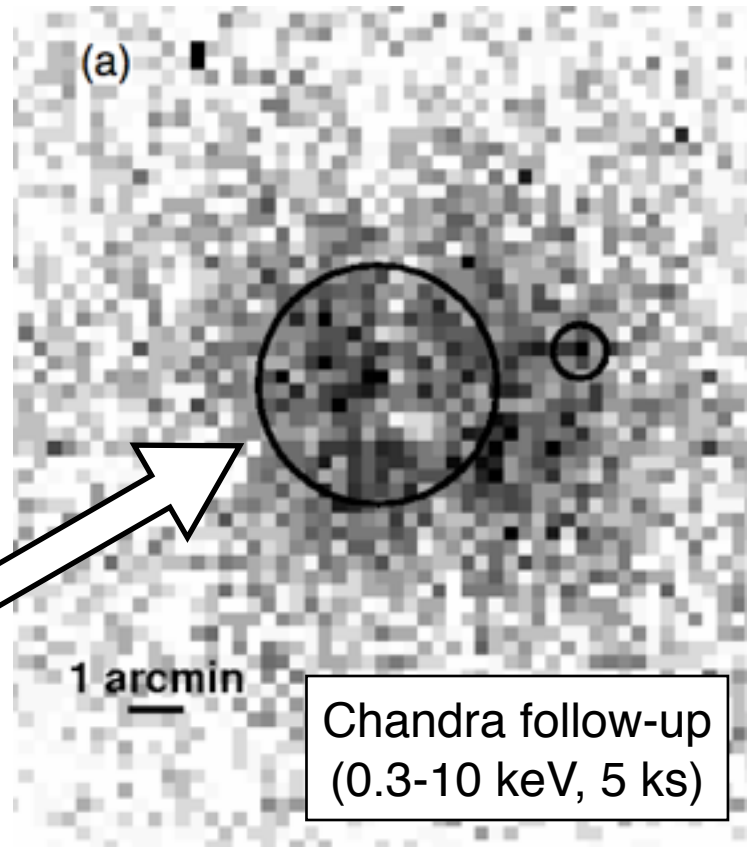
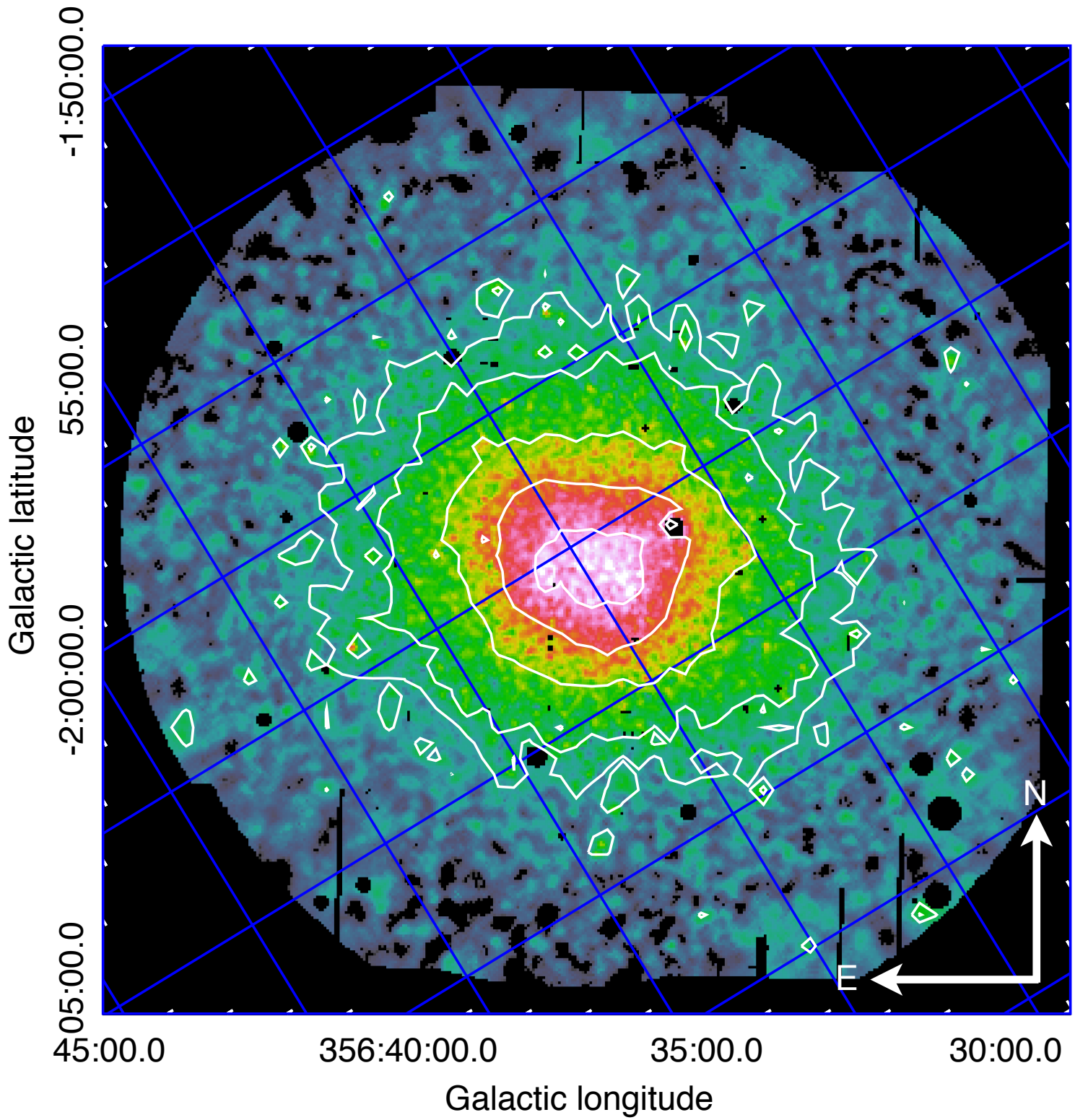
Discovery of a Nearby, Massive Galaxy Cluster Behind the Galactic Bulge with XMM

Daniel R. Wik (NASA GSFC),
Nicolas Barrière, John Tomsick,
Steve Boggs (UC Berkeley),
Sylvain Chaty, Jerome Rodriguez
(CEA Saclay)



INTEGRAL
error circle for
IGR J17448-3232

Tomsick et al. (2009)



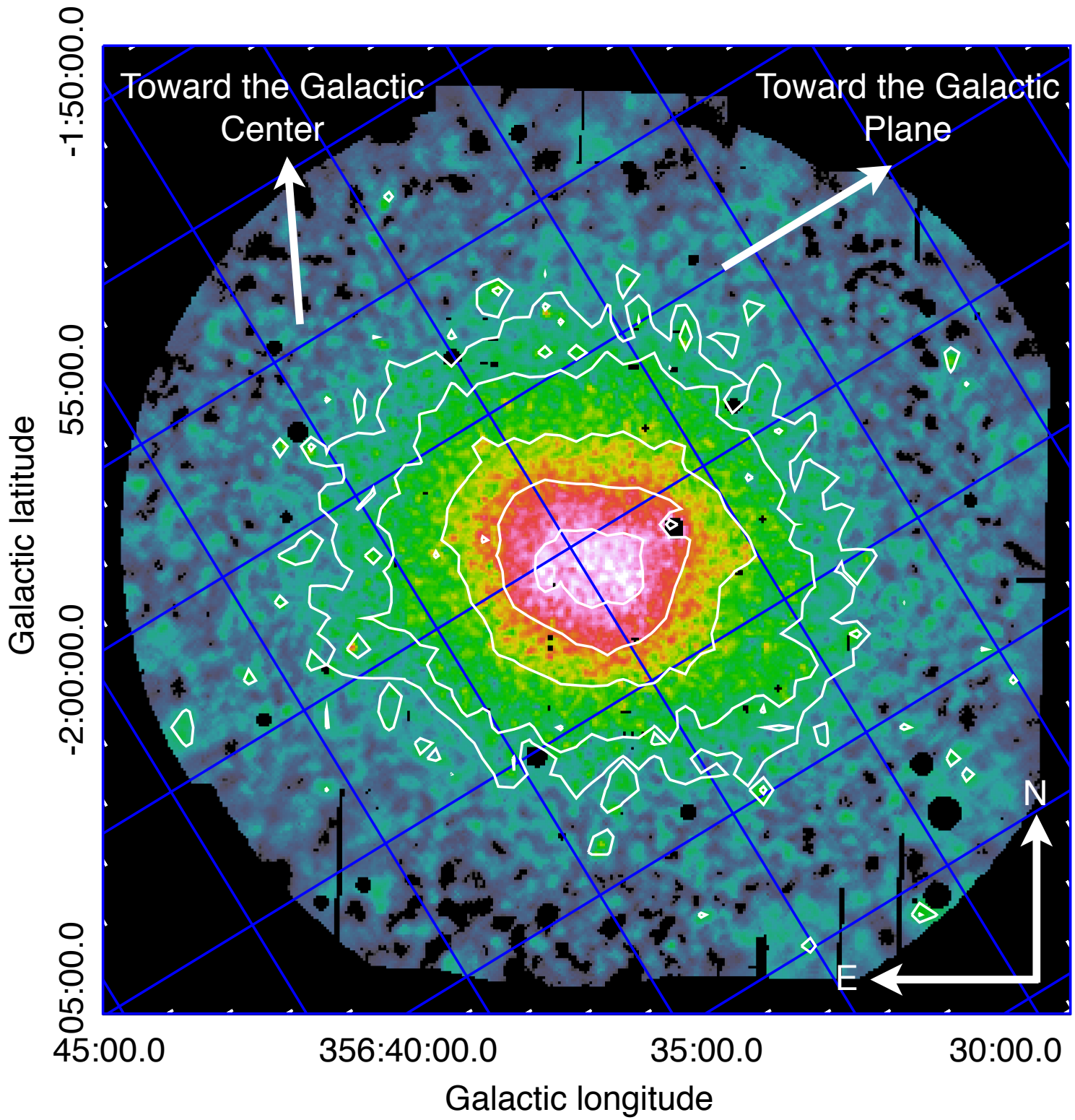
Quick Stats

OBSID 0672260101

43 ks on target
MOS1+MOS2+pn
25ks 27ks 17ks
(after flare removal)

Image:
1.1-7.2 keV
particle & soft proton subtracted
exposure corrected
binned to 5” pixels
adaptively smoothed
point source masked

Reduction via XMM ESAS package (Snowden & Kunz)



