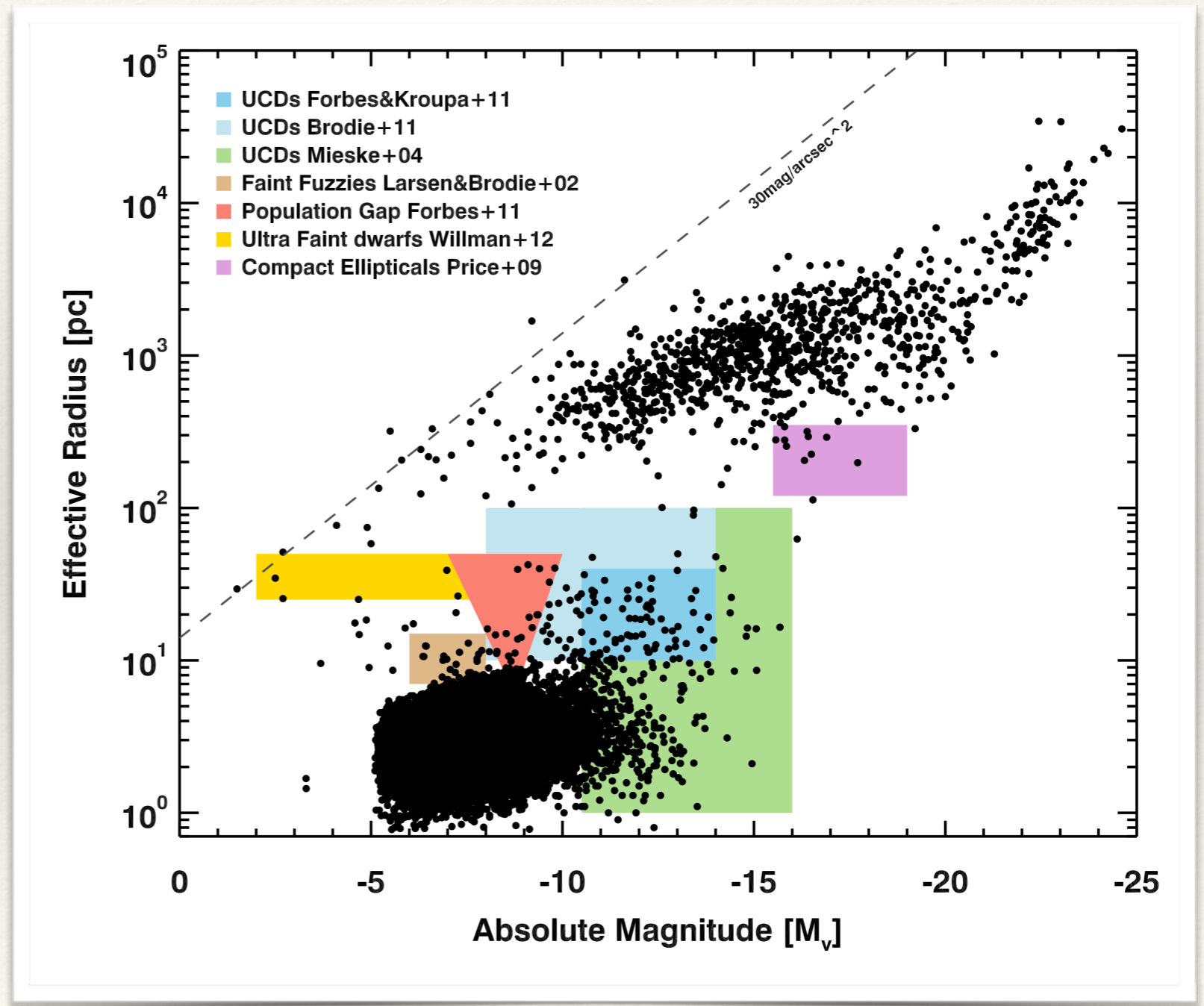# The origins of the Ultra Compact dwarfs in the Halo of NGC1399

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What are UCDs?

- Objects in the "blue" and/or "green" box

- Sizes between 3-100pc

- $-14 < M_V < -9$

- No coherent definition available as their nature is unclear.

Legend:
- UCDs Forbes&Kroupa+11
- UCDs Brodie+11
- UCDs Mieske+04
- Faint Fuzzies Larsen&Brodie+02
- Population Gap Forbes+11
- Ultra Faint dwarfs Willman+12
- Compact Ellipticals Price+09

30mag/arcsec^2

Effective Radius [pc]

Absolute Magnitude [M_v]

Voggel et al. prep. (based on Misgeld&Hilker 2011)

What are the origins of UCDs?

Two possible formation channels:

1. The high mass end of the GC luminosity function

2. The stripped nuclei of dwarf Elliptical galaxies

->**If UCDs are stripped dE galaxies they are tracers of the buildup of the stellar halo to which they lost their material**

-> Goal: constrain the contribution of each formation channel to the final luminosity function of UCDs with new strategies

The Stripping Scenario
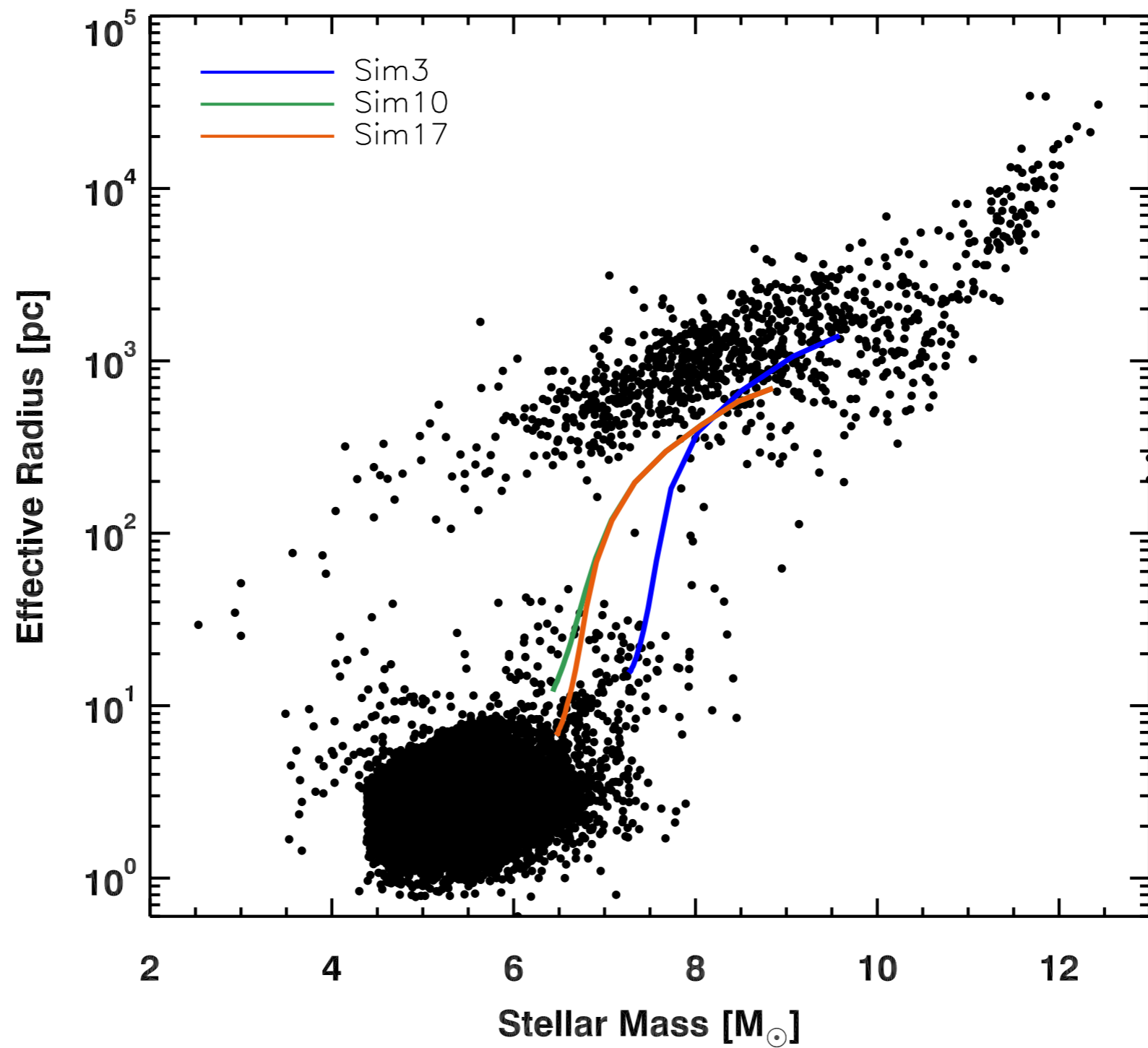
Voggel et al. in prep. (Simulation tracks based on Pfeffer&Baumgardt (2013))

