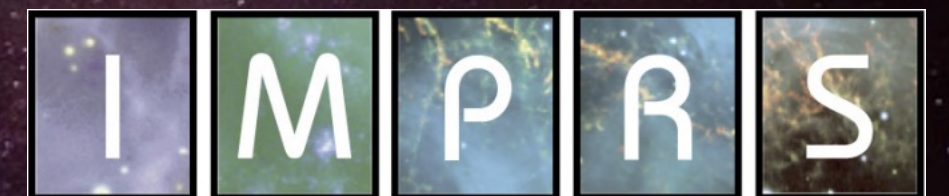


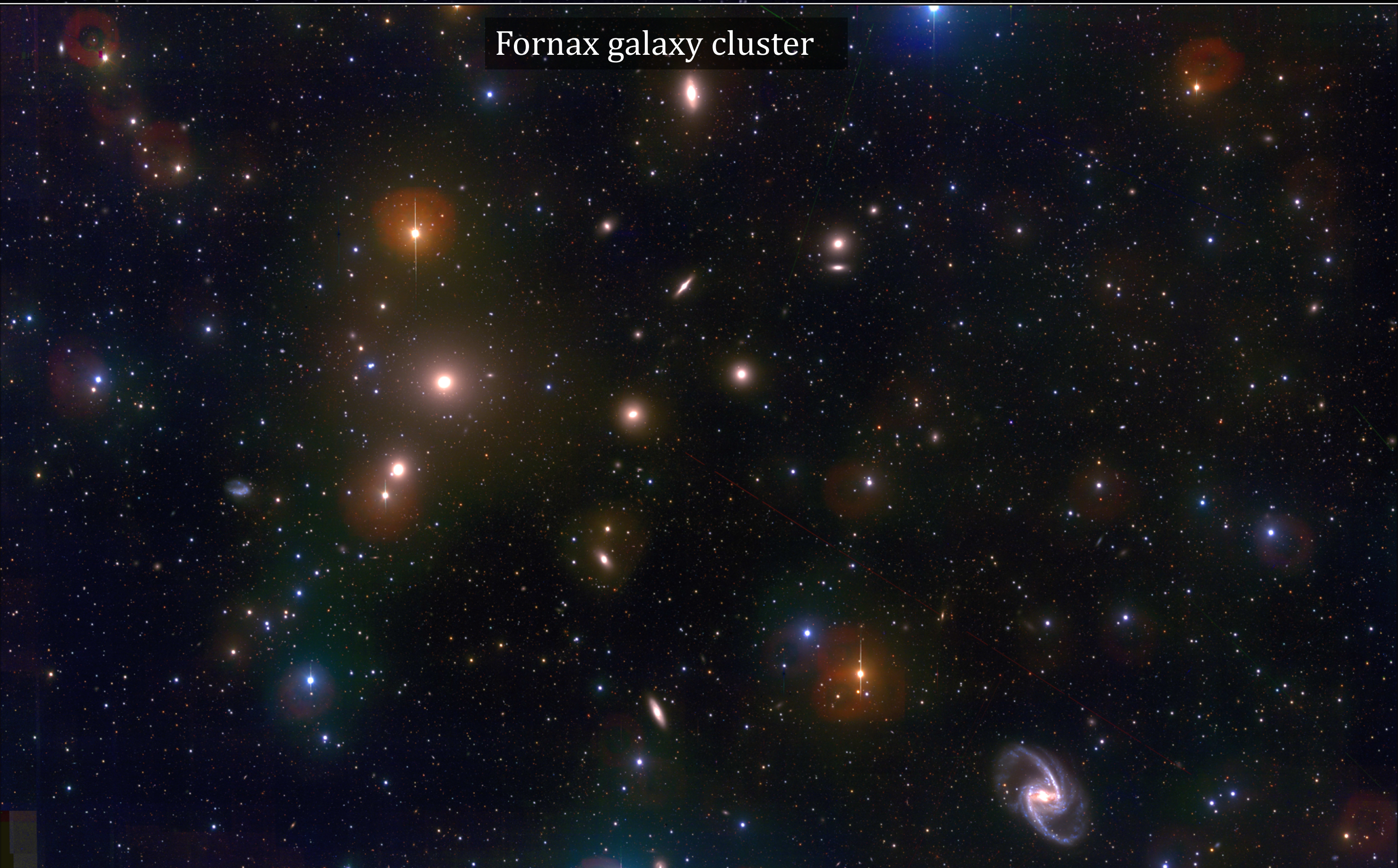
Exploring mass assembly of the Fornax galaxy cluster with globular clusters

