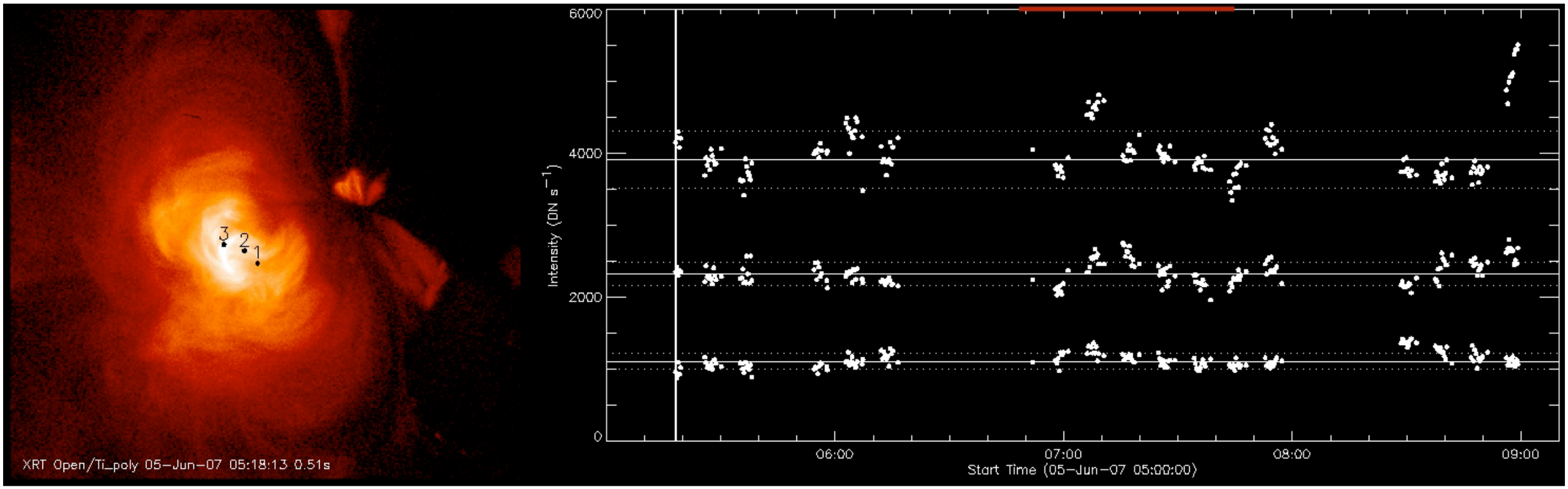
# Steady Heating Model of an Active Region Core

**A. Winebarger**, J. Schmelz, S. Saar, V. Kashyap, & H. Warren

To Be Submitted to ApJ

# The Problem




Brooks et al., ApJ, 2009

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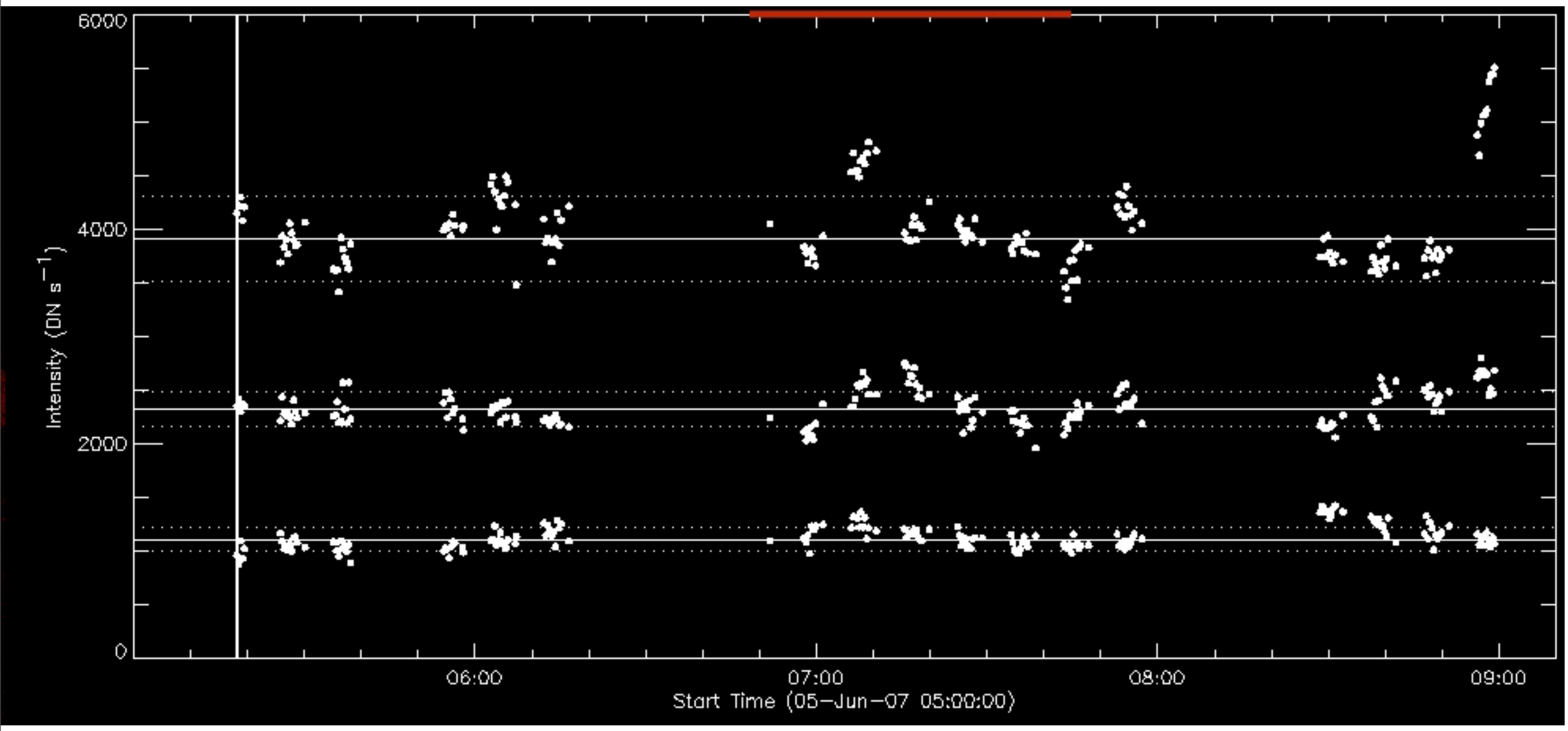


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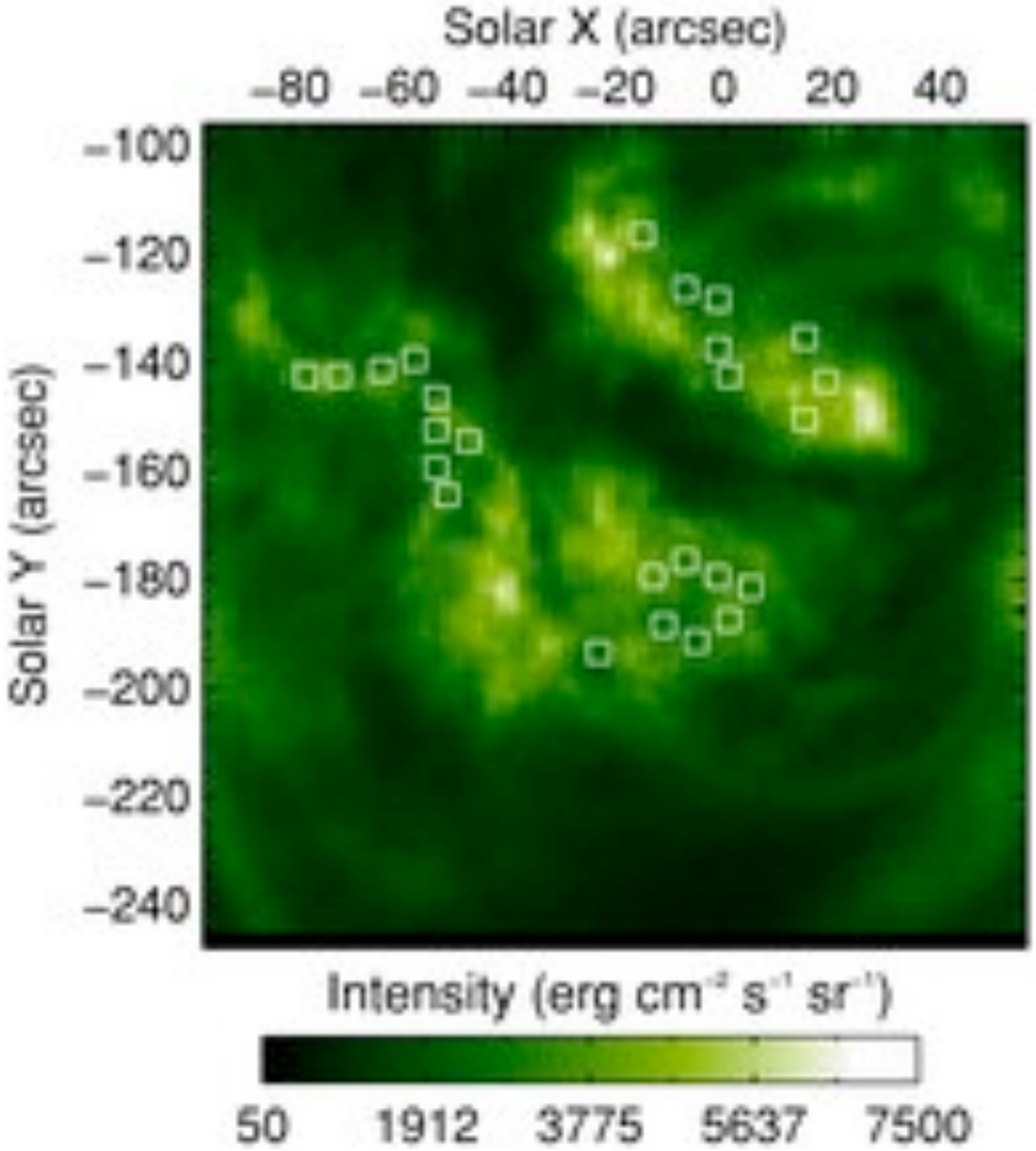


