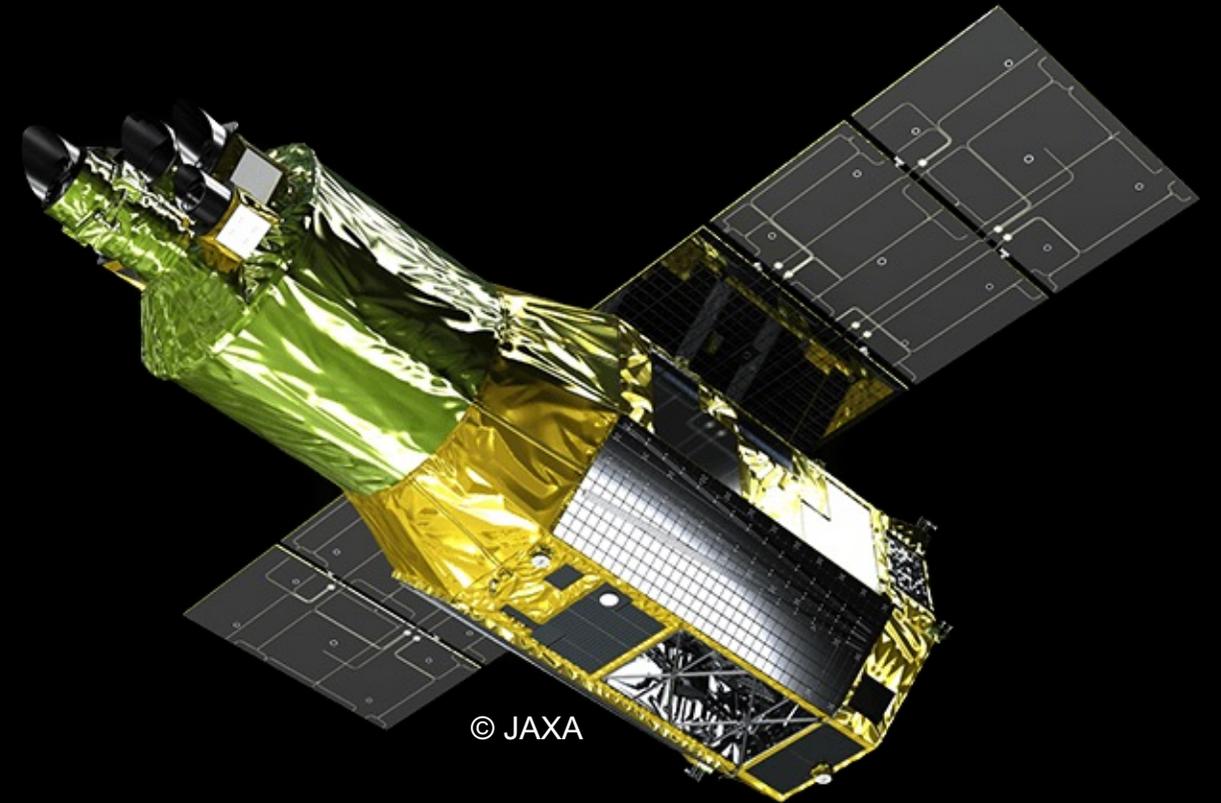


# Galaxy cluster cosmology with *X*Ri*SM* X-Ray Imaging and Spectroscopy Mission



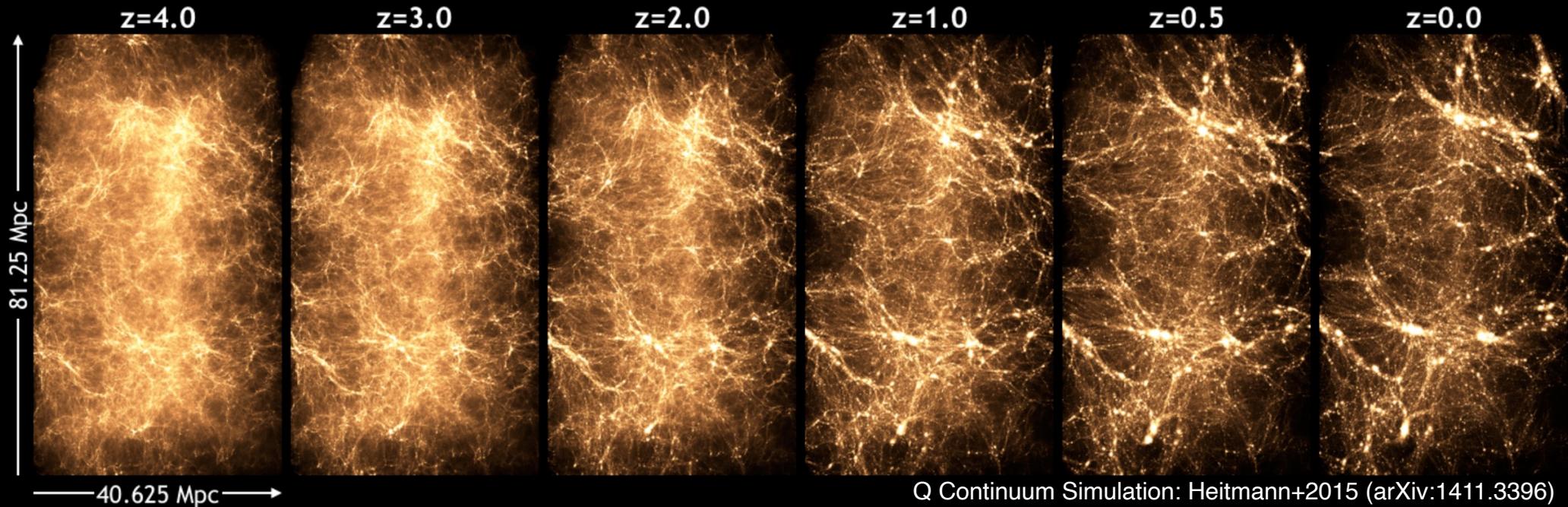
Eric Miller



MIT KAVLI  