by
Avinash Chaturvedi
ESO, Garching

Michael Hilker

Glenn Van de Ven, Nicola Napolitano, Katja Fahrion



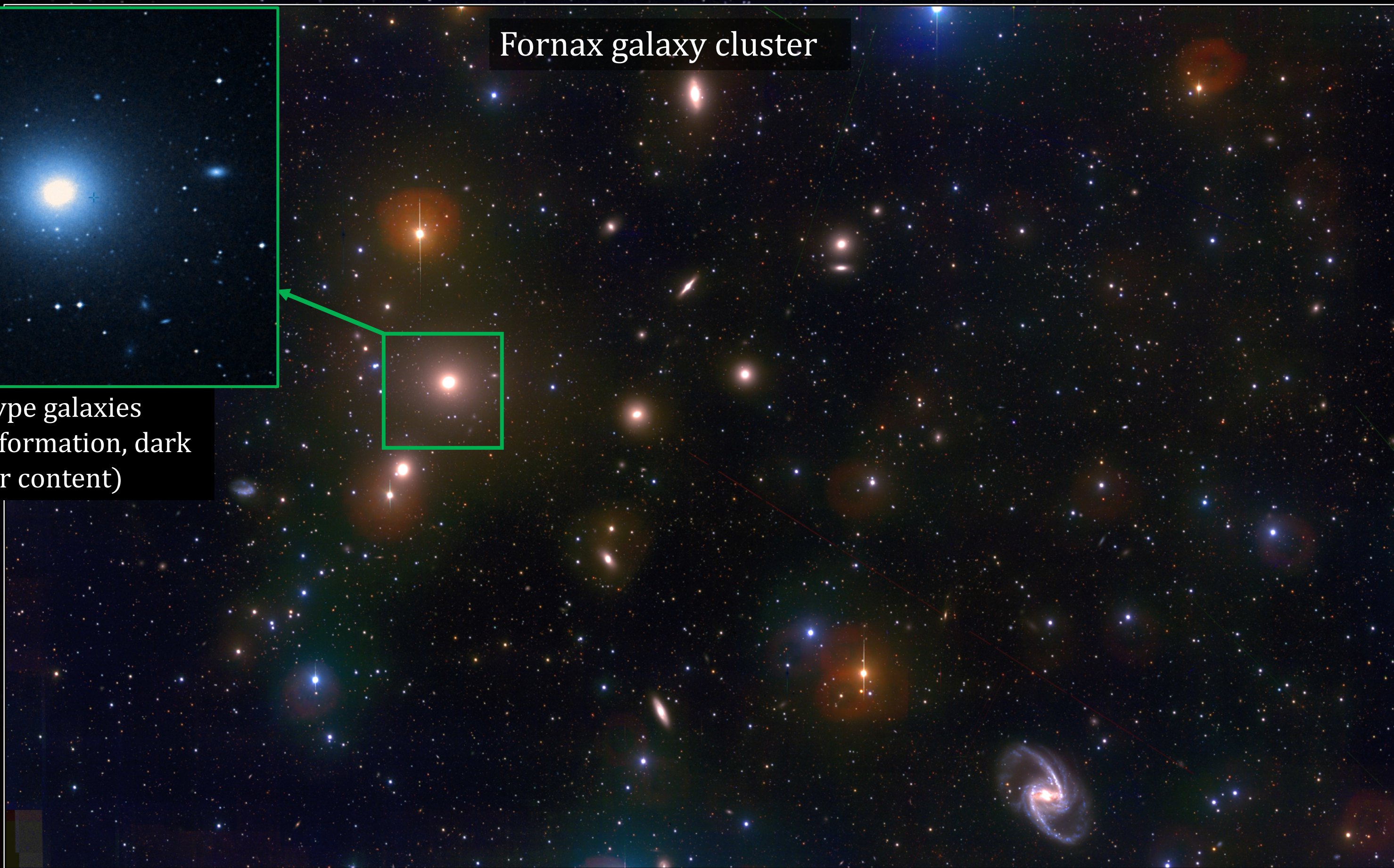


Credits : ESO



Fornax galaxy cluster

Early-type galaxies
(structure, formation, dark
matter content)