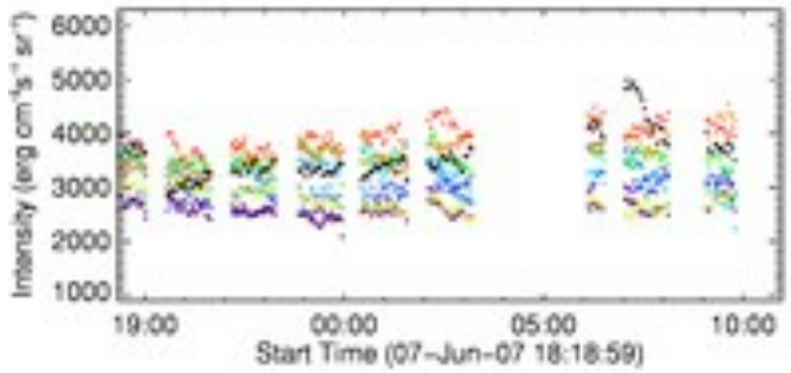


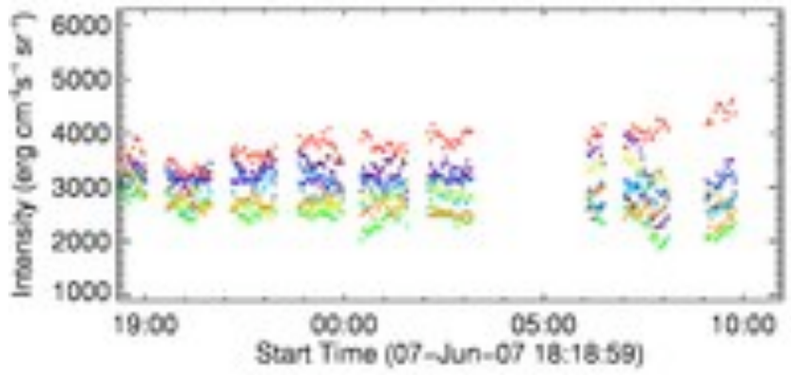


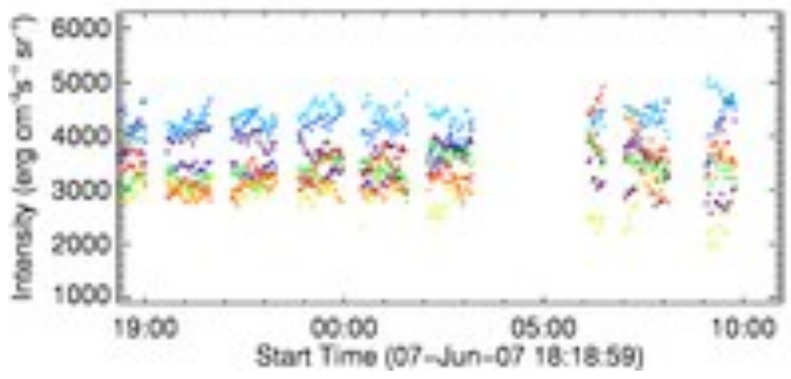


Brooks et al., ApJ, 2009

# The Problem

- Active Region Core observations are steady. Are they heated steadily? Or not?
- Steady Heating = $\tau_{reheat} << \tau_{cool}$
- Nanoflare Heating = $\tau_{reheat} >> \tau_{cool}$

# Methodology

- Measure a DEM in the center of an active region core
- Measure the densities at the footpoints
- Measure the loop lengths (using potential field extrapolation)
- Construct a steady heating model with the same lengths and densities. Does the DEM match the observed DEM?

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$T_{apex} \sim (p_0 L)^{1/3}$

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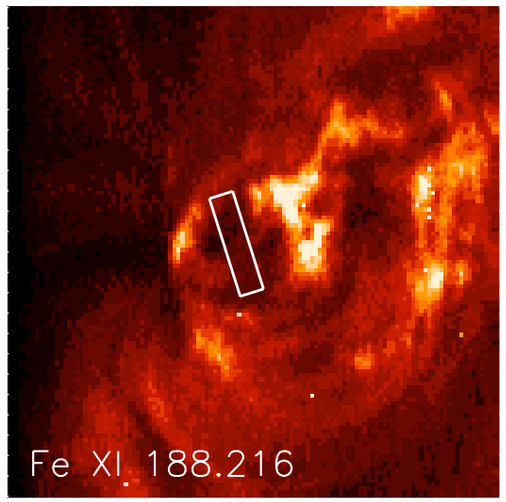
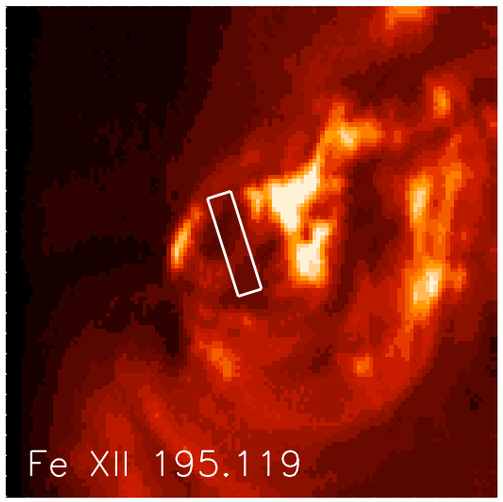
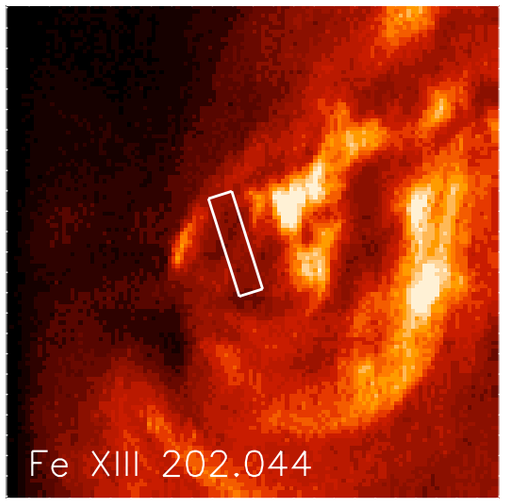
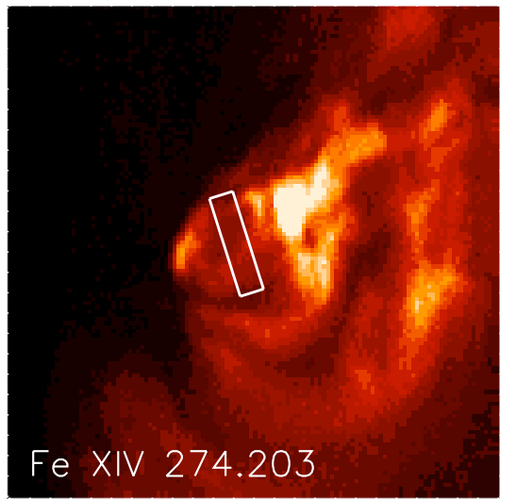
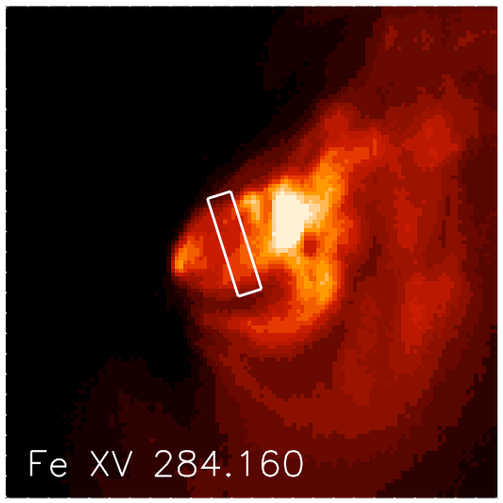
# Active Region Data