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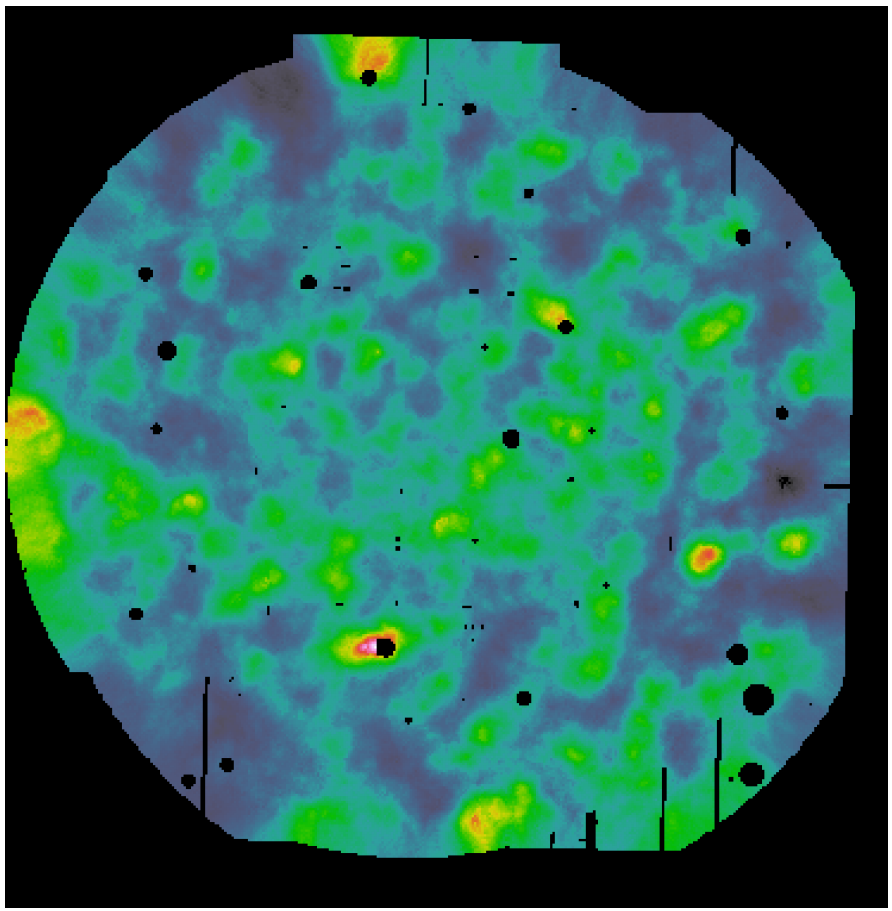
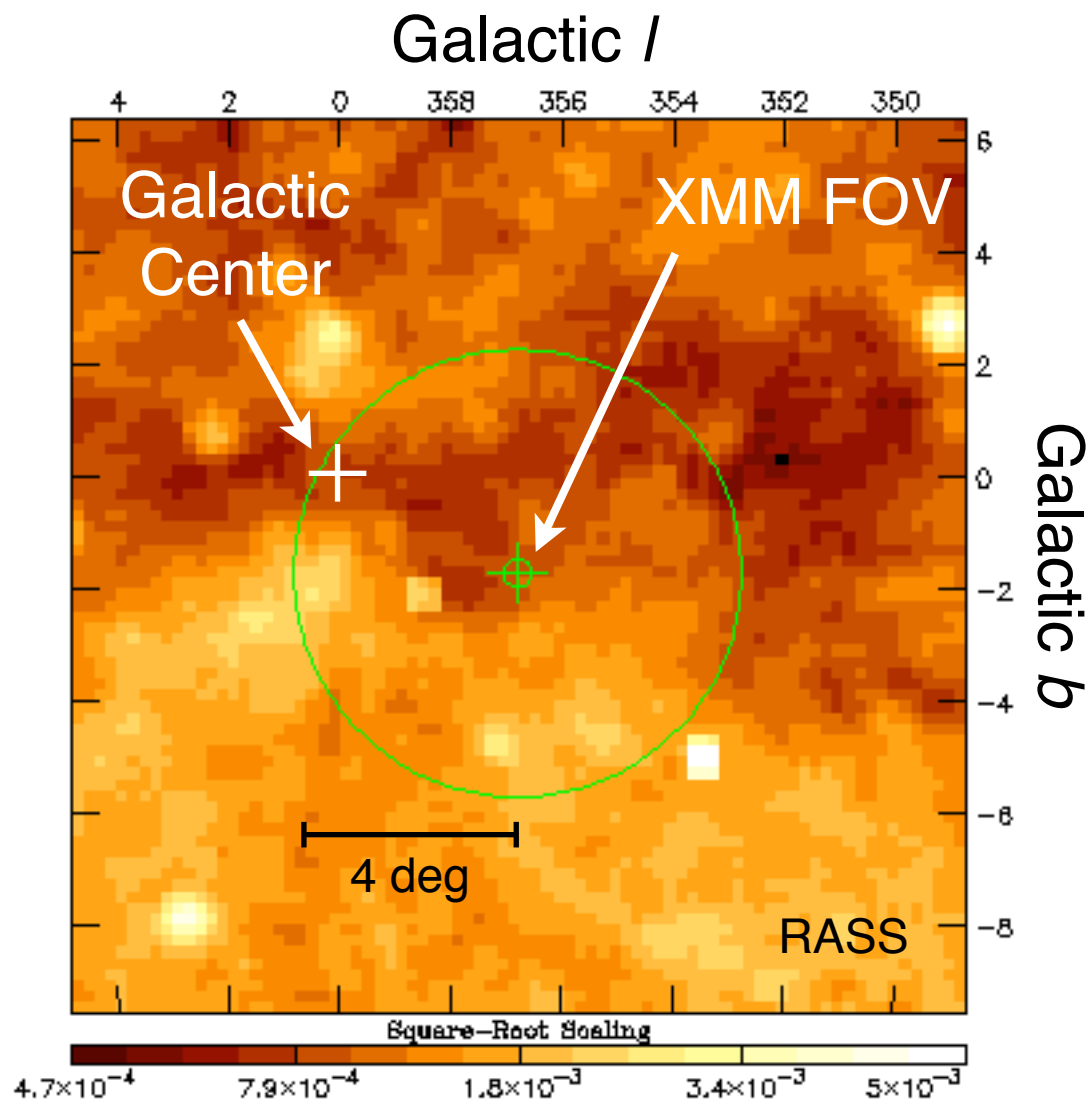
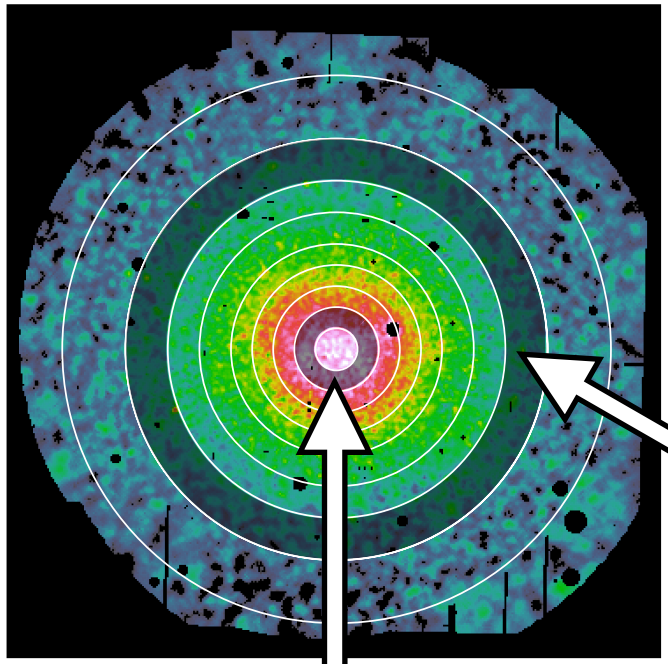
Our Galaxy is in the way