INSTITUTE

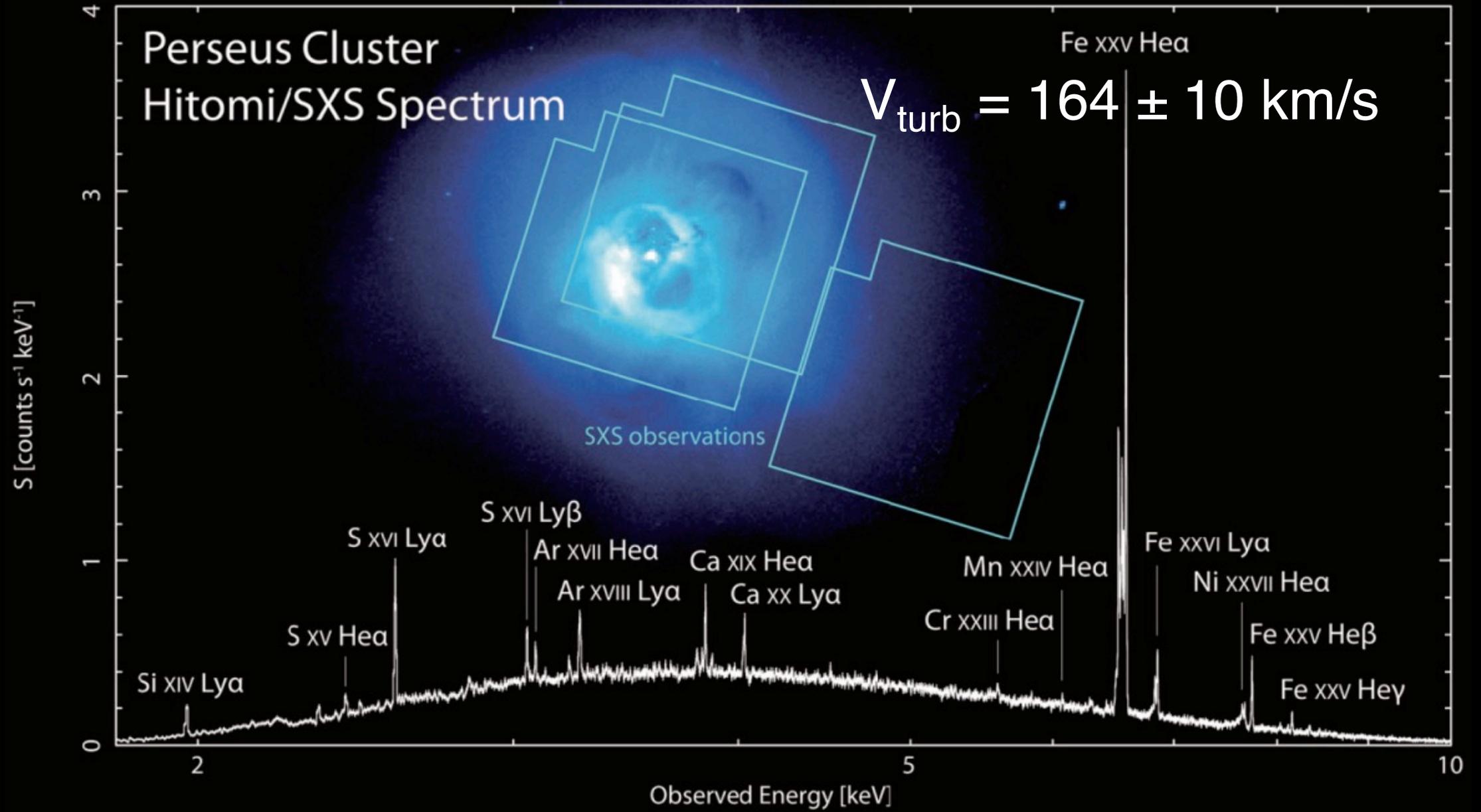
© JAXA

# Galaxy clusters are probes of cosmology.

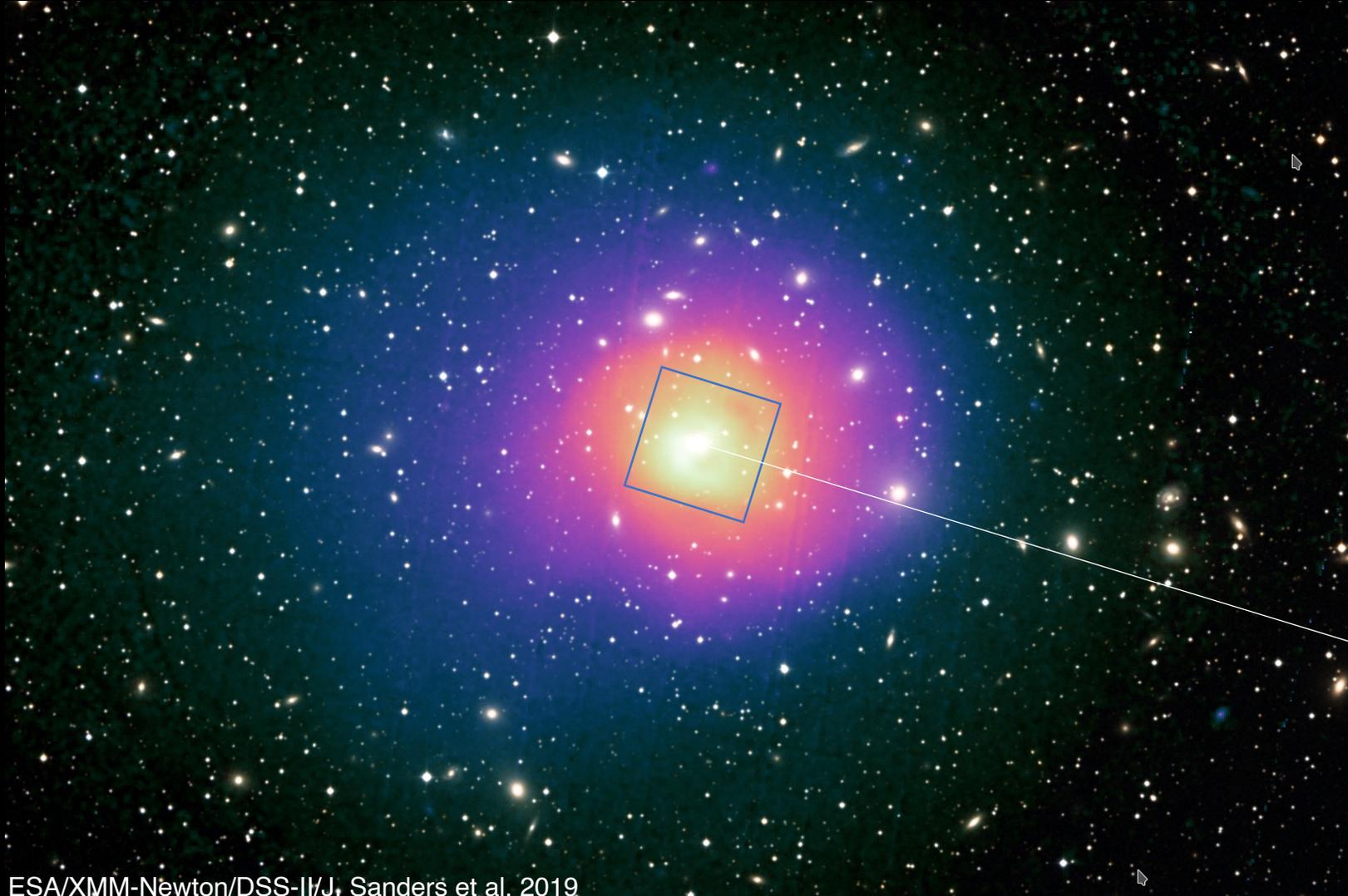


- Conditions in the early Universe determine cluster masses.
- Measuring masses is efficient with X-rays, *but* assumes all pressure support is gravitational heating.
- Non-thermal pressure from turbulence can bias this. How important is it?

