The metallicity distribution of the stellar population in the outer halo of NGC 3311

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Baryons at low densities: The stellar halos around galaxies
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Motivation

- The stellar content of BCGs, the Brightest Cluster Galaxies, have important information about the past history of their formation and evolution.
  - Past record of interactions (long dynamical timescale).
  - in situ vs accretion.
  - Two-phase scenario .

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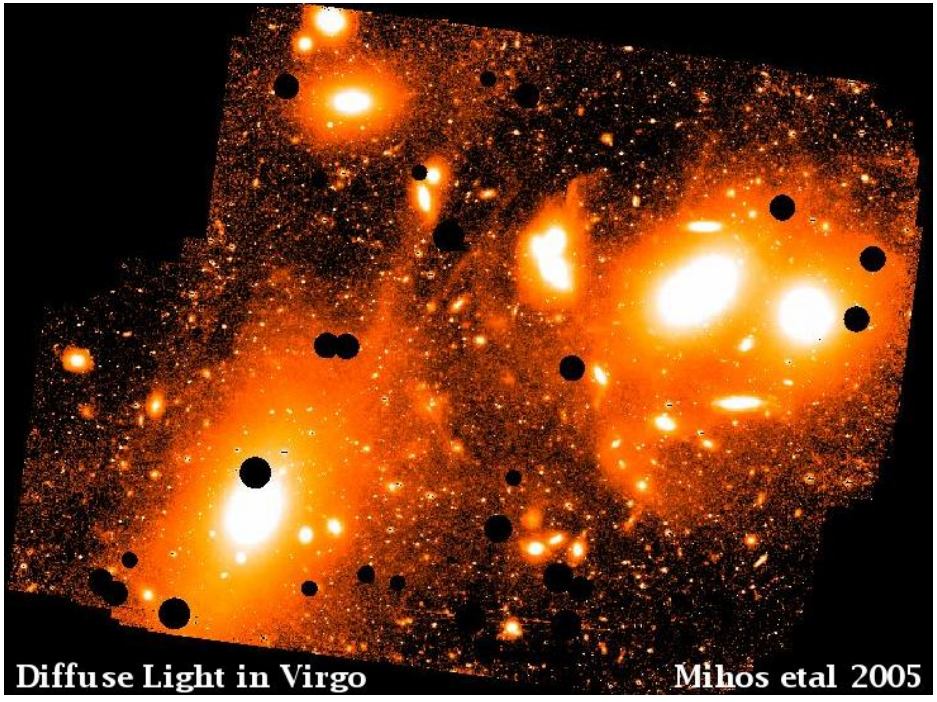
  - Two-phase scenario .
- Furthermore, the environment of galaxy clusters has another important component: the Intracluster Light (ICL).

The Intracluster Light

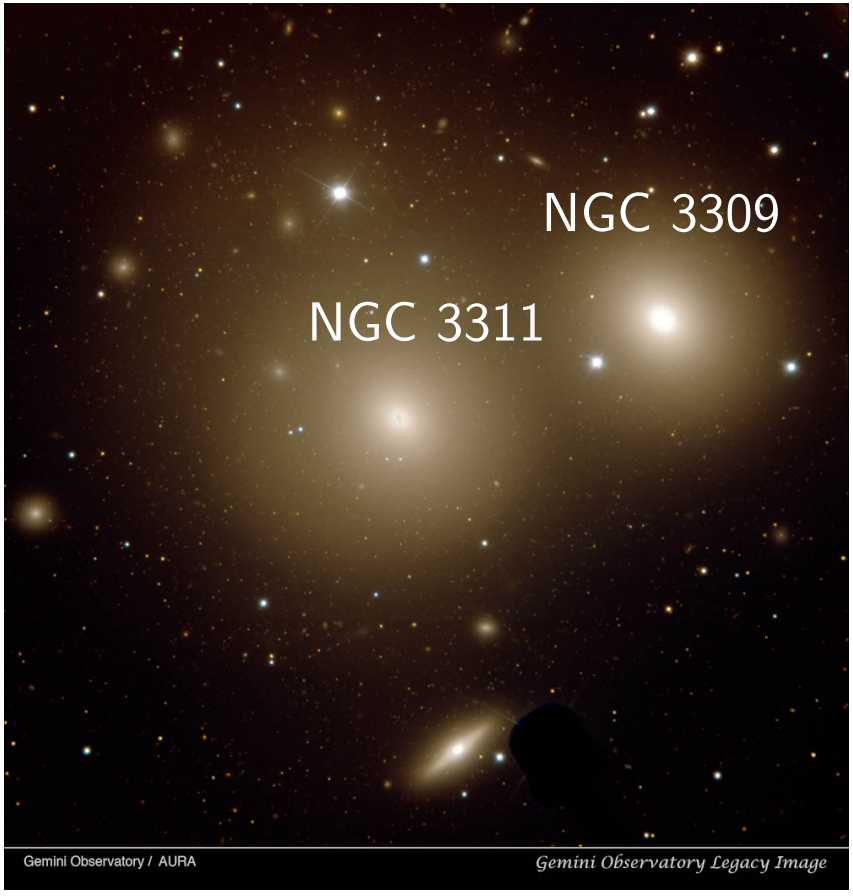


During the cluster formation, most of the material falling in clusters is dragged to the bottom of the gravitational potential well and form the BCG, but some stars are freed from their host galaxies and keep floating bound to the cluster's potential forming the ICL.

- The fraction of stars in the ICL represents $\sim 10 - 40\%$ of the cluster $M_\star$ (Murante et al. 2004, Presotto et al. 2014).

The case of NGC 3311

- Central galaxy of the cluster Abell 1060 (Hydra cluster)
  - $D \approx 50$ Mpc.