Constraining Formation Channels

❖ Comparing the properties of large UCD sample to GCs/nuclei:

  ❖ Spatial Distribution

  ❖ Size-magnitude relation

  ❖ metallicity distribution

❖ Single UCDs

  ❖ color and magnitudes

  ❖ velocity dispersion to constrain dynamical mass

  ❖ surface brightness profiles / tidal features

  ❖ resolving the stellar populations

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- Single UCDs
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  - velocity dispersion to constrain dynamical mass
  - surface brightness profiles / tidal features
  - resolving the stellar populations

The Fornax cluster
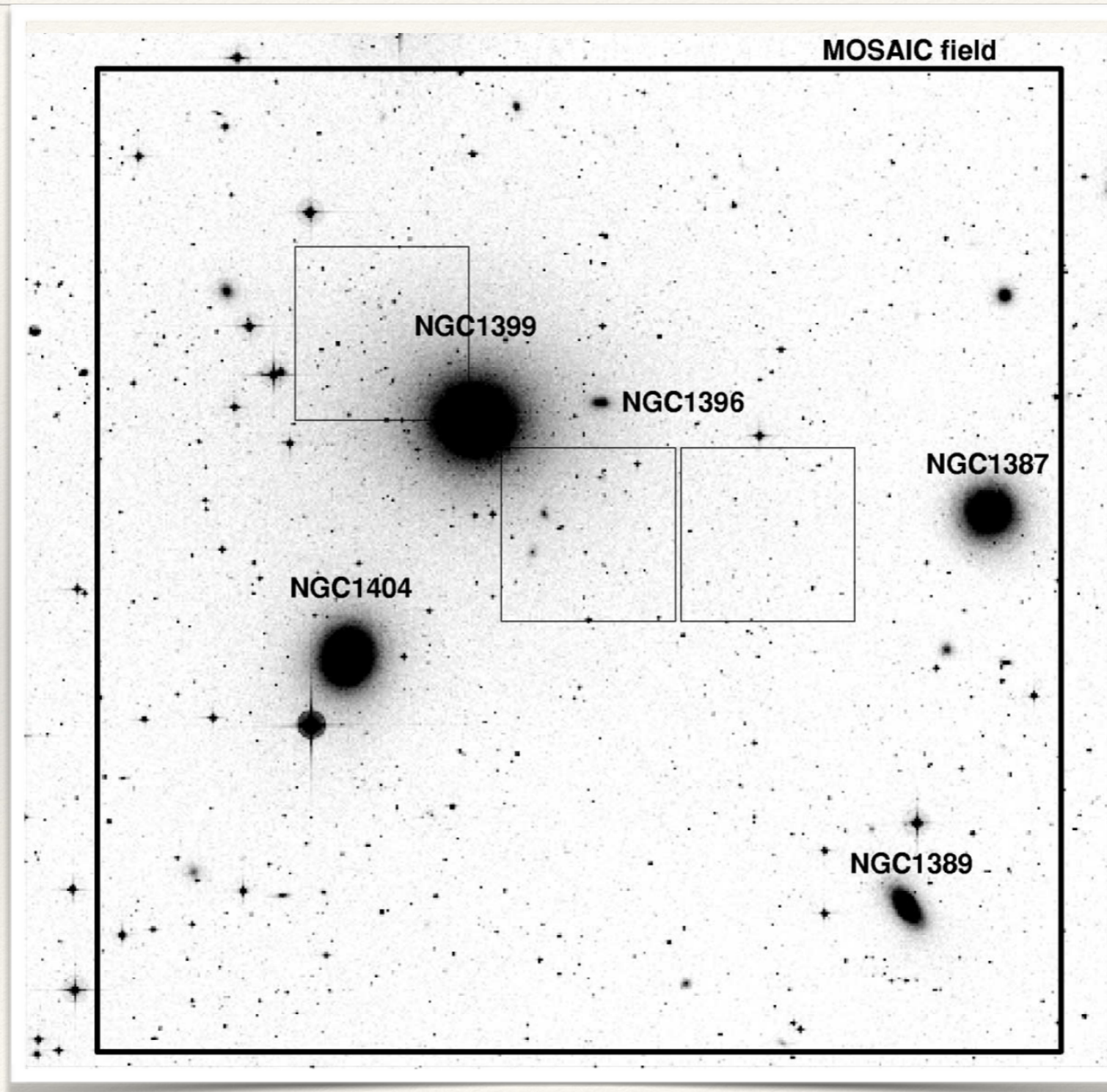
Dirsch et. al 2003

Spatial Distribution of UCDs and GCs

- Spatial distribution of GCs (black) and UCDs (blue) around NGC1399, the central Fornax galaxy
- All UCDs are confirmed members of the Fornax cluster
- Wide field sample of GCs and UCDs (Dirsch et al. 2003)
- Three smaller FORS2 fields with photometry on 109 UCDs in good 0.6″ seeing conditions
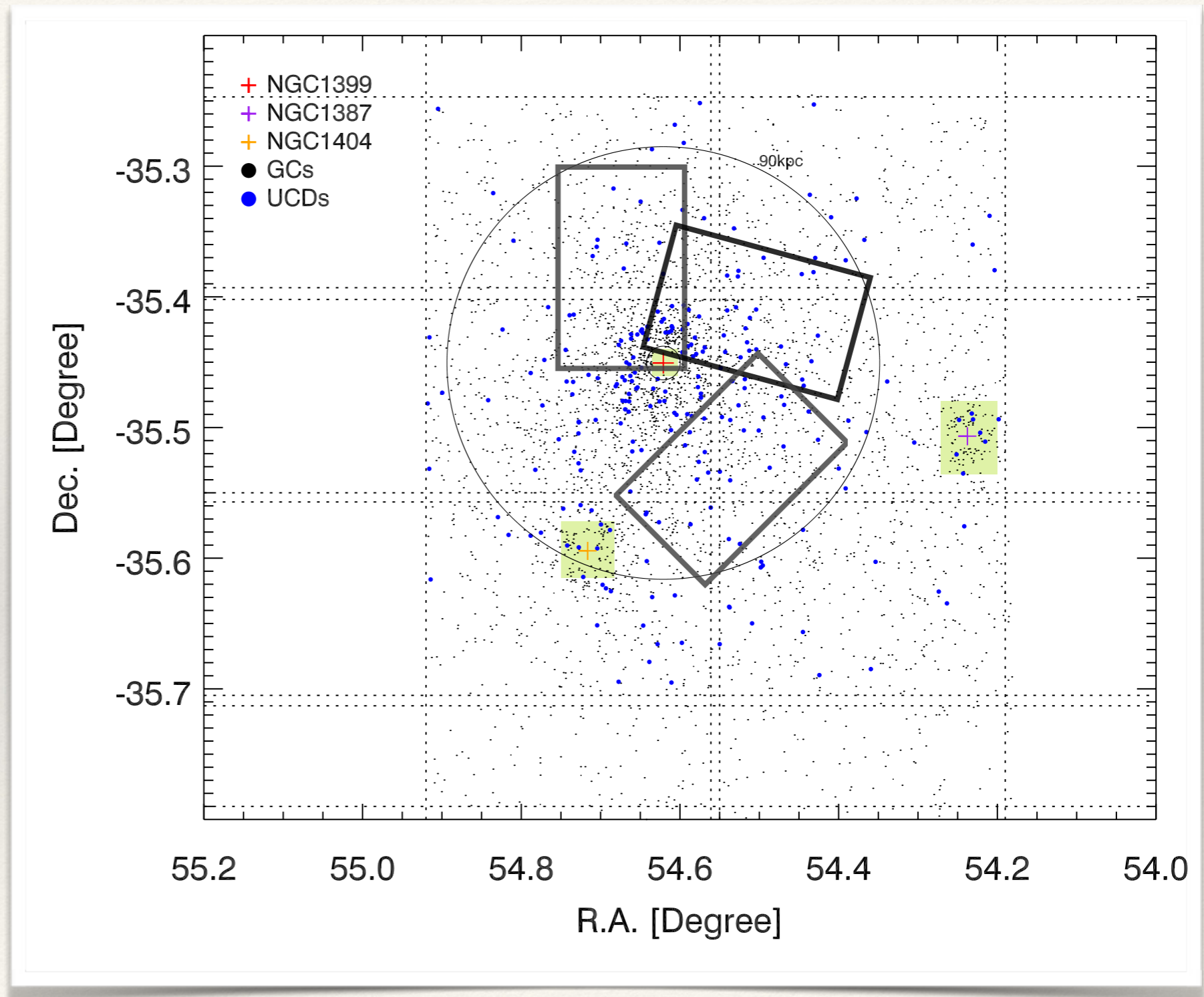
Voggel et al. to be submitted

