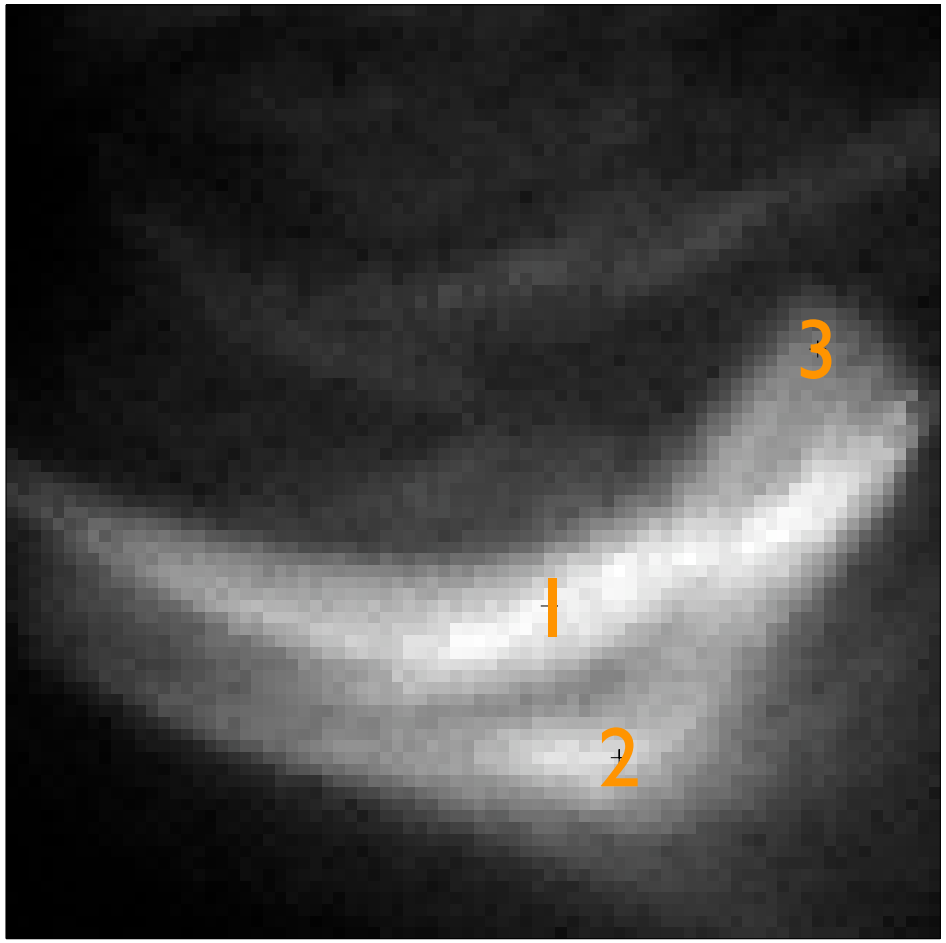
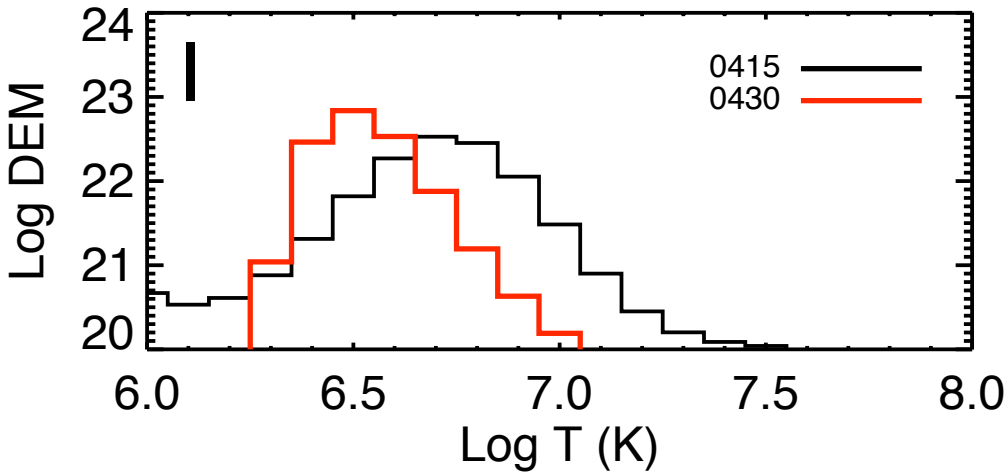
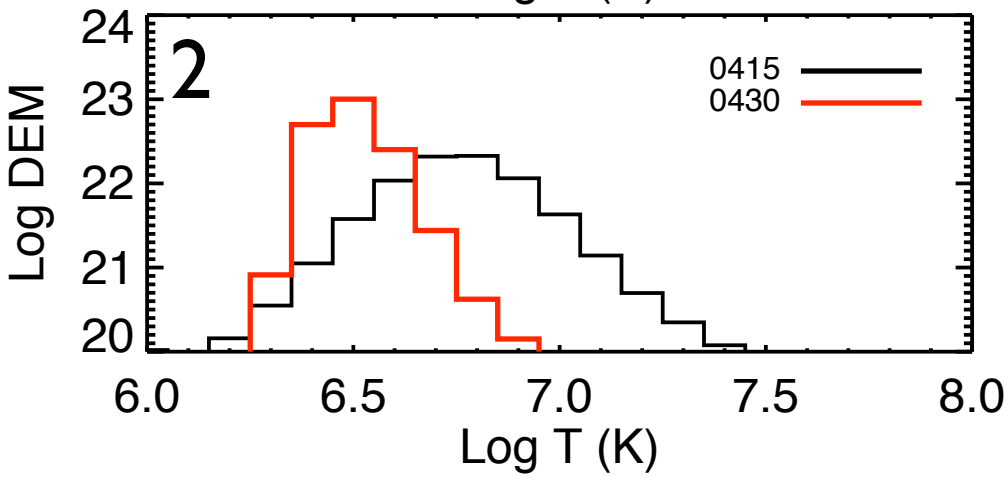
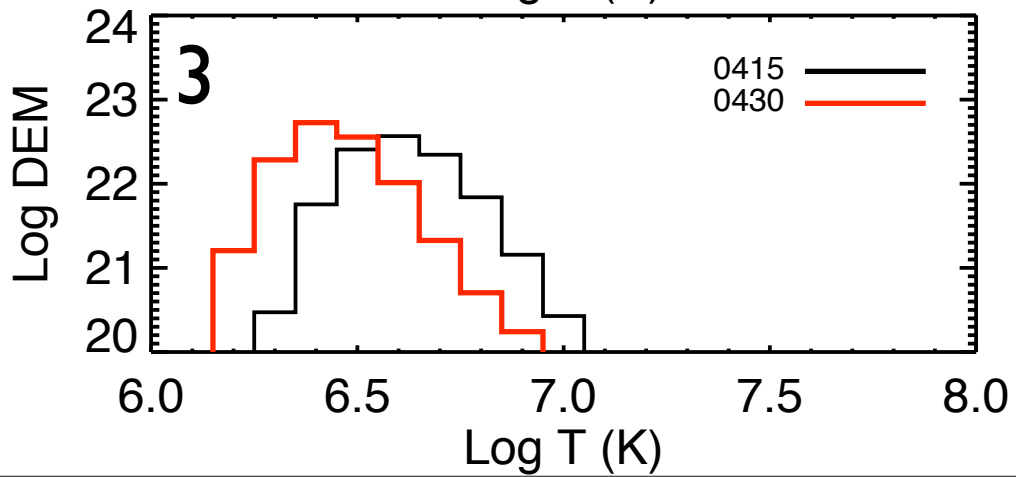
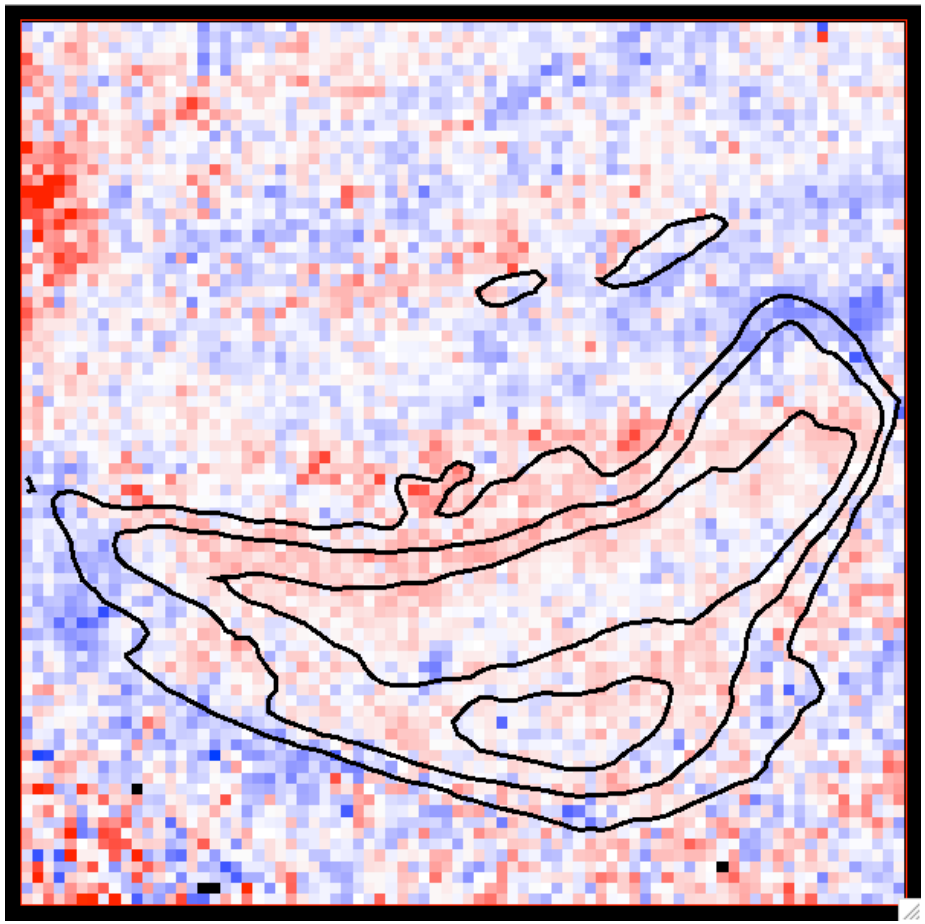








Emission measure: 2-13 MK



Red = EM gain

Blue = EM loss

- Some emission measure loss near the footpoints, some emission measure gain in the loop
- Signature of chromospheric evaporation?
- Cooling causes intensity decrease in XRT images

Conclusions

- The July 10, 2007 flare decreases in XRT intensity due to decreasing emission measure in the loop
- The December 13, 2007 flare decreases in XRT intensity due to cooling of the flare plasma
- The DEM method is a useful tool for deconvolving temperature and density effects on intensity

Future and related work

- Better data sets: many-filter sets with a higher cadence, non-saturated data closer to peak of flare
- Incorporate data from other Hinode instruments: EIS for temperature and emission measure comparisons, SOT for underlying magnetic field structure
- See posters by DeLuca, Weber, Schmelz & Hannah.