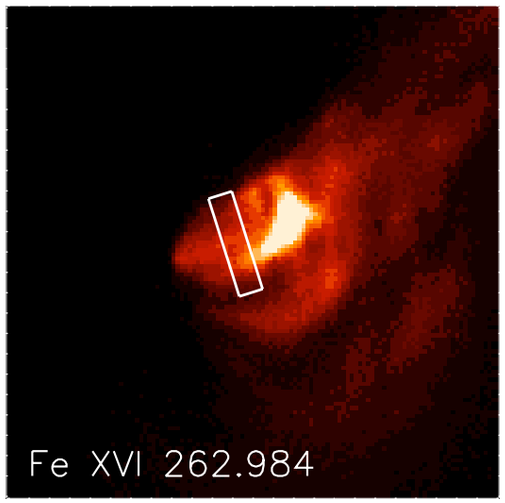


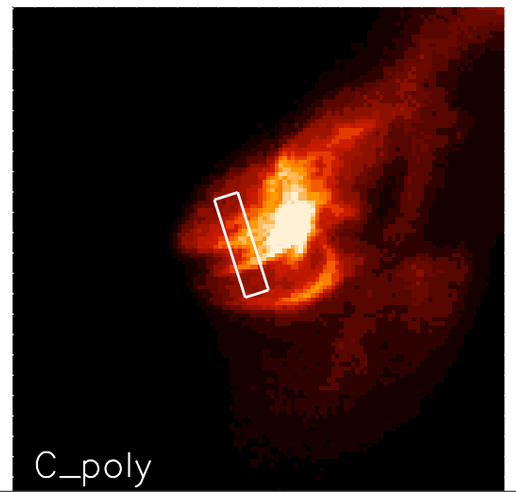



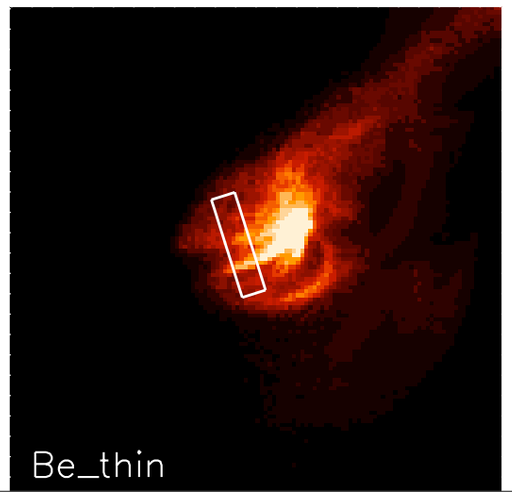



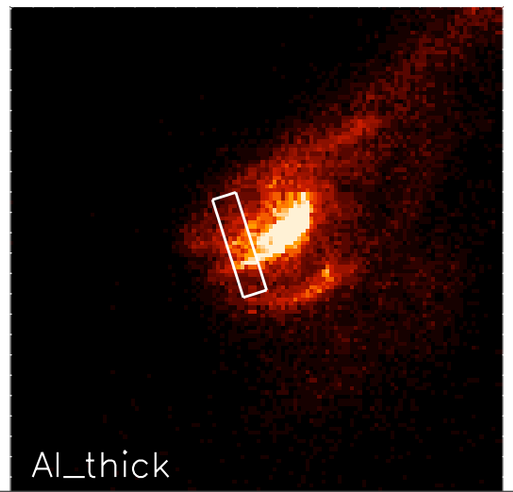



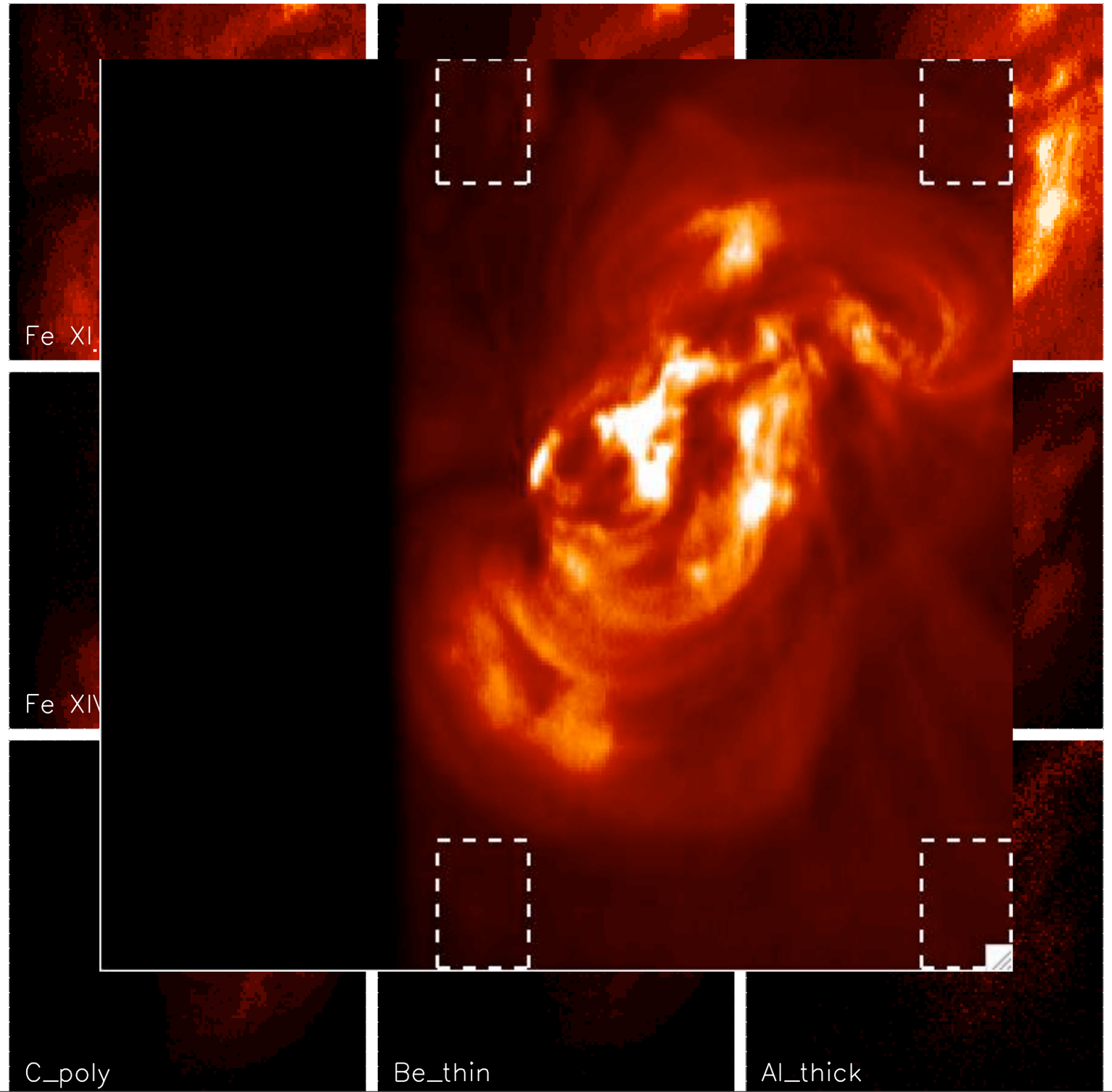

## EIS lines:

Fe X 177.239
Fe XI 180.401
Fe XI 188.216
Fe XII 186.880
Fe XII 195.119
Fe XIII 202.044
Fe XIII 203.826
Fe XIV 264.787
Fe XIV 274.203
Fe XV 284.160
Fe XVI 262.984

## XRT filters:

Al-mesh
C-poly
Ti-poly
Al-poly/Ti-poly
C-poly/Ti-poly
Be-thin
Be-med
Al-thick
Be-thick

# Active Region Data

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XRT filters:

