

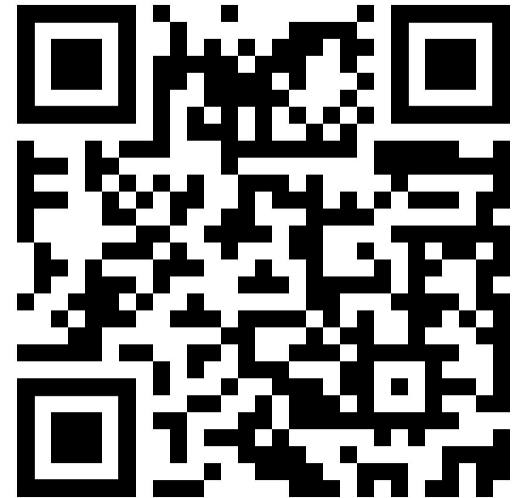
# Average energy of the X-ray spectrum as a model-independent proxy for the mass of galaxy clusters

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# Reason: need for a mass proxy for wide area X-ray surveys

We suggest yet another indicator  
of temperature and mass -  
**average energy**  
of observed X-ray spectrum:

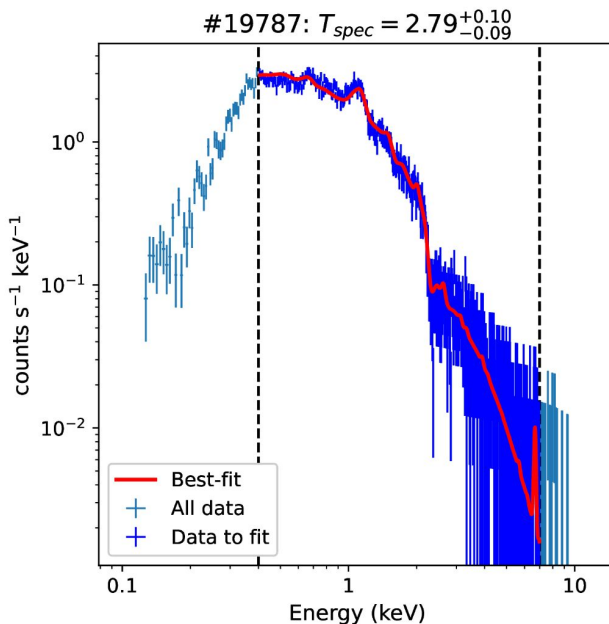
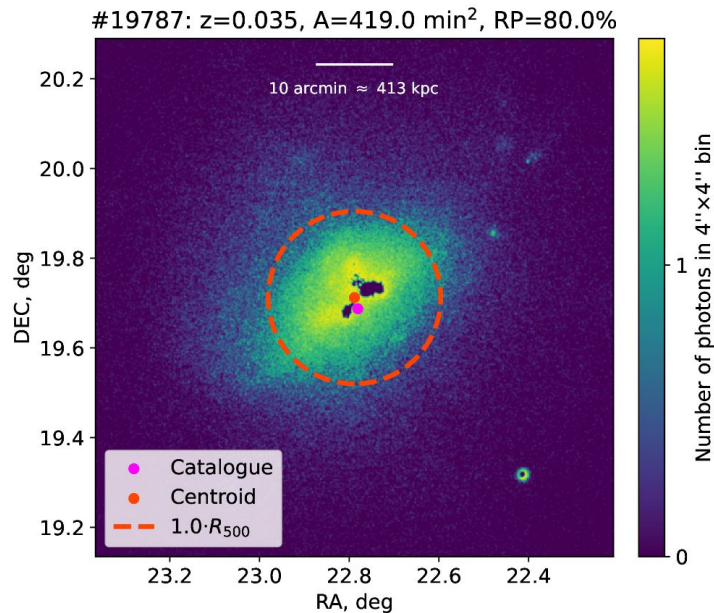
$$E_{\text{av}} = \frac{\sum E_i s_i}{\sum s_i}$$

(idea: Vikhlinin 2006)

To calibrate it, we

(1) use realistic mock clusters from  
**Magneticum** simulations: 84 clusters  
with  $M_{500} > 10^{14} M_{\text{sun}} h^{-1}$  and  $z < 0.2$

(2) mimic **SRG/eROSITA** observations and  
derive cluster temperature, luminosity  
and average energy