# Perseus Cluster core is “quiescent”!

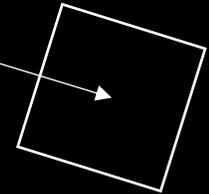


# Measuring $V_{\text{turb}}$ beyond the core is key.

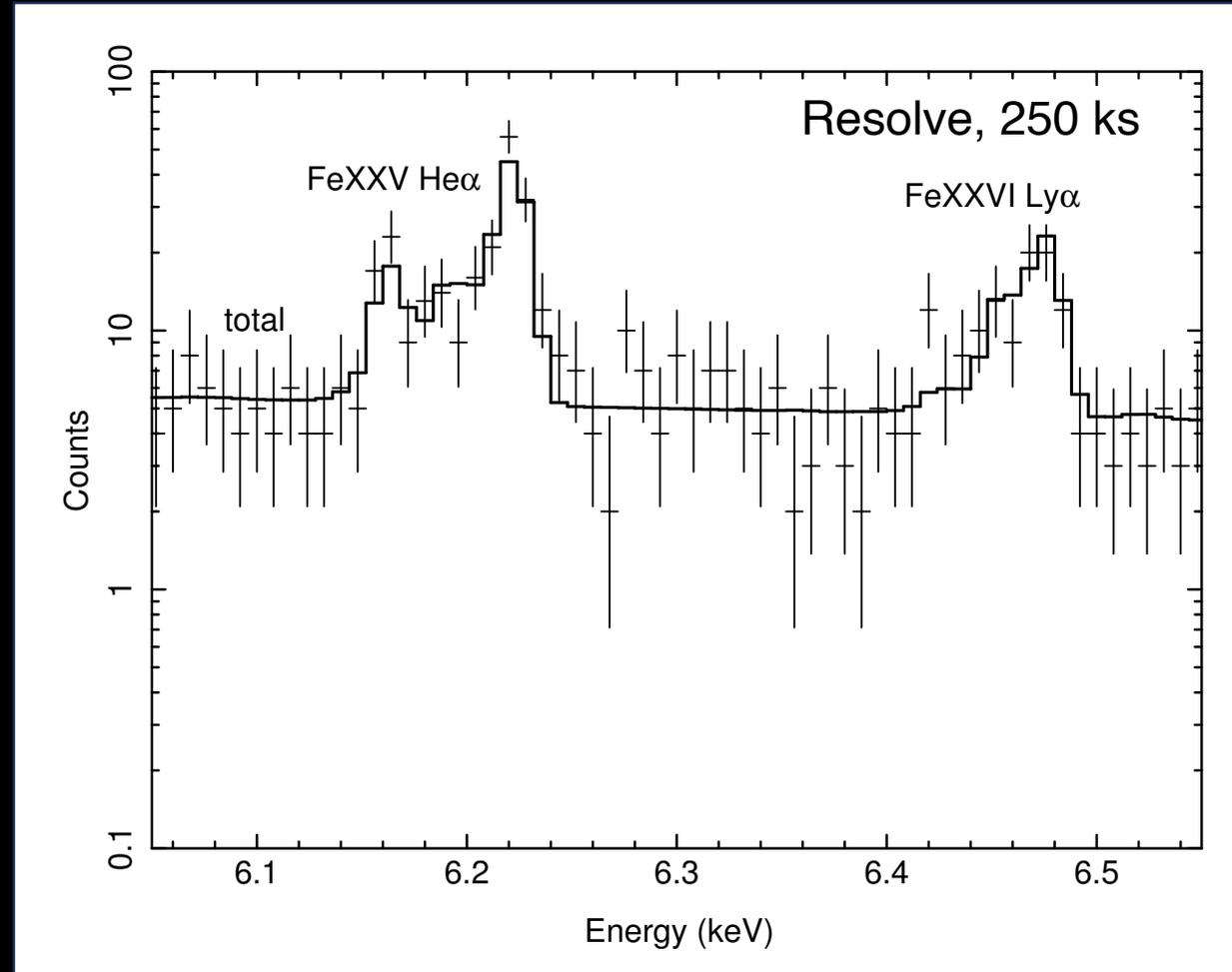