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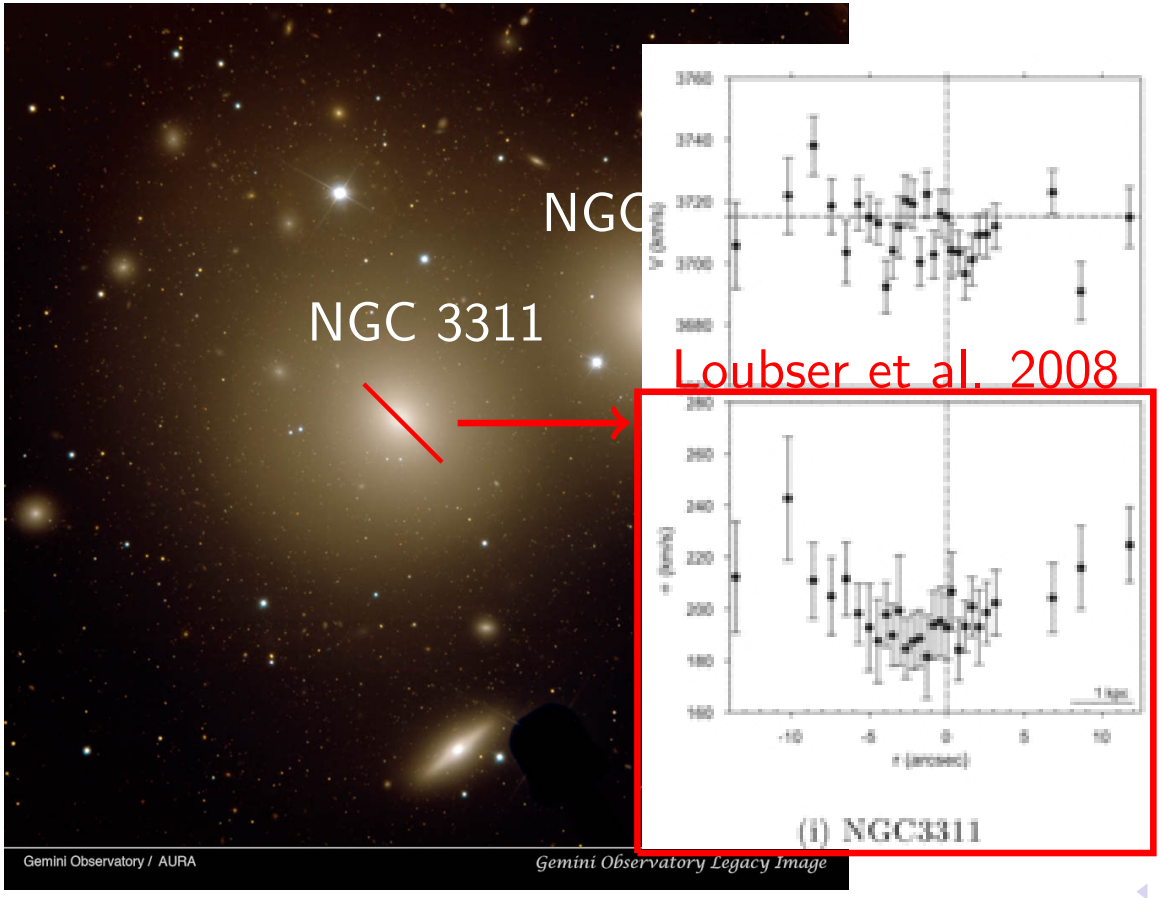
- Central galaxy of the cluster Abell 1060 (Hydra cluster)
  - $D \approx 50$ Mpc.
- Rising, asymmetric velocity dispersion profile.



The case of NGC 3311

- Central galaxy of the cluster Abell 1060 (Hydra cluster)
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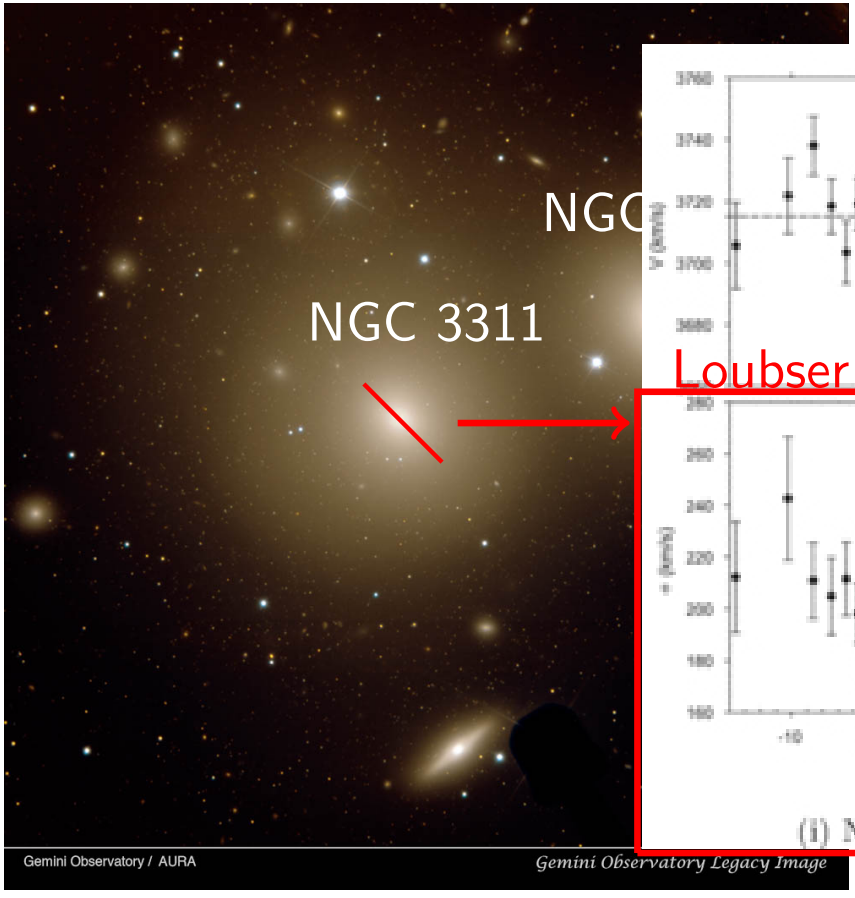
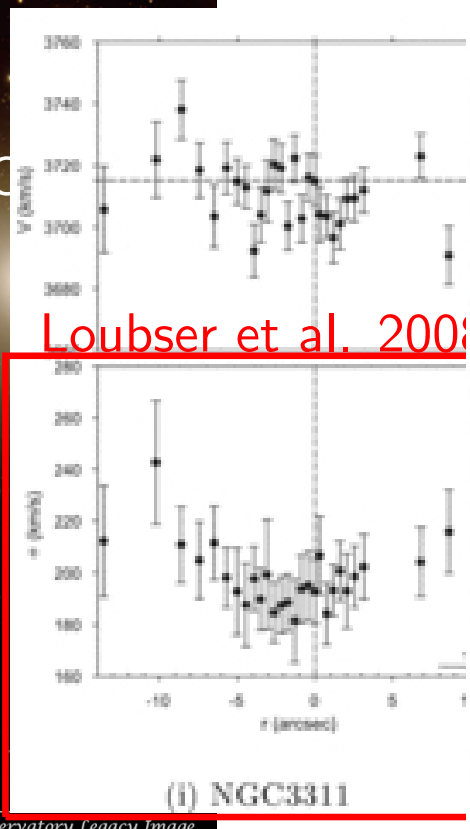
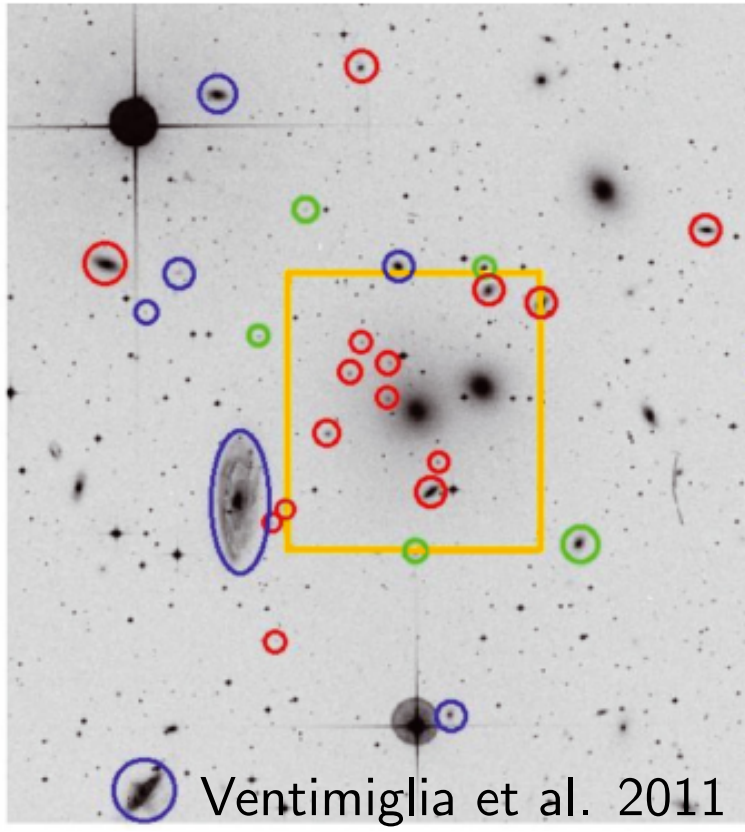
- Rising, asymmetric velocity dispersion profile.
- Unmixed populations of PNe.