Example of cluster's filtered image  
and corresponding spectrum

# RESULTS:

- Database of cluster images and spectra
- Single-T approximation is acceptable
- Temperature as a function of  $E_{av}$ :

$$T_{500} = (1.35 \pm 0.04) \text{ keV} \left( \frac{E_{av}}{1 \text{ keV}} \right)^{6.8 \pm 0.3}$$

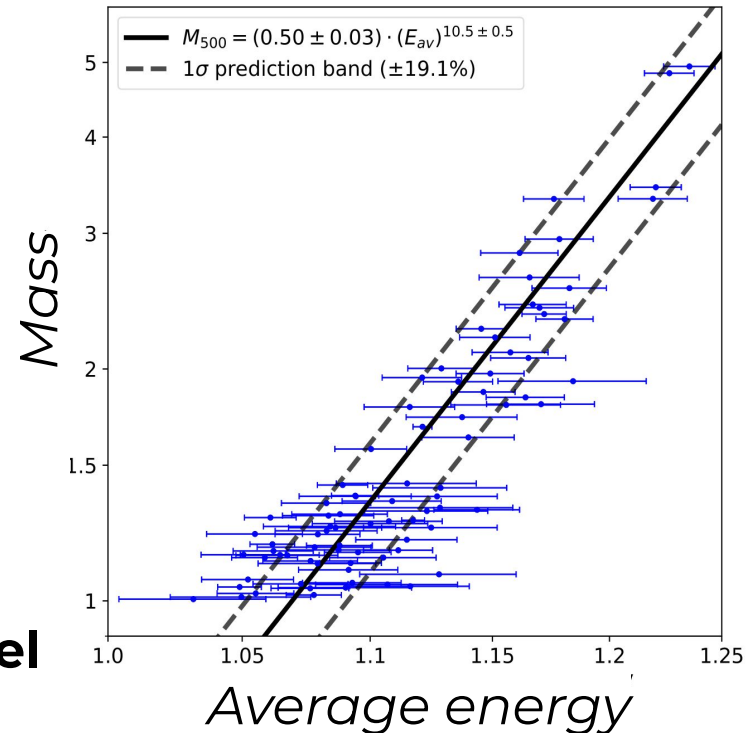
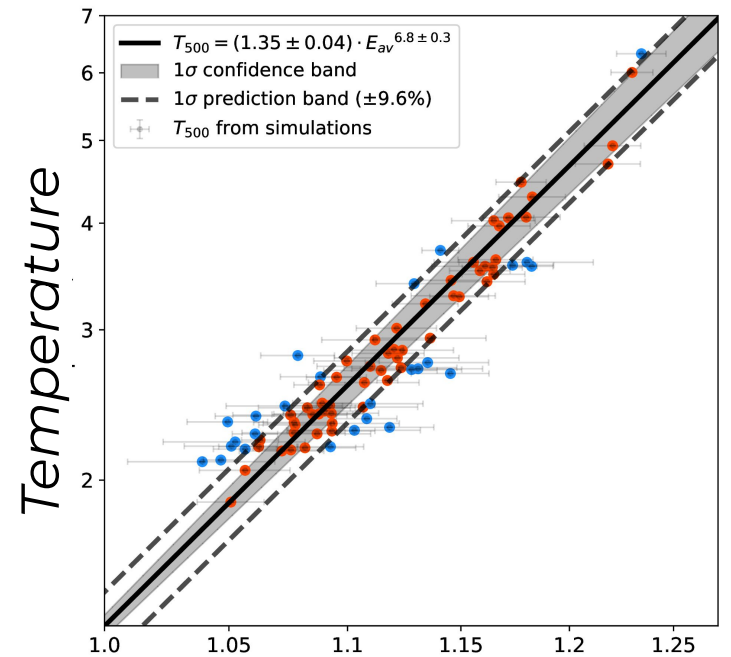
with  $\sim 10\%$  scatter (incl. background)

- Mass as a function of  $E_{av}$ :

$$M_{500} = (0.50 \pm 0.03) \cdot 10^{14} M_{\odot} h^{-1} \left( \frac{E_{av}}{1 \text{ keV}} \right)^{10.5 \pm 0.5}$$

with  $\sim 20\%$  scatter (comparable to scatter of  $T$ - $M$  and  $L$ - $M$  relations)

- No need in assumptions about the model



Database: [github.com/pi4imu/RRCS\\_DB](https://github.com/pi4imu/RRCS_DB)

Preprint: [arXiv:2408.12026](https://arxiv.org/abs/2408.12026)

