RPS - tidal interactions:
HI and NIR imaging in A085/A496

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EWASS 2017
Normal spiral

Evolutionary sequence?

S0 and Red-passive Sp

Dressler (1980)
Our “recipe”:

- Studying *nearby clusters* \((z \leq 0.2)\), having
- *different physical* conditions \((L_x, \text{ mass, relaxation, etc})\).
- We observe the *whole volume* in HI, opt and NIR.
- We analyse/quantify galaxy *disruptions* and
- combine with the *ICM* \((X\text{-ray})\) distribution and with
- the cluster *substructures* …..

... all this provides hints on galaxy evolution in clusters, individually and statistically.
Strategy (a simple description)

- **Case 1**: if the *HI* component is perturbed but the *stellar* disk is not → **ICM** (*hydrodynamics*)

- **Case 2**: if both the *gas* and *stellar* components are perturbed → *gravitational* mechanisms

Kenney, Abramson & Bravo-Alfaro, 2015

HI and NIR imaging in A496; Bravo-Alfaro et al. In prep
Still few clusters have been imaged (whole volume) in HI

Observations: A496 (z=0.03; a relaxed, isolated cluster)

\( L_x (0.1-2.4 \text{ eV}) \sim 3.8 \cdot 10^{44} \text{ ergs/s} \)

The polygon indicates the area imaged in HI, with the NRAO-VLA. The red square is the field observed with WIRCam and the 3.6 CFHT.
Abell 085 \( z = 0.05 \): more massive, more substructures and brighter in \( L_x \) than A496 \((z=0.033)\). A85 is part of a super cluster \((L_x (0.1-2.4 \text{ eV}) \sim 9.4 \cdot 10^{44} \text{ ergs/s})\)

NIR imaging on Abell 85, coming from the 2m Tel (OAN) and the 5m Palomar Tel. Bravo-Alfaro et al. 2009, 2017 in prep.
A85: 26 NIR fields

Venkatapathy et al. 2017, accepted for publication, AJ
We confirmed several interacting galaxies in A85 (in pairs and groups). We measured the asymmetries with a novel index: $\alpha_{An}$ (Venkatapathy et al. 2017)

We find a fraction (25%) of galaxies with clear asymmetries in opt-NIR, suggesting that **tidal interactions** are playing a role in A85. But...
KAZ 364, a confirmed jellyfish galaxy in A85,
Seen in optical bands
(Poggianti et al. 2016, Bellhouse et al. (2017)
No old stars found along the filaments → the blue stars must be formed in situ, after a strong RPS event!!

NUV-Galex  SDSS-g
J-band, this work  H-band, this work
In total three very disrupted galaxies in A85 have no red stars along the peculiar arms (until our limit of 22.4 mag arcsec$^{-2}$ in J-band) $\rightarrow$ RPS is very active in A85 too.
Abell 496: the full view in HI

- 58 HI detections
- 20% - 30% show HI disruptions, either:
  - gas deficiency,
  - HI-asymmetry,
  - and/or optical-HI offsets.
Exemples of galaxies with significant opt-HI offsets in Abell 496:

Distribution of bright spirals ($b \leq 17.5$) in A496. A very different typical compared with Coma and A85 (i.e. HI deficient objects near the cluster center).

HI-normal

HI-deficient (yet detected)

HI deficient (non detected)
The distribution of bright spirals in A496

- Pink zone: perturbed in HI and normal in NIR: RPS
- Blue zone: perturbed in HI and perturbed in NIR: tidal
- Green zone: a peculiar region almost totally depleted of spirals!
Summary

- Multi-λ : a powerful tool to study environment & evolution.
- Pre-processing: active in these clusters with both, RPS and tidal interactions.
- We get lots of information on the dynamical state of the clusters.

Questions and puzzles

- Very disrupted galaxies in clusters : How?
- How RPS can be so strong at larger cluster-centric distances?

Thank you!