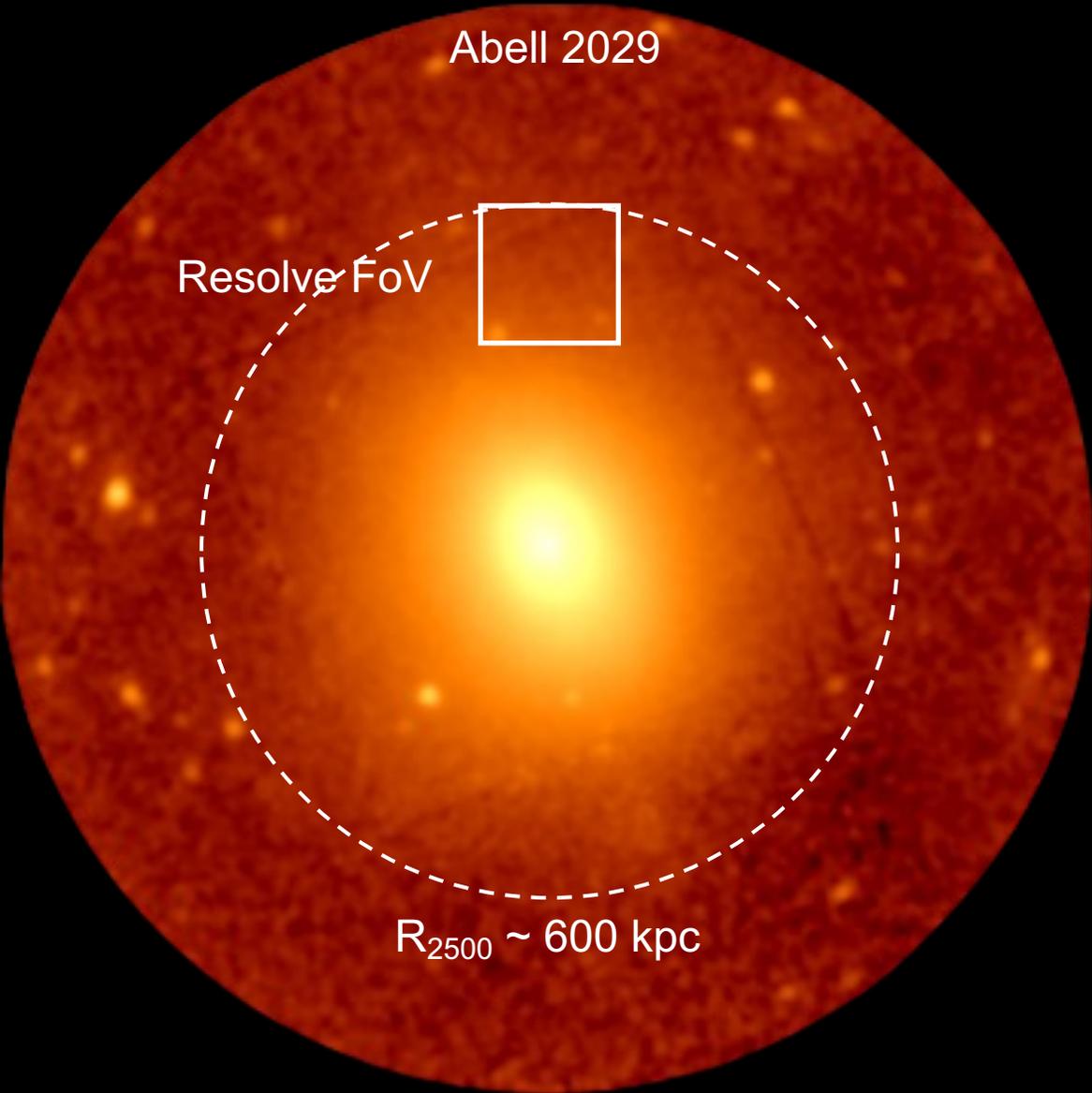


- Expect 5–20% non-thermal pressure at  $R_{2500}$ .  
→  $V_{\text{turb}} > 250 \text{ km/s}$
- *Goal:* Measure turbulent ICM velocity in a relaxed cluster away from the core.