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Be-thin
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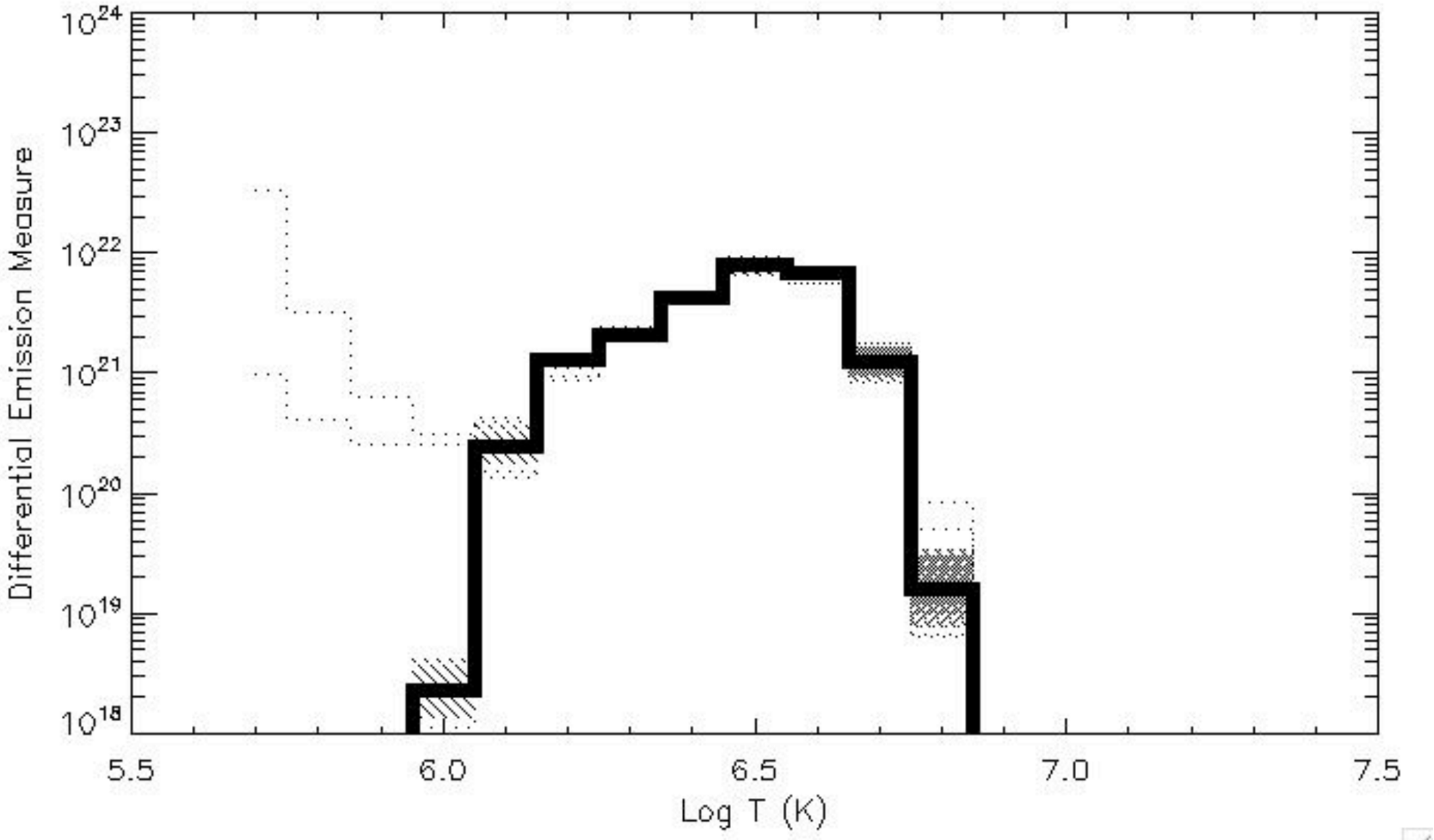
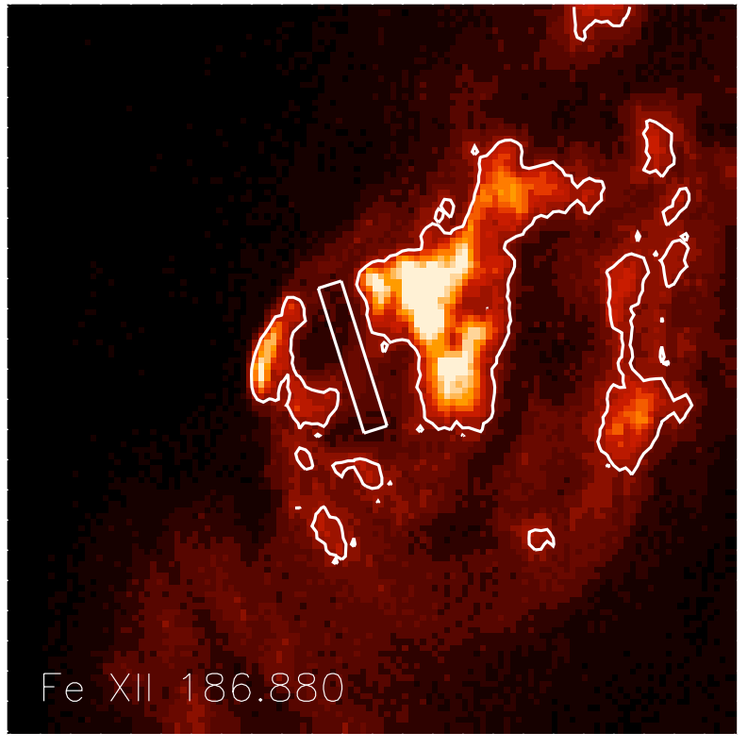
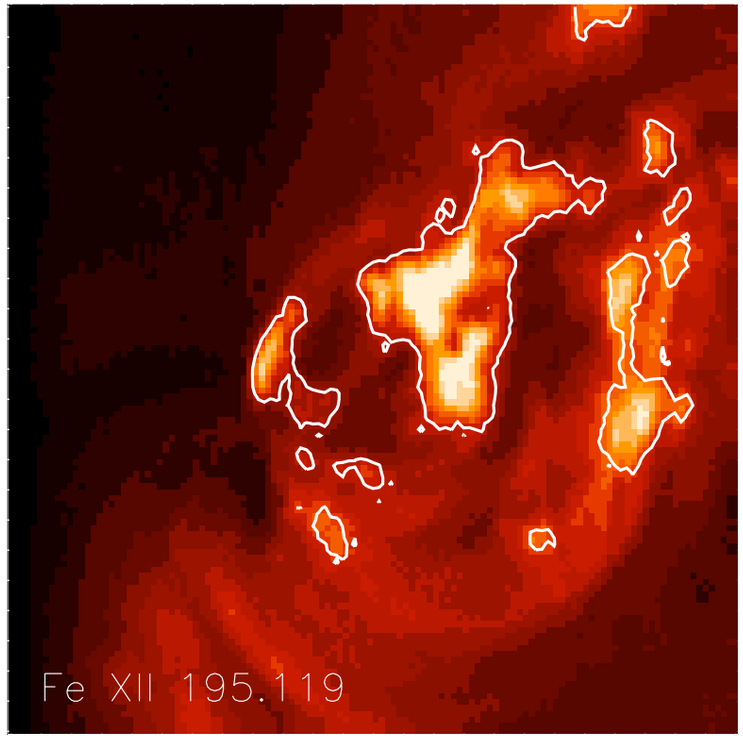
# Combined DEM

