

HECTOR - Early Science

Identification of ram-pressure
affected galaxies



Oguzhan Cakir, Matt Owers, Mina Pak, Gabriella Quattropiani,
and anyone who is interested in

The aim

- Disentangling the impact of different merger phases on the galaxy properties.

Cluster mergers;

- Being the most energetic events ($\sim 10^{63-64}$ erg) in the known universe (*Markevitch et al, 1998*).

- Relative speeds

**a pressure jump in the ICM →
stronger RPS**

- Host most extreme

→ high-speed shocks

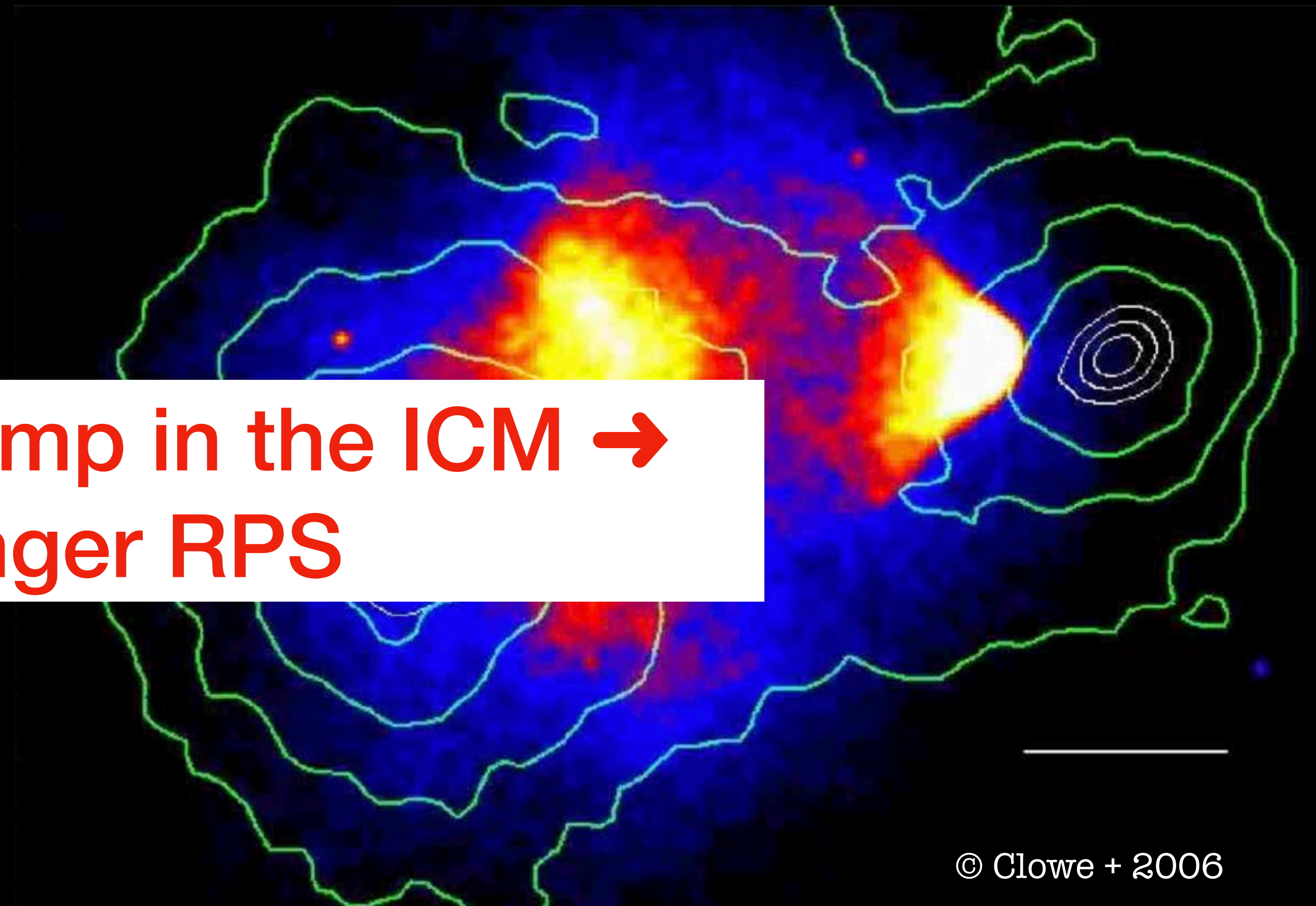
→ cold fronts

Disturbance in the ICM !!!



visible in X-ray

BULLET CLUSTER



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The aim

- Disentangling the impact of different merger phases on the galaxy properties. We need
 - to identify ram–pressure affected galaxies
 - to determine the incidence of these objects across a sample hosting clusters with different dynamical states.

Identification

- We search for direct evidence of RPS in the forms of

- Asymmetric one-sided tails
- Extraplanar gas
- Triggered SF regions
- Truncation



**Visual Classification
&
Structural Analysis**

in the ionized gas distribution.

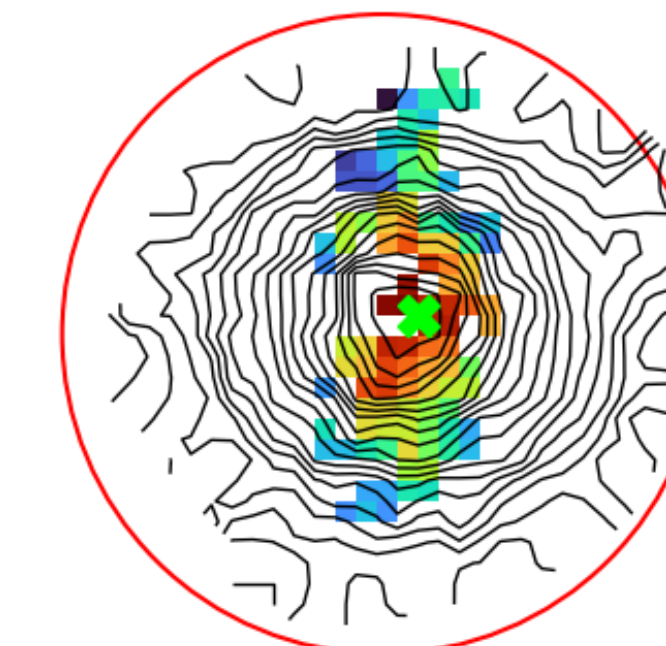
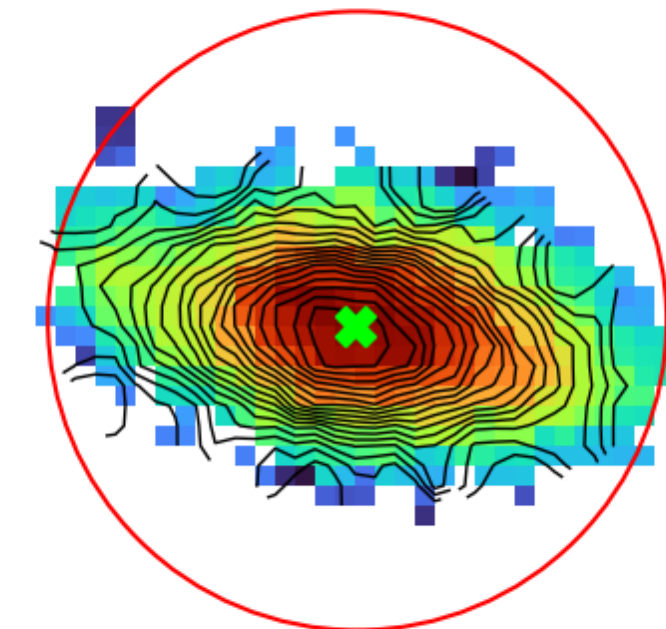
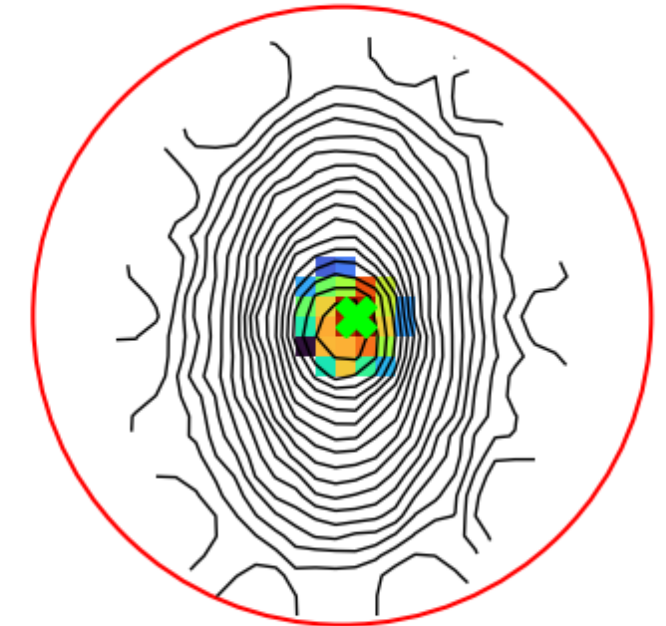
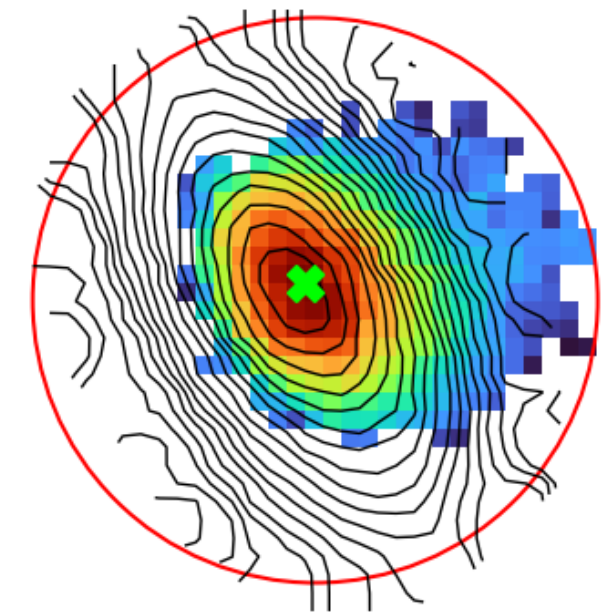
What has been done so far?