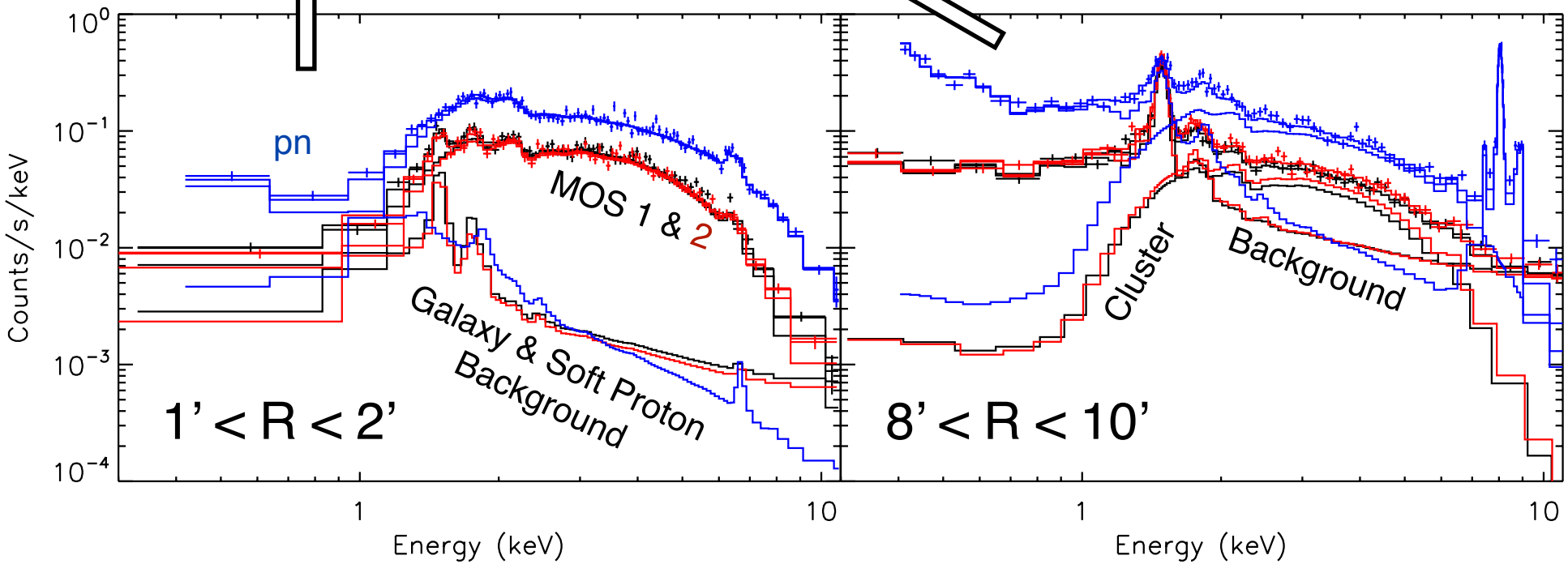
XMM EPIC 0.5-0.8 keV





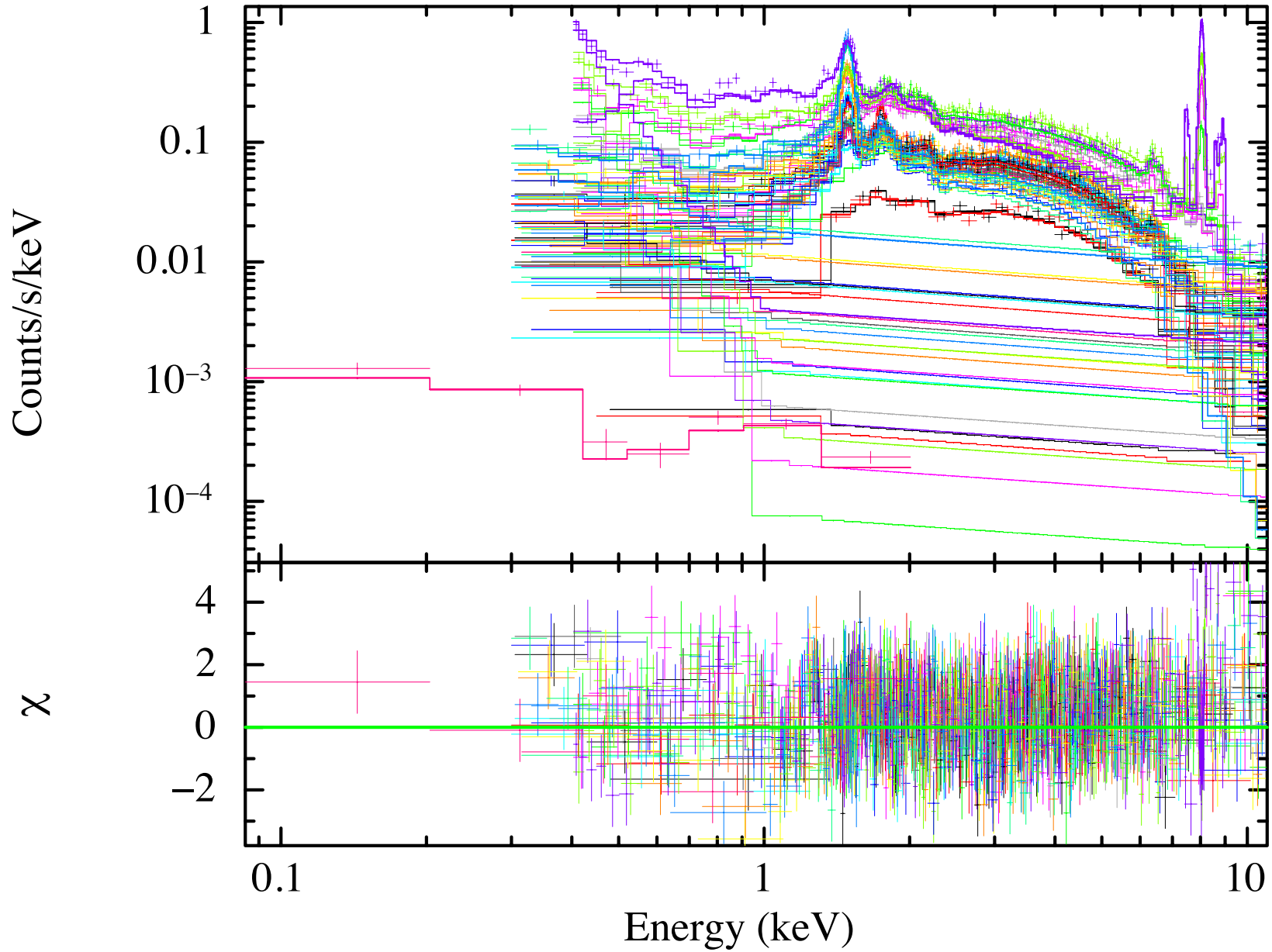
Properties in the core are much less sensitive to foreground and background modeling





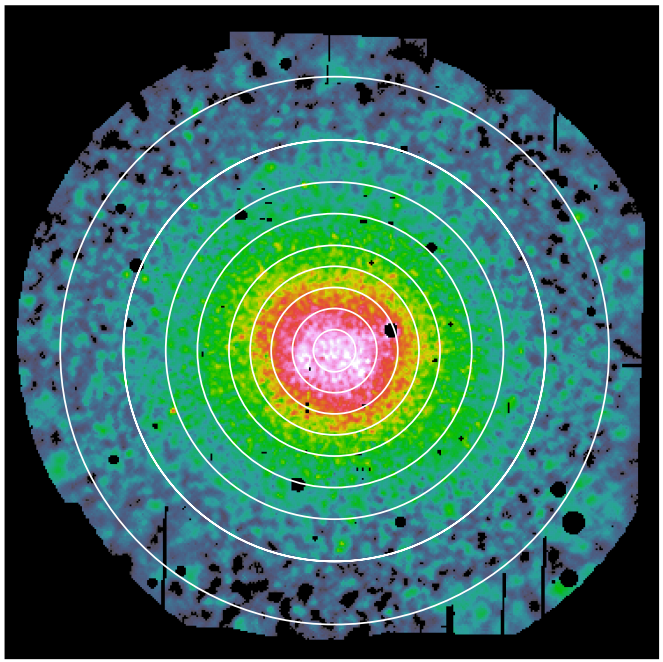
Simultaneous spectral modeling of all data

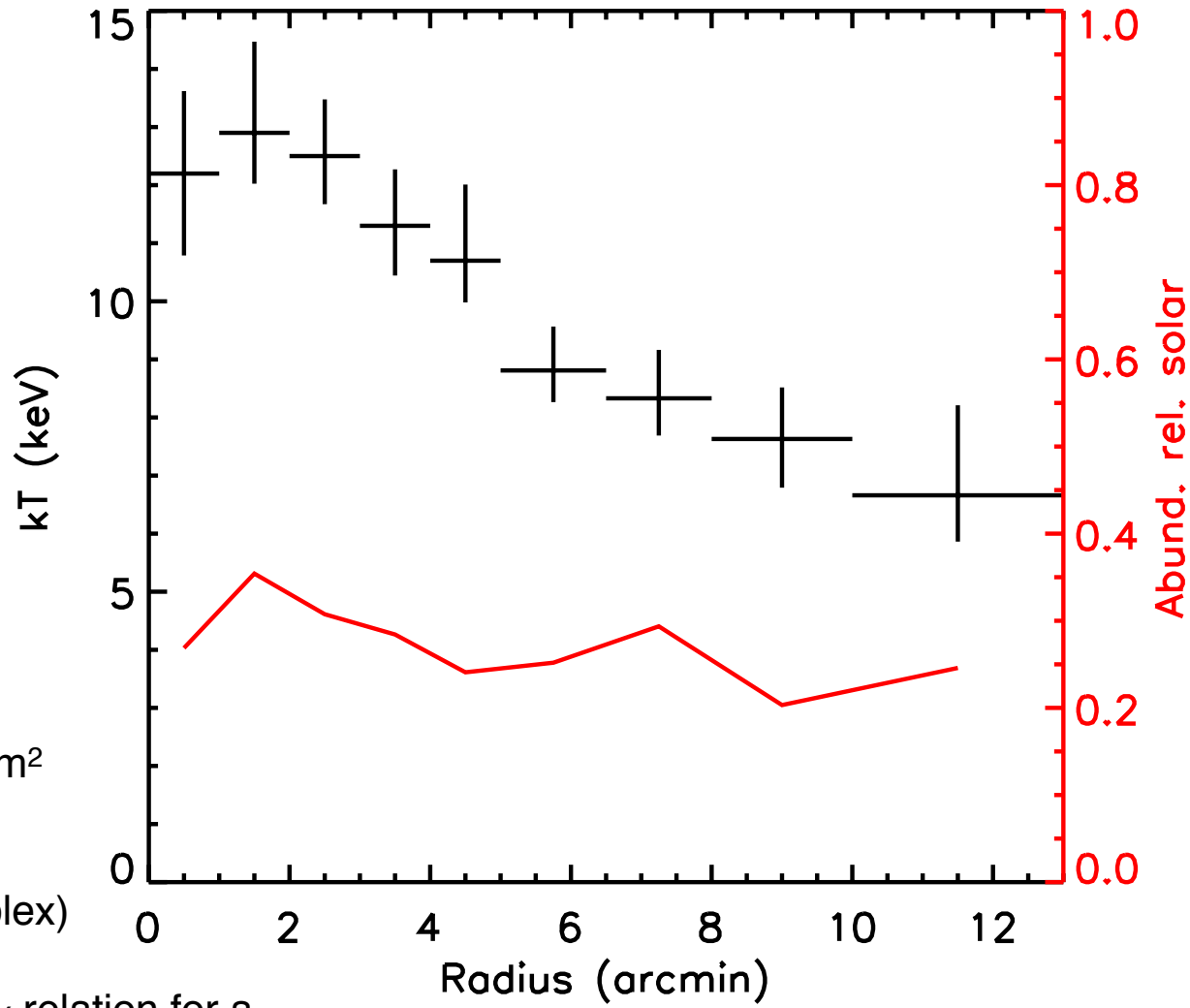
9 annuli, 28 spectra including RASS data



Single Temperature APEC Fits

Outer regions depend sensitively on fore/background assumptions





- unabsorbed $F_{2\text{-}10\ keV} \sim 6\text{x}10^{-11}$ ergs/s/cm^2
- $kT_{EW} \sim 10$ keV
- abundance is 0.2-0.3 solar
- z~0.054 (based on the Fe-K line complex)
- $L_{X,bol} \sim 1.1\text{x}10^{45}$ ergs/s
  - underluminous relative to the L_X-T_X relation for a
  - $kT_{vir} \sim 10$ keV cluster (e.g., Maughan et al. 2012).

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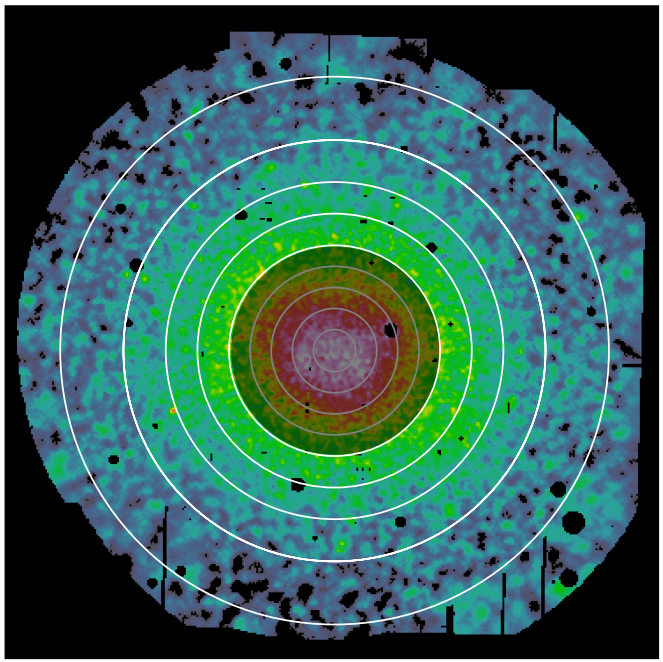