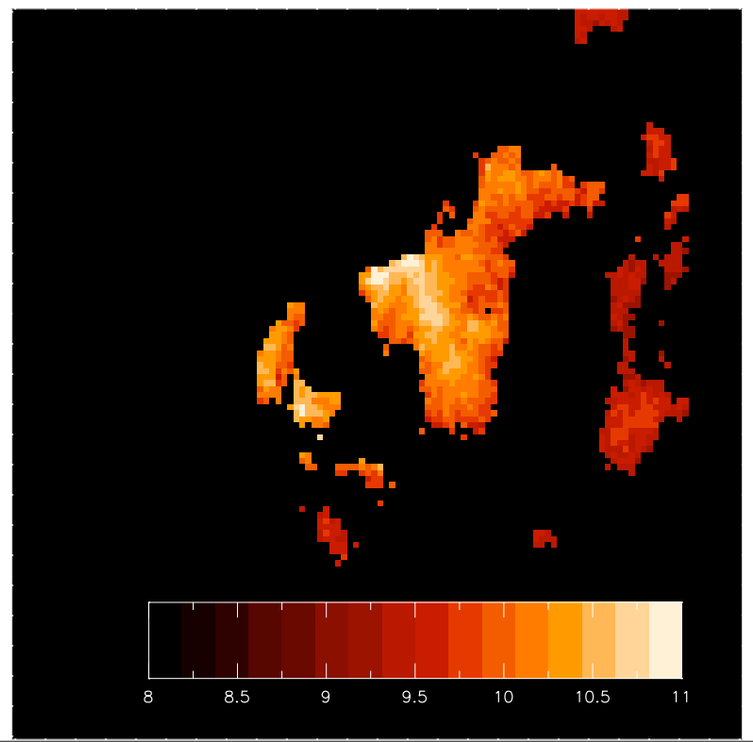


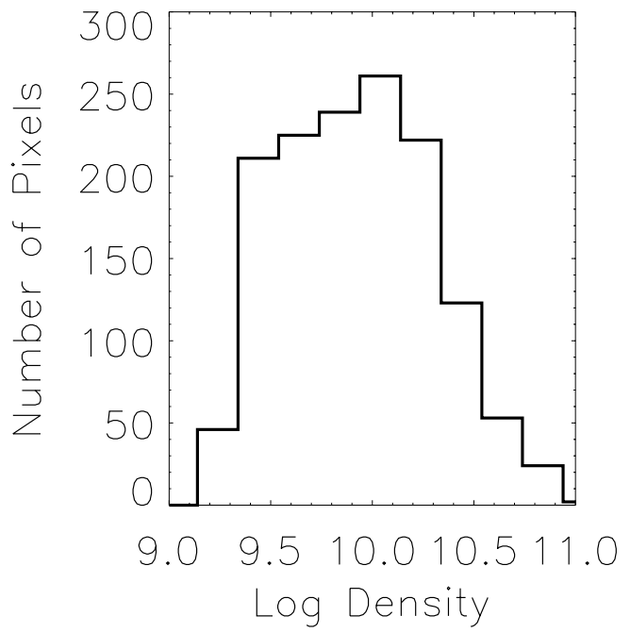

Mark Weber : xrt_dem_iterative2

# Density Measurements

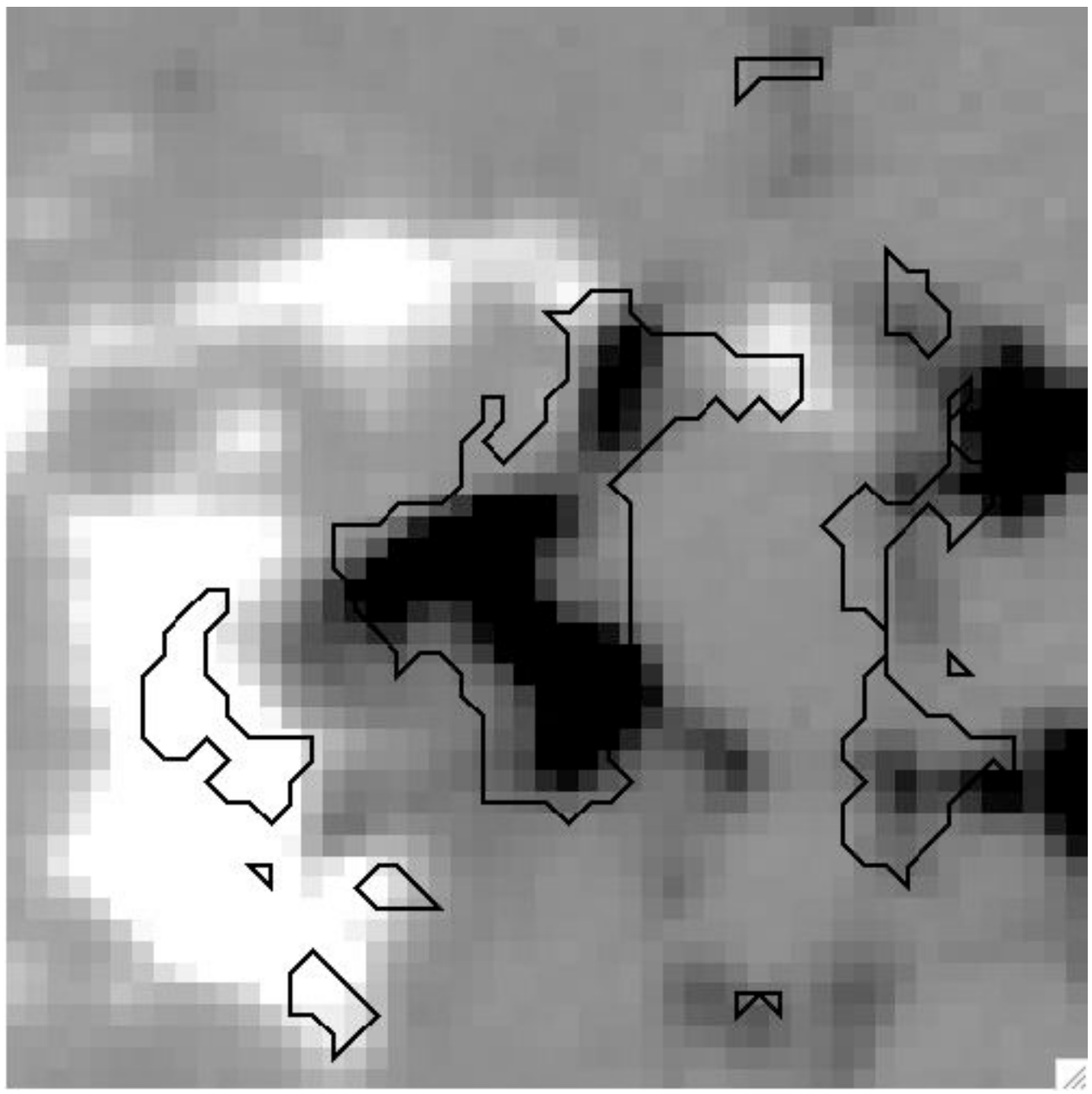


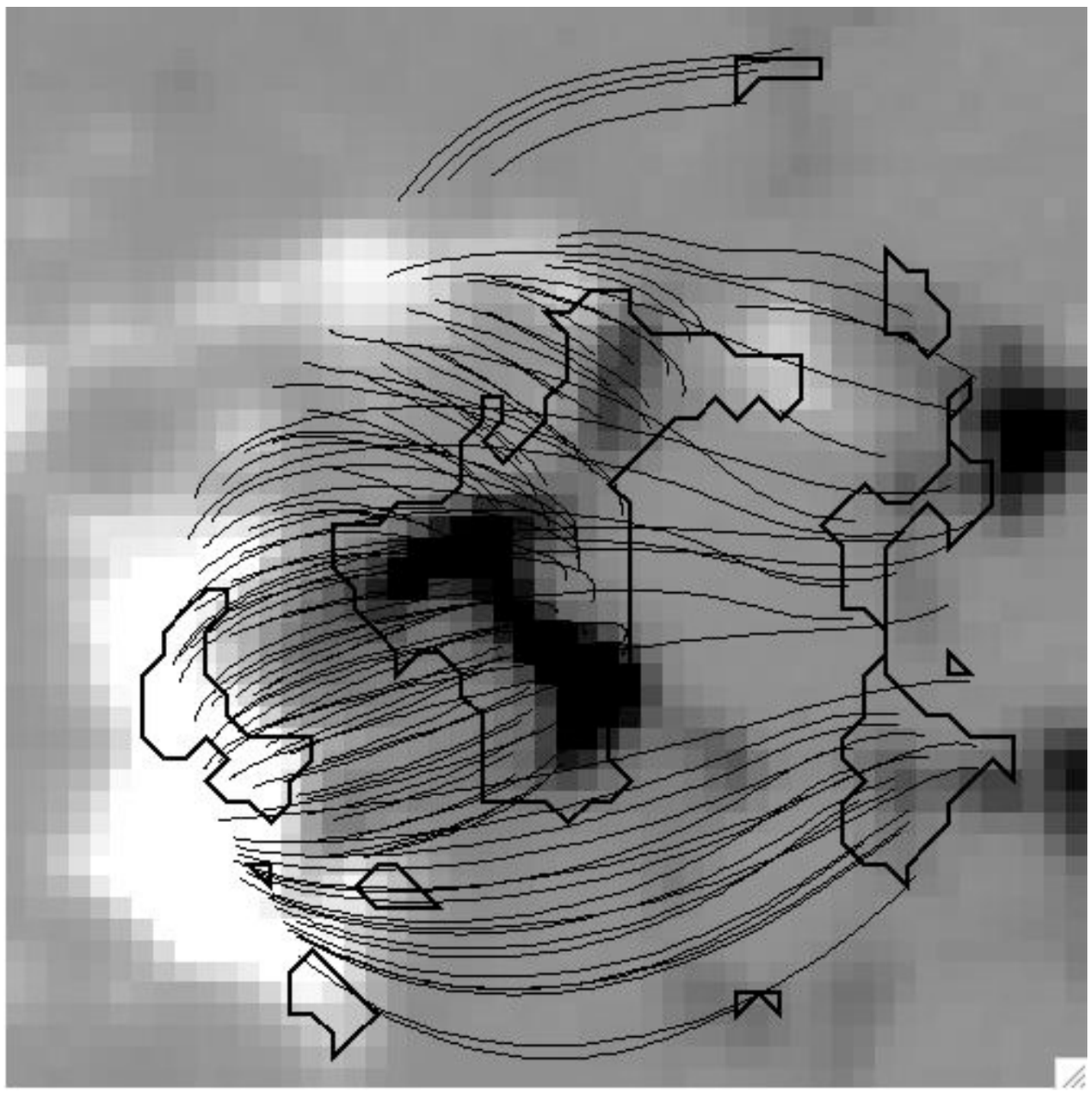