Based on SAMI DR3 data ...

Visual Classification Scheme

Based on $H\alpha$ + $[NII]$
Emission Maps

- **Asymmetric (A)**: Clear asymmetry one-sided emission (e.g. tail) and/or extra-planar emission and truncation at least one side.
- **Truncated (T)**: Relatively symmetric (and central – but not necessarily) emission with clear truncation at sides.
- **Unperturbed (U)**: No clear asymmetry and/or truncation wrt the continuum.
- **Unclear (U)**: Weird emission features or clear asymmetry which might not be explained by RPS or other features (e.g. spiral arms etc.)



Visual Classification Scheme

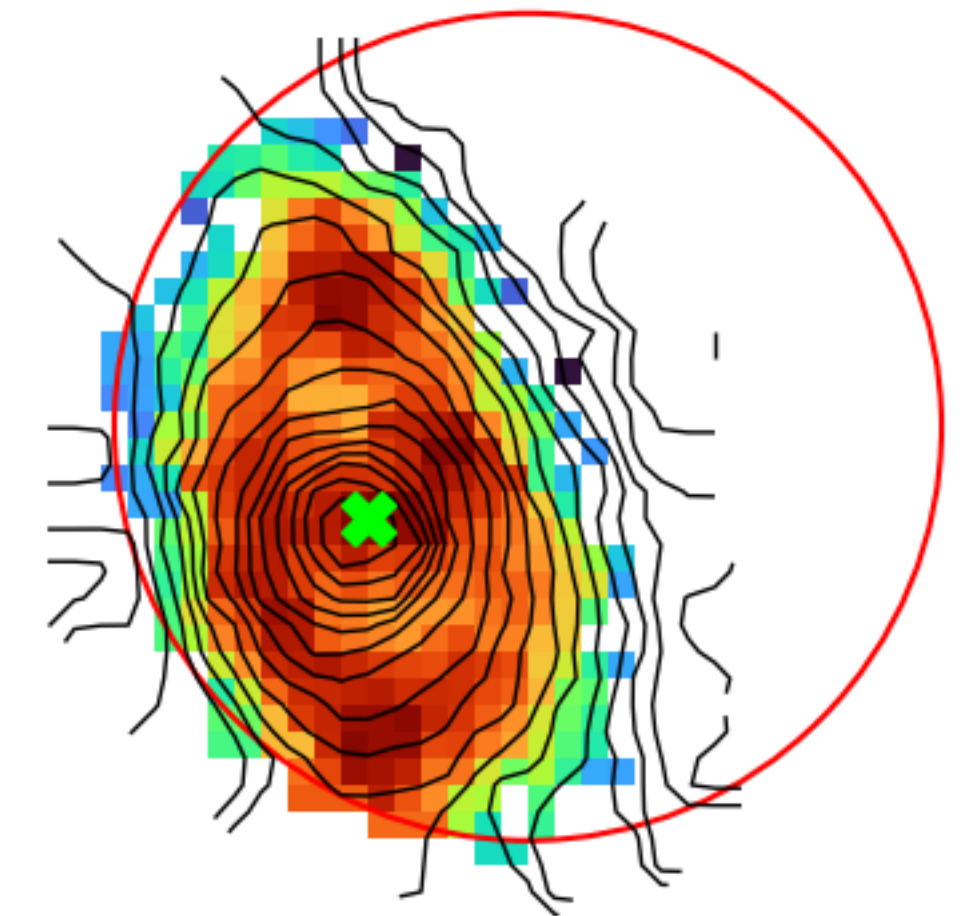
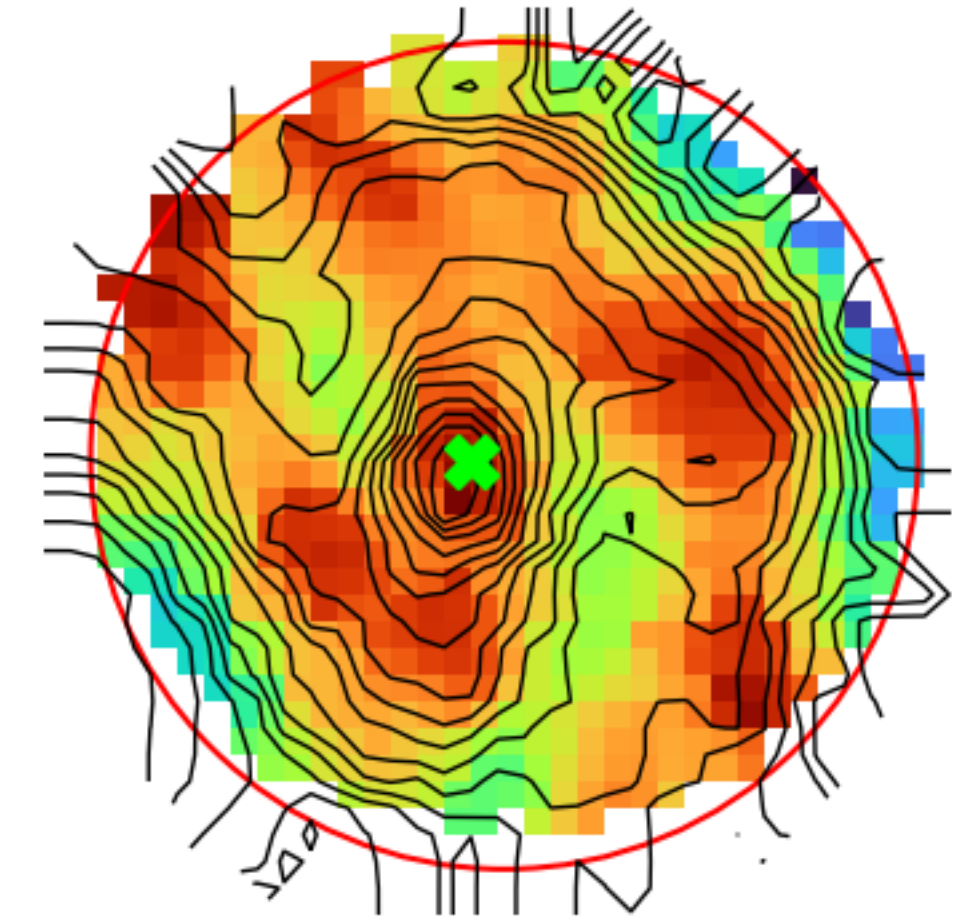
- **Aperture effect**

- SAMI's FoV \rightarrow 15 arcsec
 - most galaxies are limited by FoV
- It also depends on how well the centring has been done.