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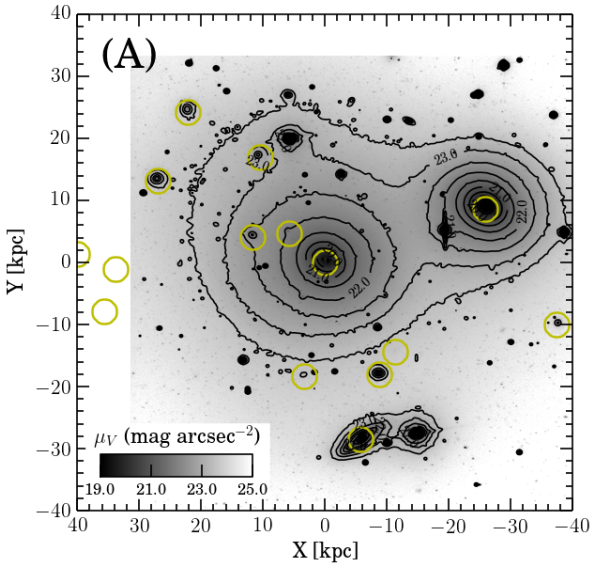
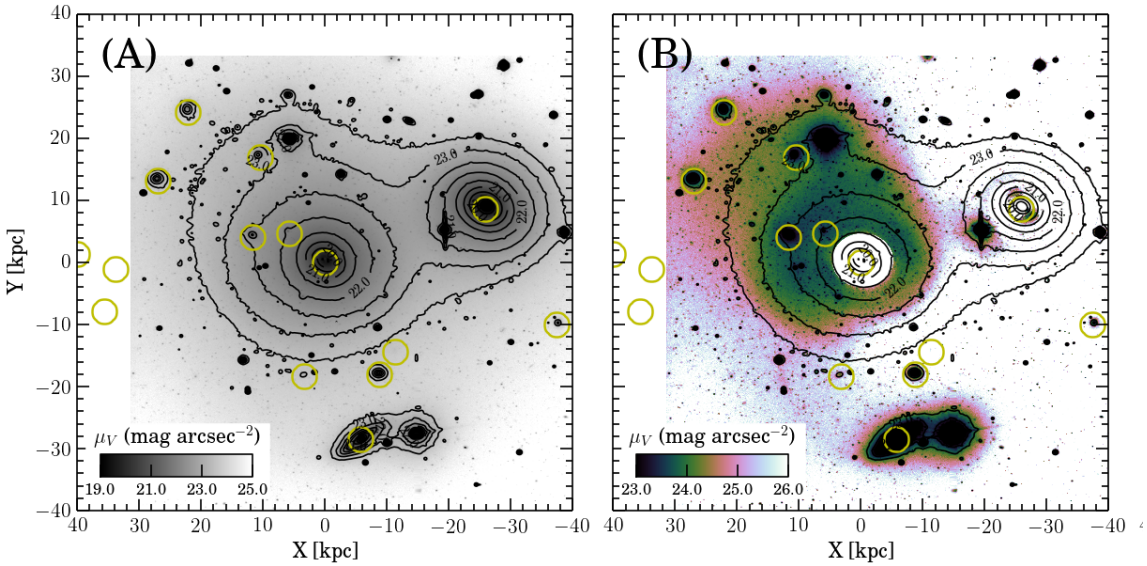


- (A) V-band image + dwarf galaxies from Misgeld et al. 2008;

The case of NGC 3311



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- (B) V-band residuals from maximum symmetric model of Arnabold et al. 2012;