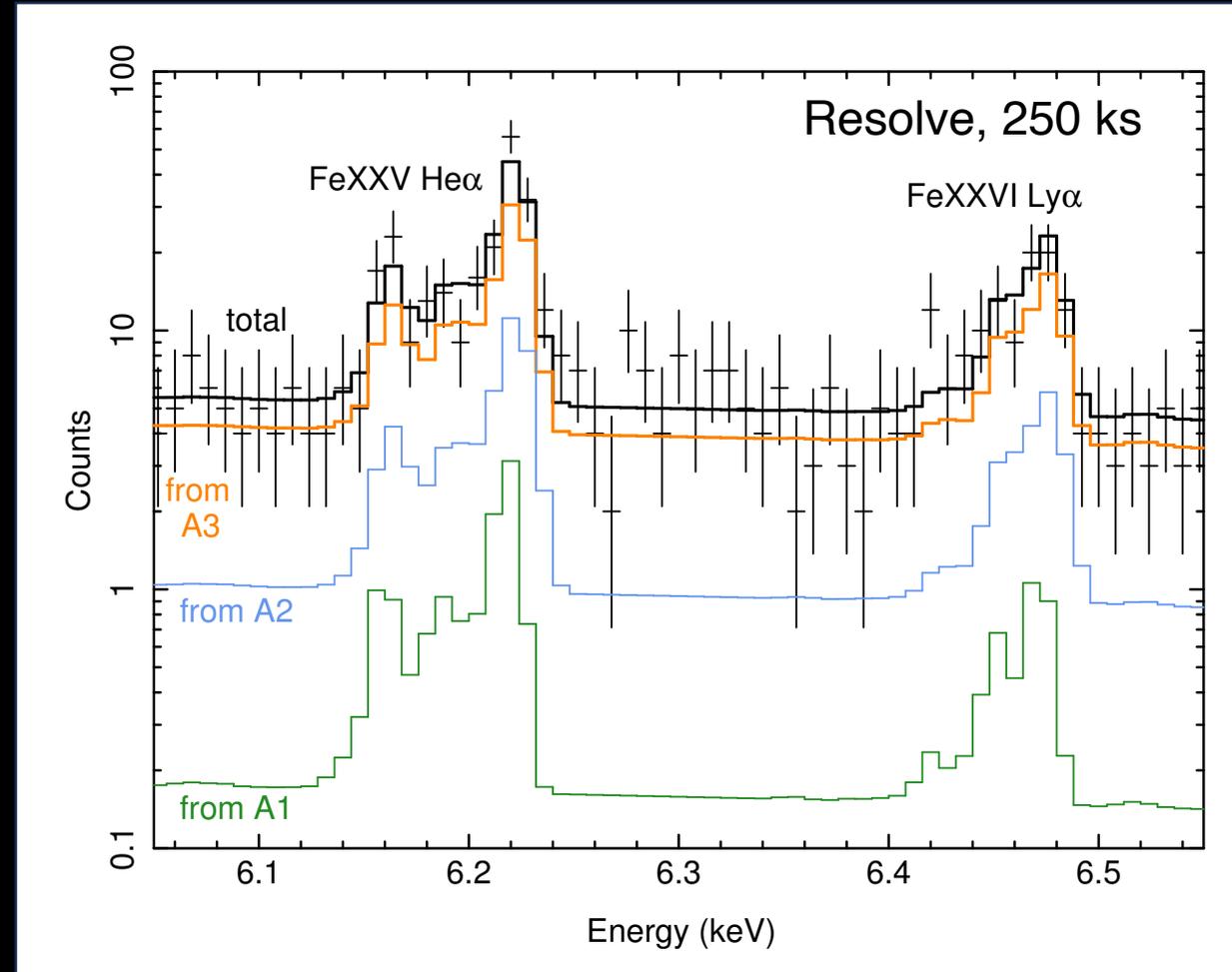
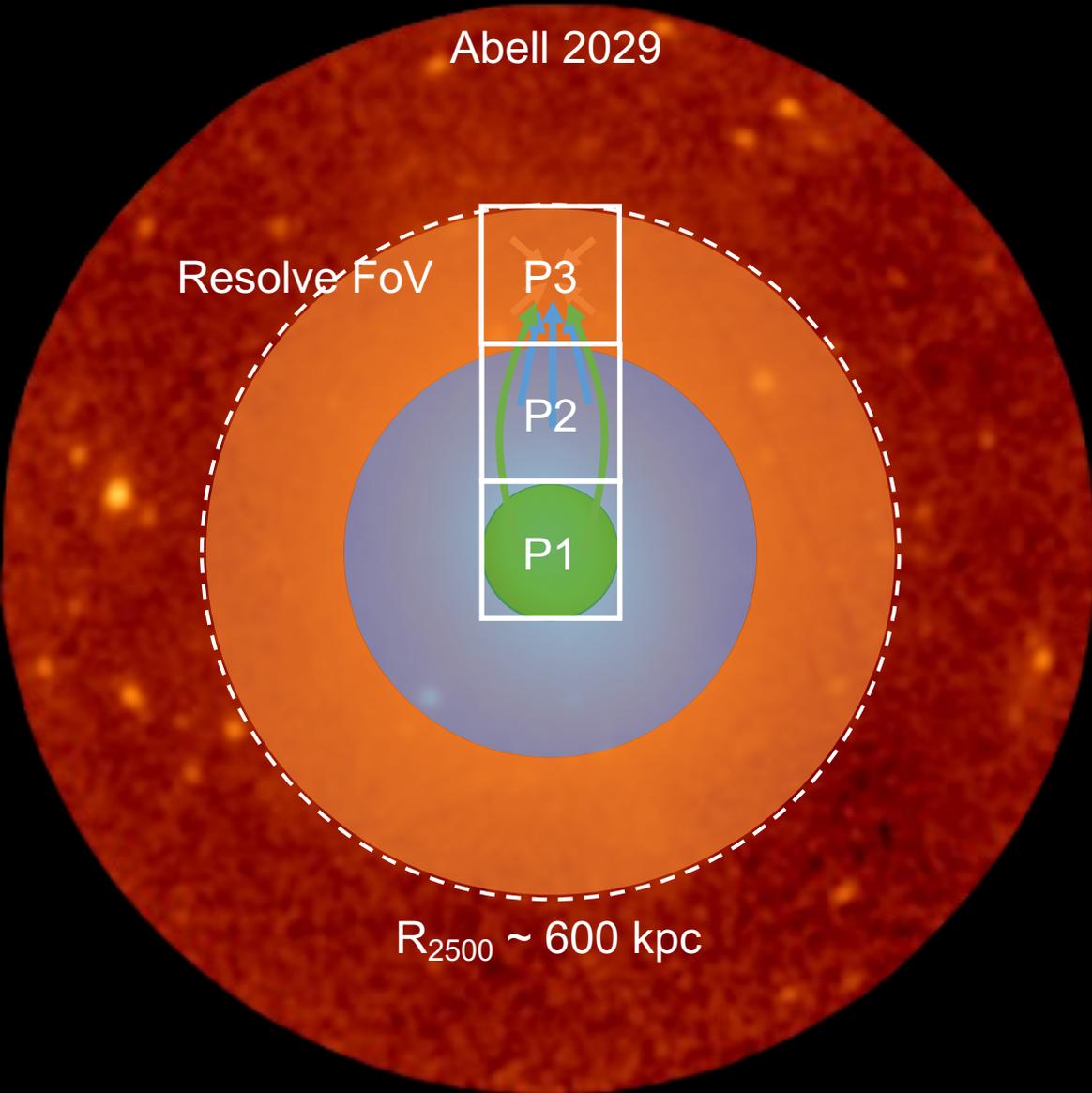
$R_{2500} \sim 600 \text{ kpc}$



# XRISM will measure turbulence beyond the core.



# Spectral-spatial mixing problem is solvable.



We can measure  $V_{\text{turb}}$  to  $\pm 50$  km/s.

# Come see my poster and talk about XRISM!

# XRISM

X-Ray Imaging and Spectroscopy Mission

Take the elevator to the 5<sup>th</sup> floor and turn right.