Credits : ESO

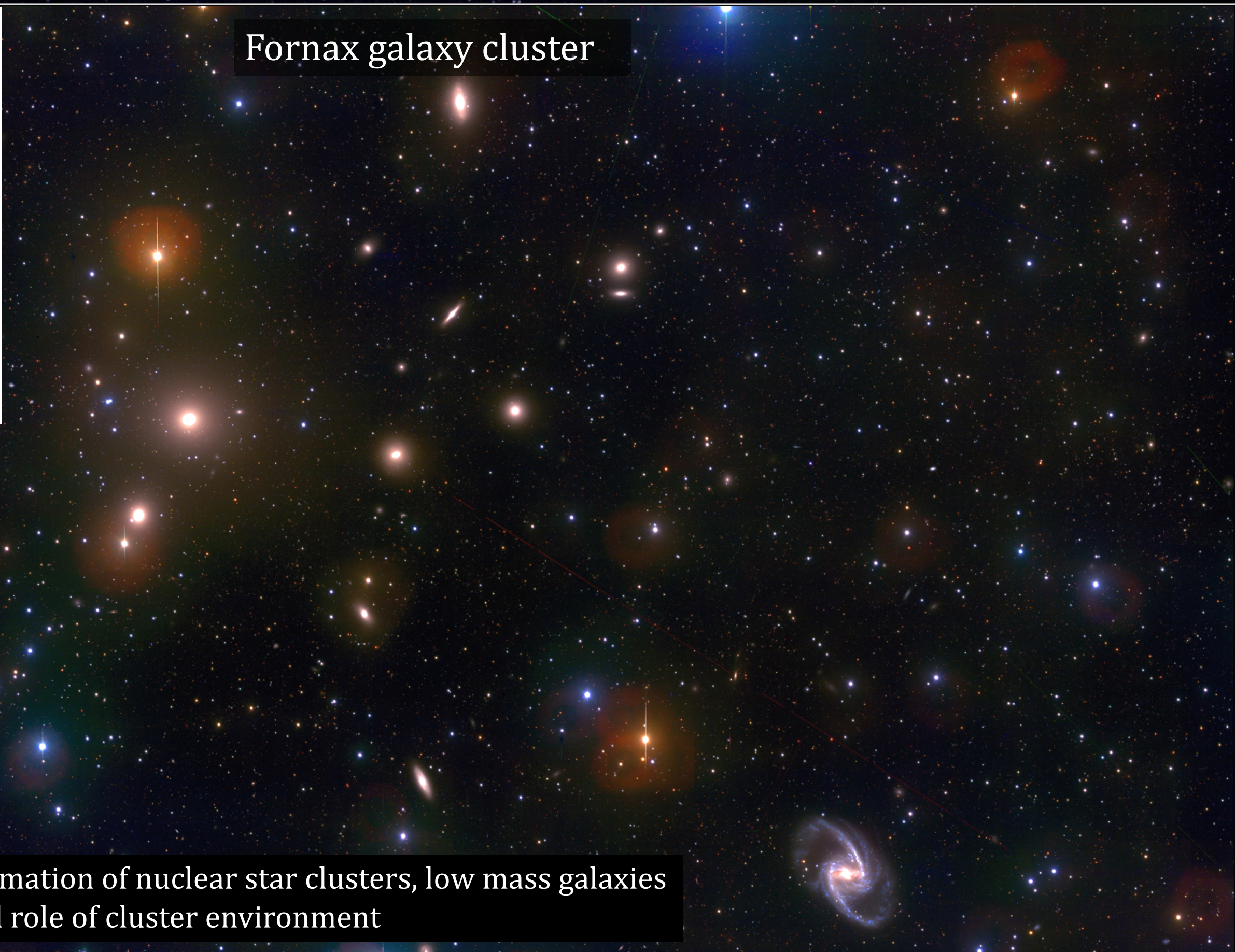


Early-type galaxies
(structure, formation, dark
matter content)



Formation of nuclear star clusters, low mass galaxies
and role of cluster environment