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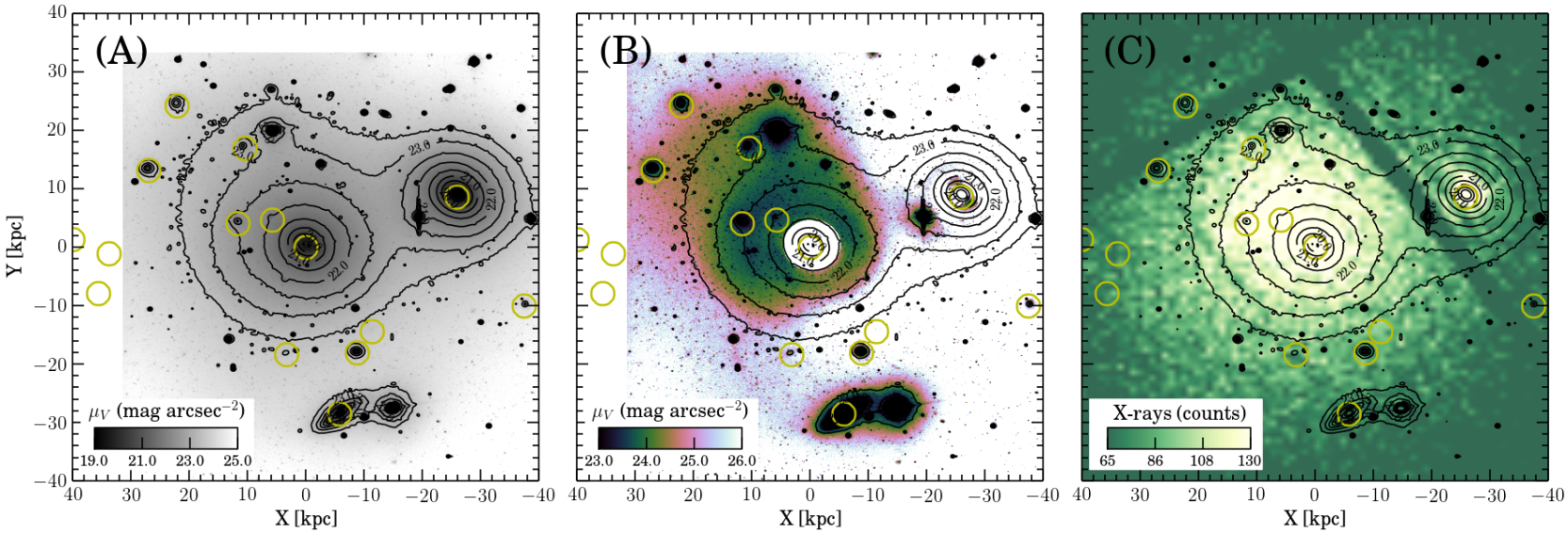
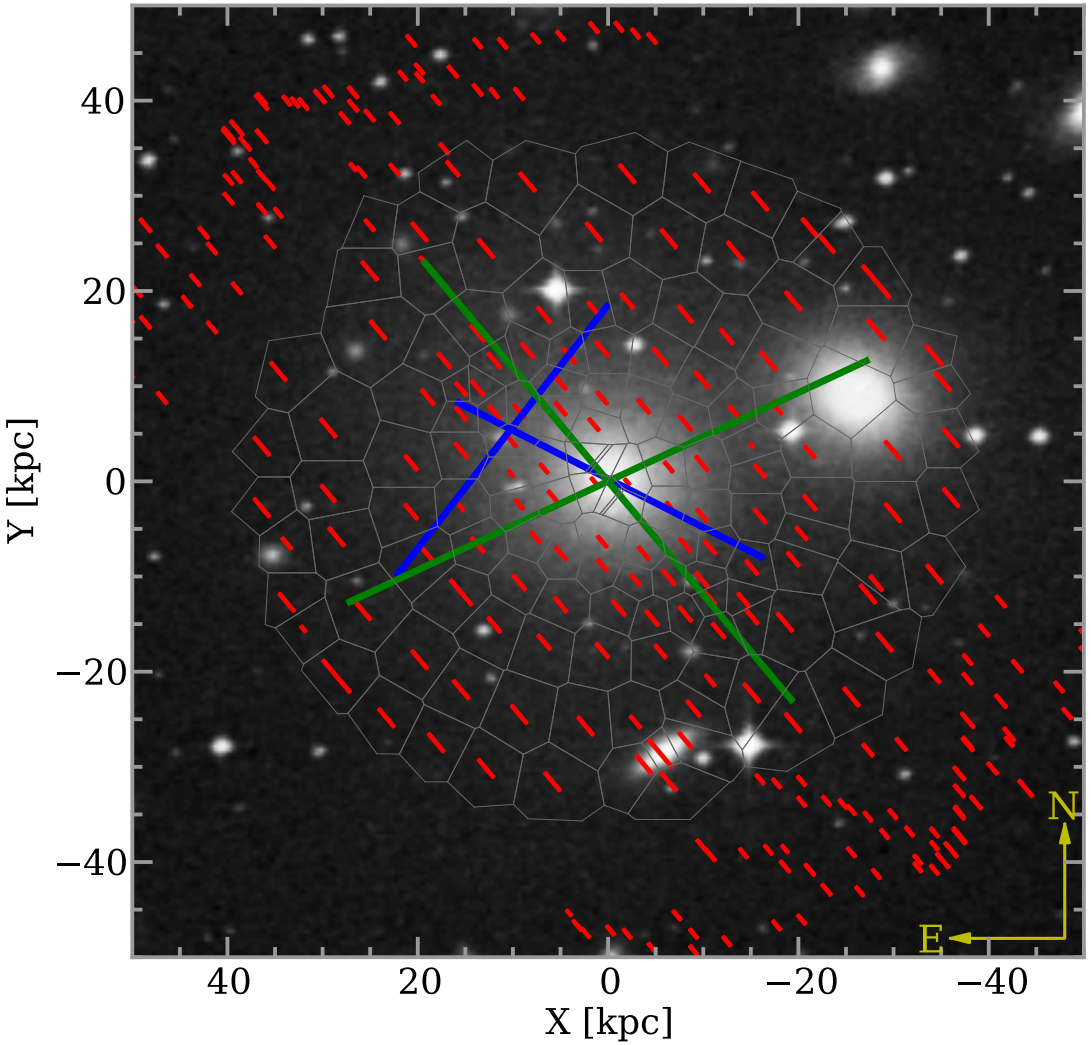


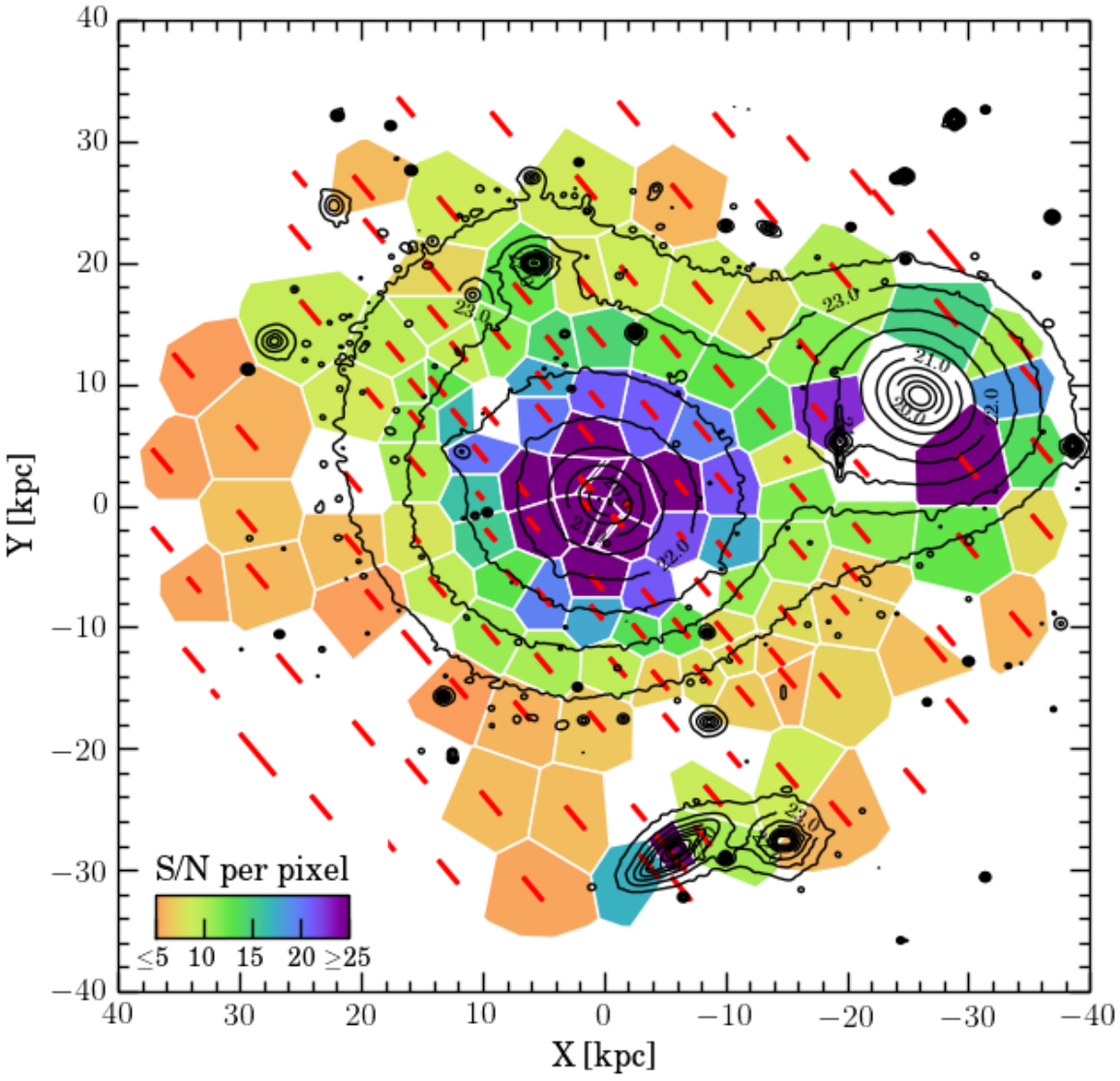
- (A) V-band image + dwarf galaxies from Misgeld et al. 2008;
- (B) V-band residuals from maximum symmetric model of Arnabold et al. 2012;
- (C) X-rays from Hayakawa et al. 2004.