Spatial distribution of GCs around NGC1399

* Projected surface density profiles around NGC1399
* Top panel: GC sample (red line) and UCD sample(green)
* Solid lines: Fitted power law to the surface density
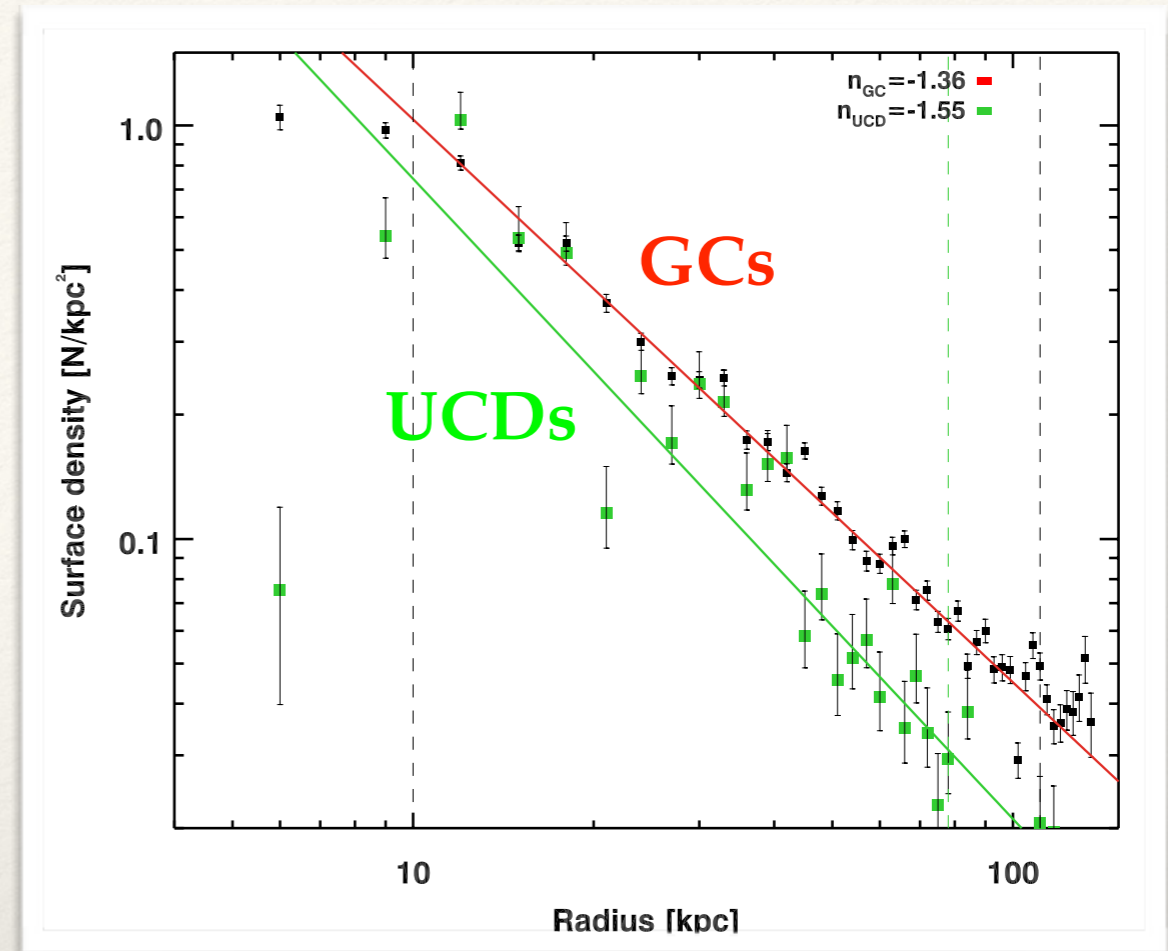
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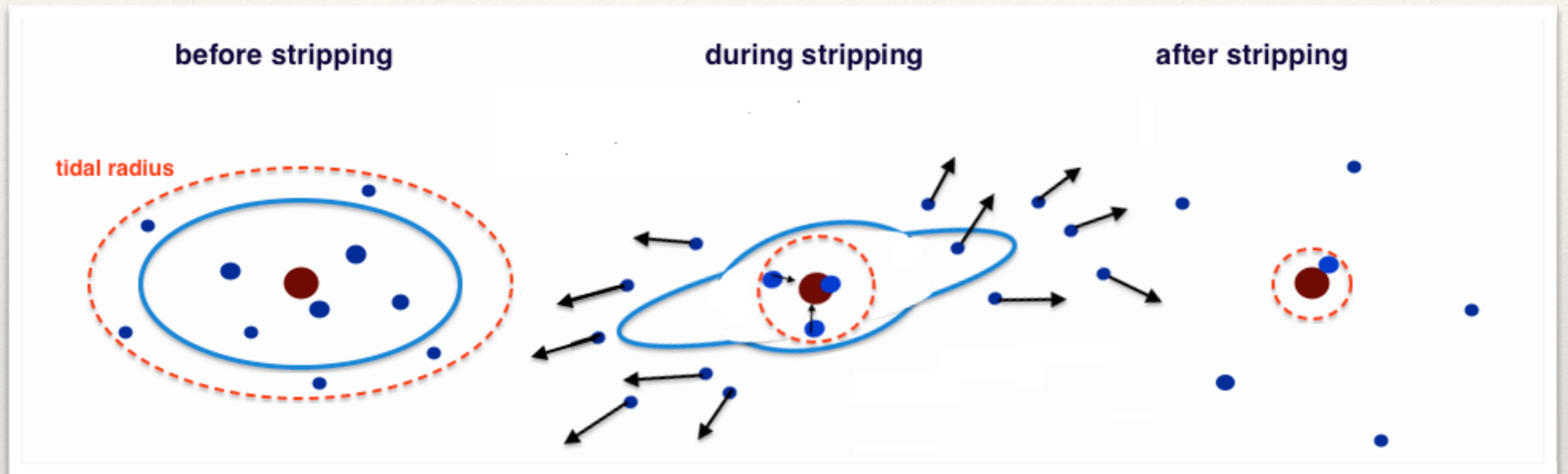- Solid lines: Fitted power law to the surface density
- Bottom panel: for the blue and red GC population separately
- Red population steeper and more centrally concentrated than the blue component