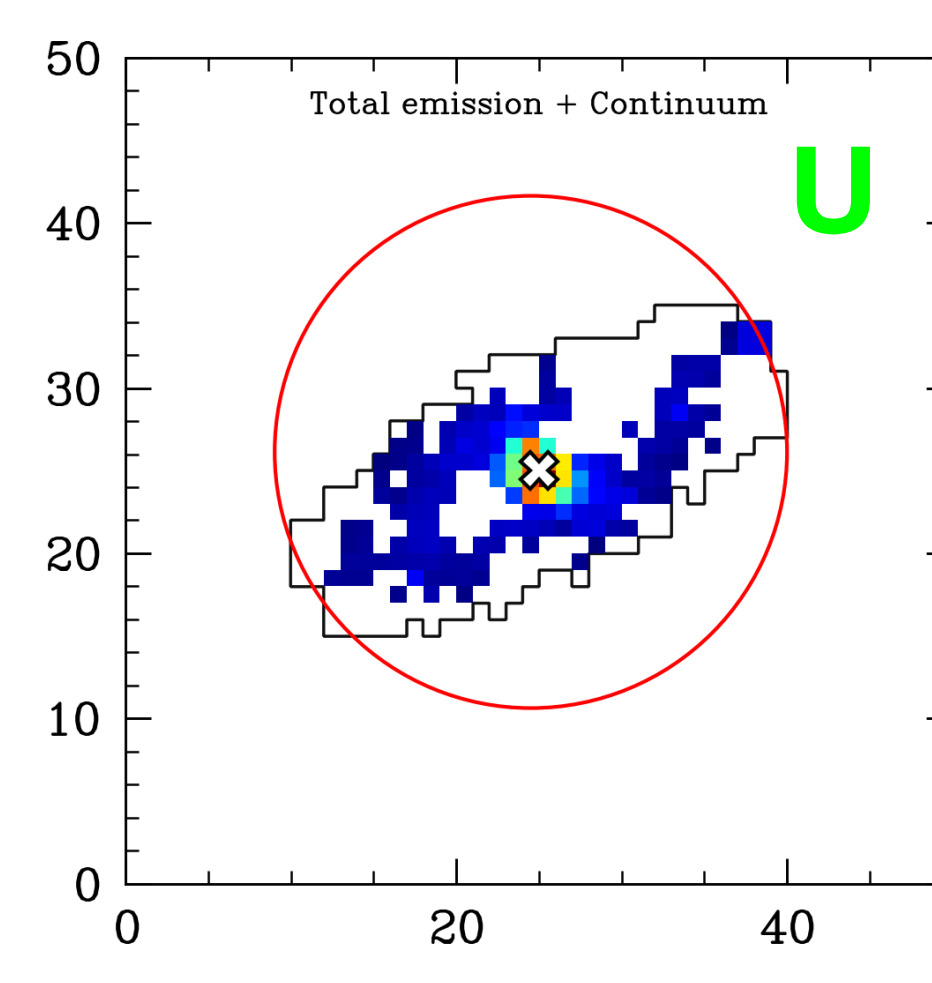
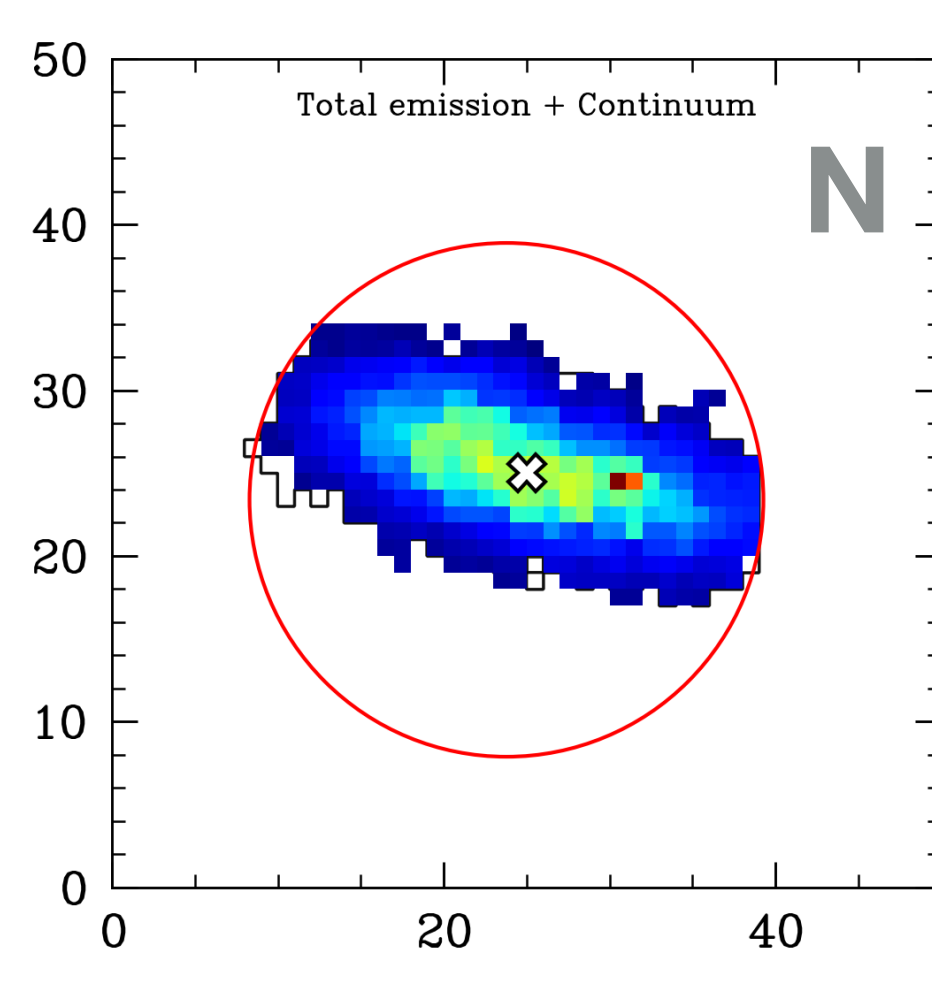
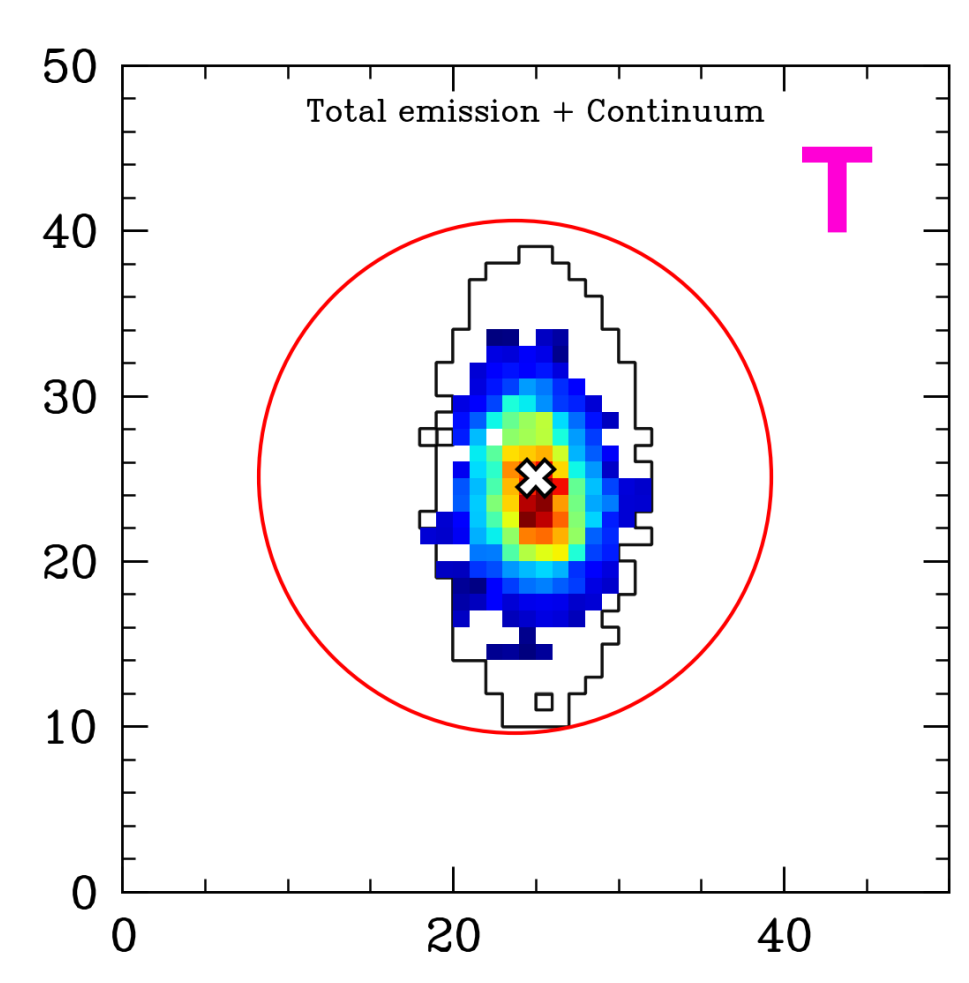