Fornax galaxy cluster

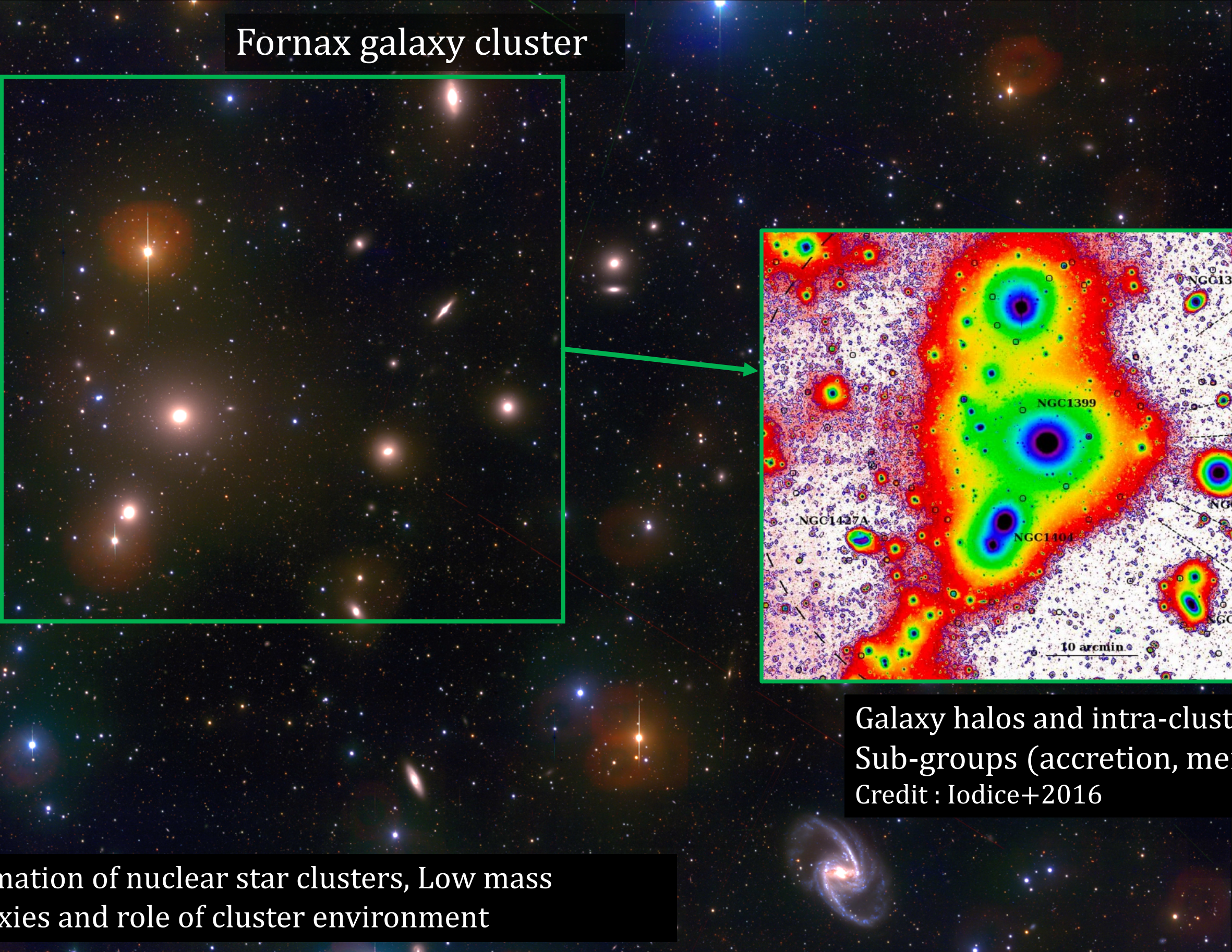




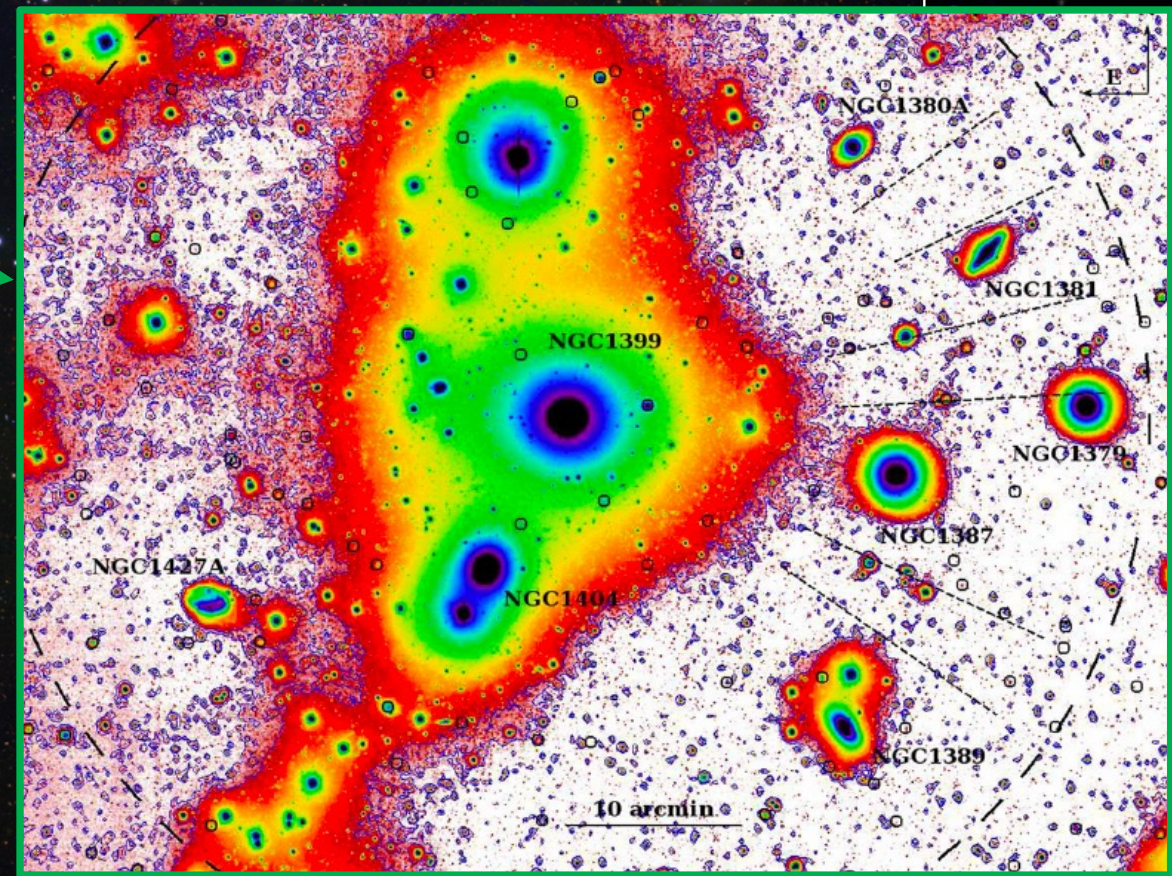
Early-type galaxies
(structure, formation, dark