Probing the Clumping of the Intracluster Medium Within and Beyond the Virial Radius of Abell 1795

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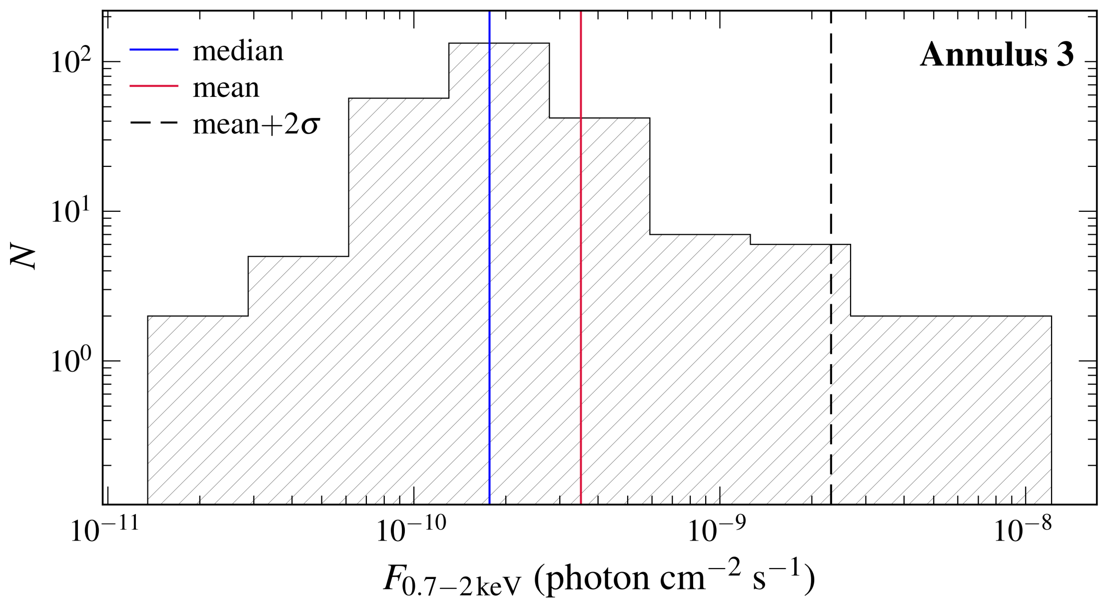
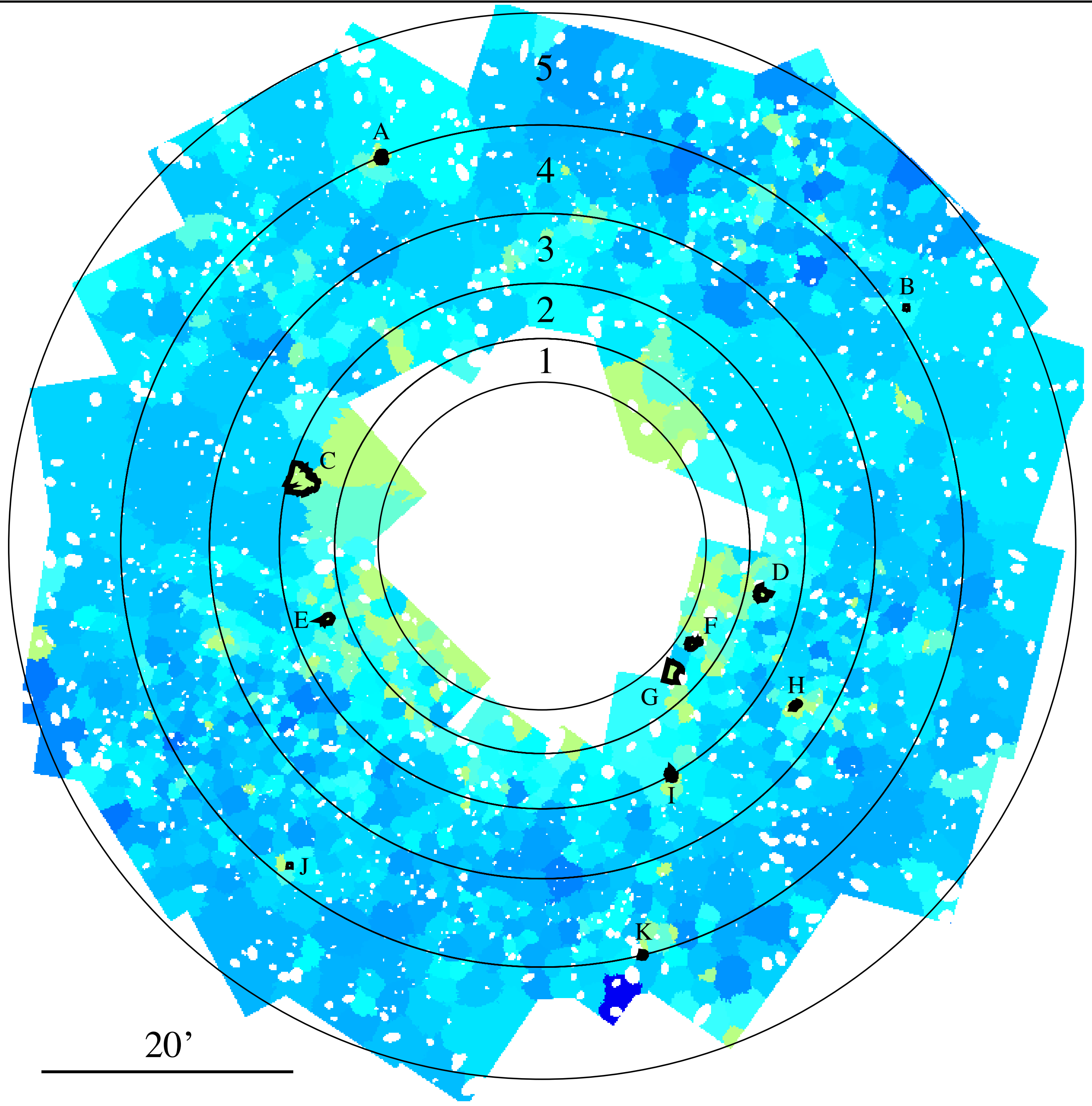
Total mass and gas mass fraction measurements of galaxy clusters are important tools for cosmology. These are commonly performed assuming a uniform distribution for the intracluster medium (ICM), which permeates galaxy clusters. Clumping of the ICM, however, can return biased measurements. Its effect is predicted to increase with the cluster radius, and becomes significant beyond the virial radius, where available X-ray measurements are sparse. *Chandra* ACIS-I observations, however, provide full azimuthal coverage within and beyond the virial radius ($26' \simeq 1.9$ Mpc) of Abell 1795. Therefore, these observations present a unique way to probe the cluster outskirts. In this work, we explore the diffuse X-ray emission of Abell 1795 with particular attention to the outskirts and to the role of gas inhomogeneities.