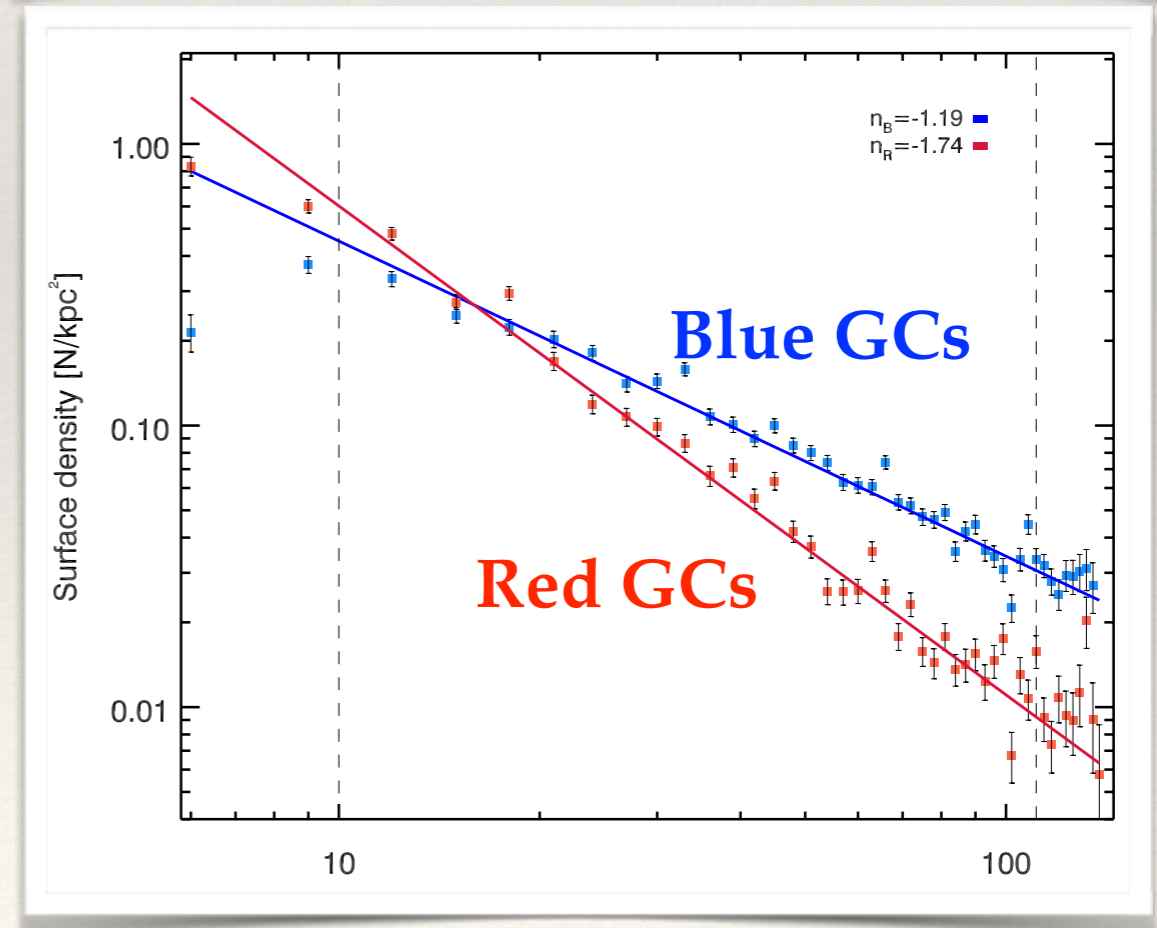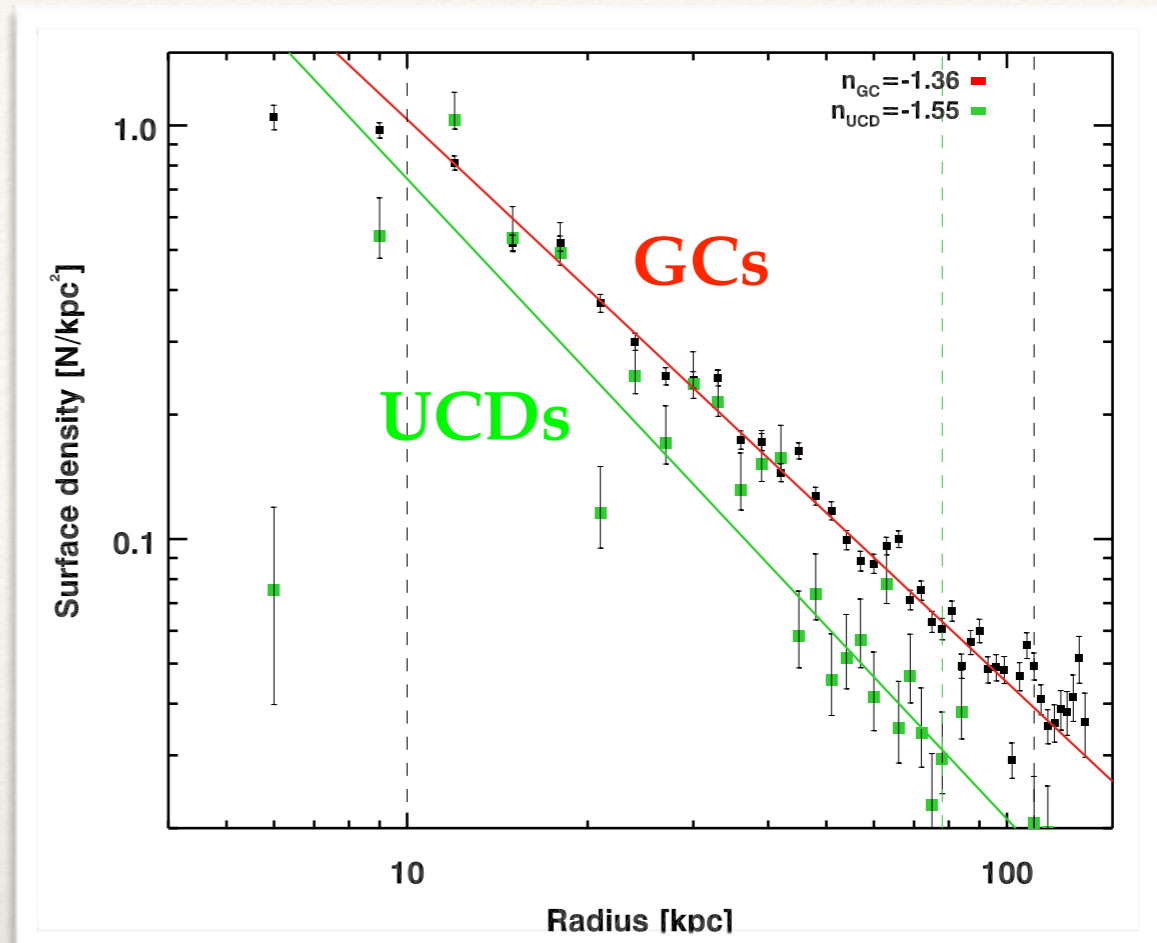
What happens to the GCs of a dE during stripping?

before stripping — tidal radius

during stripping

after stripping

dwarf Elliptical → **UCD**

GC system of dEs: Lotz et al. (2001, 2004)
Dynamical Friction: Arca-Sedda & Capuzzo-Dolcetta (2014), Capuzzo-Dolcetta,(1993)

# Spatial Clustering of GCs around UCDs

❖ Is the surface density of GCs around UCDs systematically higher than what is expected from the main distribution of the GCs in the halo?