# Loop Length





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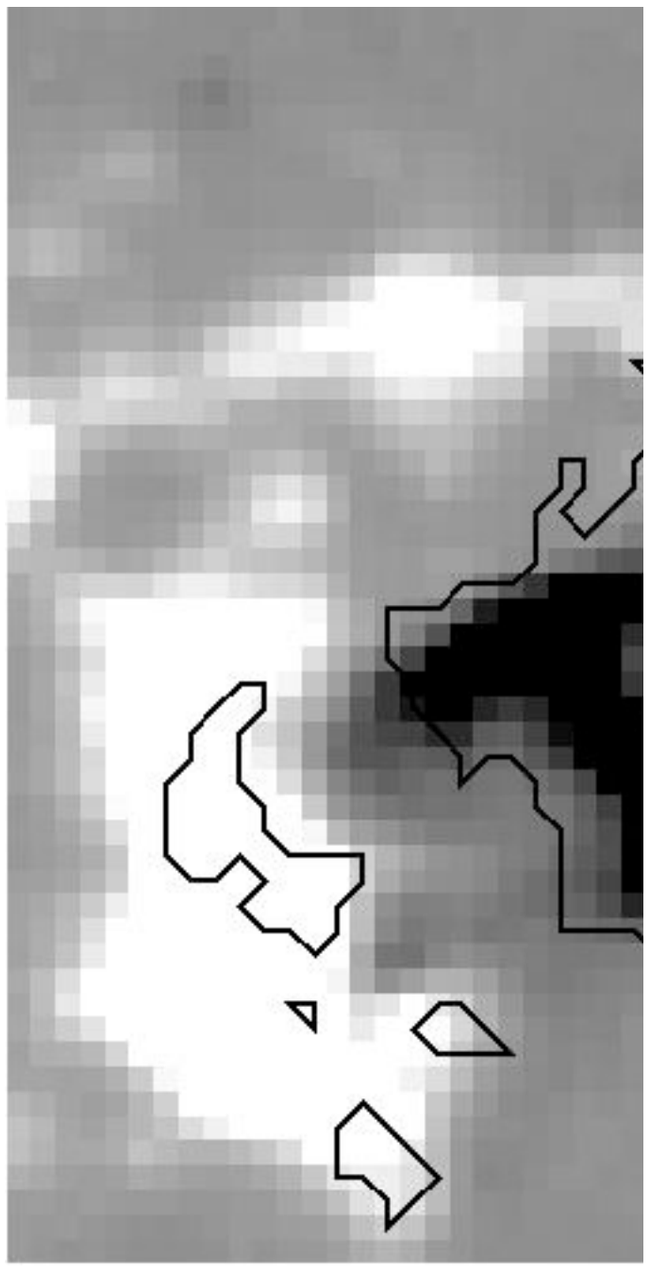
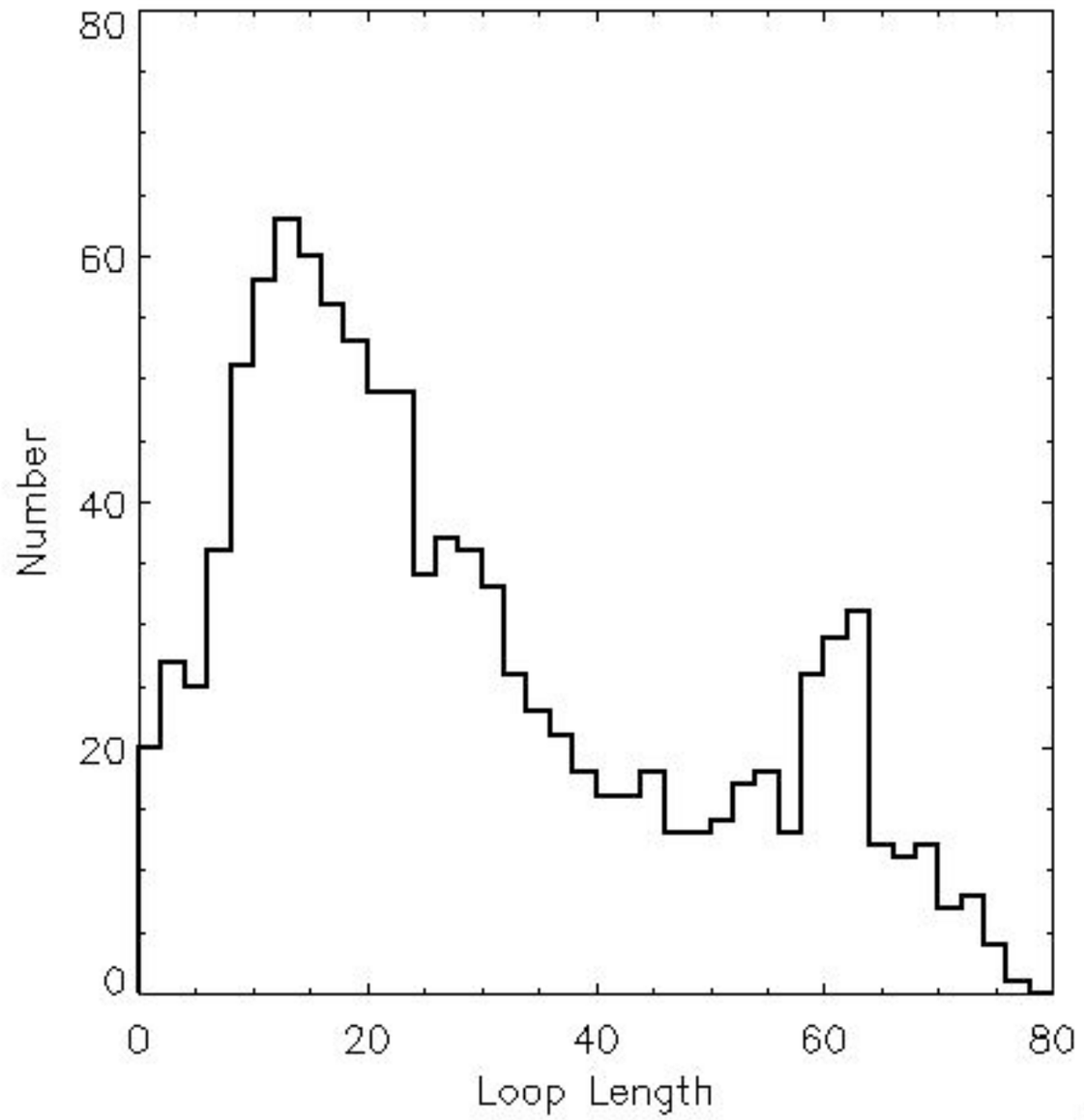
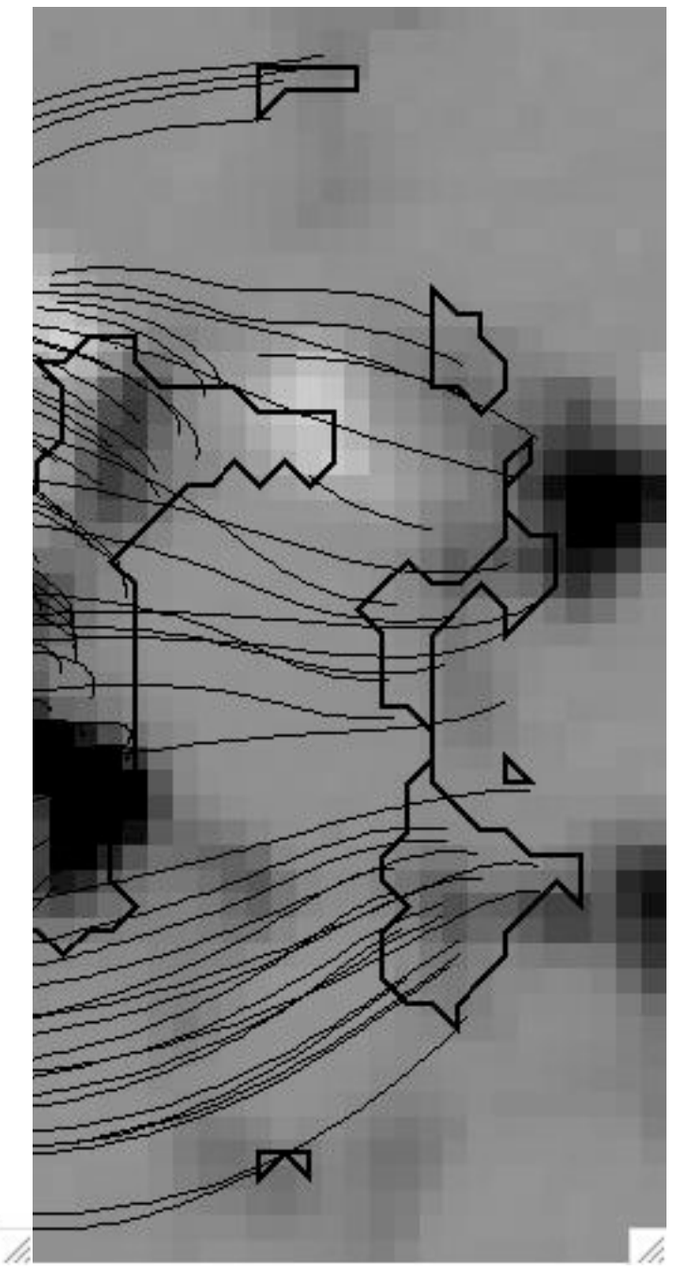
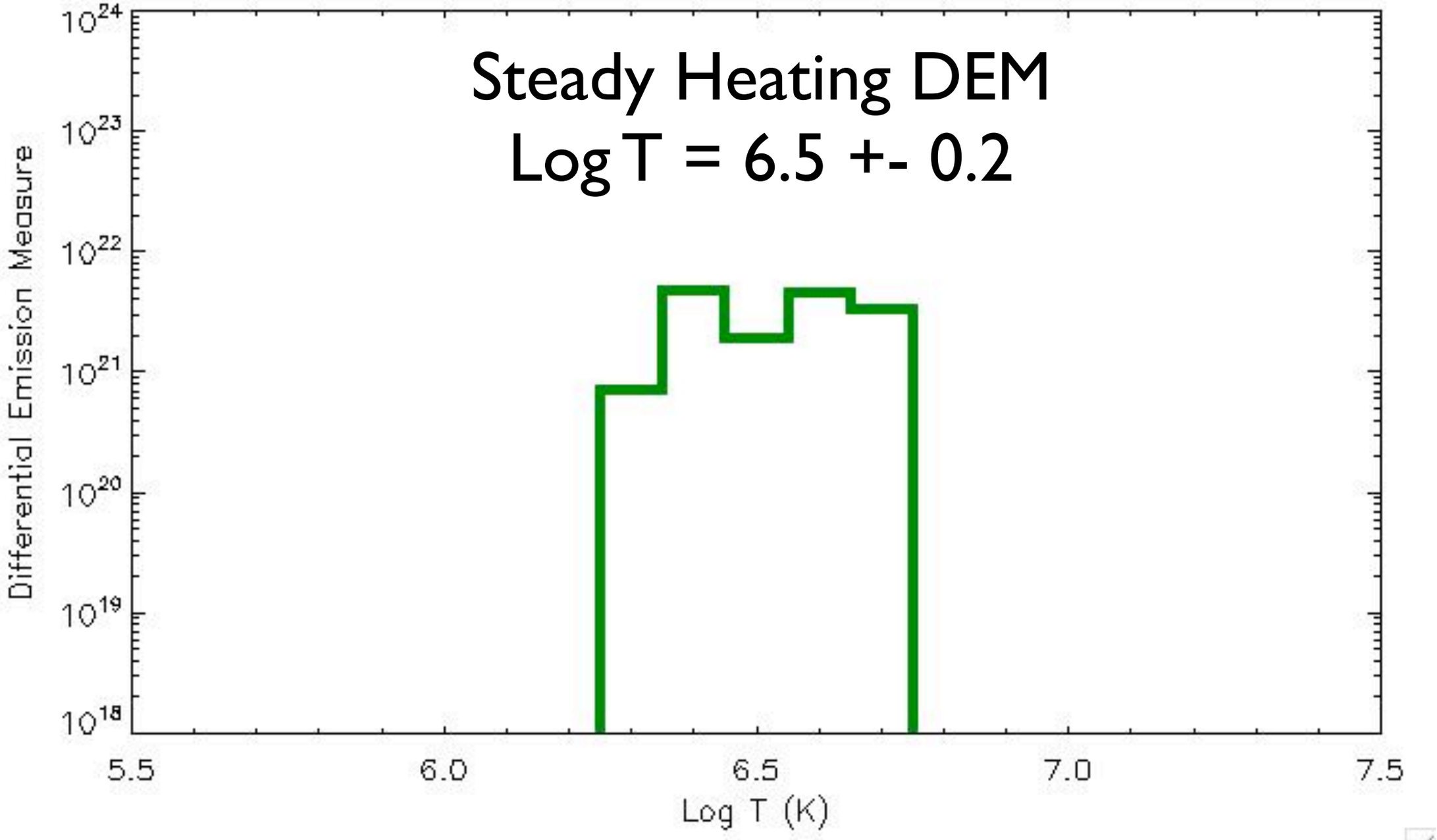