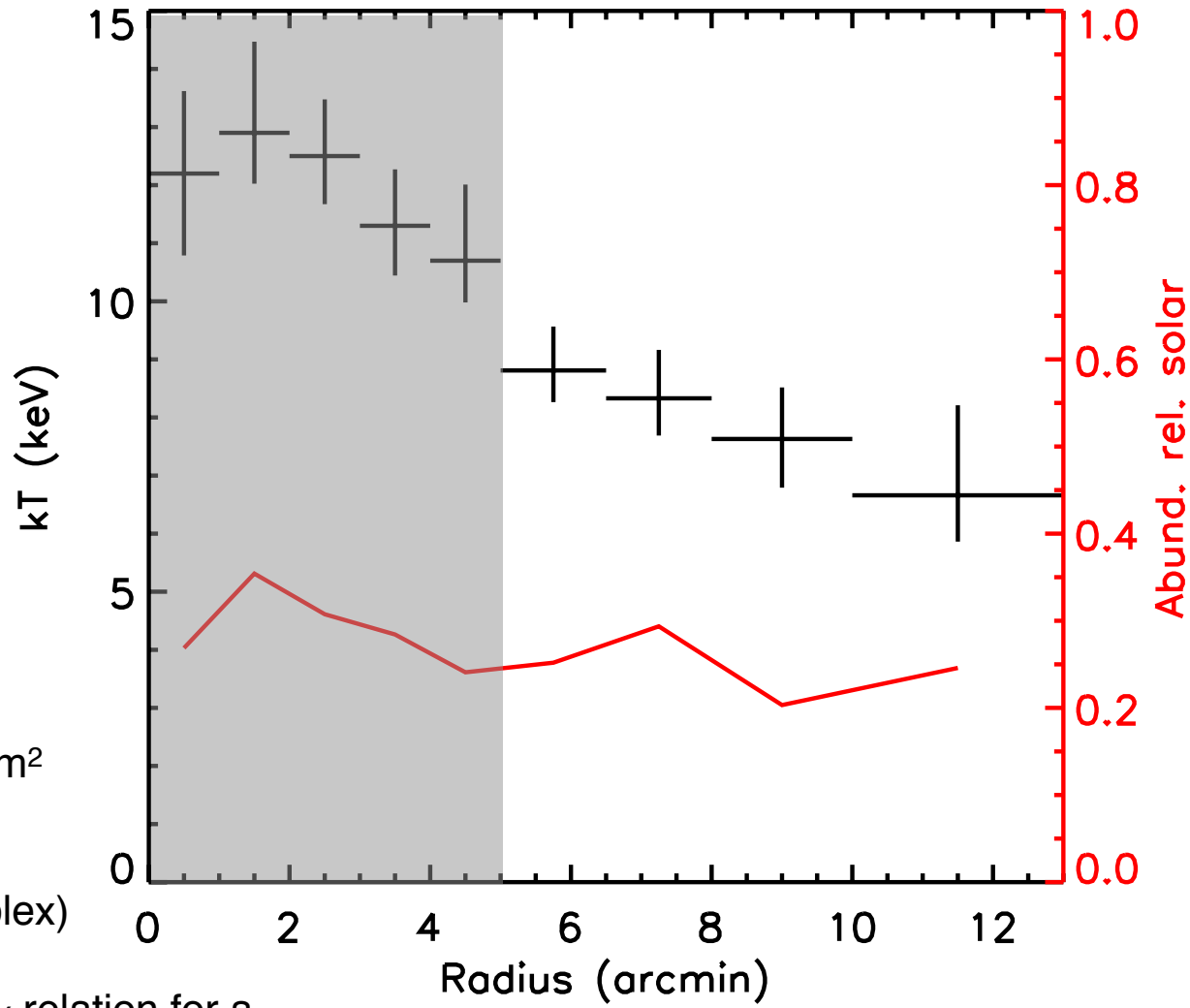

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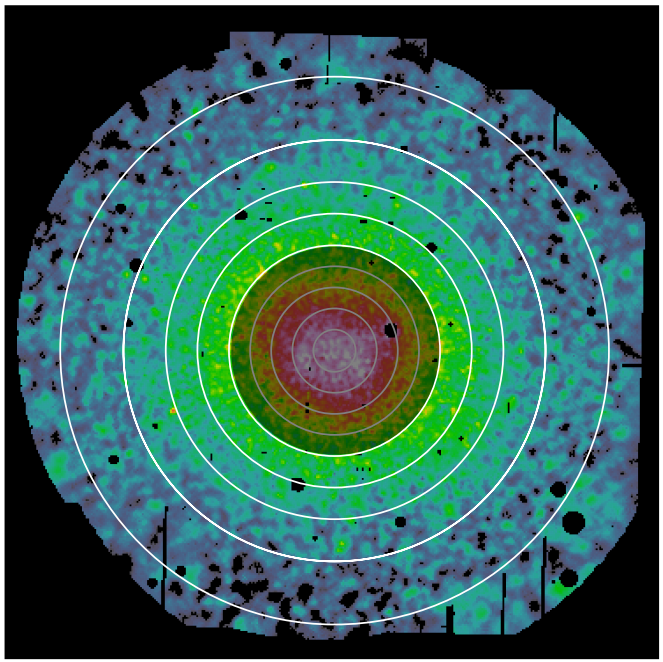

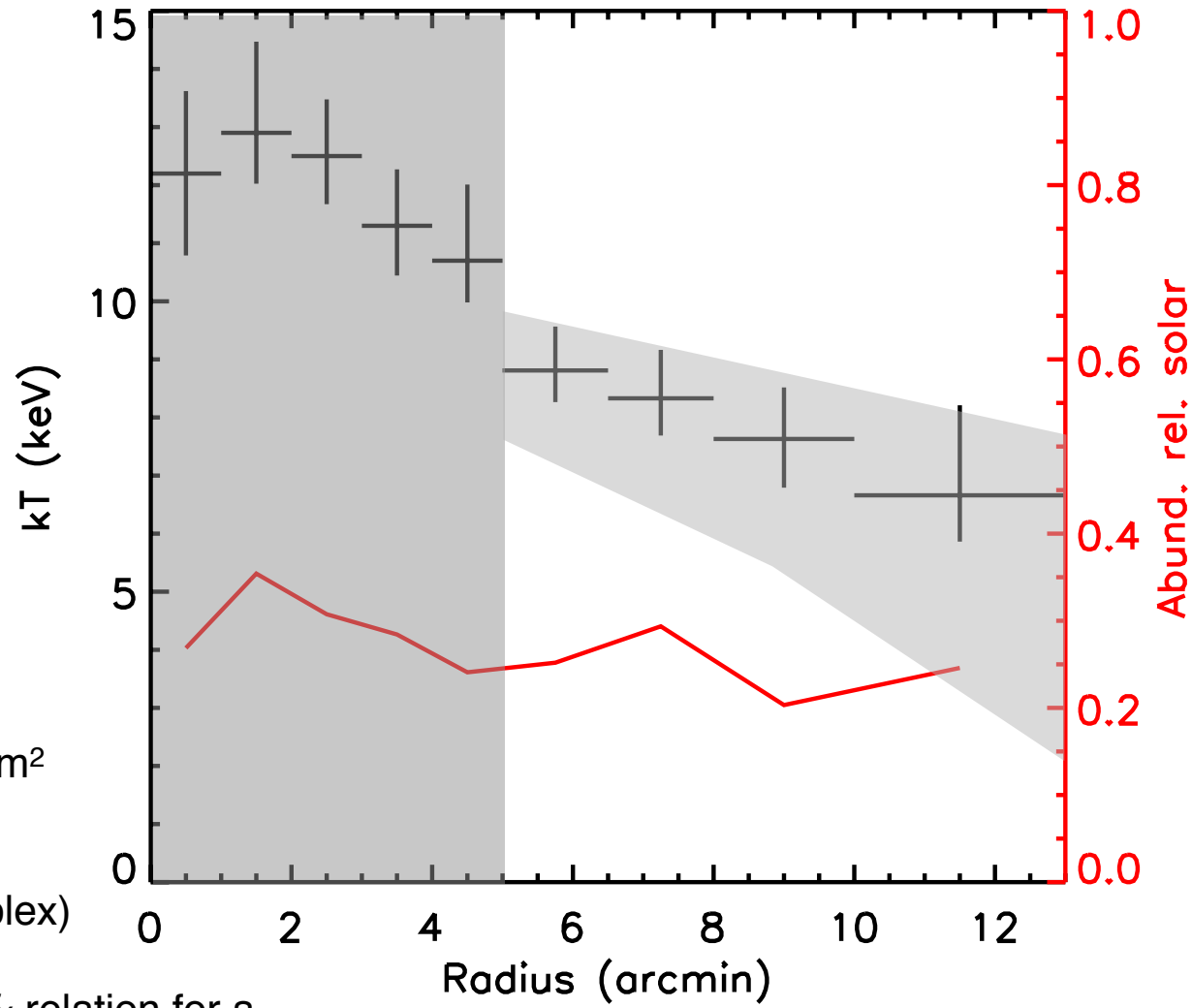

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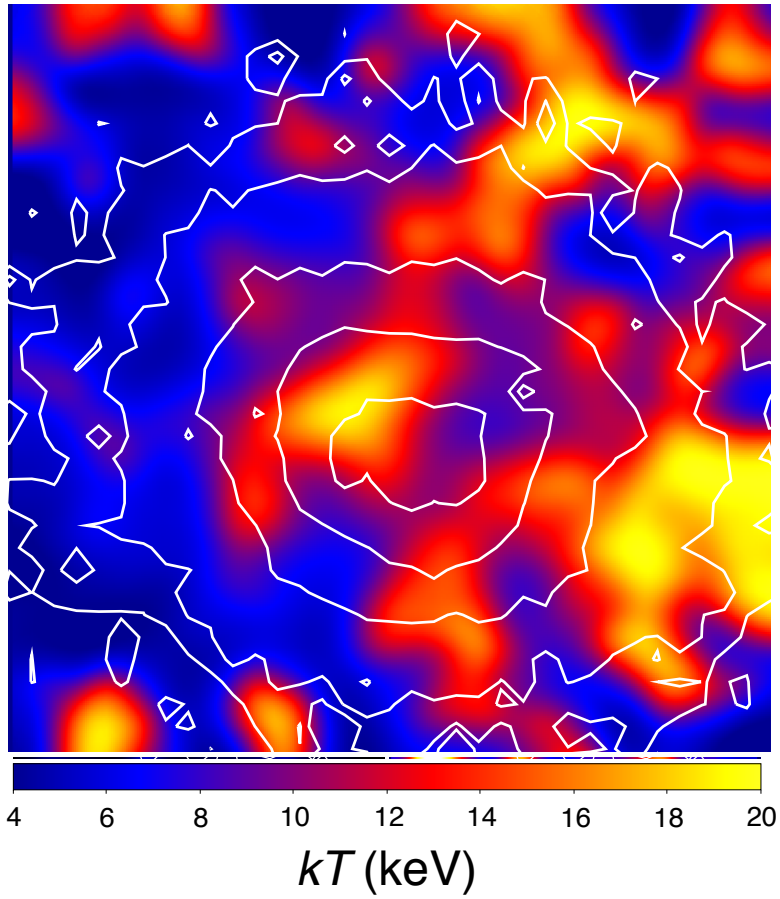
Thermodynamic Property Maps

- Define 7 energy bands, create images of counts, exposure, particle background, soft proton background, and Galaxy/cosmic background
- “Extract spectra” by computing rates within a region for each band
- Fit spectrum with XSpec, fixing the abundance, absorption, and redshift
- Repeat on grid across the cluster
  - each region circular, r = 50”
  - regions spaced 25” apart
- Interpolate kT and Norm with Gaussian weighting

Temperature



0.8-1.1 keV, 1.1-1.35 keV, 1.9-2.1 keV, 2.35-3.2 keV, 3.2-4.5 keV, 4.5-6.0 keV, 6.0-7.2 keV