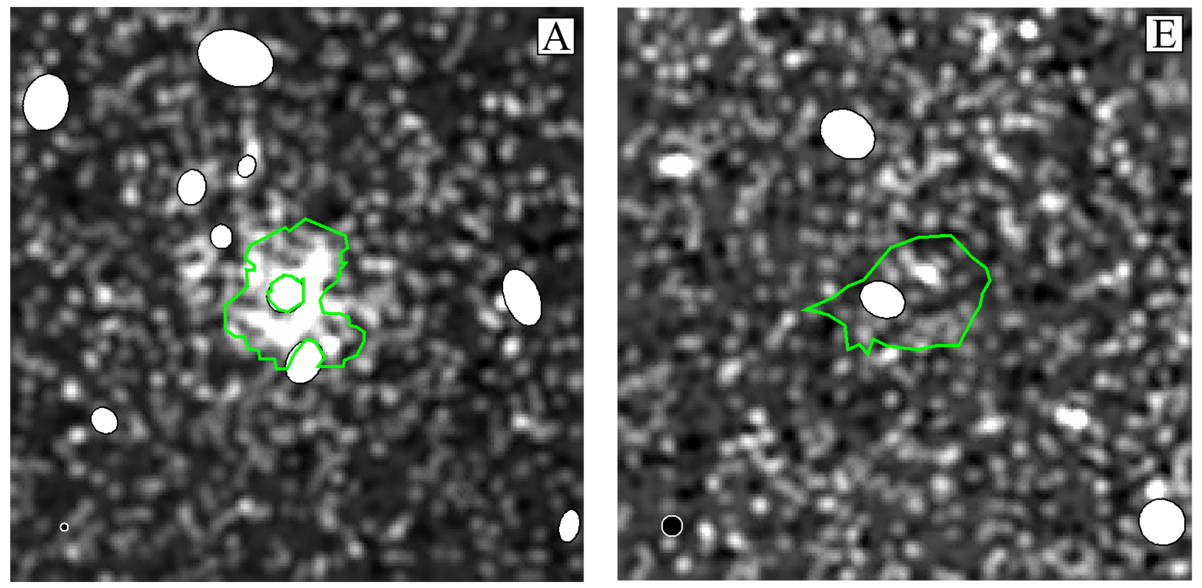
Method: The flux distribution of the ICM measured in an annulus reveals the possible clumpiness of the gas (Zhuravleva et al., 2013). In the presence of ICM inhomogeneities, the mean of the distribution shifts to high fluxes, thus, forming a 'high−flux tail'.