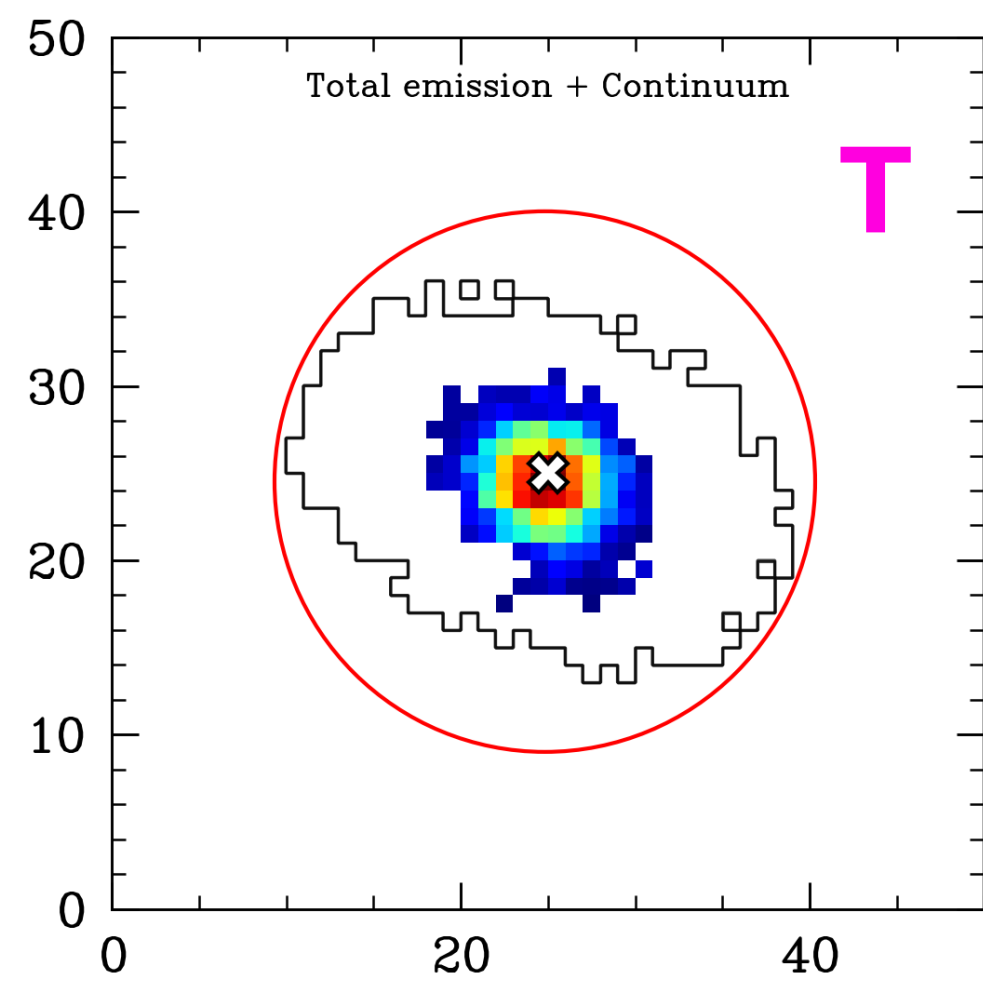
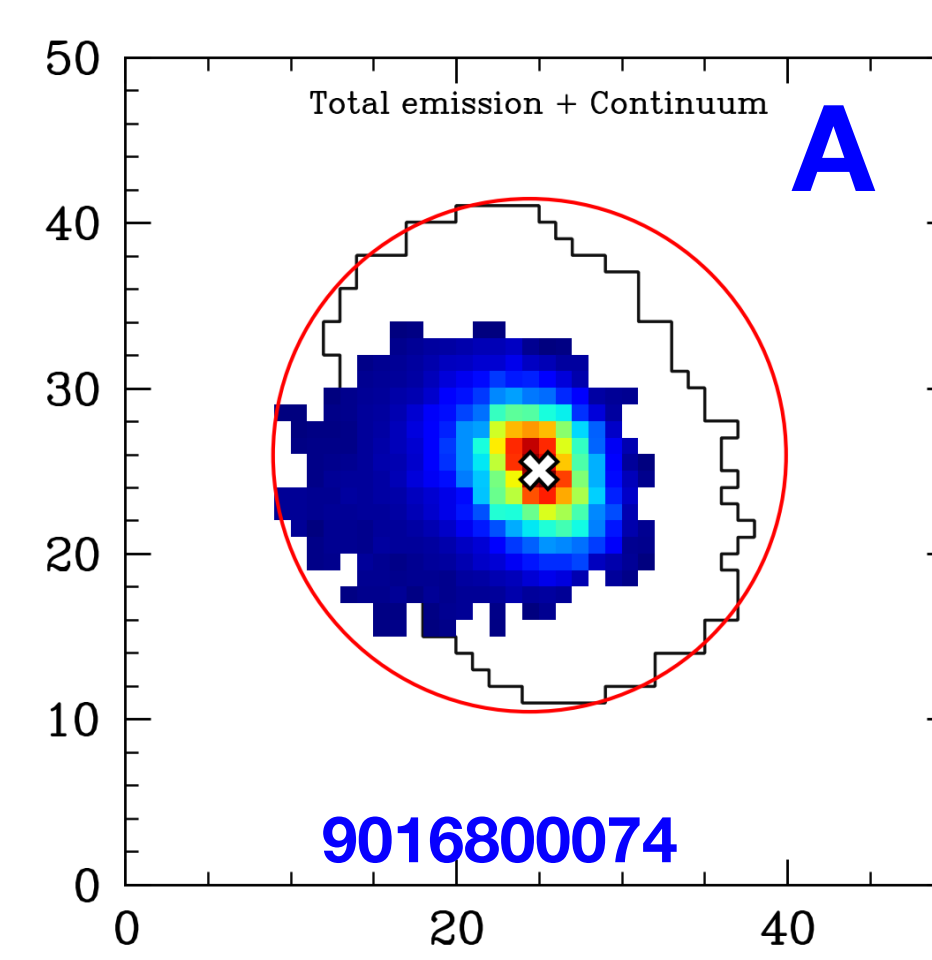
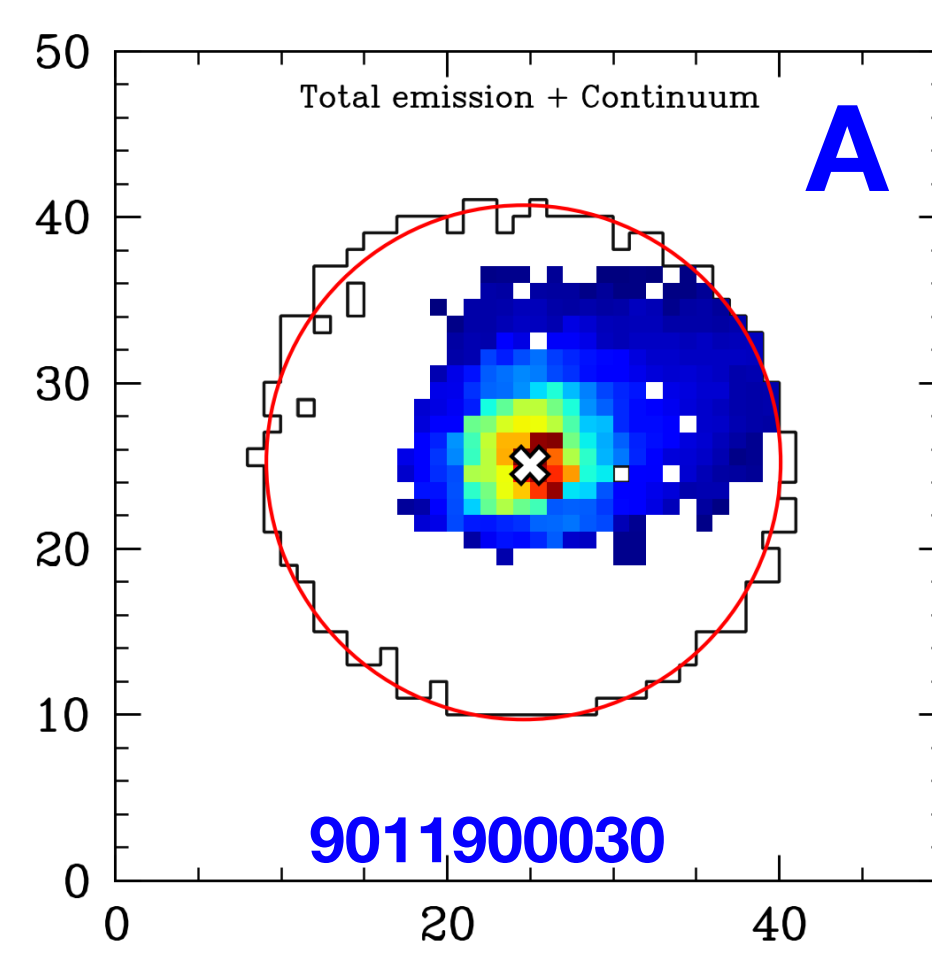