-> We find a systematic *average* overdensity within 500pc for all GCs and the colour separated samples

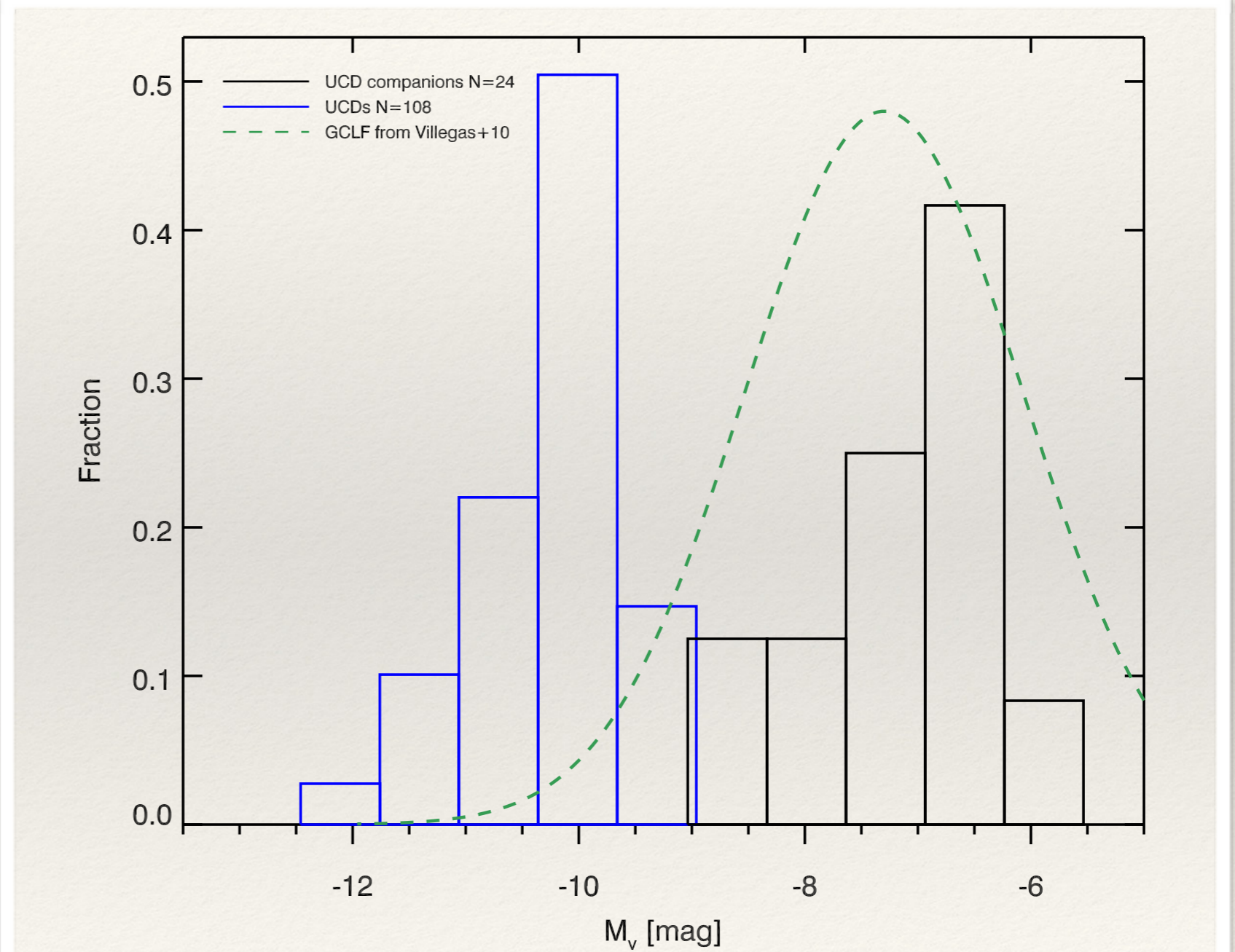-> Red GCs are correlated stronger with UCDs than blue ones