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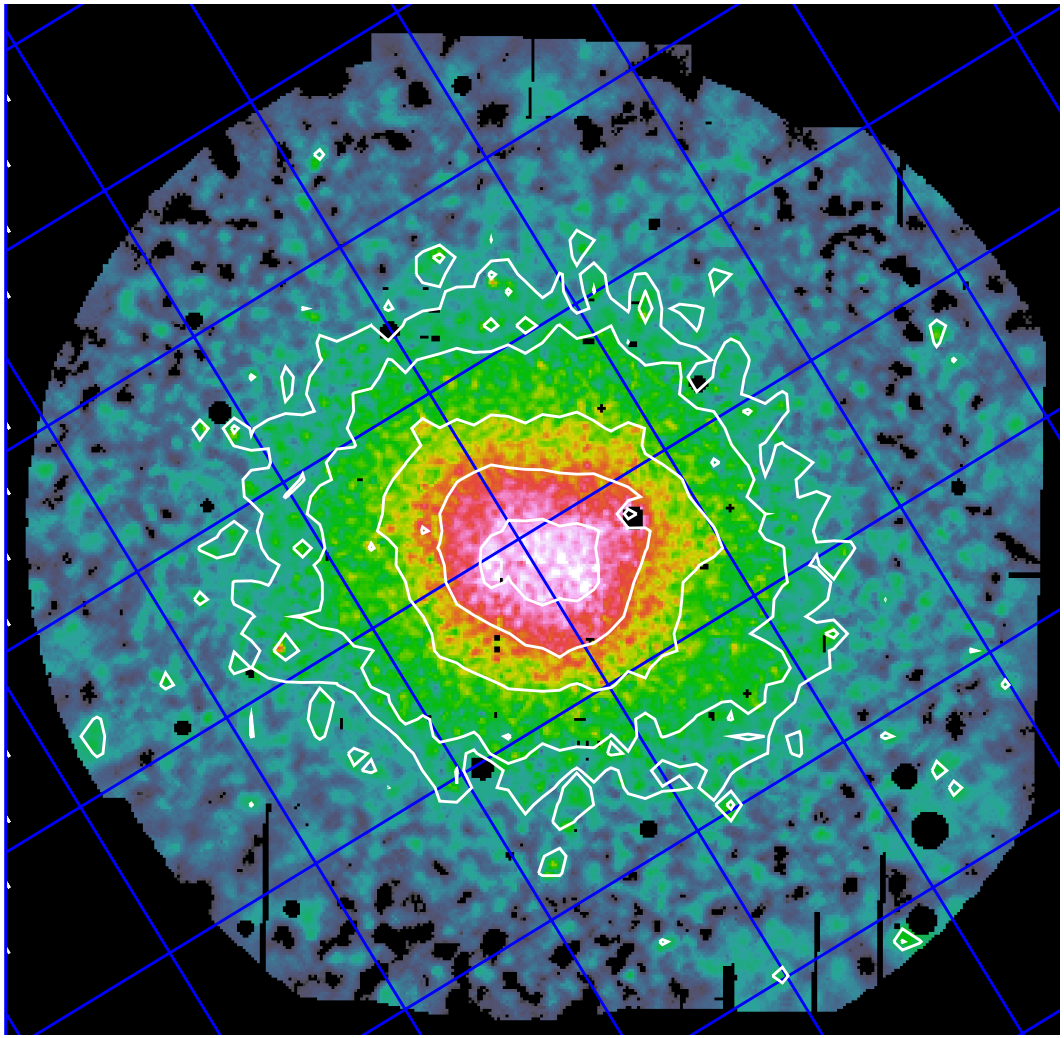

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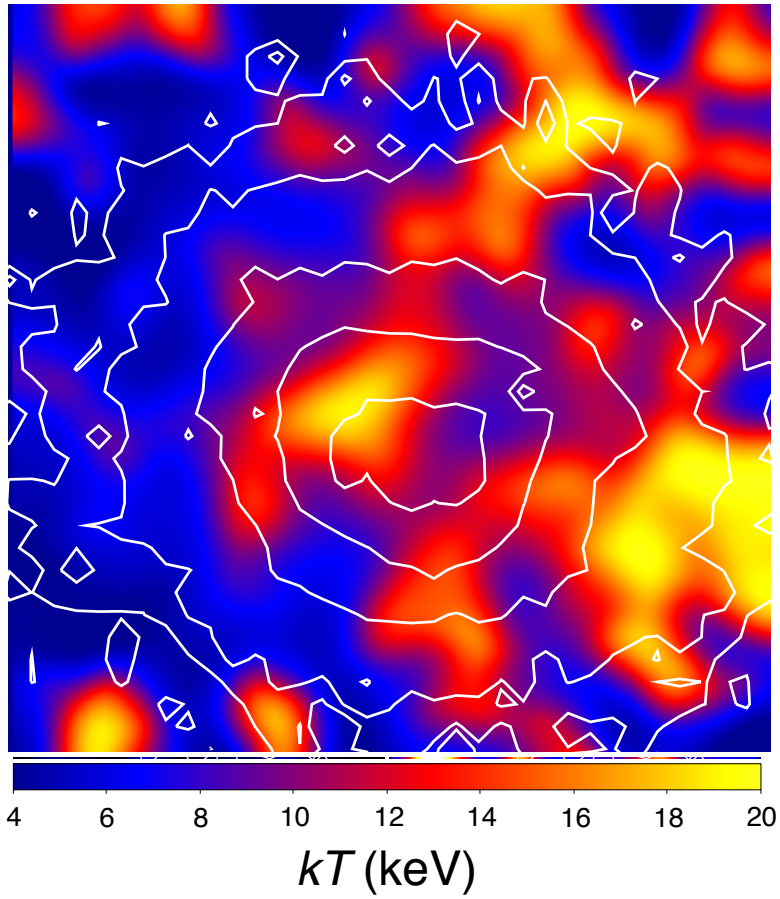

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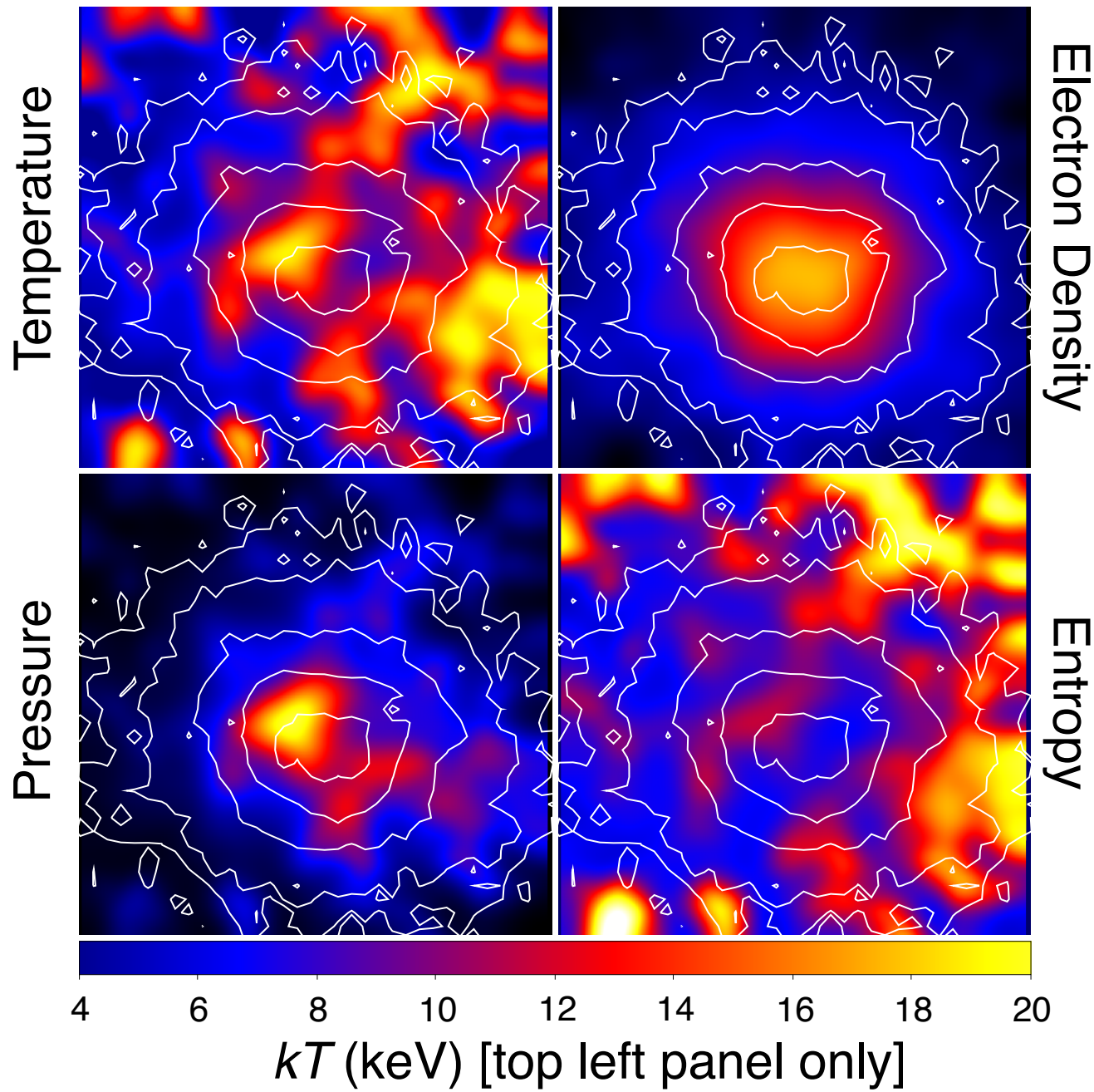