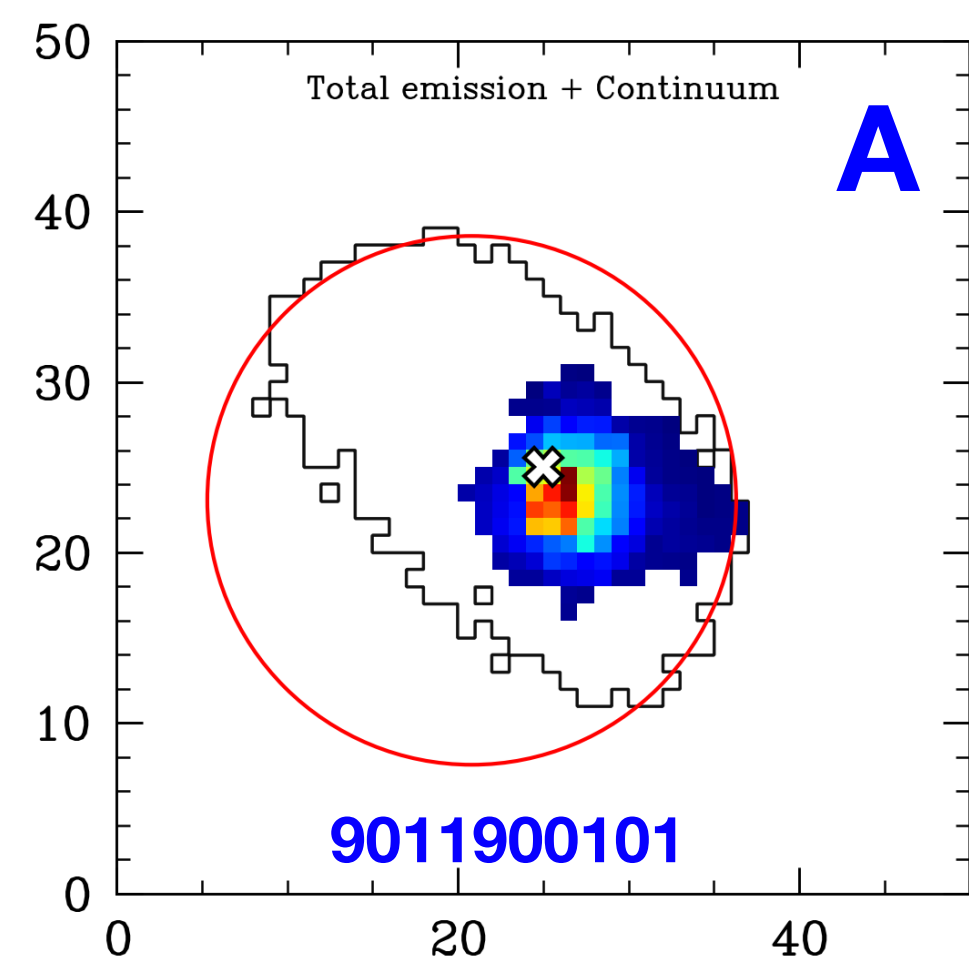
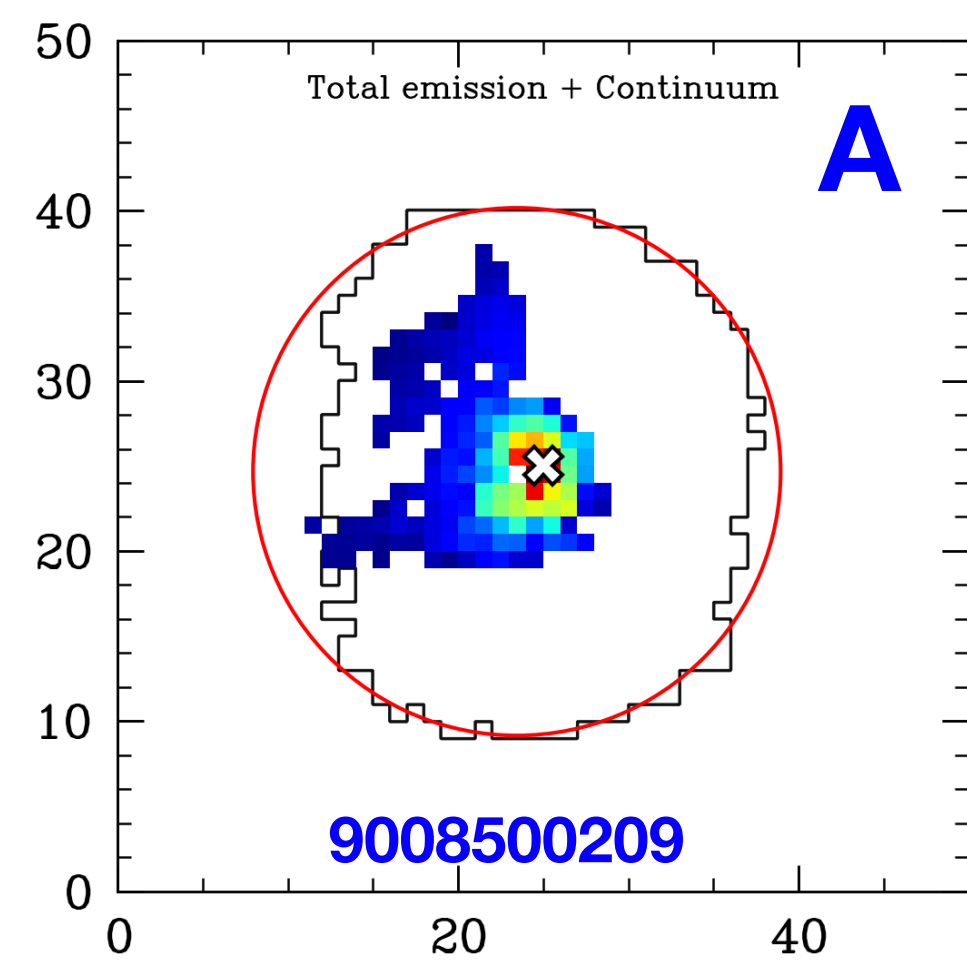
if the emission fills the bundle or

