Galaxy structure, Star formation history & Environment

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(Kelkar et al 2015, in prep)

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NGC 2623  Image credit: NASA
MOTIVATION

Morphology $\rightarrow$ Star formation history

Structure $\rightarrow$ Environment
MOTIVATION

Morphology → Star formation history

Structure → Environment

Structure → Environment
**INGREDIENTS**

- ~ 530 galaxies from the 10 high-z clusters from the **ESO Distant Cluster Survey** within $0.4 < z < 0.8$ (White et al 2005)

<table>
<thead>
<tr>
<th>Morphology</th>
<th>Star formation history</th>
<th>Environment</th>
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Undisturbed galaxies

visually asymmetric galaxies

interacting galaxies

galaxies with tidal features

mergers

internal causes

QUALITATIVE
Measuring structural disturbances in galaxies using residuals

- **RFF** - a measure of deviation from a smooth light profile.
  \[
  RFF = \frac{\sum_{i,j} A |I_{i,j} - I_{i,j}^{GALFIT}|}{0.8 \times \sum_{i,j} A \sigma_{Bkg_{i,j}}}
  \]

- **A_{res}** - measure of asymmetry in the residuals under 180° rotation.
  \[
  A = \left( \frac{\sum_{i,j} |I_{i,j} - I_{i,j}^{180}|}{\sum_{i,j} I_{i,j}} \right) - \left( \frac{\sum_{i,j} |B_{i,j} - B_{i,j}^{180}|}{\sum_{i,j} I_{i,j}} \right)
  \]

(Hoyos et al 2011)

Original image  Residual image  Residual image rotated by 180°
Linking visual and quantitative structure: Mergers lie in specific area on the RFF-Ares plane!

- We statistically separate these visual mergers optimally from our sample.

- Completeness: 78%
  Contamination: 31%

RFF can provide a good measure of roughness in the galaxy.
Visual structural disturbances in galaxies correlate with structure or roughness in galaxies.
YOUNGER, STAR FORMING AND DISTURBED GALAXIES ARE ROUGHER!

Poggianti et al 2009, See also Kauffmann et al 2003
Does disturbance depend on global environment?
Does disturbance depend on global environment?

Wolf et al. 2009, Poggianti et al. 1999

Smooth Passive spirals in clusters

Wolf et al 2009, Poggianti et al 1999
SUMMARY

- RFF is not sensitive to the causes of structural disturbances in galaxies
- Younger, star forming and disturbed galaxies are rougher
- Global environment has very limited effect on roughness of galaxy when we remove the effects due to morphology and star formation
- Causes of disturbances in spirals are mostly external in origin, independent of environment
- Higher fraction of smooth passive spirals in clusters seem to suggest a gentle mechanism for quenching of star formation in cluster galaxies, without affecting the structure of galaxies

THANK YOU!