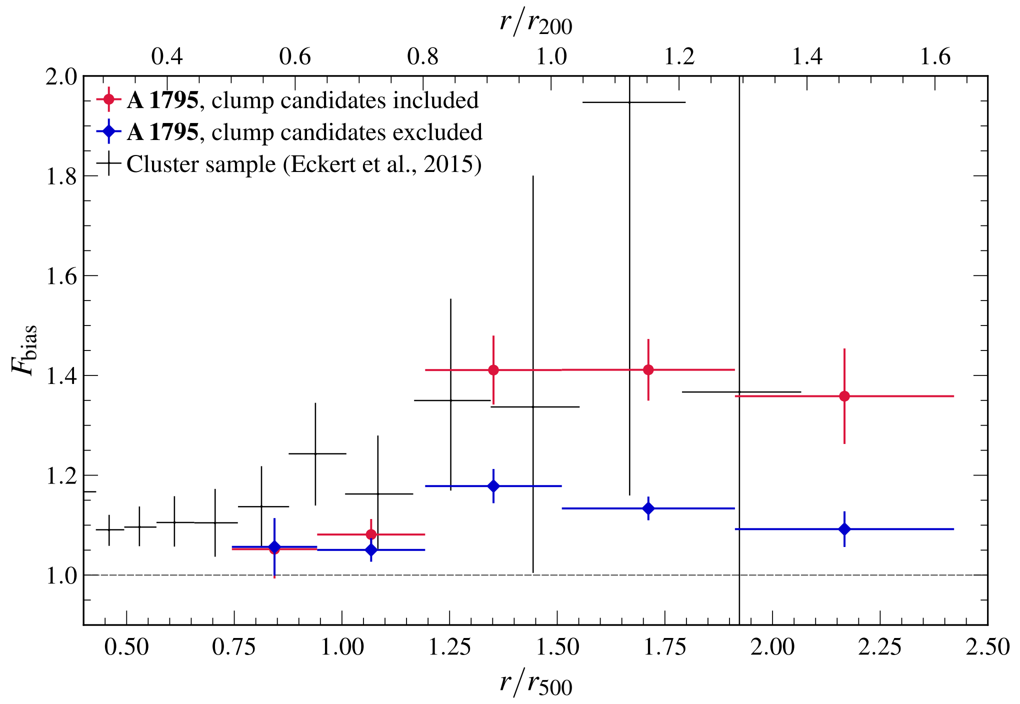
Results: Localizing 2σ outliers on the flux image *(top right)* of Abell 1795 outskirts returns 11 clump candidates (denoted with letters *A−K*). The cluster core and point sources are masked, thus, this adaptively binned image portrays the flux structure of the ICM.

Verifying the origin of clump candidates was carried out by measuring X-ray hardness ratios and by searching for optical counterparts. **This revealed that none of the candidates are genuine clumps.** For example, we show that candidate *A* and *E* are a background galaxy cluster and a massive member galaxy of Abell 1795, respectively *(bottom right figure)*.