if the galaxy is not well-covered

\rightarrow aperture-affected



Some Examples



Structural Parameters

Based on $H\alpha + [NII]$
Emission Maps

- Offsets between centroids

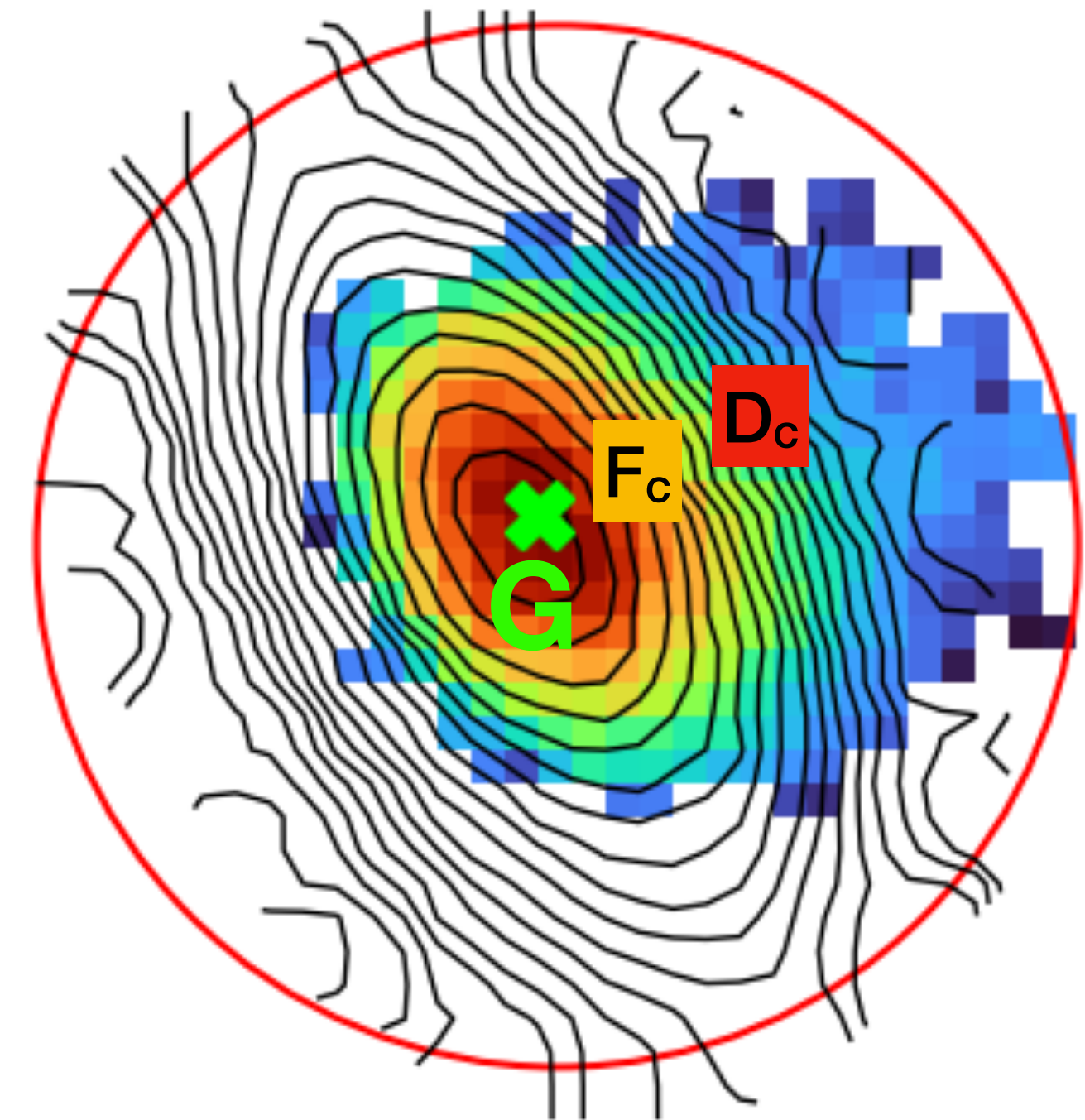
- $d = \sqrt{(x_G - x_i)^2 + (y_G - y_i)^2} \quad i = \{F_c, D_c\}$

- Asymmetry

- $A = \frac{\sum |I_{180} - I_0|}{2 \sum I_0} \begin{cases} A_{\text{wgt}} & \text{if } I_0 \text{ is flux image (Conselice+2000)} \\ A_{\text{shape}} & \text{if } I_0 \text{ is binary detection map} \end{cases}$
(Pawlik+2016)

- Concentration

- $C = \log_{10} \left(\frac{r_{50, H\alpha+[NII]}}{r_{50, \text{continuum}}} \right)$ (Schaefer+2017; Owers+2019)