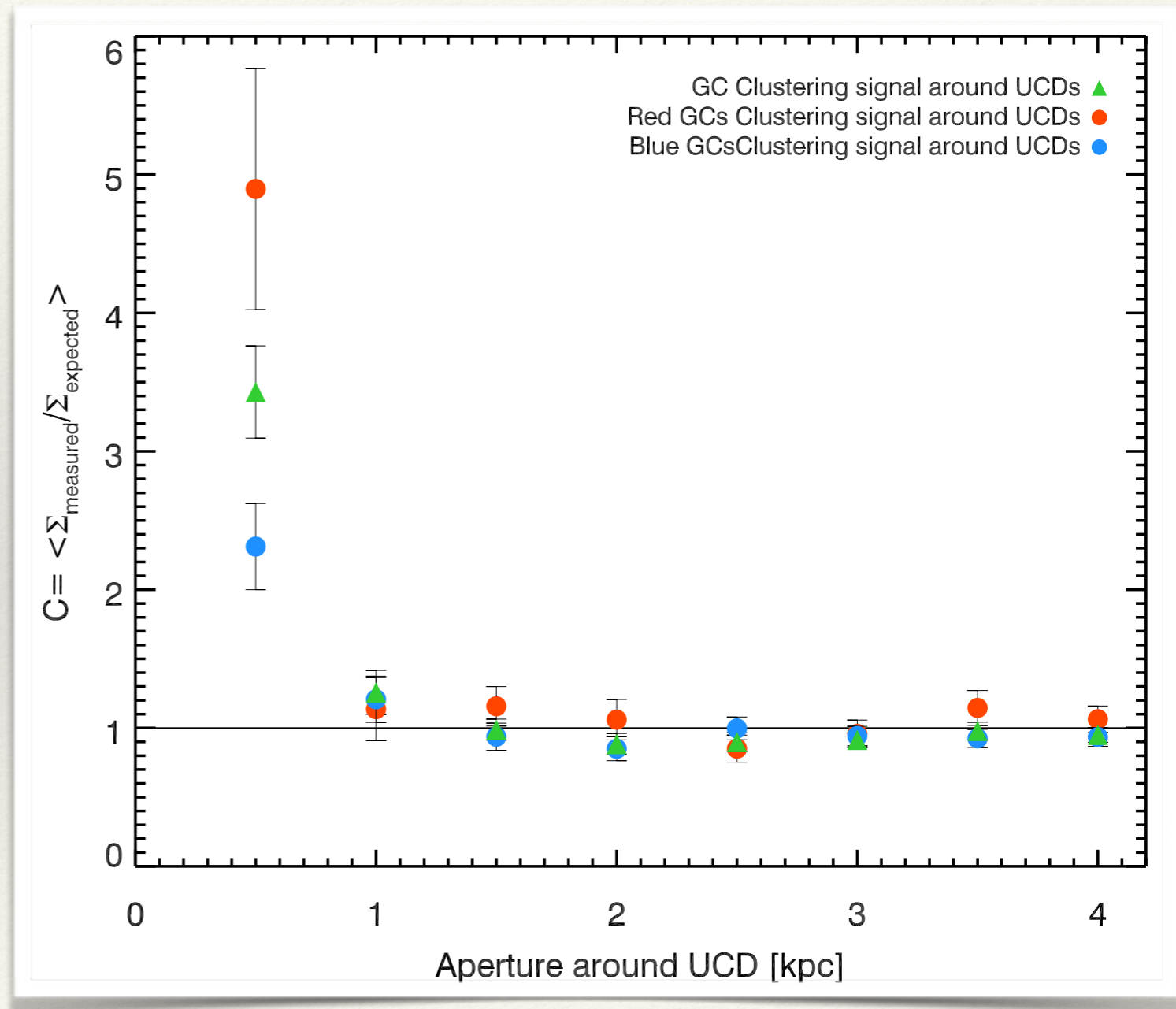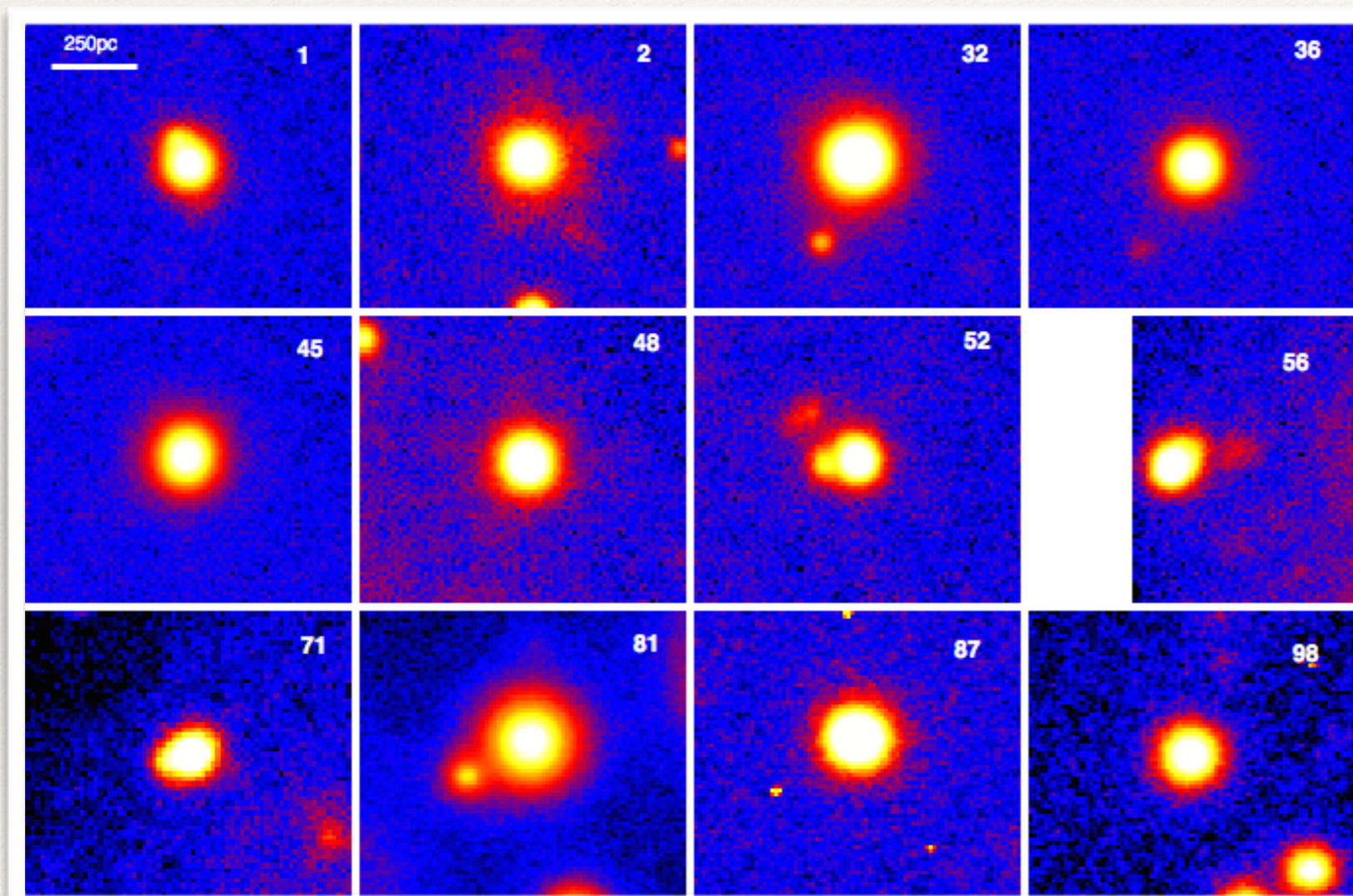
Surface Brightness Profiles of UCDs
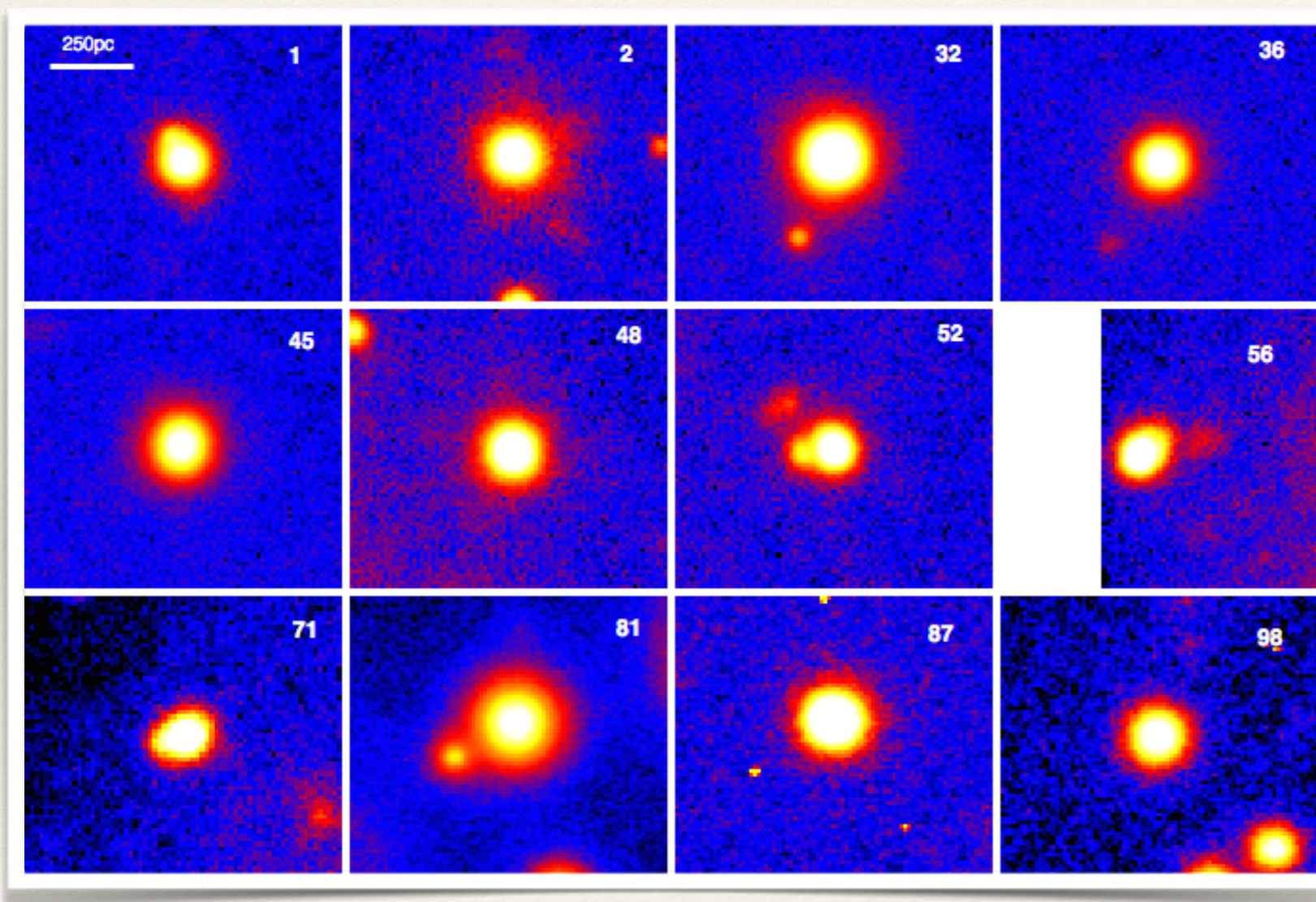
❖ Studied detailed structural composition of 108 UCDs in the halo of NGC 1399 by fitting several profiles with GALFIT