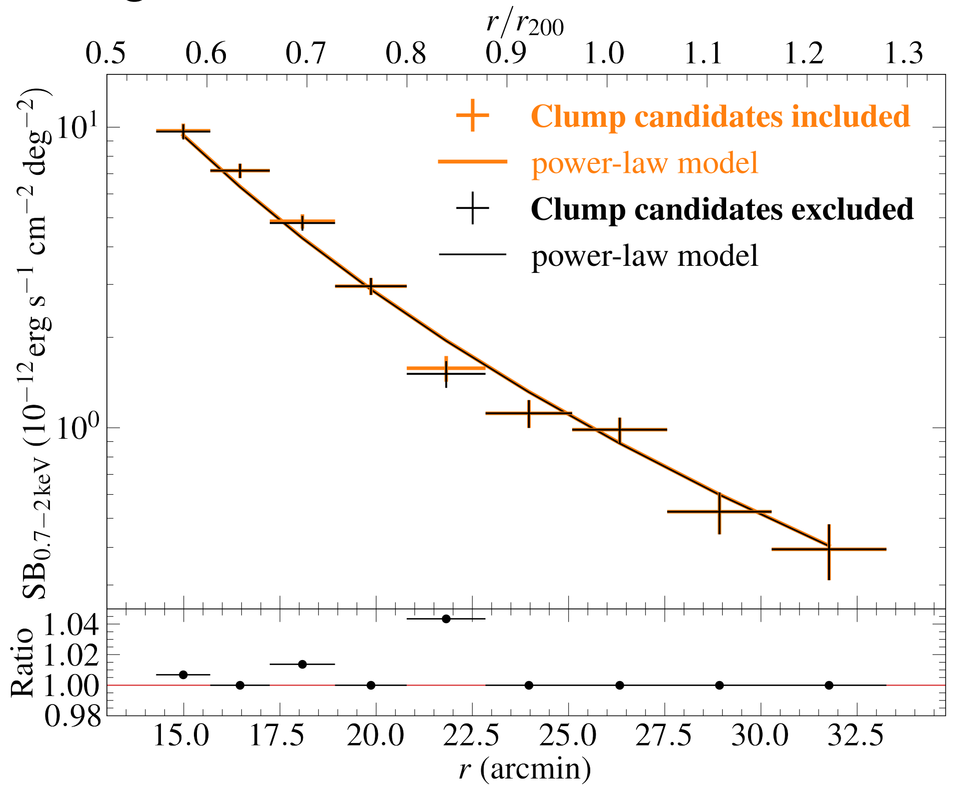




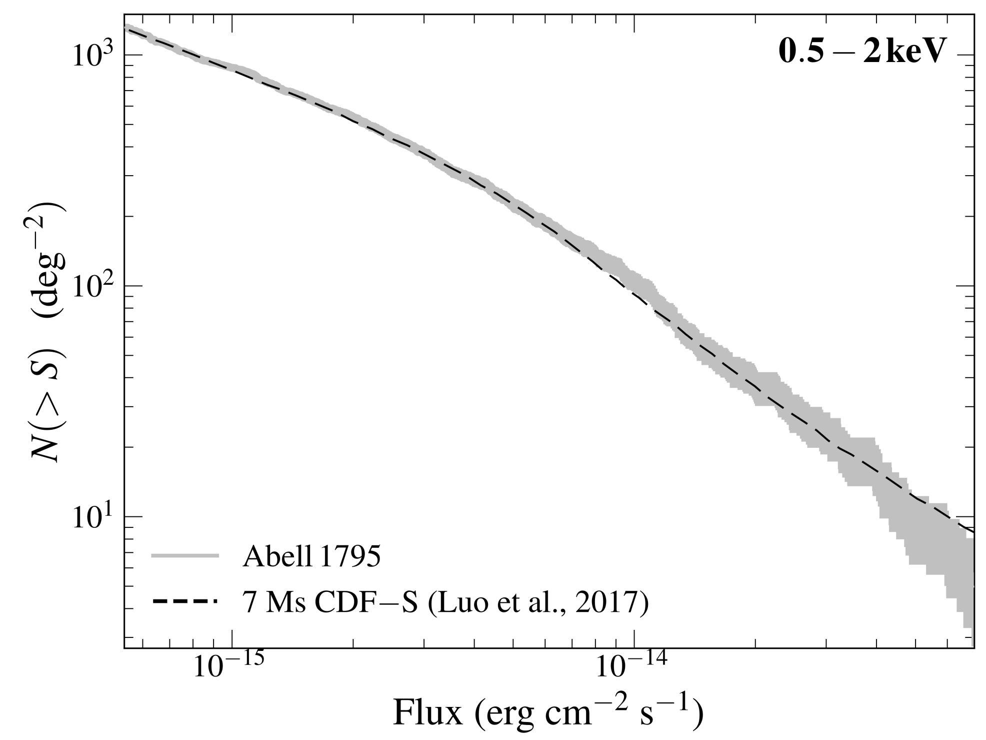
Flux bias due to unresolved inhomogeneities: The $F_{bias} = F_{mean}/F_{median}$ flux bias assesses the effect of clump candidates on the measured flux profile. Here, we compare the results for Abell 1795 with the average measurements of Eckert et al. (2015) for a sample of 31 *ROSAT/PSPC* observed galaxy clusters. A perfectly uniform ICM is characterized by $F_{bias} = 1$. Note that $F_{bias} > 1$ even for the data where the 11 clump candidates are removed, implying the presence of a moderate amount of unresolved clumping in Abell 1795.



The identified ICM inhomogeneities have no significant effect on the measured **surface brightness profile** of the cluster outskirts: the ratio between the profiles with and without ICM inhomogeneities is ~1.



Any variations in the **log*N*−log*S* plot** built for the sources in the cluster field compared to the sources of *Chandra Deep Field South* (Luo et al., 2017) can be attributed to cosmic variance, while clumping causes no detectable excess.



References: Zhuravleva I., Churazov E., Kravtsov A., Lau E. T., Nagai D., Sunyaev R., 2013, MNRAS, 428, 3274; Eckert D., Roncarelli M., Ettori S., Molendi S., Vazza F., Gastaldello F., Rossetti M., 2015, MNRAS, 447, 2198; Luo B., Brandt W. N., Xue Y. Q., Lehmer B., Alexander D. M., Bauer F. E., Vito F., et al., 2017, ApJS, 228, 2