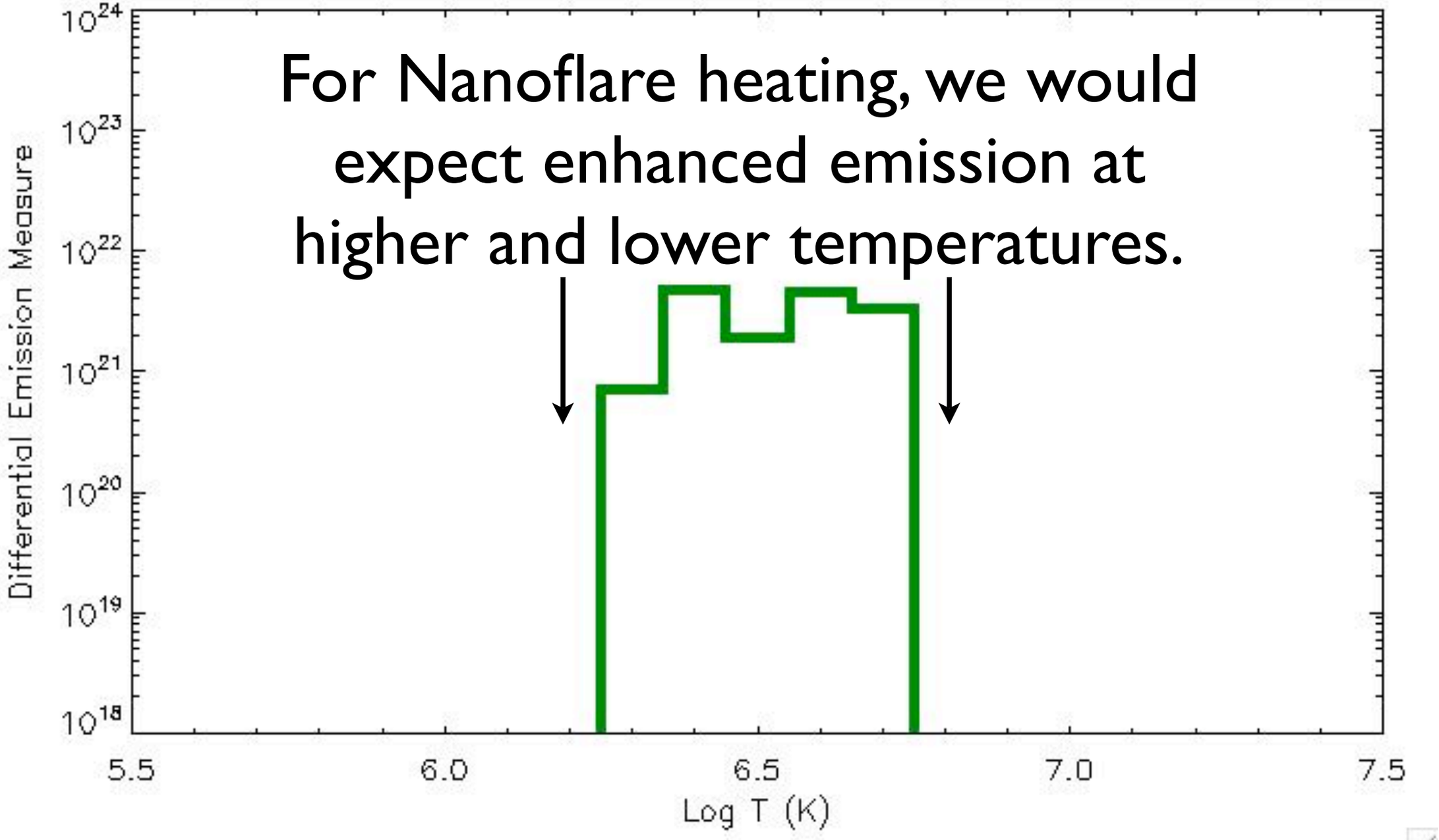


# Model DEM


Steady Heating DEM
Log T = 6.5 +- 0.2
Differential Emission Measure
$10^{24}$
$10^{23}$
$10^{22}$
$10^{21}$
$10^{20}$
$10^{19}$
$10^{18}$
5.5
6.0
6.5
7.0
7.5
Log T (K)