Observations



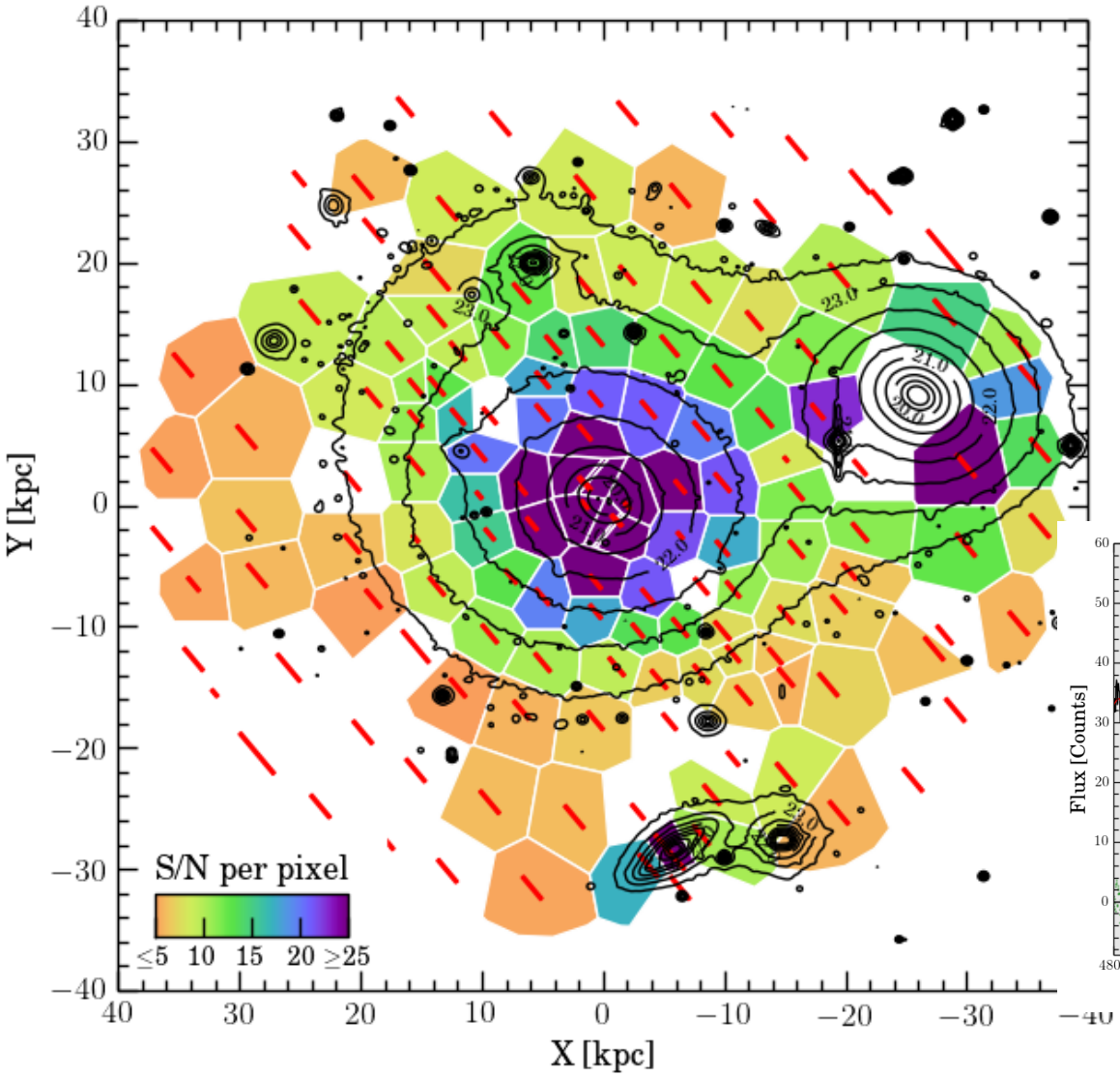
- FORS2 observations at VLT in MXU masking mode.
- Onion-like pattern produced with 6 masks.
- Long-slits from previous works (Richtler et al. 2011; Coccato et al. 2011)

Methods

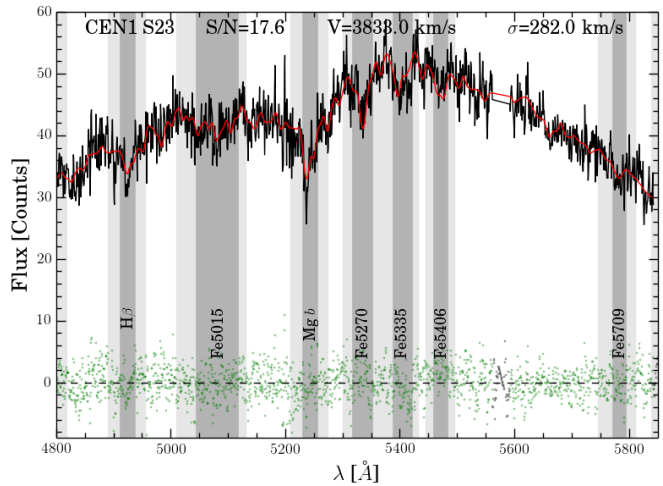


- S/N $>$ 5 required;