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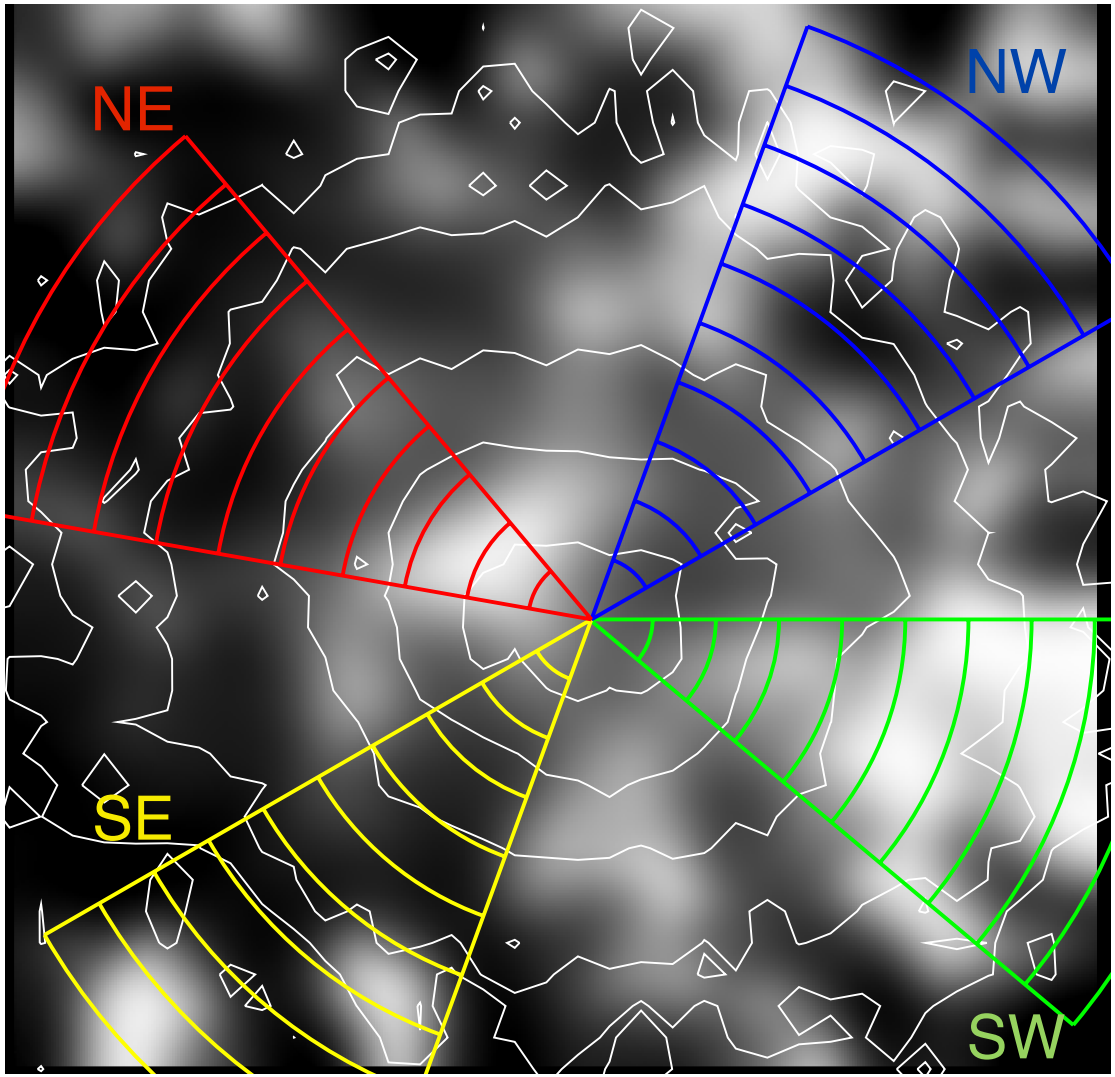
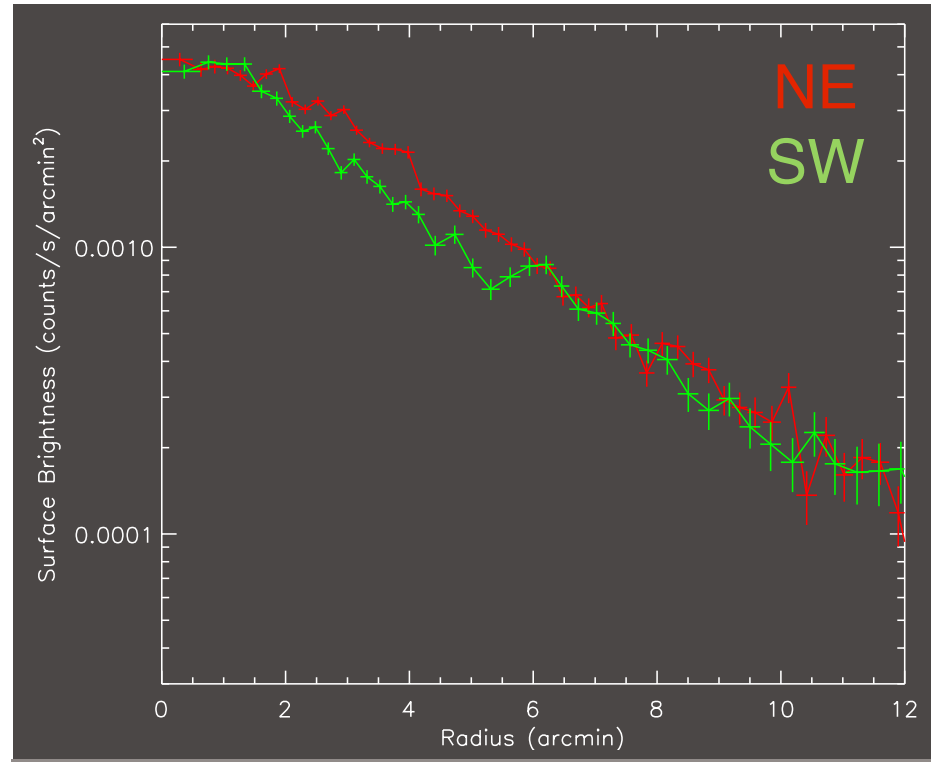
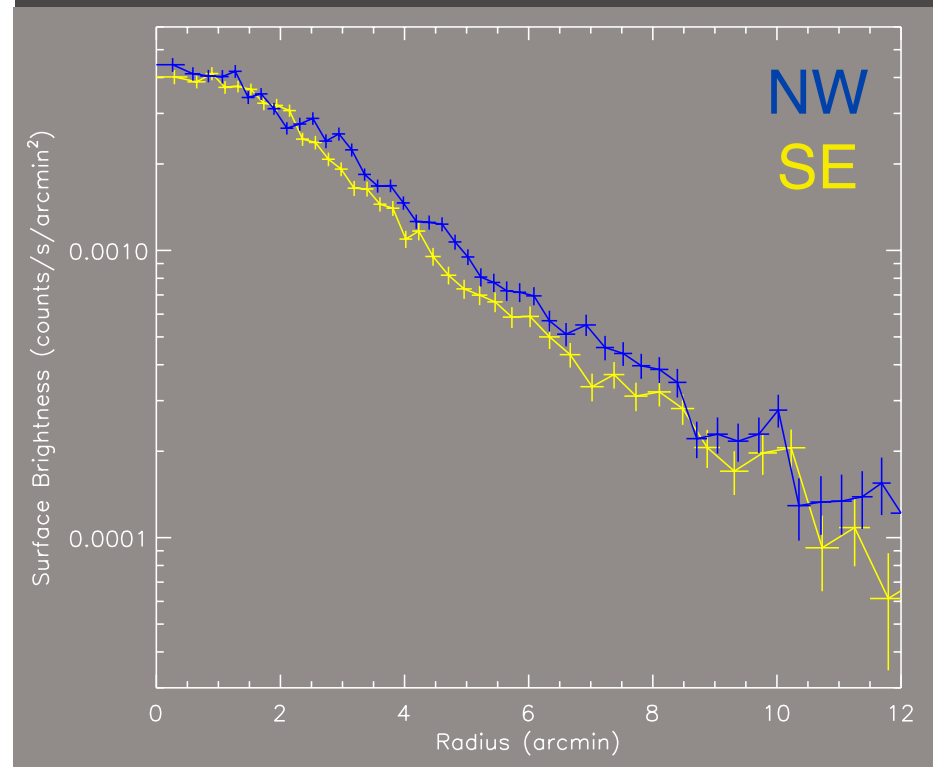
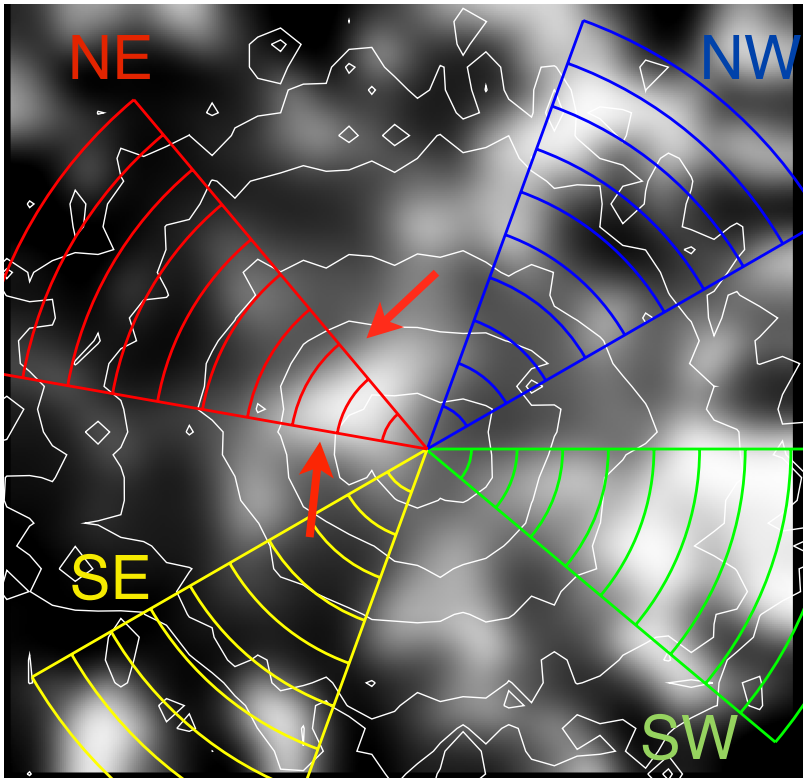


