Galaxy Mergers as a Function of Environment. Using the Structural Parameters of Residual Images.
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A) THE STAGES SURVEY.
STAGES is a multiwavelength project designed to investigate the impact of environment in galaxy evolution. Its target is the A901/902 supercluster. It is located at z=0.165. It harbors different environments with different densities. This dataset is best suited to study galaxy interactions, which are more frequent in clusters.

STAGES has obtained an ACS/HST F606W complete scan of the cluster. There is a wealth of additional data to complement the ACS/HST observations, including X-ray (XMM-Newton), infrared (Spitzer), UV (Galex), radio (GMRT), and spectroscopic (2dF) observations for selected subsamples.

STAGES has been used to study galaxy groups, strong lensing, and the evolution of spiral galaxies as they enter galaxy clusters. The purpose of the present work is to study the galaxy merger fraction as a function of morphology and environment.

B) MAIN IDEAS AND SAMPLES.

IDEAS: Study of the merger fraction of galaxies via structural parameters. Galaxies involved in merger episodes will have disturbed morphologies. High asymmetries, shreddedness and multiple nuclei are clear symptoms.

Previous studies only made use of the information contained in the direct images of galaxies. This work deepens in this line of work by exploring the information contained in the residual images of galaxies after subtracting a smooth Sérsic model. This model represents the largest galaxy in merging episodes. Residual images will contain information about the smaller galaxies involved in the merger, and the morphological disturbances of the large galaxy.

SAMPLES: Mass selected sample (log M/M₅₅ > 9.0) in three different environments (Field, Cluster, and Cluster Core environments) with morphologies. The parent sample is taken from the STAGES ACS/HST observations.

Sample Breakdown:
- 153 Field Galaxies (88 E, 59 S0, & 306 Sp).
- 719 Cluster Galaxies (167 E, 193 S0, & 359 Sp) of which,
  - 165 are Cluster Core Galaxies (53 E, 60 S0, & 52 Sp).
- 54/1171 objects were visually found to be mergers (large symbols in lower panels).

Which of the remaining 1117 objects are also mergers?

C) Detecting Mergers using GALFIT+Structural Parameters.

C.1) Use of GALFIT to create a Sérsic model.
We create a Sérsic model using the GALFIT code. The GALFIT configuration used is set up by Gal-Hyt.

C.2) Structural Parameters. The CAS and G-M20 parameters are the most commonly used set of parameters in works studying the merger fraction of galaxies using structural analysis.

G measures how evenly is the light distributed.
M20 measures how shredded is the light distribution.
C measures the light concentration.

This is the first work to explore the information contained in the residual images after subtracting a smooth Sérsic model.

D) Best Parameters to Estimate Merger Fraction.

F is the “Sample Purity” Weighted (0.25) harmonic average of “specificity (p)” and “sensitivity (r)”.

Red line is constructed so that F is maximized.

E) Comparison Between Several Combinations.

Red dots: Ellipticals
Black points: Lenticulars
Blue points: Spirals

Purities, completeness and contamination for each diagnostic is given in each panel.

F) Summary and Conclusions.

1) We have developed a method to detect mergers. We use GALFIT+Structural Parameter analysis.
2) The Gini index (residuals) + Asymmetry (Direct Image) produces the best overall merger sample. Use of G (Residuals) + M20 (Residuals) attains 96% completeness.
3) Mergers are mainly found in Sp systems. E and S0 hosts have already processed their guests.
4) Mergers are rare in the core. They are common in Cluster and Field.