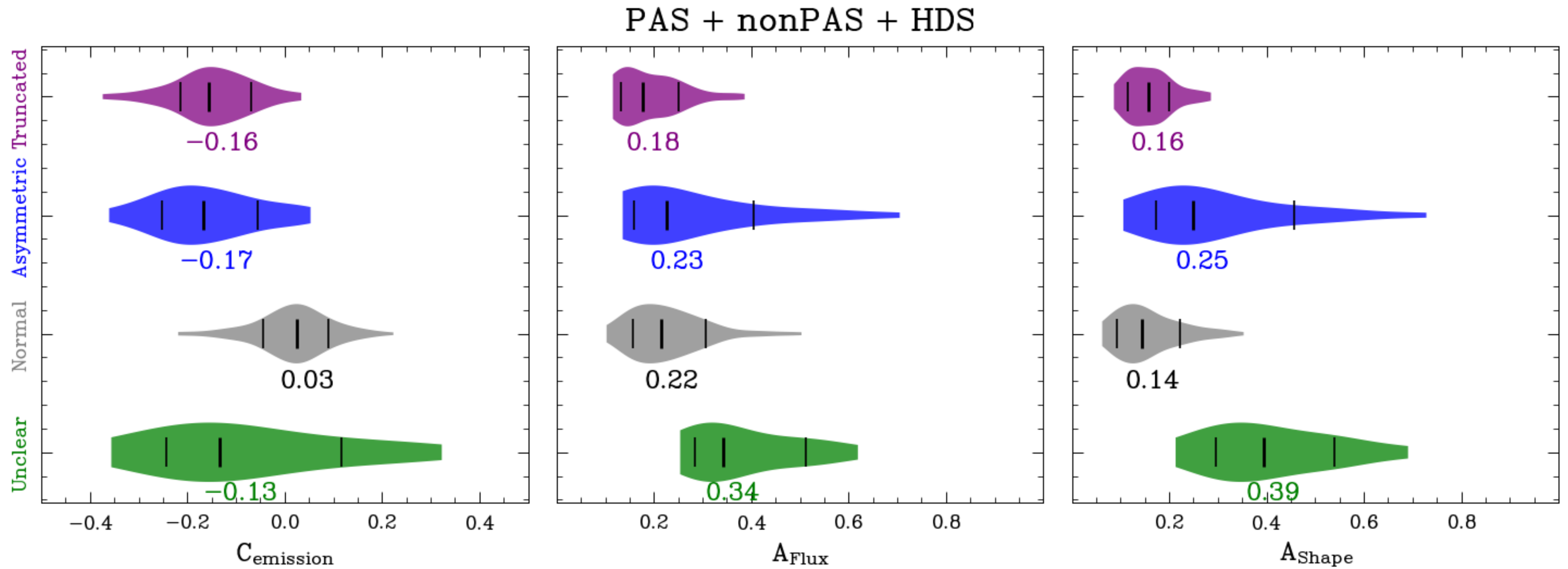


G : galaxy centre

F_c: emission flux-weighted centroid

D_c: emission binary detection centroid

Mapping visual classes into structural parameters

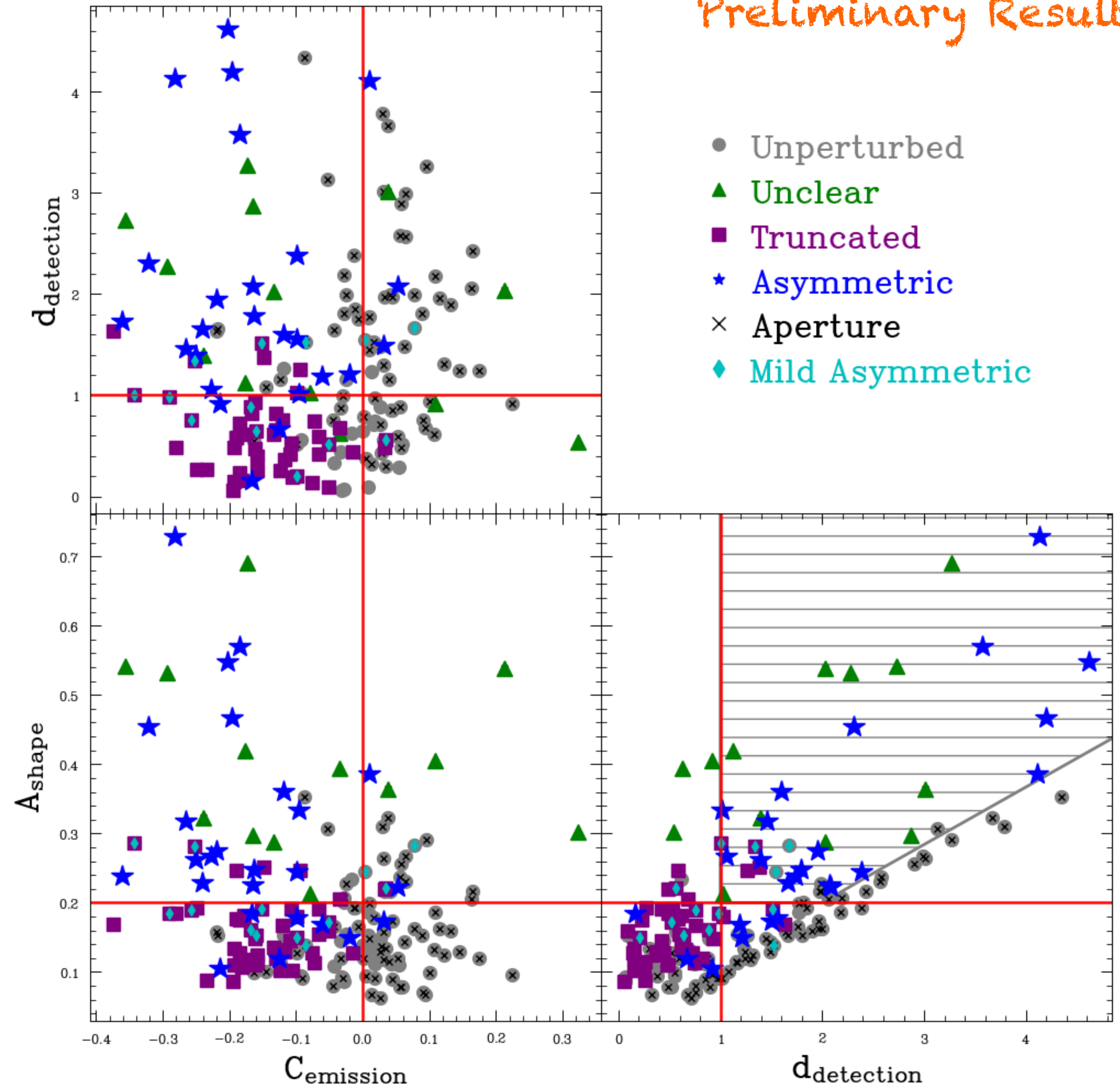


Preliminary Results ...

Mapping visual classes into structural parameters

- **Asymmetric:**
 - offset $\gtrsim 1$ px
 - $A_{\text{shape}} \gtrsim 0.2$
 - $\log C_{\text{emission}} \lesssim -0.1$
- **Truncated:**
 - offset $\lesssim 1$ px
 - $A_{\text{shape}} \lesssim 0.2$
 - $\log C_{\text{emission}} \lesssim -0.1$
- **Unperturbed:**
 - $\log C_{\text{emission}} \gtrsim -0.1$

Preliminary Results ...