Luminosity Function of UCDs and GCs

- Luminosity Function of UCDs in the FORS fields (blue)

- GCLF of NGC1399 from Villegas et al. 2010 in dashed green

- For the 24 objects that showed very nearby point sources (r<200pc) we measured their magnitude after subtracting the UCD model

- Histogram of companion sources to the UCDs in black

Surface Brightness Profiles of UCDs

- Studied detailed structural composition of 108 UCDs in the halo of NGC 1399 by fitting several profiles with GALFIT

- 16 UCDs (14.8%) are extended above the resolution limit of ~23pc when fitted in a single Sersic fit

- Fitted a core+envelope model with fixed 10pc King core and a Sersic envelope

Magnitude Size Plane

Single Component

Effective Radius [pc]

M_V [mag]
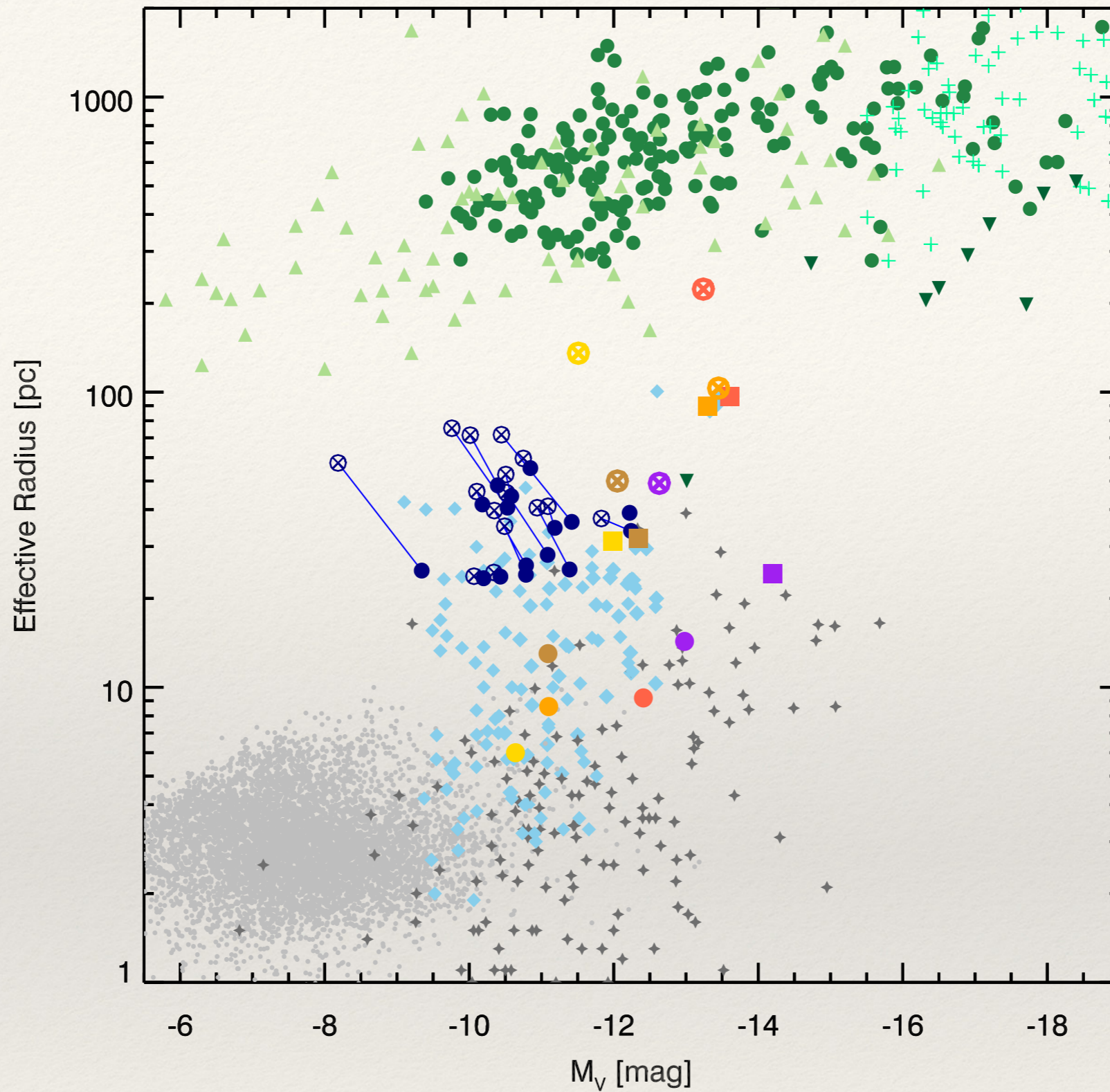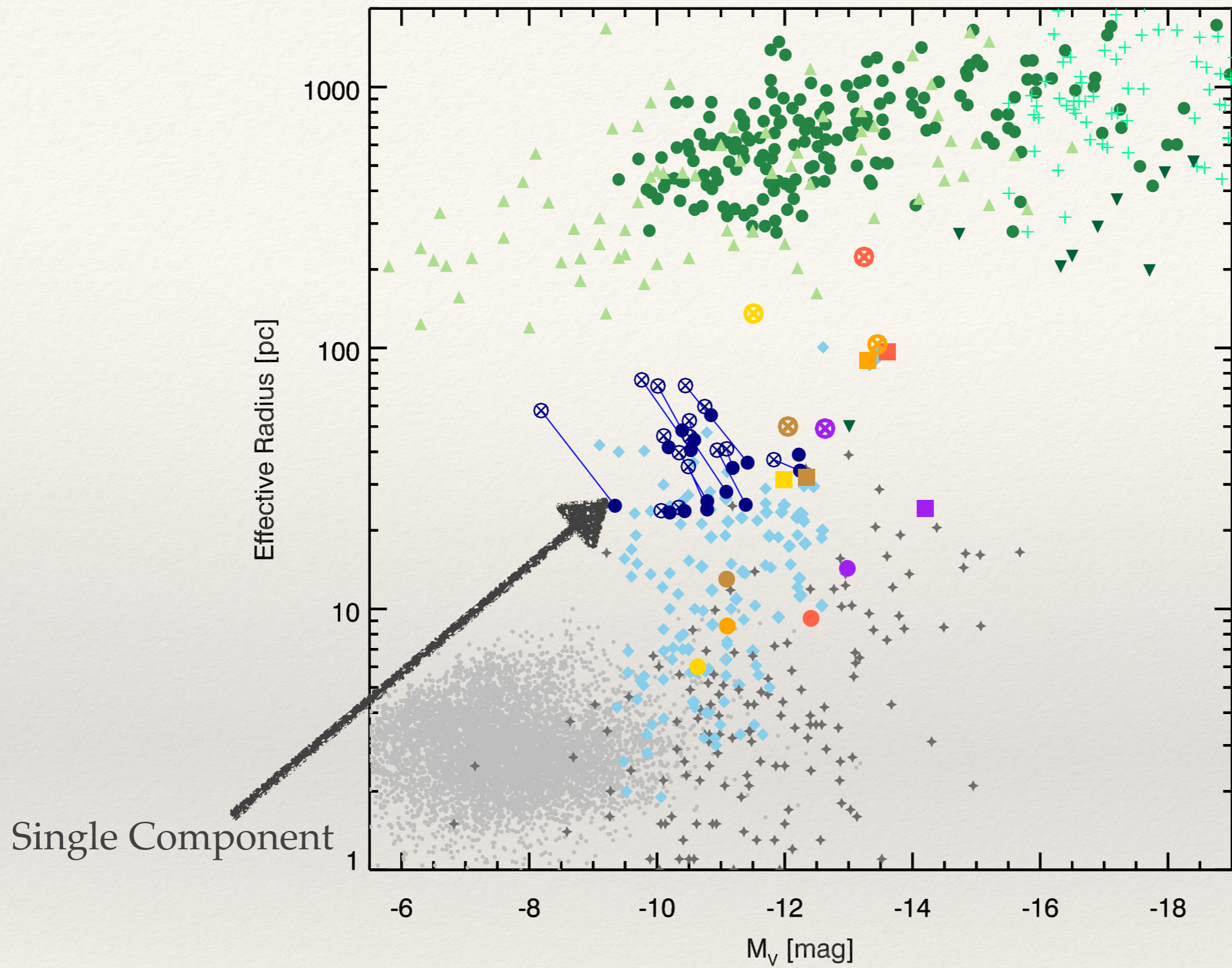
Magnitude Size Plane
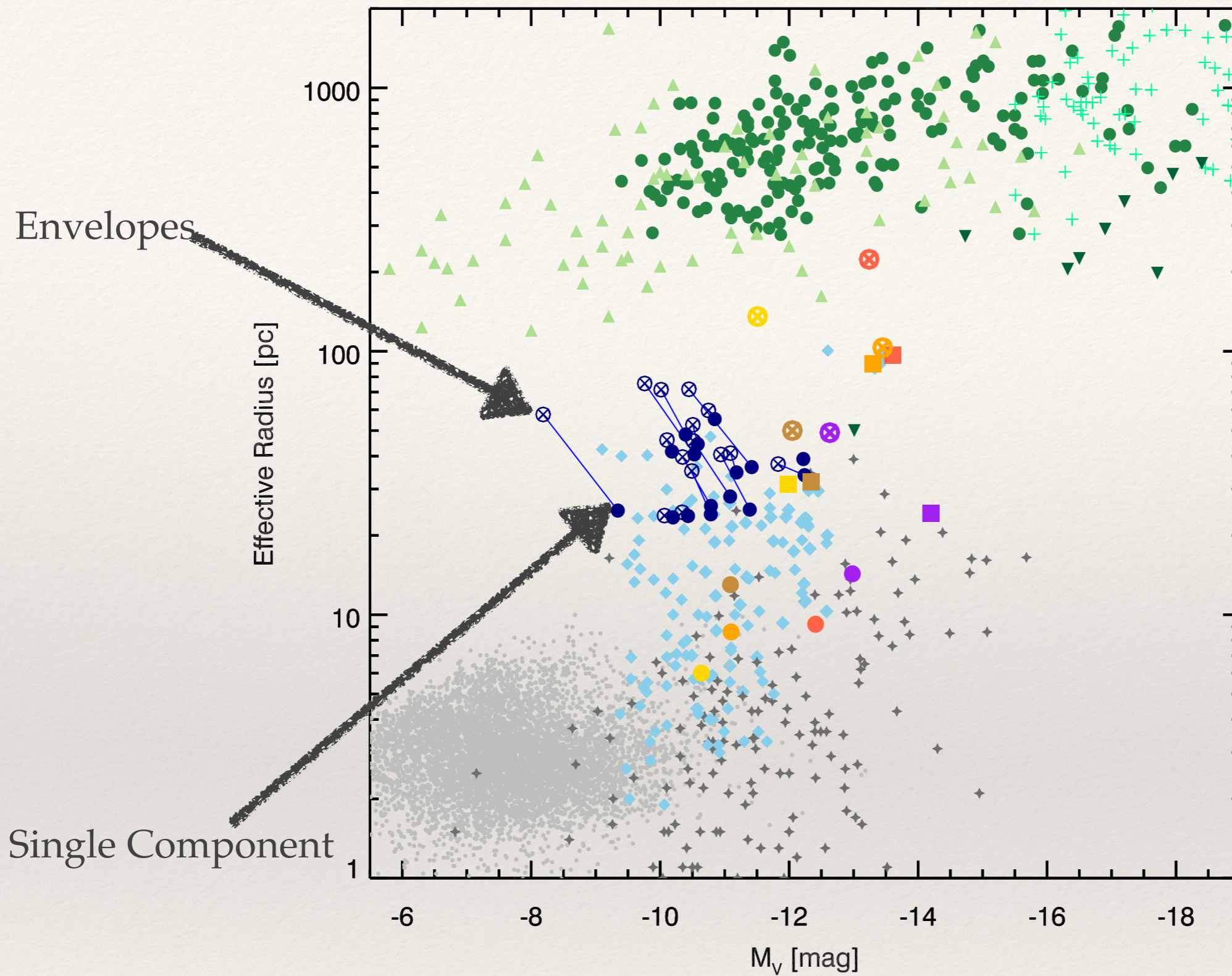
Magnitude Size Plane