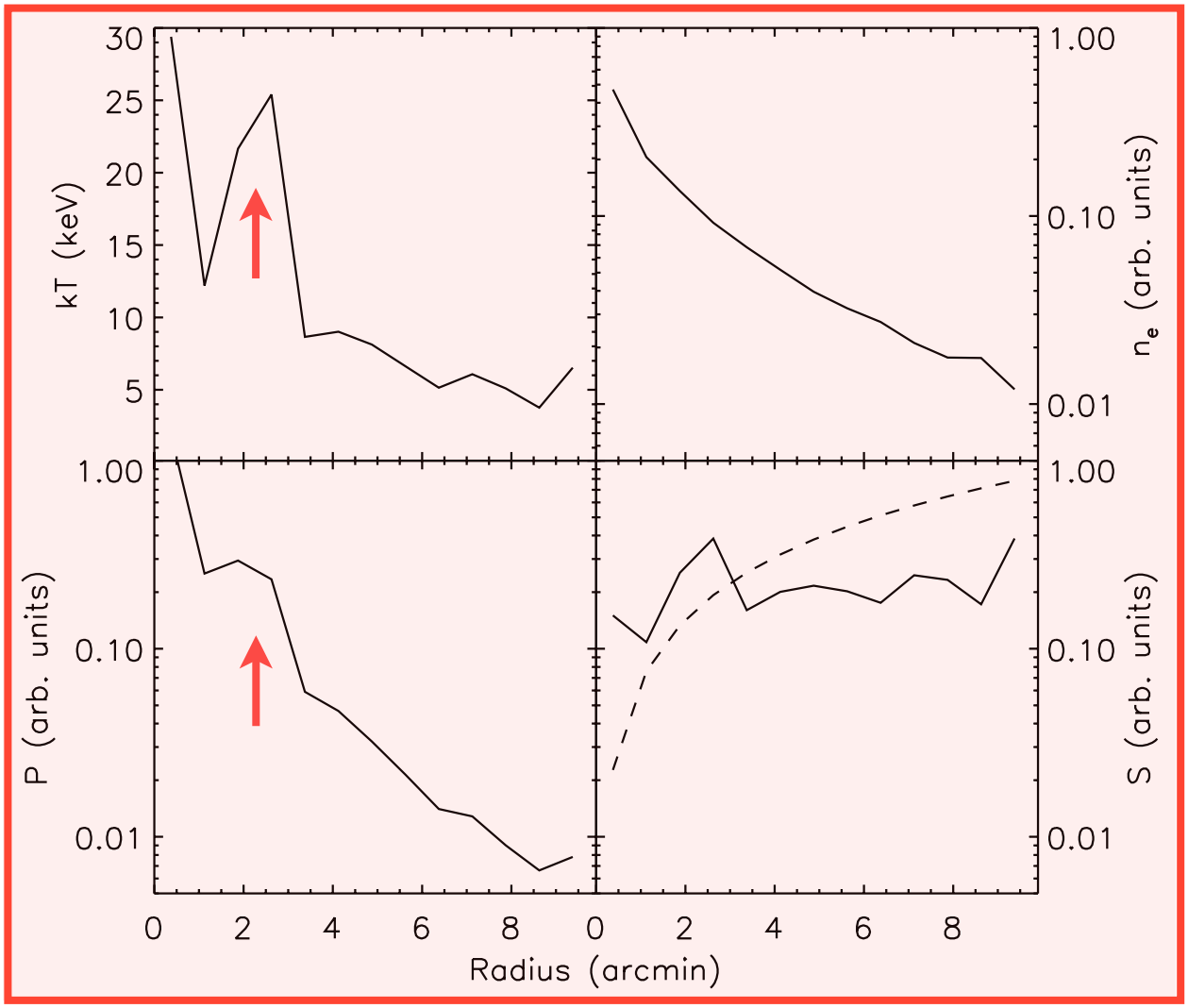




Thermodynamic Profiles

NE: Shock near center?





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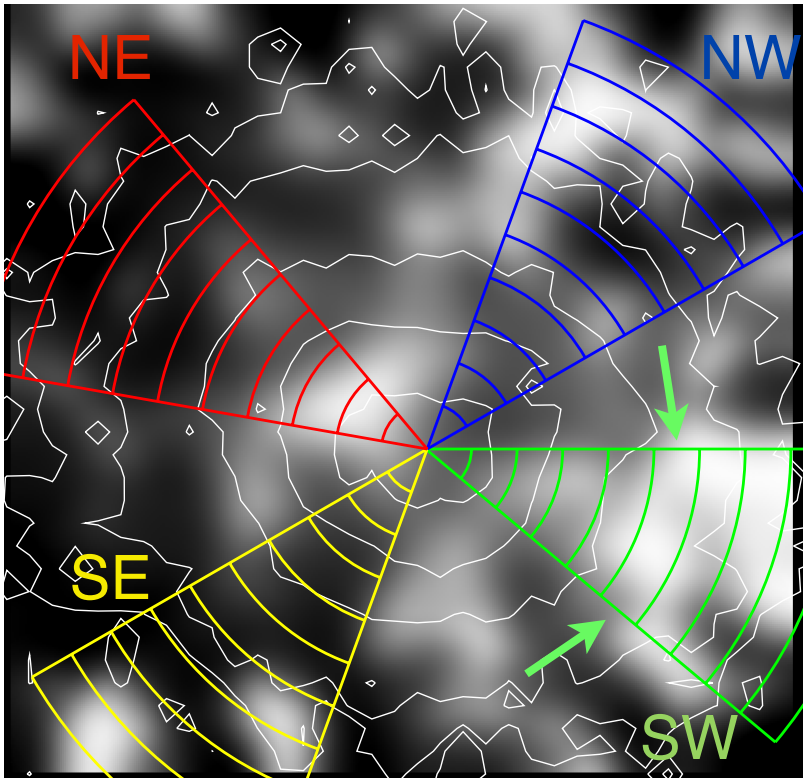
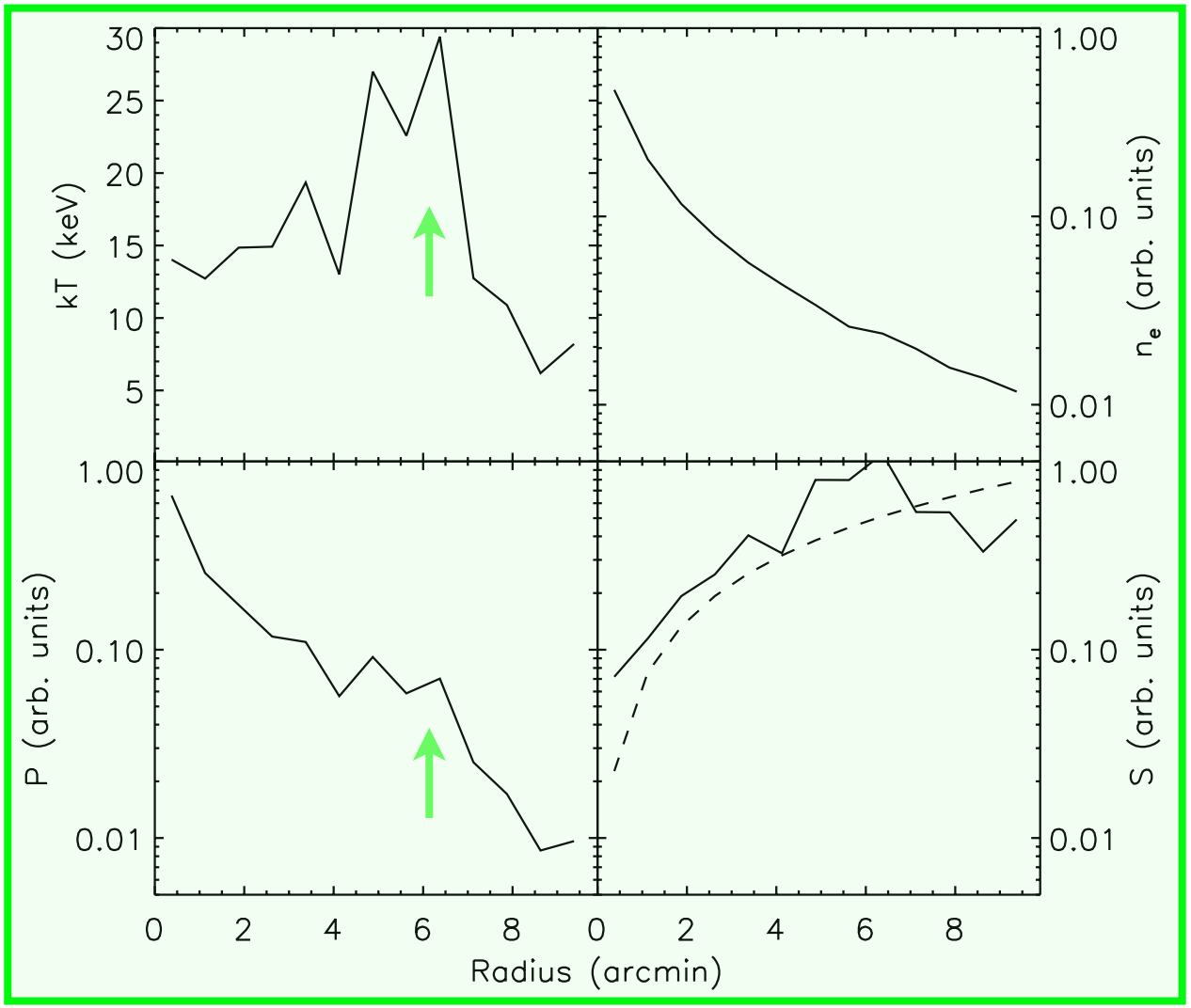
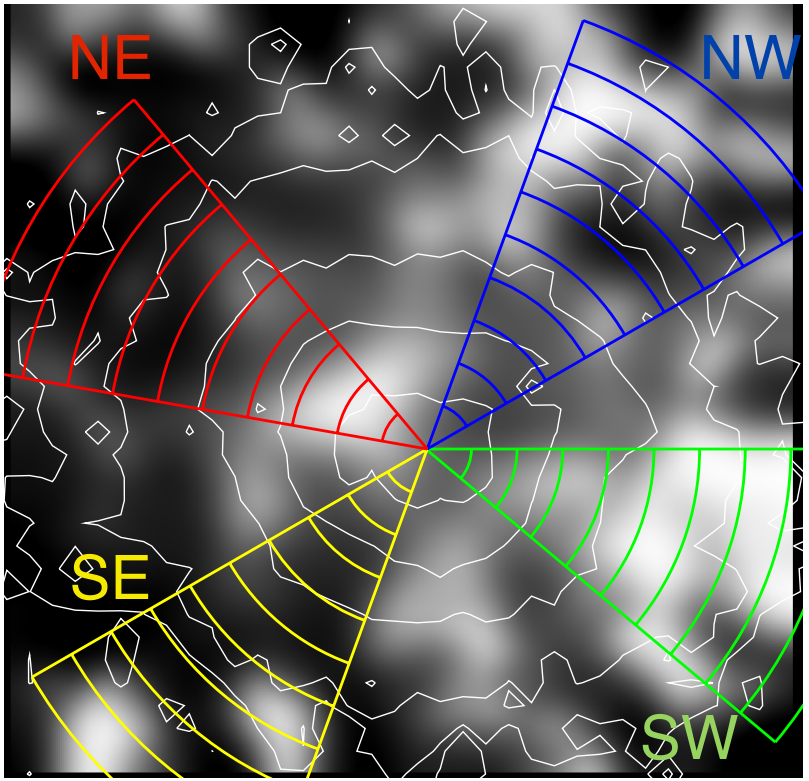