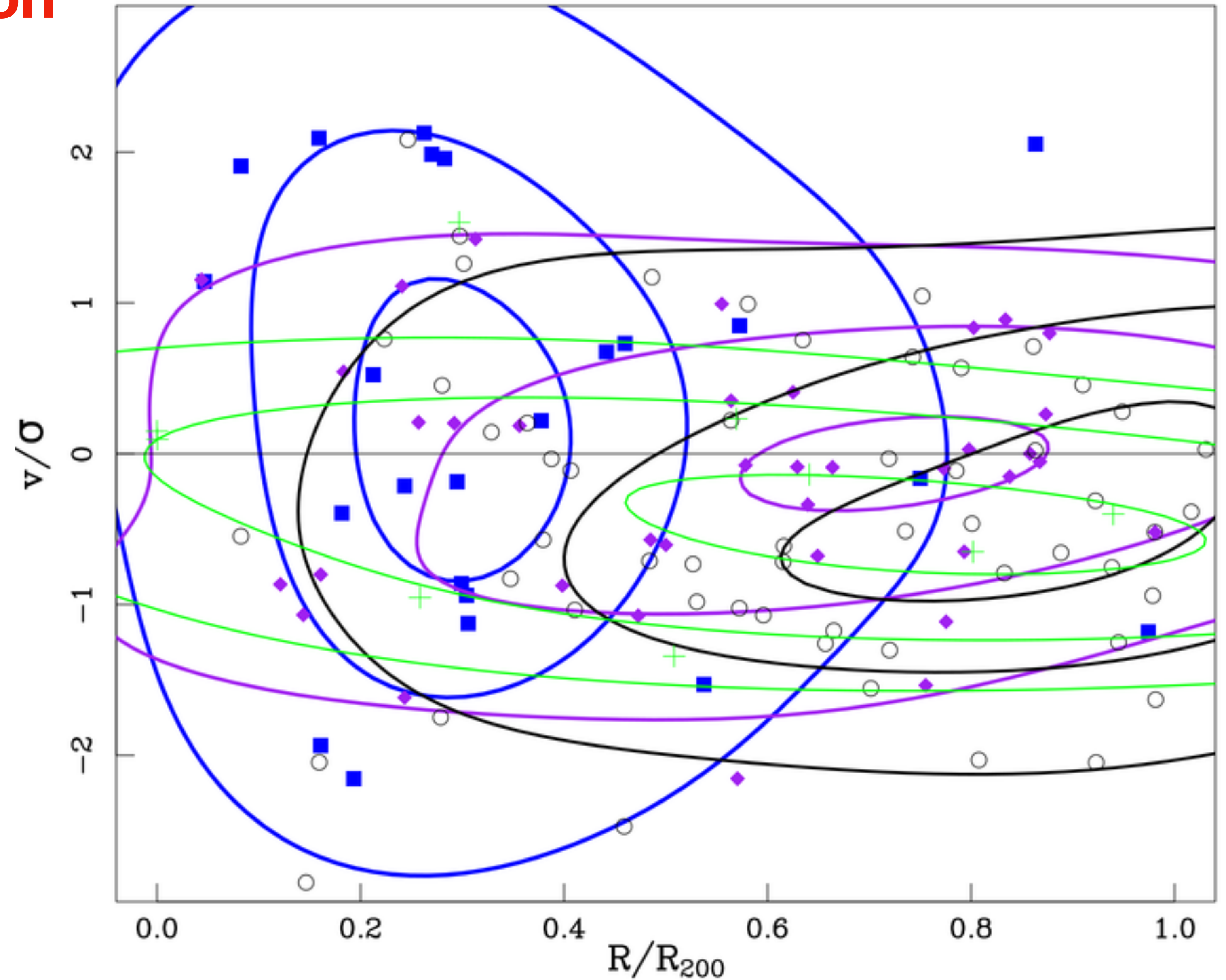
Phase Space Distribution

Blue Square → Asymmetric

Purple Diamond → Truncated

Grey Circle → Unperturbed

Green Plus → Unclear

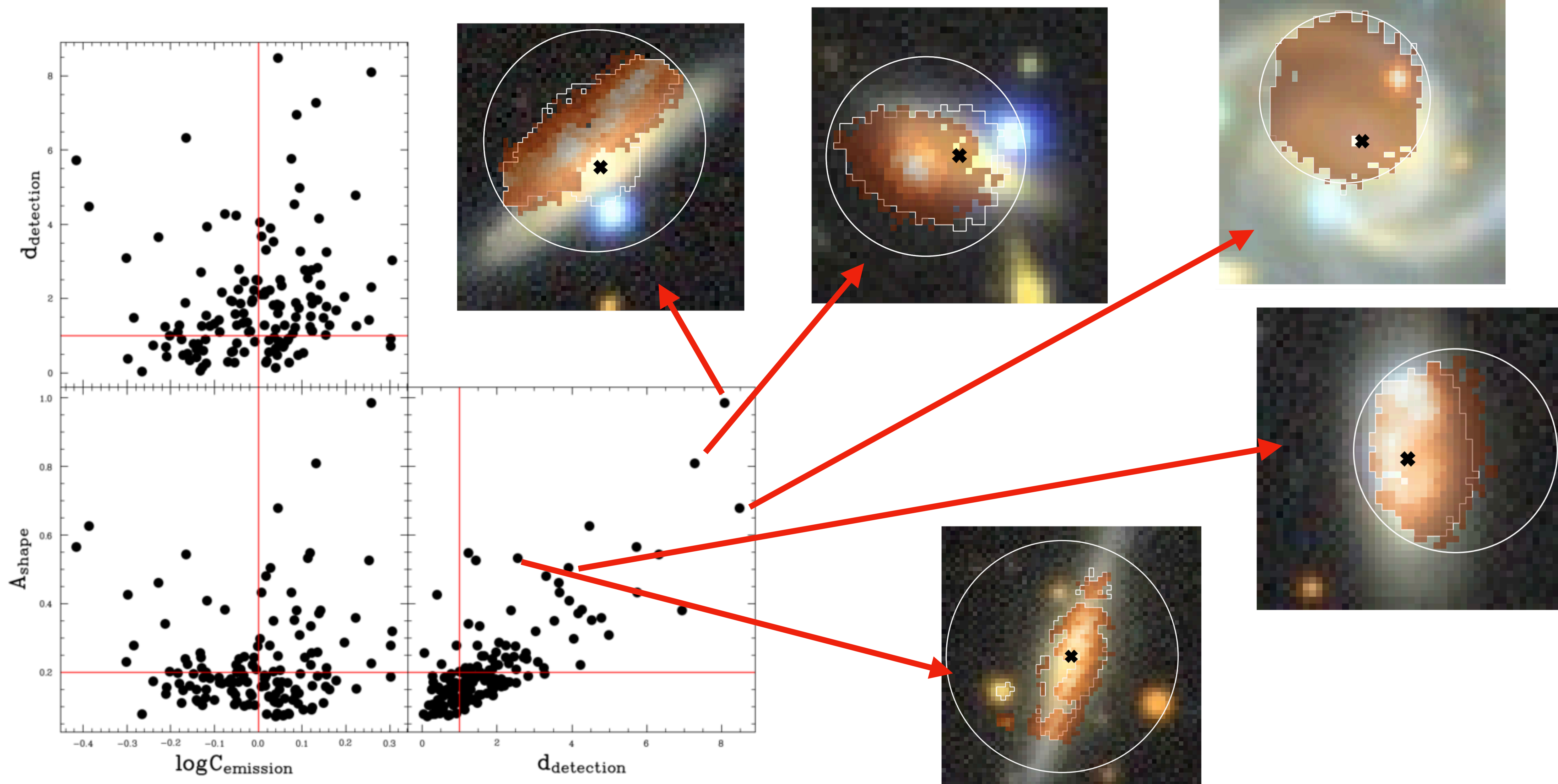


Preliminary Results ...

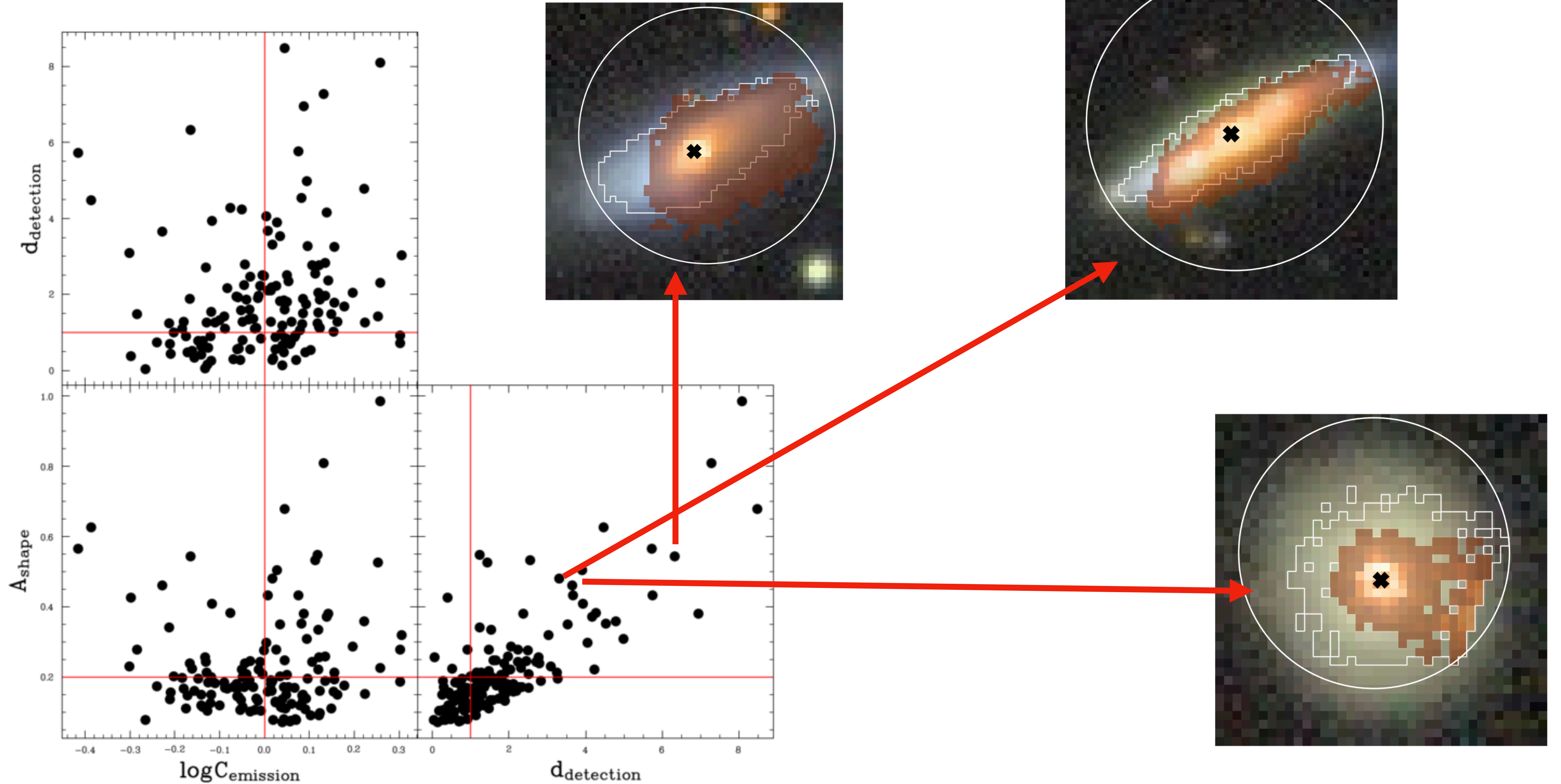
and more ... (currently working on)

- tail orientations
- comparison of star forming properties

What about HECTOR DR1 ?



What about HECTOR DR1 ?





Thanks for your attention!