X-RAY MORPHOLOGY AND COOL CORE STATE IN GALAXY CLUSTERS

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The dominant mechanism invoked to explain the bimodality between Cool Core (CC) and Non Cool Core (NCC) objects relates the presence or absence of a CC to the recent merging history of the cluster. We tested this hypothesis on a sample of 100 local clusters observed with Chandra finding a clear correlation between an indicator of the thermodynamical CC state (central entropy) with several morphological indicators (Center Shift, Concentration Parameter and Cuspiness). Since these indicators can be easily measured also with poor quality data, we suggest to use them to identify relaxed CC objects for cosmological studies.

Fig. 1: The three morphological indicators plotted VS the core entropy for each one of the clusters studied. The horizontal and vertical red line represent the values chosen to discriminate respectively CC/NCC and morphologically relaxed/disturbed clusters.

For each one of the two samples (69 and 99 clusters) we performed Kendall and Spearman correlation tests to estimate quantitatively the correlation between the morphological and the thermodynamical state. The results obtained from the Spearman test are as follows (Kendall test provides consistent results):

- Concentration Parameter VS Entropy: \( \rho = -0.861 \); Probability of Null hypothesis: \( 3.4 \times 10^{-30} \)
- Centroid Shift VS Entropy: \( \rho = +0.657 \); Probability of Null hypothesis: \( 1.6 \times 10^{-13} \)
- Cuspiness VS Entropy: \( \rho = -0.868 \); Probability of Null hypothesis: \( 5.2 \times 10^{-22} \)

We found evidence of strong correlation between relaxed morphological state and Cool Core thermodynamical state. This fact supports the hypothesis that cool cores are found in morphologically relaxed clusters and that their absence can be related to recent mergers.

From our studies, it emerges that Cuspiness and Concentration Parameter can be used to identify Cool Core clusters with a good accuracy. Centroid Shift is in this sense less accurate, since about 1/3 of the clusters classified as relaxed are NCC, likely because of projection effects.

REFERENCES

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