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# Morphological analysis of SZ and X-ray maps of galaxy clusters with Zernike polynomials

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The study of the morphology of multiwavelength maps of galaxy clusters is largely used to evaluate, as possible, their dynamical state. We report about a new method of morphological analysis which consists in analytically modeling the maps with Zernike polynomials (ZPs), a complete basis of orthogonal functions defined on a unit circle. By using several ZPs it is possible to efficiently model the different shapes of the maps inside a circular aperture, highlighting the presence of inhomogeneities and/or small-scale structures that could be related to dynamically disturbed clusters. We have validated the method on mock high-resolution Compton maps (i.e. y-maps) for synthetic galaxy clusters in THE THREE HUNDRED catalogue. We verify that the contribution of the different ZPs in modelling the maps, quantified with a single parameter, results in a valuable tool to recognize various morphologies, and it is also correlated with a proper 3D dynamical-state indicator available for the synthetic clusters. We also show the early results of this analysis applied on real maps of clusters observed by the Planck satellite. We select a sample of low-redshift ($z < 0.1$) clusters in the Planck-SZ catalogue and model their y-maps with ZPs, inside a circular aperture of radius equal to R500. In the same way, we also analyse simulated Planck y-maps generated for the synthetic THREE HUNDRED clusters. Hence, we search for a correlation, if any, between the morphological analysis with ZPs and the proper dynamical classification of those simulated objects. The results allow us to evaluate the capability of the method to recognize different dynamical populations in the sample of real Planck-selected clusters. We also report about the preliminary results of the Zernike fitting on mock X-ray maps of the THREE HUNDRED clusters.

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