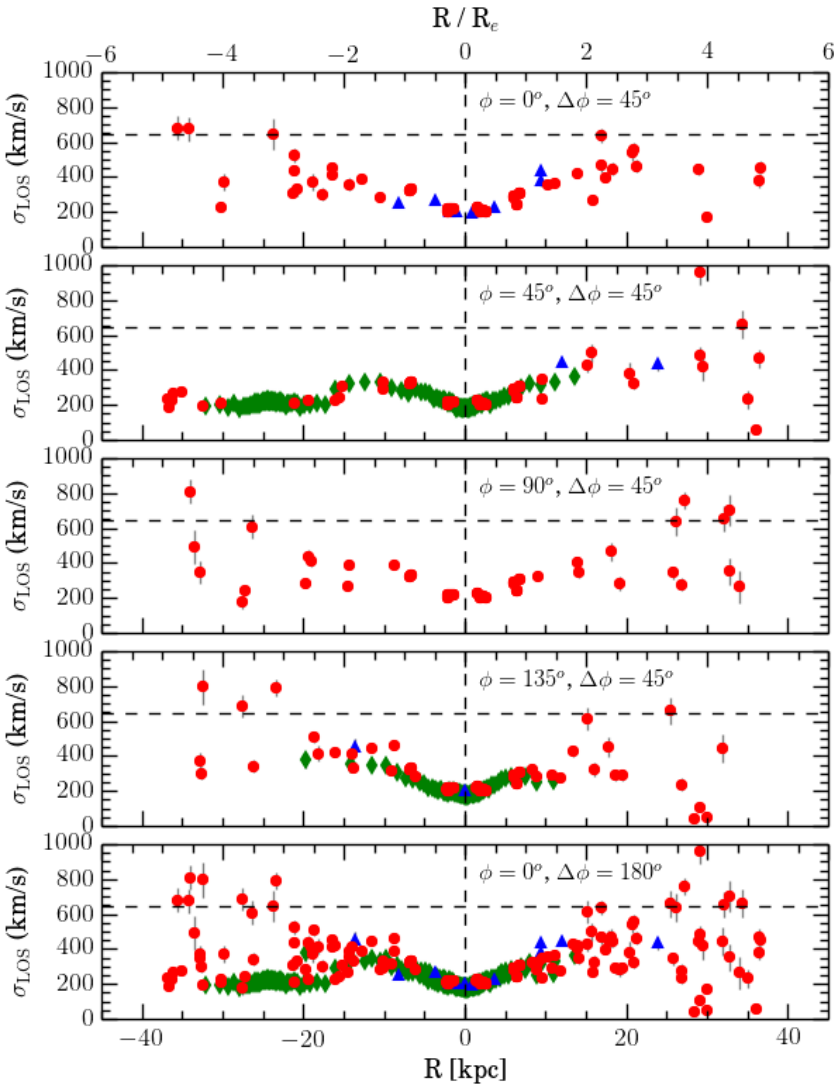
Methods



- S/N $>$ 5 required;
- LOSVD with pPXF (Cappellari & Emsellem 2004);
- Absorption-line strength in the Lick/IDS system.