matter content)



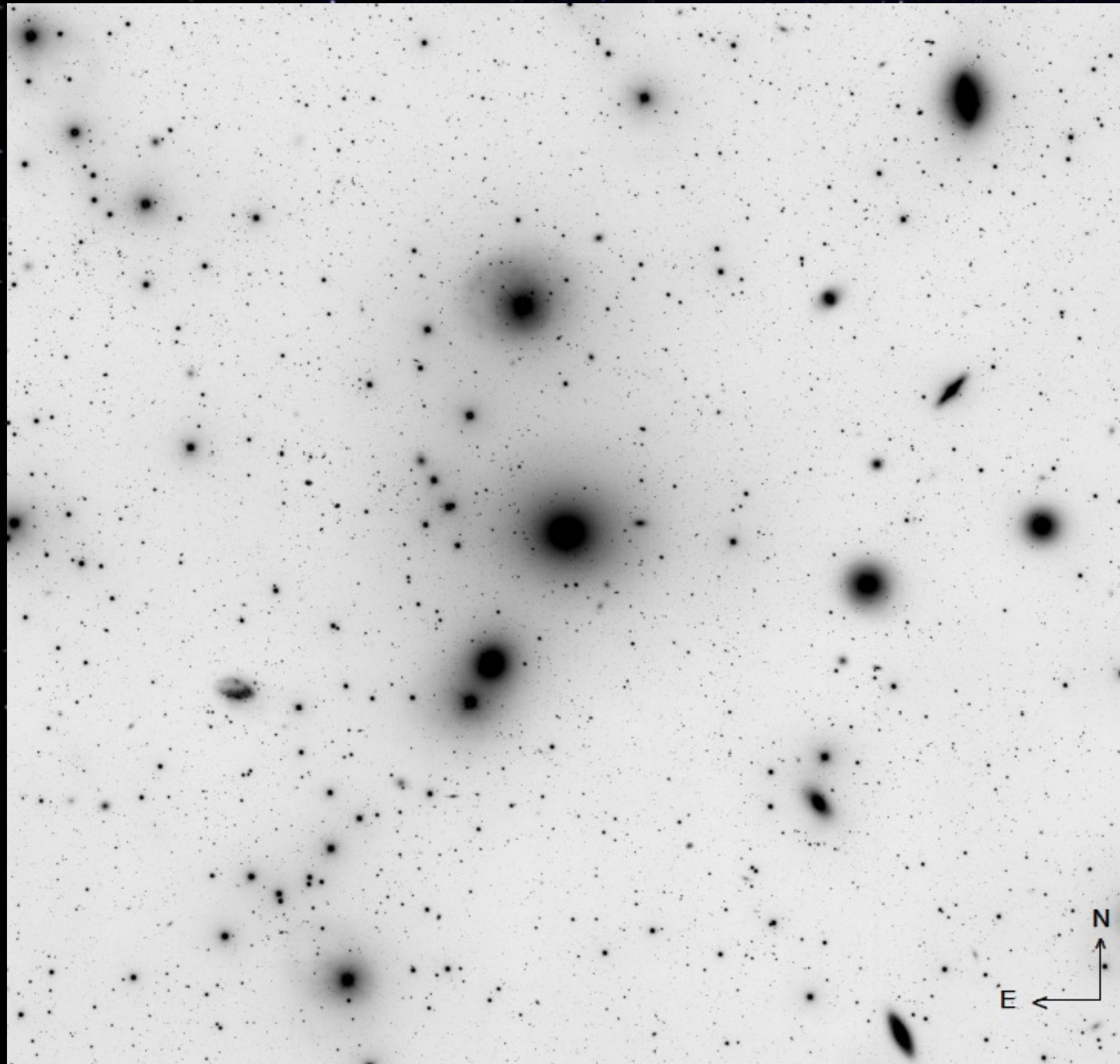
Formation of nuclear star clusters, Low mass galaxies and role of cluster environment