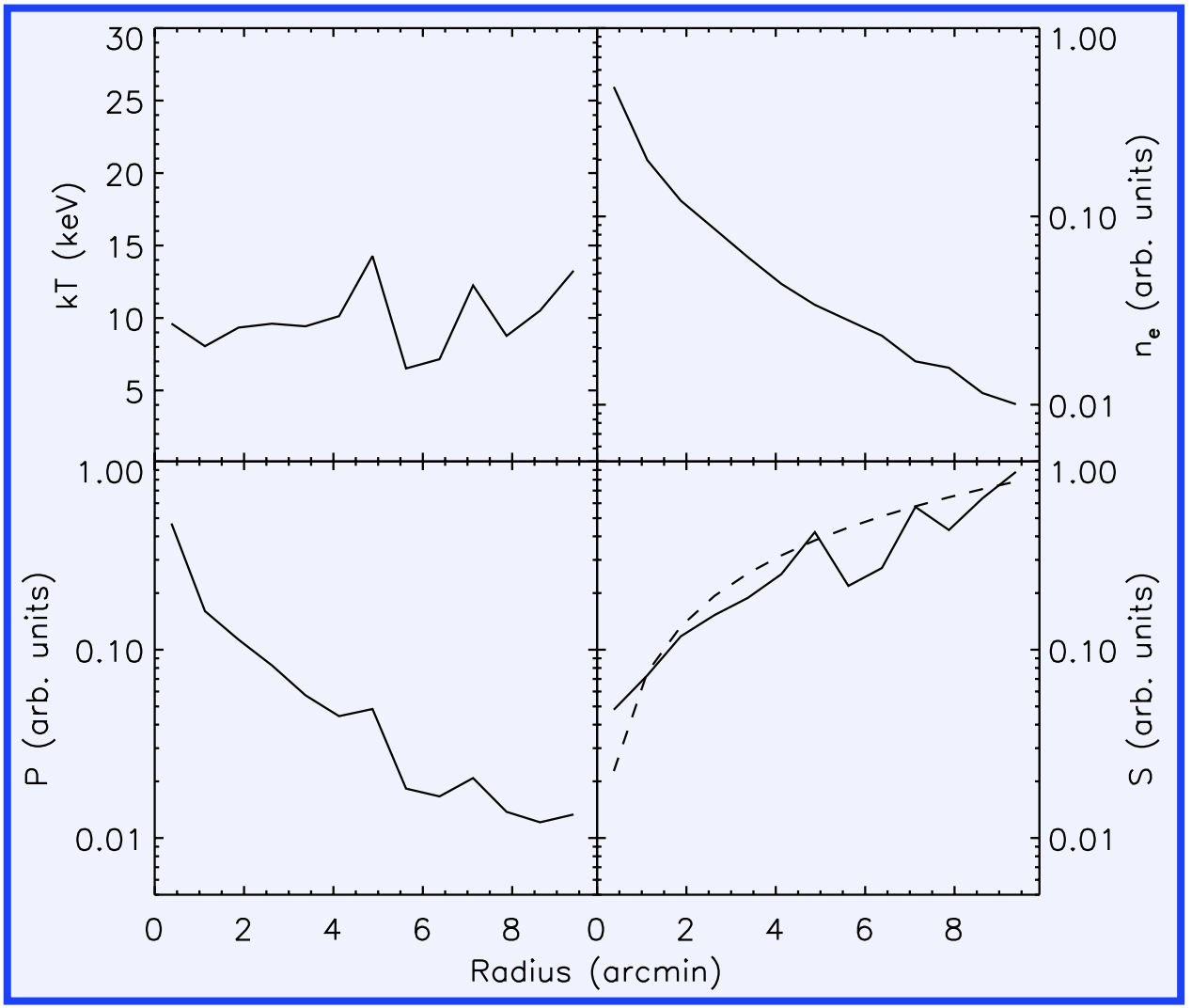
SW: Shock farther out?



Thermodynamic Profiles

NW: Normal to the Merger Axis





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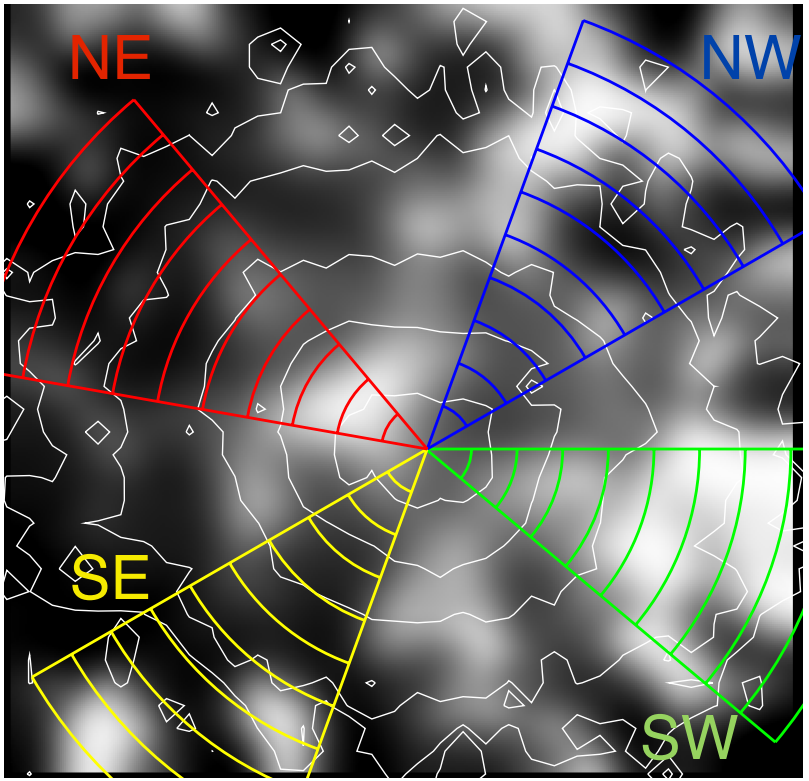
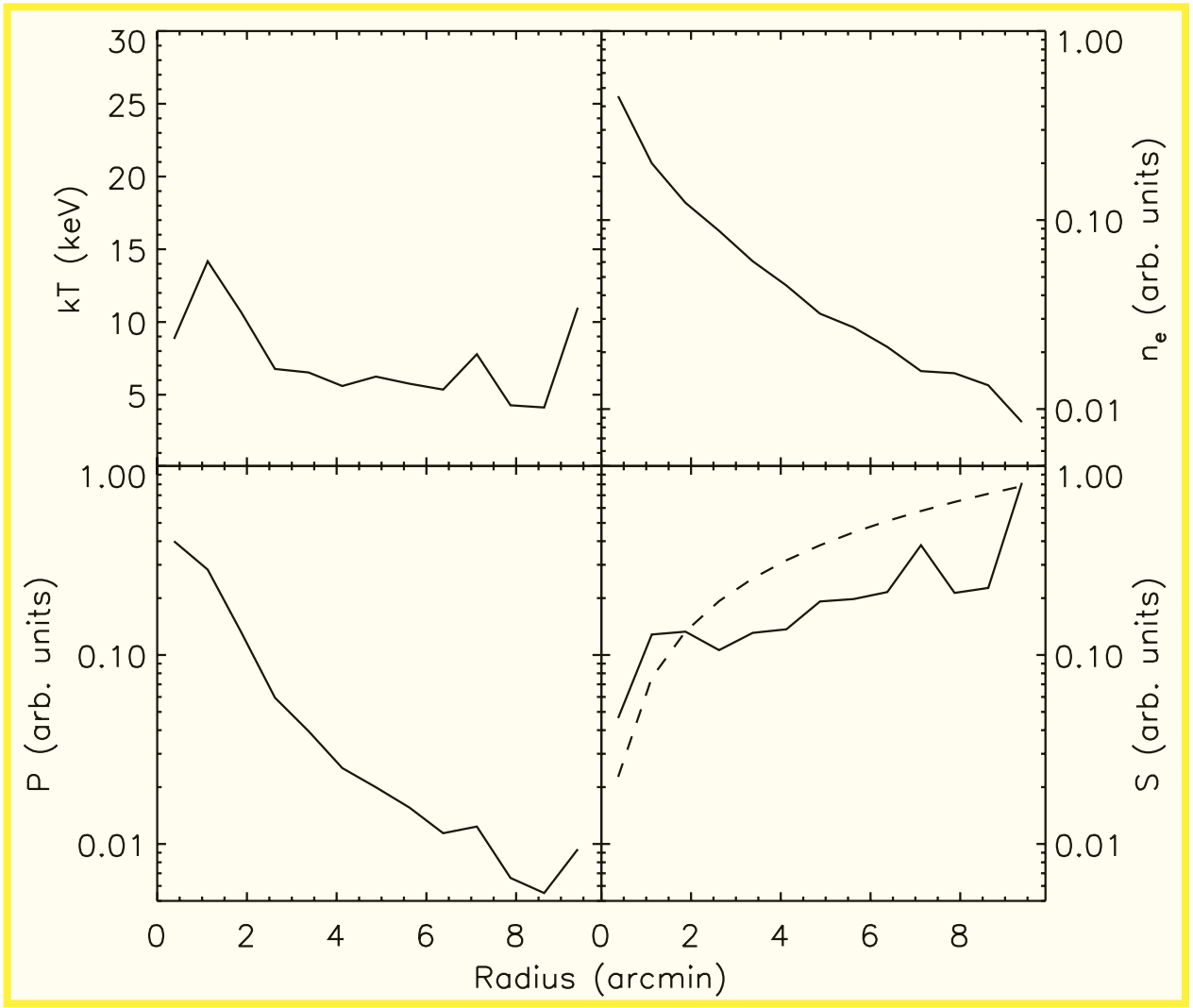


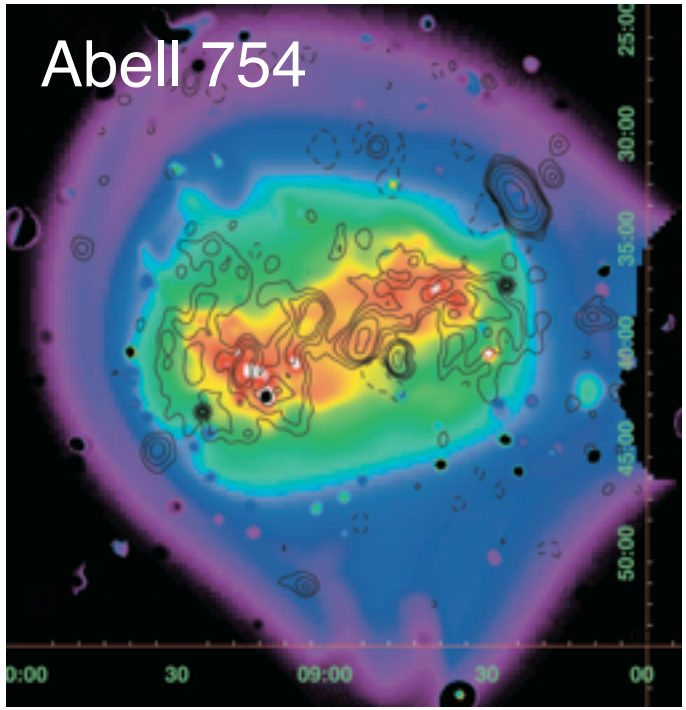
SE: Normal to the Merger Axis



Looks Like a Massive, Merging Cluster!

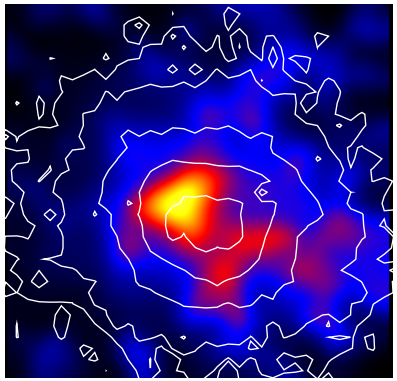
Abell 754 analog?

- Analyzed center (<R_{2500}) of a massive cluster
- Identified 2 potentially shock-heated regions along elongated axis
- Merger plane likely not aligned with sky plane (no obvious surface brightness edges)
- Galactic absorption (potentially varying across FOV???) and uncertainty of soft proton background complicates drawing detailed conclusions
- Discovery paper nearly submitted (Barrière et al.)



Henry, Finoguenov, & Briel 2004

Pseudo pressure maps



Similar mass, redshift, dynamics?