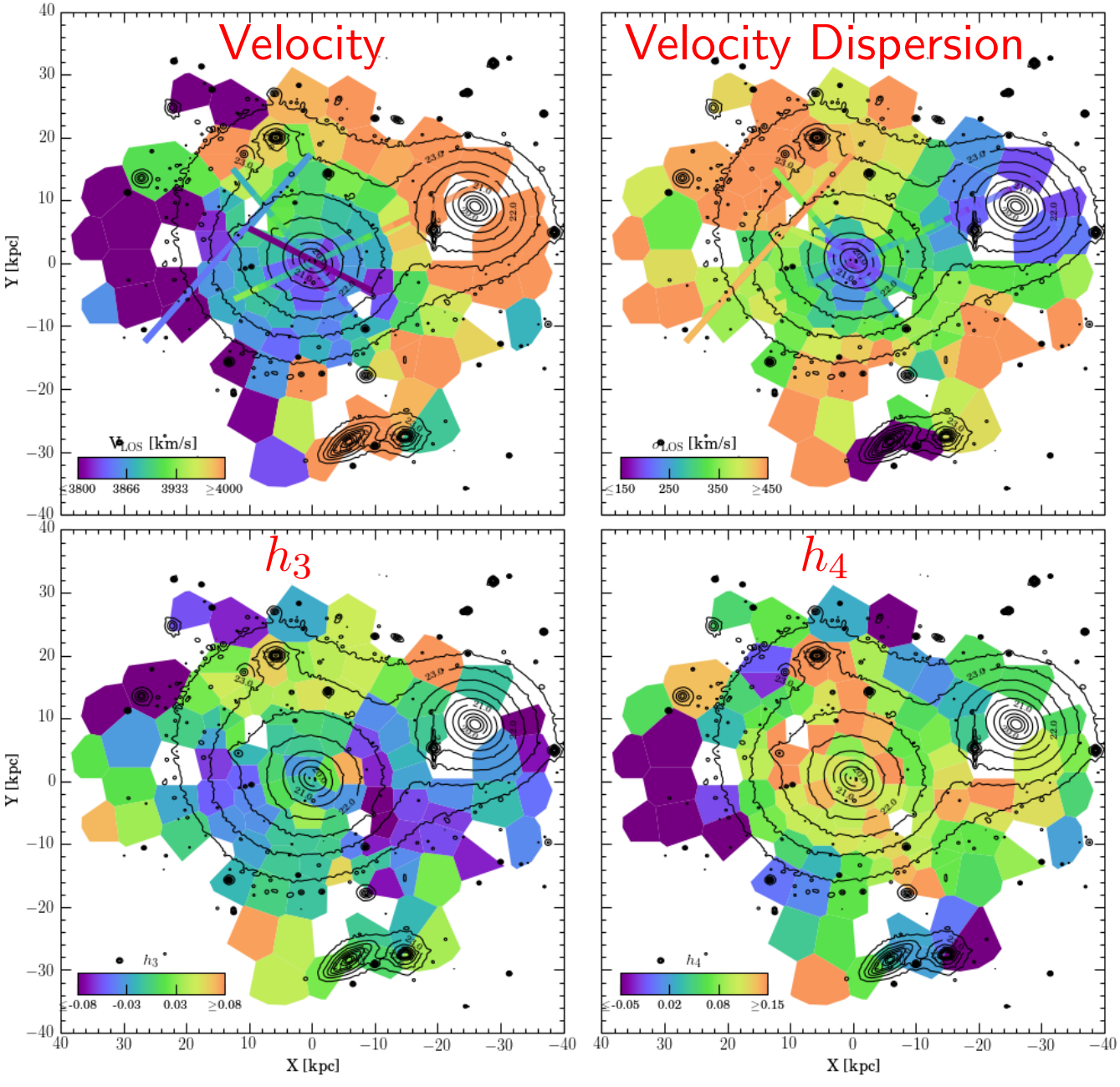


Velocity dispersion profile

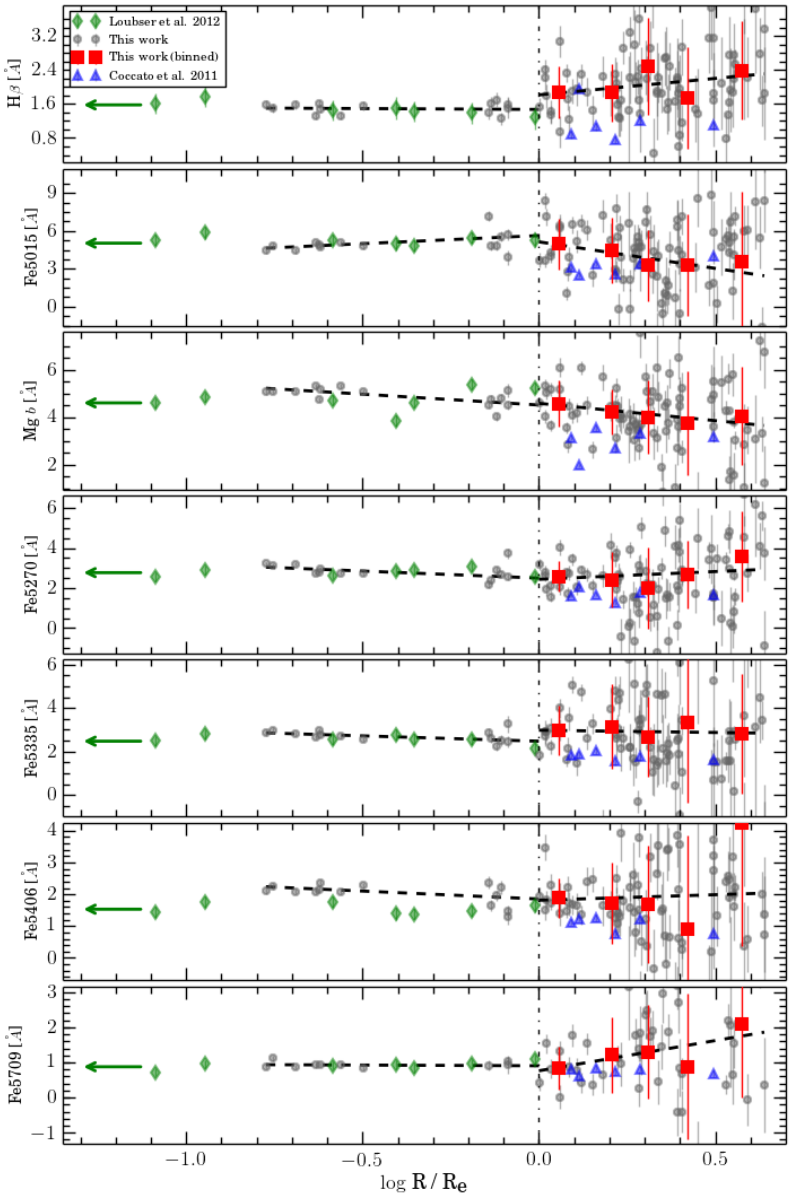


- Agreement with previous long-slit analysis.
- Asymmetric profile.
- Extension to the cluster galaxies velocity dispersion ($\sigma_{\text{gal}} = 647$ km/s, Struble & Rood, 1999).
- Superposition of different stellar populations in the line-of-sight may be causing the high velocity dispersion in some regions.