Fornax galaxy cluster



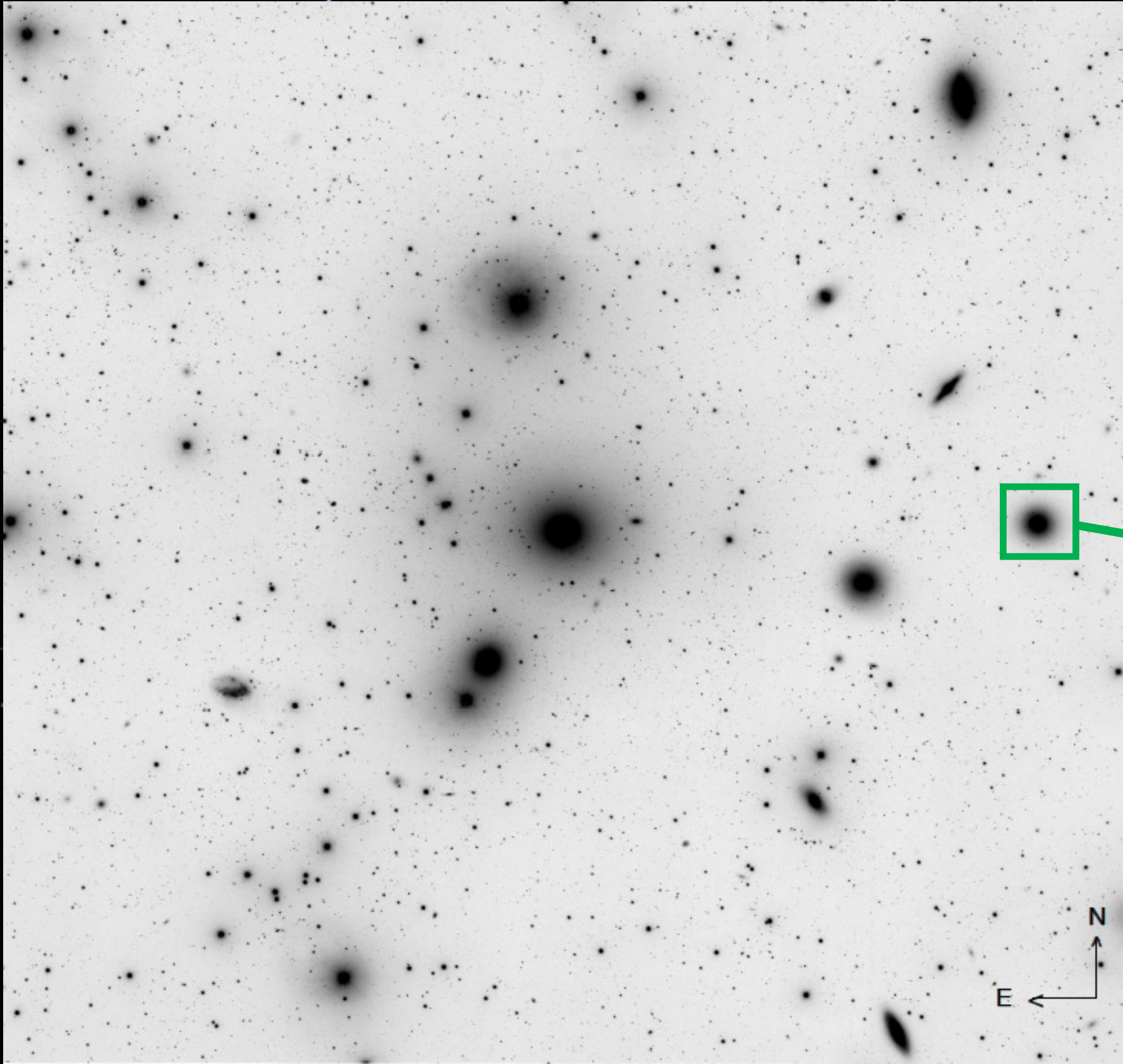
Galaxy halos and intra-cluster light
Sub-groups (accretion, merger)
Credit : Iodice+2016