# Model DEM


For Nanoflare heating, we would expect enhanced emission at higher and lower temperatures.
Differential Emission Measure
$10^{24}$
$10^{23}$
$10^{22}$
$10^{21}$
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$10^{18}$
5.5
6.0
6.5
7.0
7.5
Log T (K)

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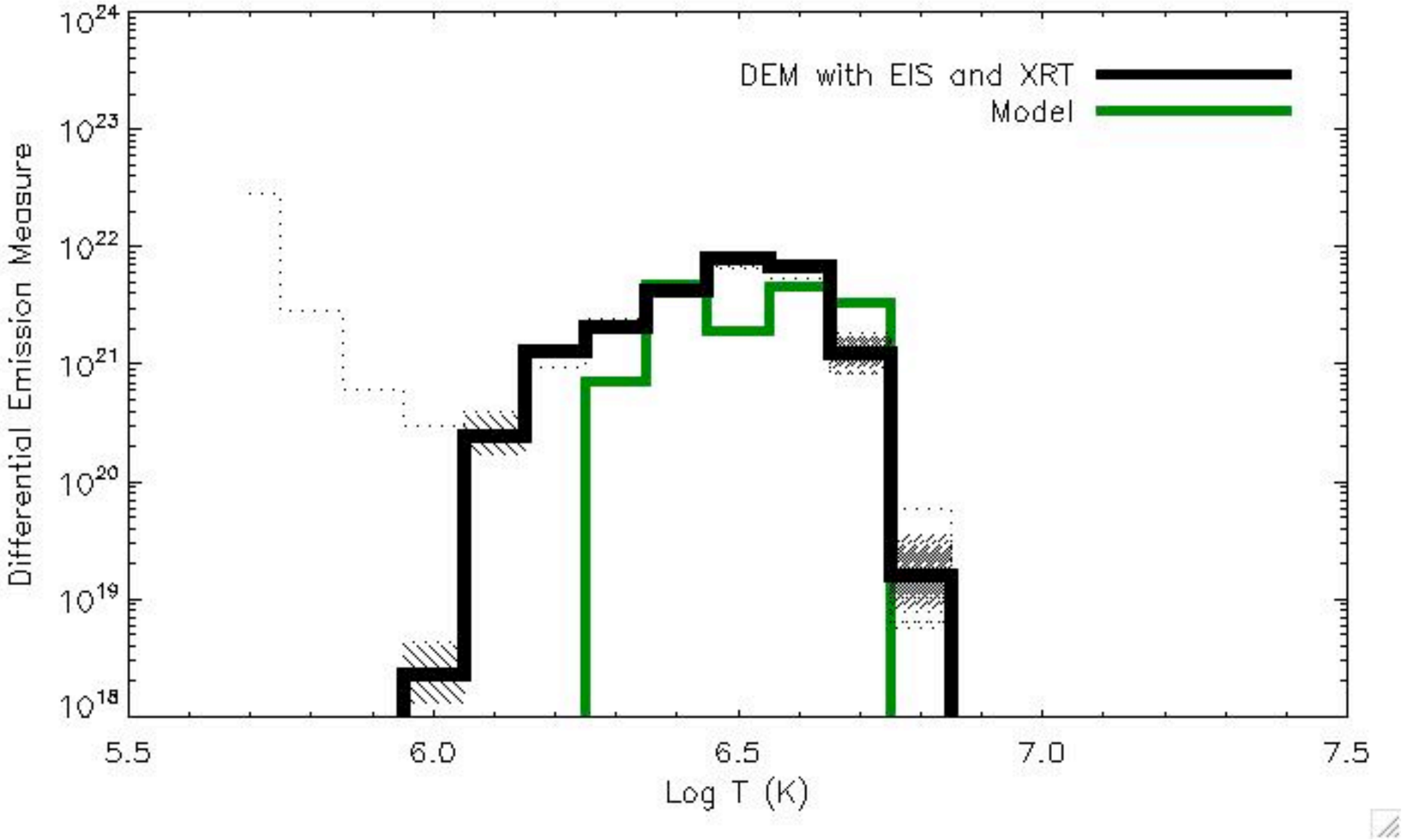
DEM with EIS and XRT
Model
Differential Emission Measure
$10^{24}$
$10^{23}$
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$10^{21}$
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5.5
6.0
6.5
7.0
7.5
Log T (K)

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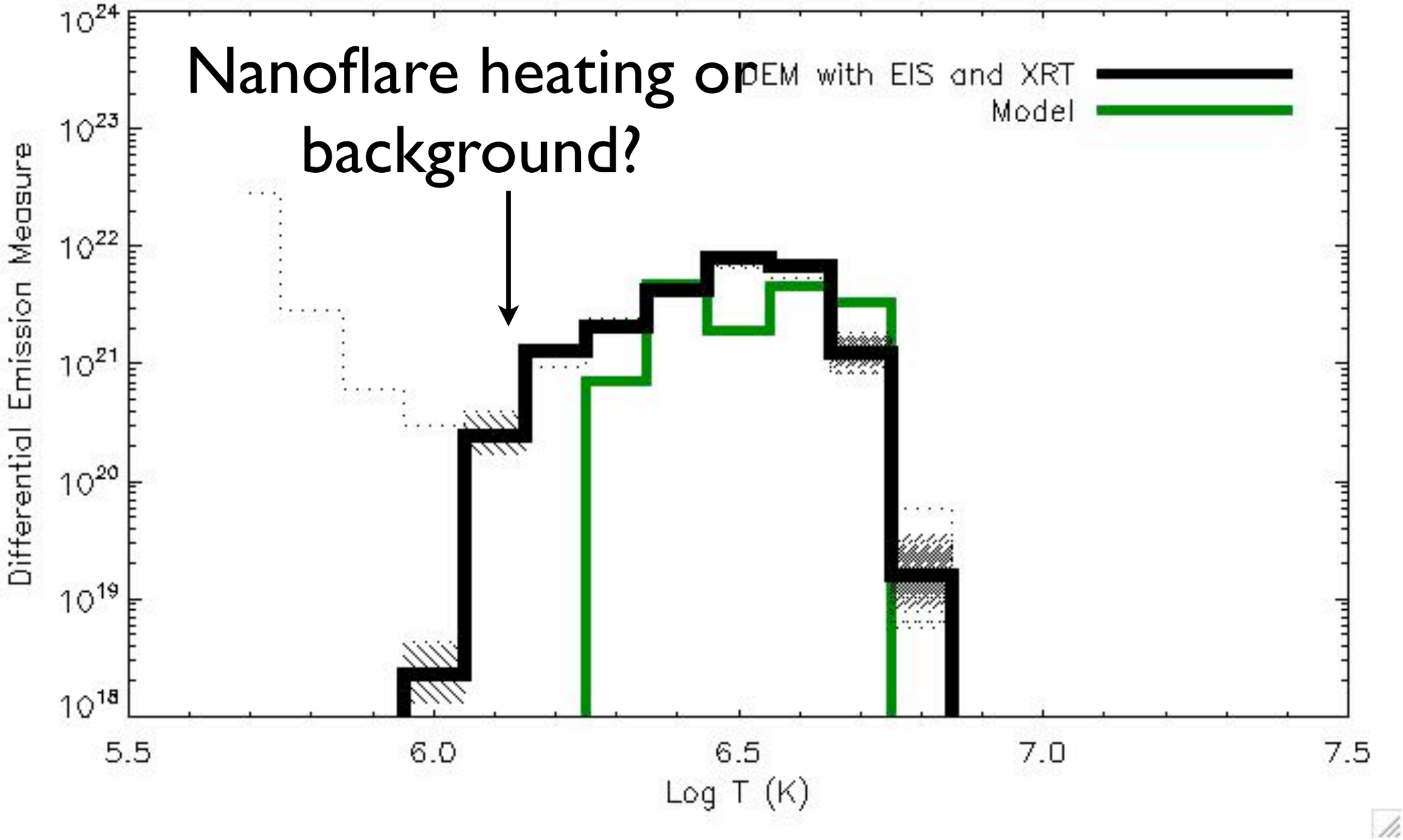
Nanoflare heating or background?
DEM with EIS and XRT
Model
Differential Emission Measure
$10^{24}$
$10^{23}$
$10^{22}$
$10^{21}$
$10^{20}$
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$10^{18}$
5.5
6.0
6.5
7.0
7.5
Log T (K)

# Conclusion

- Steady heating remains a valid assumption for Active Region cores.
- Errors in Loop Length and Density have not been considered, but $T_{apex} \sim (p_0 L)^{1/3}$.

# Thanks Helen!