Contribution ID: **166** Type: **Astrofisica relativistica e particellare**

Study of the dynamical state of galaxy clusters from observations in X-band via Zernike polynomials

Monday 3 June 2024 18:00 (5 minutes)

Galaxy clusters abundance as a function of mass and redshift is a powerful tool to constrain cosmological parameters, such as Ωm and σ8. However, their mass can be estimated for instance under the assumption that the gas filling the volume of the cluster, i.e. the Intra-Cluster Medium, is in hydrostatic equilibrium with the total matter content of the cluster, which consists mainly of dark matter. For this reason, the determination of the cluster dynamical state becomes fundamental for any study envisaging to use clusters as cosmological probes. It has been shown that the morphology of the gas is directly related to the dynamical status of the gas. In this context, the decomposition in Zernike polynomials has been shown to be a good proxy for the dynamical state of clusters in the Sunyaev–Zel'dovich millimetric observations. In this work we calibrate this approach on mock X-ray maps from THE THREE HUNDRED simulations. These maps are decomposed via Zernike polynomials in order to include all their morphological information in the expansion coefficients that are, for convenience, rearranged in a single
parameter C. By comparing C with the dynamical state parameter χ we find a non negligible linear correlation. We then apply this relation to real XMM-Newton X-ray observed maps to determine their dynamical state and compare to other morphological indicators that probes only small or large scales from literature.

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Astrofisica relativistica e particellare

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Session Classification: Astrofisica Relativistica e Particellare