Credits : ESO archive ,FDS Survey PI: Capaccioli

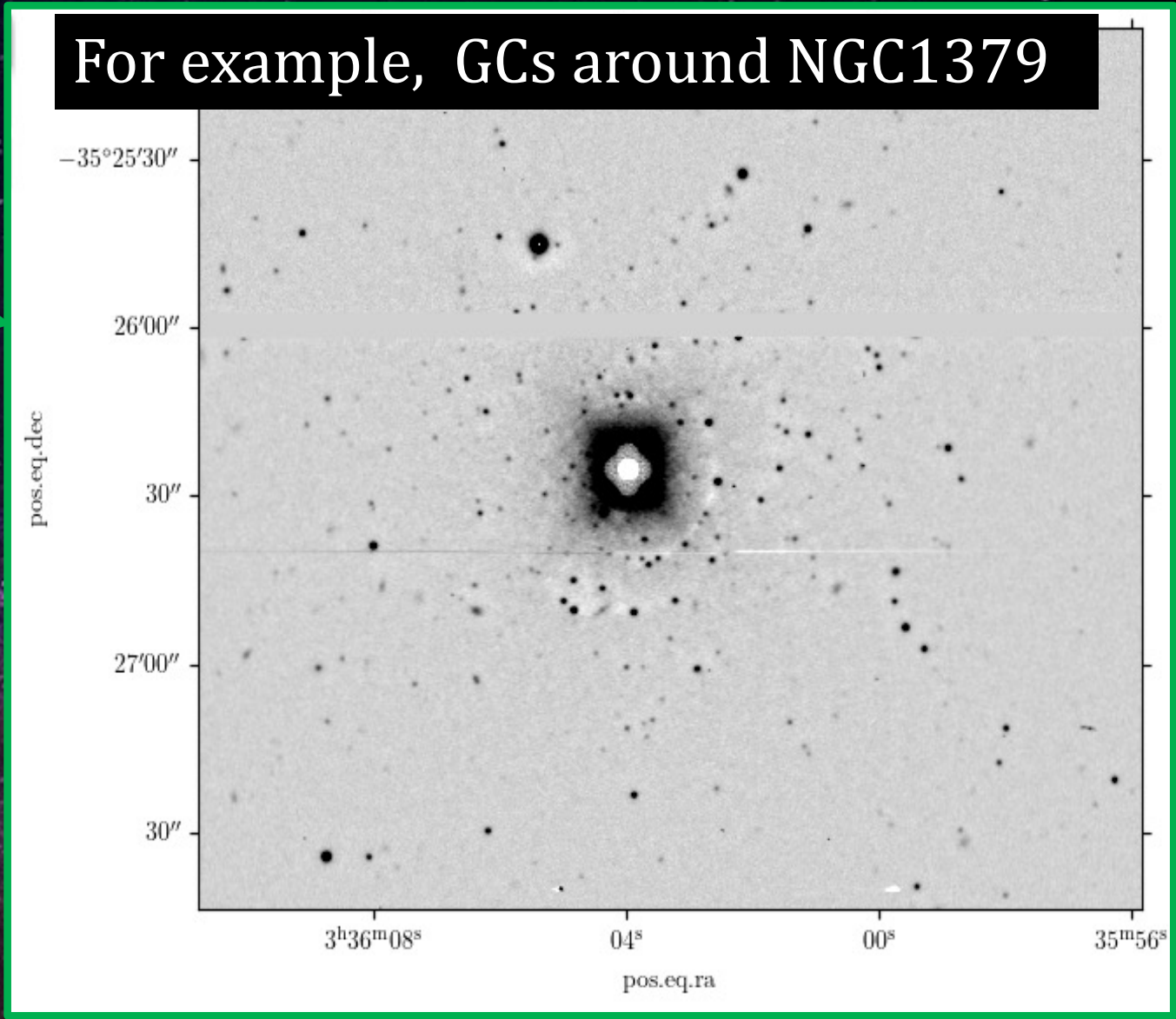
Globular Clusters (GCs)