Tidal tails around UCDs

- Two large tidal tails detected with ~350pc radial extension found around UCD in Fornax

- high relative radial velocity v=1074km/s compared to NGC1399 with v=1425km/s

- In total 18 objects show stripping evidence. Which agrees with predictions from Pfeffer et al. (2014) which expect $21.19^{+10.41}_{-8.95}$ stripped nuclei for the surface of our FORS fields

—> Direct observation of the transformation of a dE galaxy into a UCD?
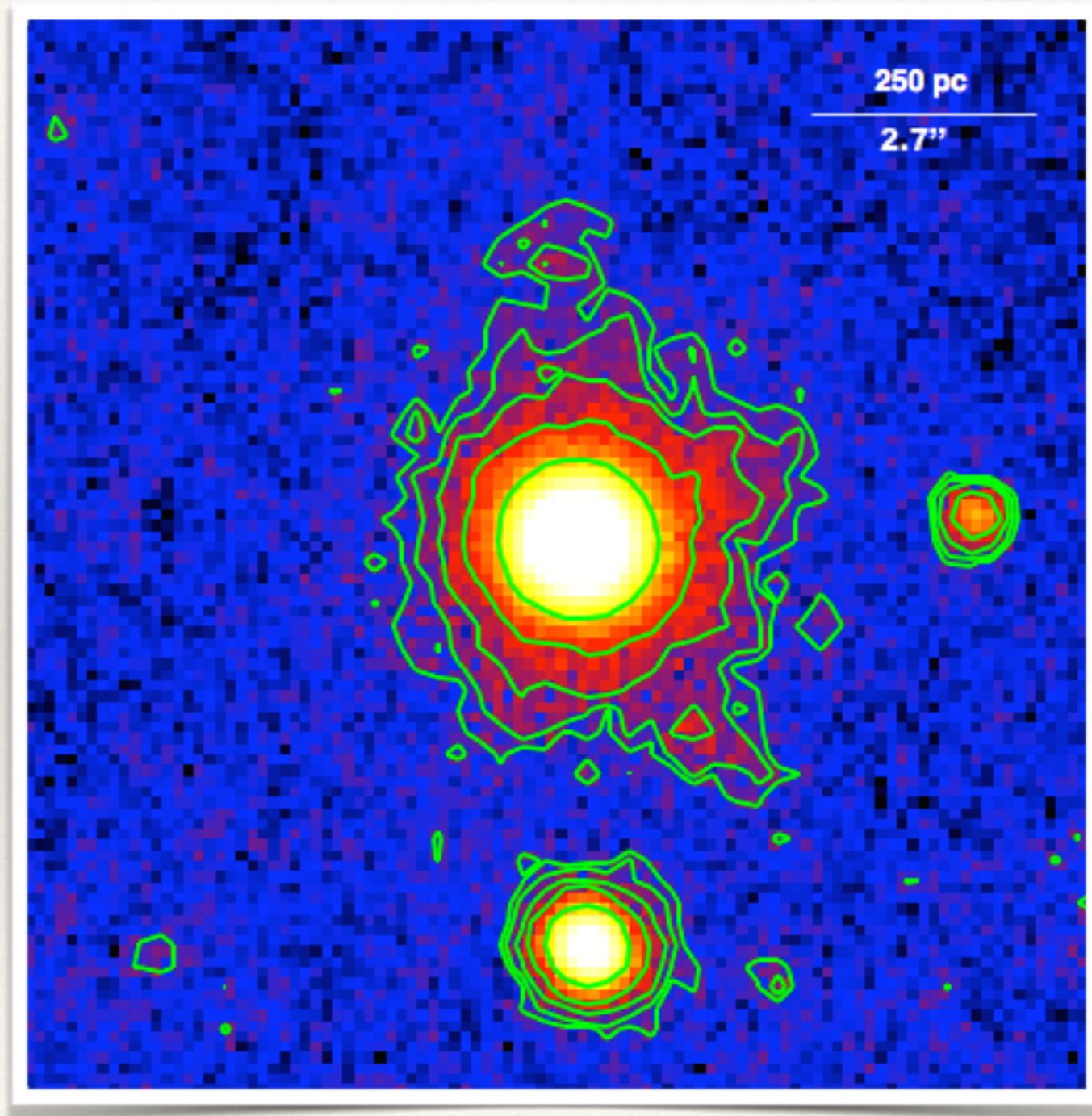
Summary

❖ GCs are significantly more common at 500pc around UCDs compared with what is expected from the global distribution -> UCDs and GCs are spatially correlated

❖ Large UCDs well fitted with Sersic profiles. When decomposing into two components, the envelop lies in between galaxy and star cluster branch in size magnitude space.

❖ First direct evidence for UCD formation through tidal stripping.

❖ 16.67% of our UCDs have direct stripping evidence which is in agreement with predictions from simulation and a lower limit for the contribution of the stripped nuclei UCD formation channel.

-> UCDs can trace the buildup of the Galactic Halo