Four moments of velocity distribution

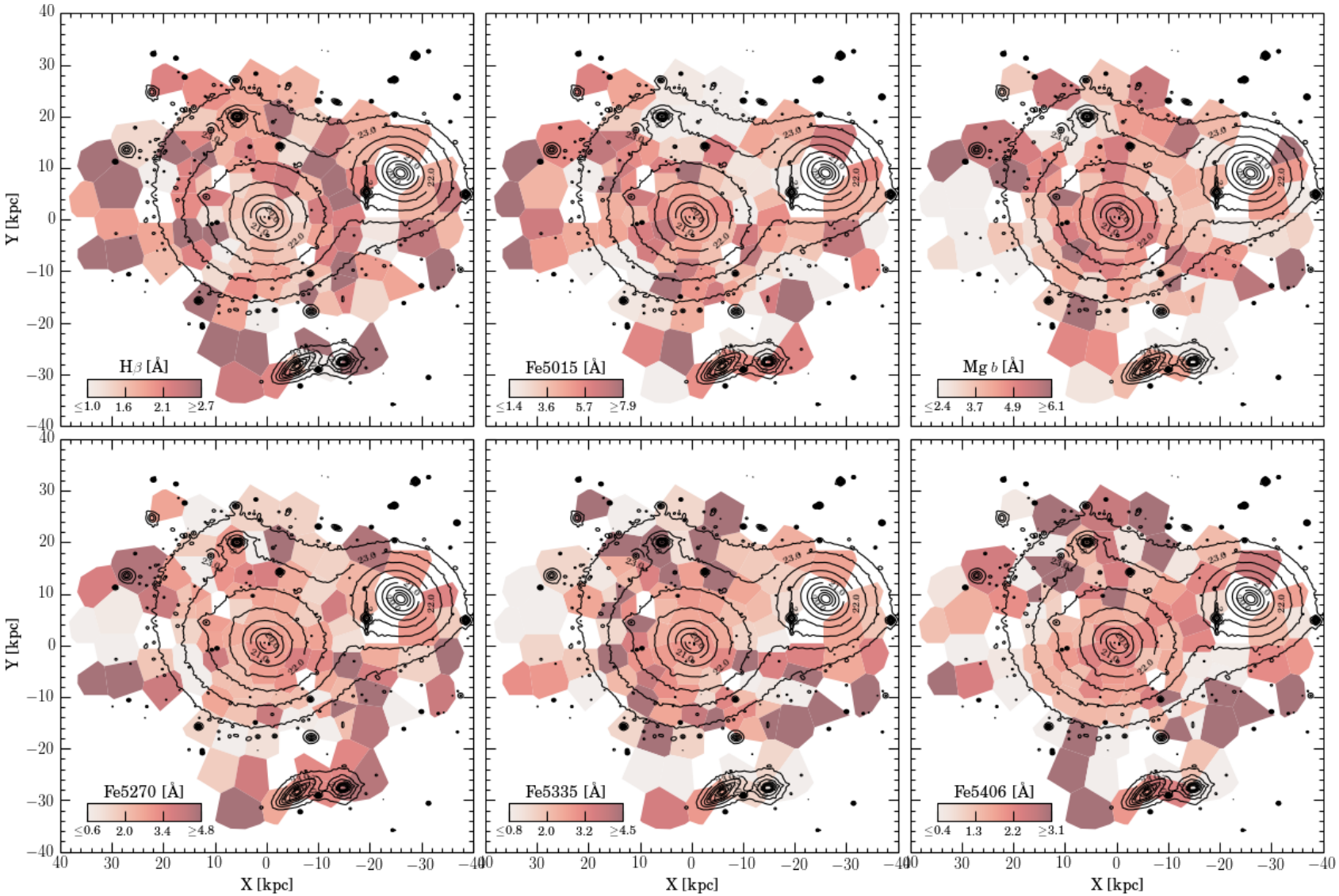


Radial profiles of the Lick indices



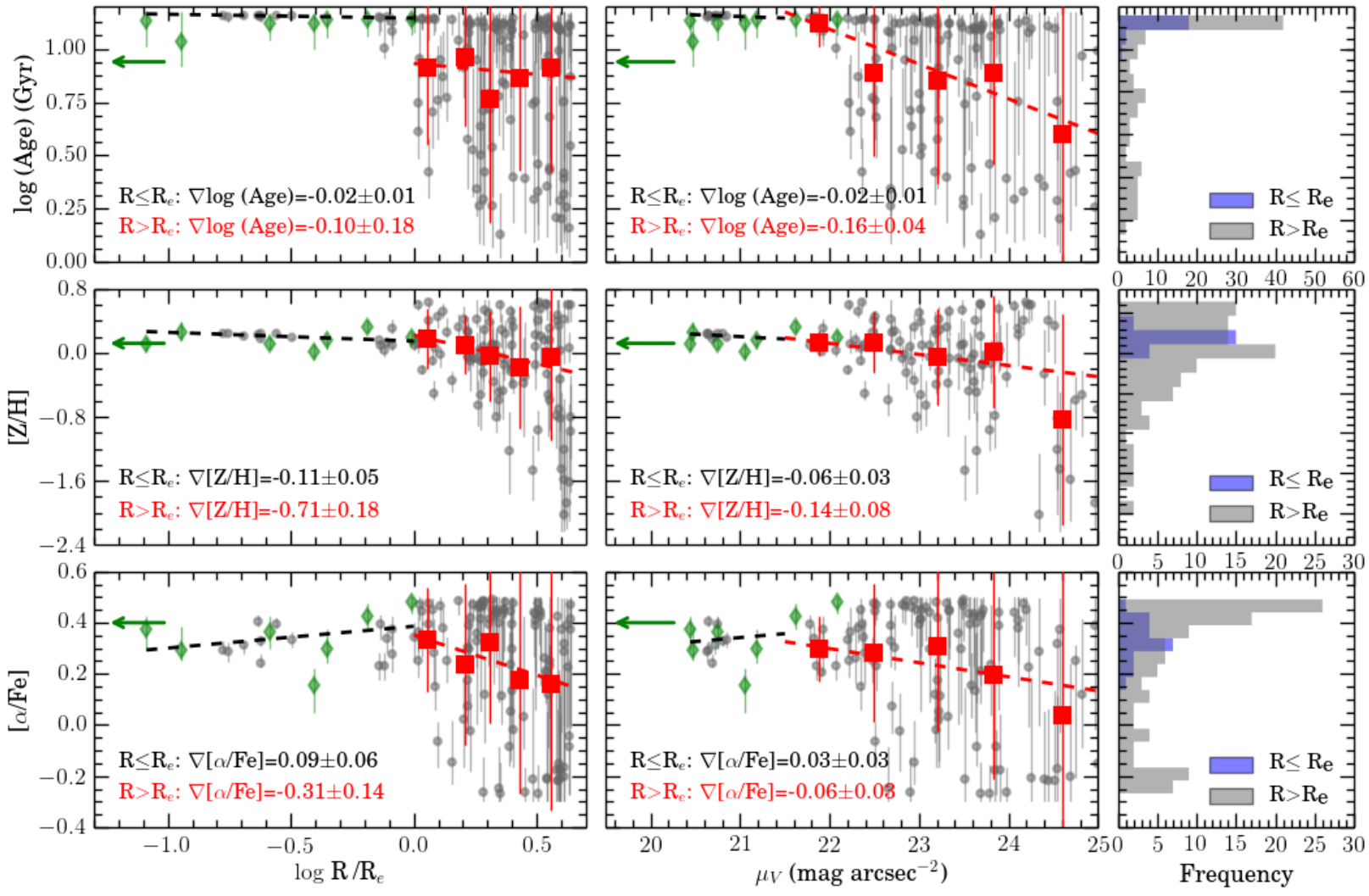
- Scatter is not solely due to S/N, but representative of the azimuthal variation.
- Significant break in gradients at $R \approx R_e$: Hβ, Fe5015, Fe5270, Fe5406, Fe5709
- Indication of the different stellar population for the inner and outer halos independent of model.

Mapping of the Lick indices

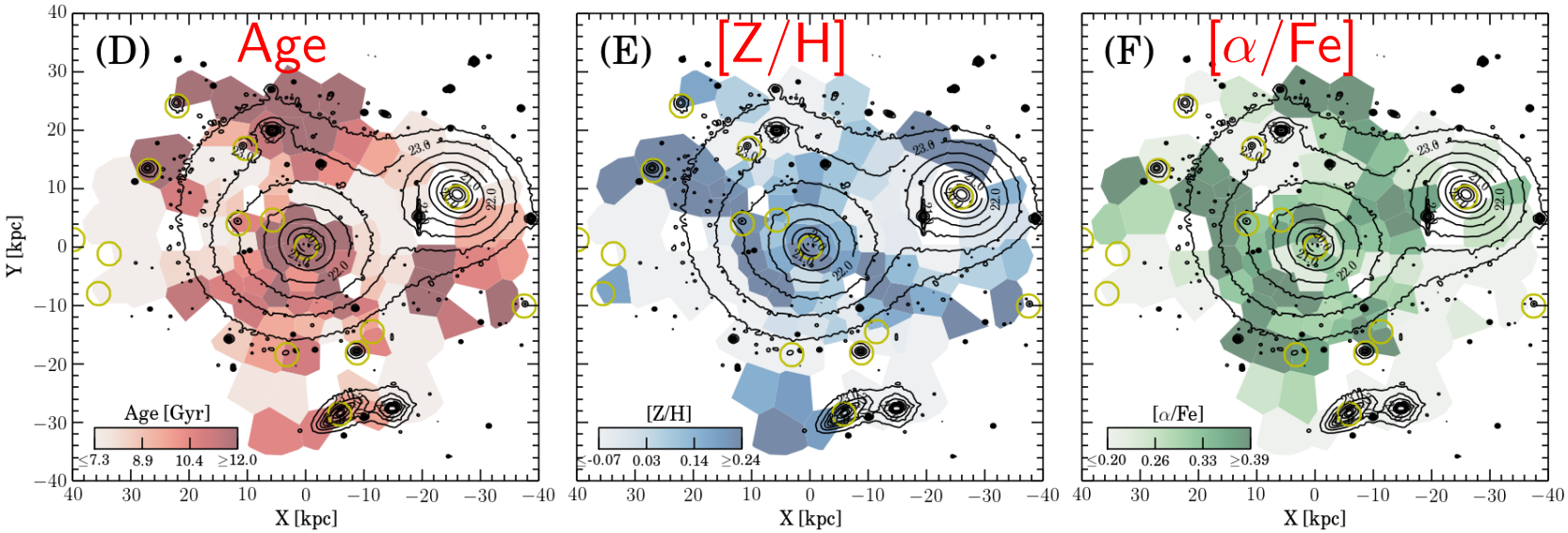


Radial profile for age, metallicity and [α/Fe]

- Modelling of the indices with SSPs from Thomas et al. 2011



Mapping of the stellar populations



- Metallicity gradient ratio in agreement with Pastorello et al. 2014.
- Inner halo ($R < R_e$) dominated by old, metal rich population: in situ
- Outer halo ($R > R_e$) shows indicate a superposition of populations: the extension of the inner halo + accreted material from satellite galaxies.

Summary

- We obtained 2D maps for the line-of-sight velocity distribution and for the stellar population parameters of NGC 3311.
- Velocity dispersion in NGC 3311 varies both as function of the galactocentric distance and as function of the azimuthal angle.
- Stellar population analysis is consistent with current picture of two-phase scenario of formation of massive elliptical galaxies.
  - $R \sim R_e$ indicate a transition between two stellar populations in NGC 3311.
  - Inner halo of the galaxy is old, metal and [α/Fe] rich.
  - Outer halo contains both an extension of the inner halo plus a population of metal and [α/Fe] poor, possibly stripped from satellite galaxies.