- Bright, compact sources
- Discrete kinematical tracers



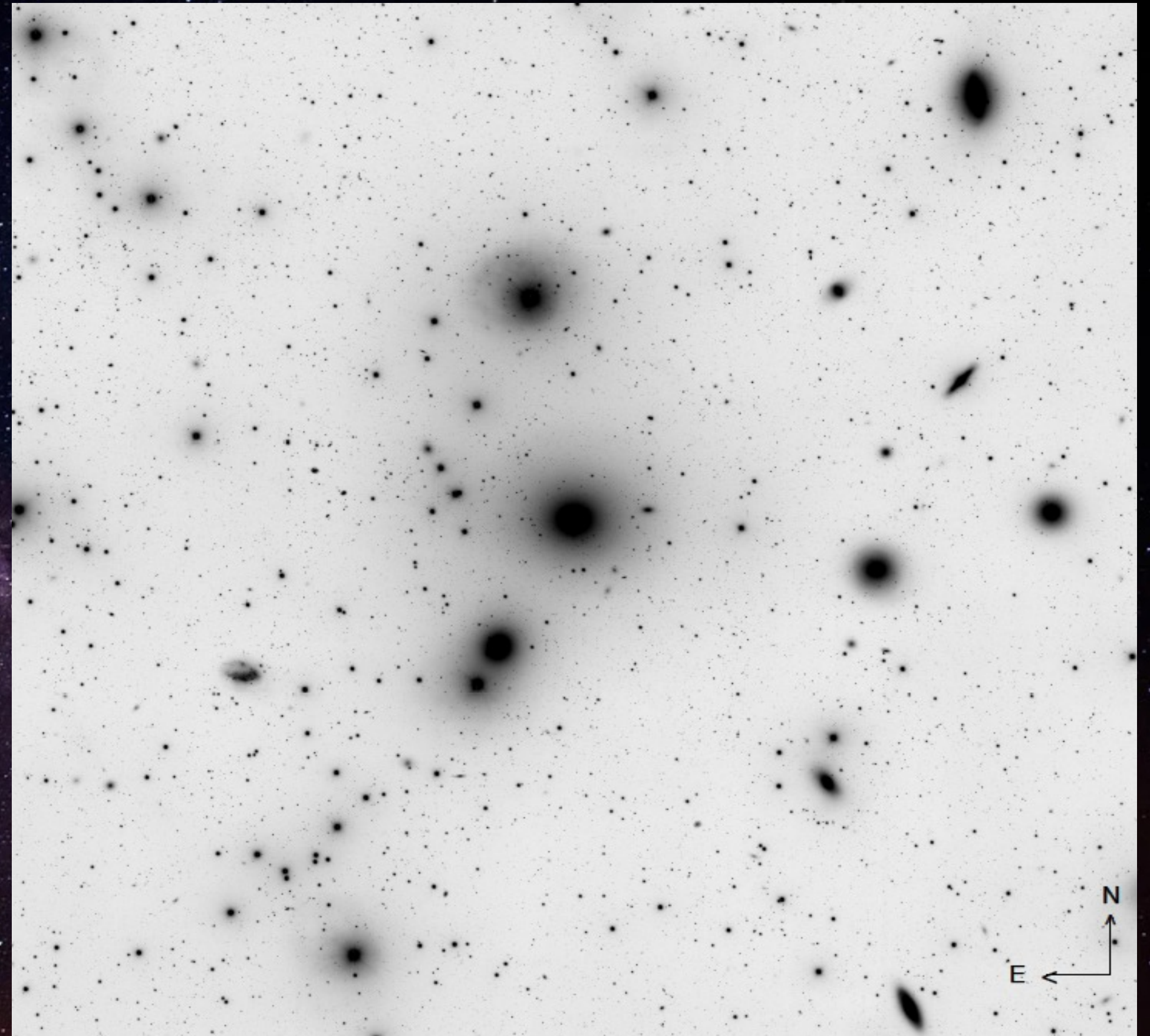
Credits : ESO archive ,FDS Survey PI: Capaccioli

- ## Globular Clusters (GCs)
- Bright, compact sources
 - Discrete kinematical tracers

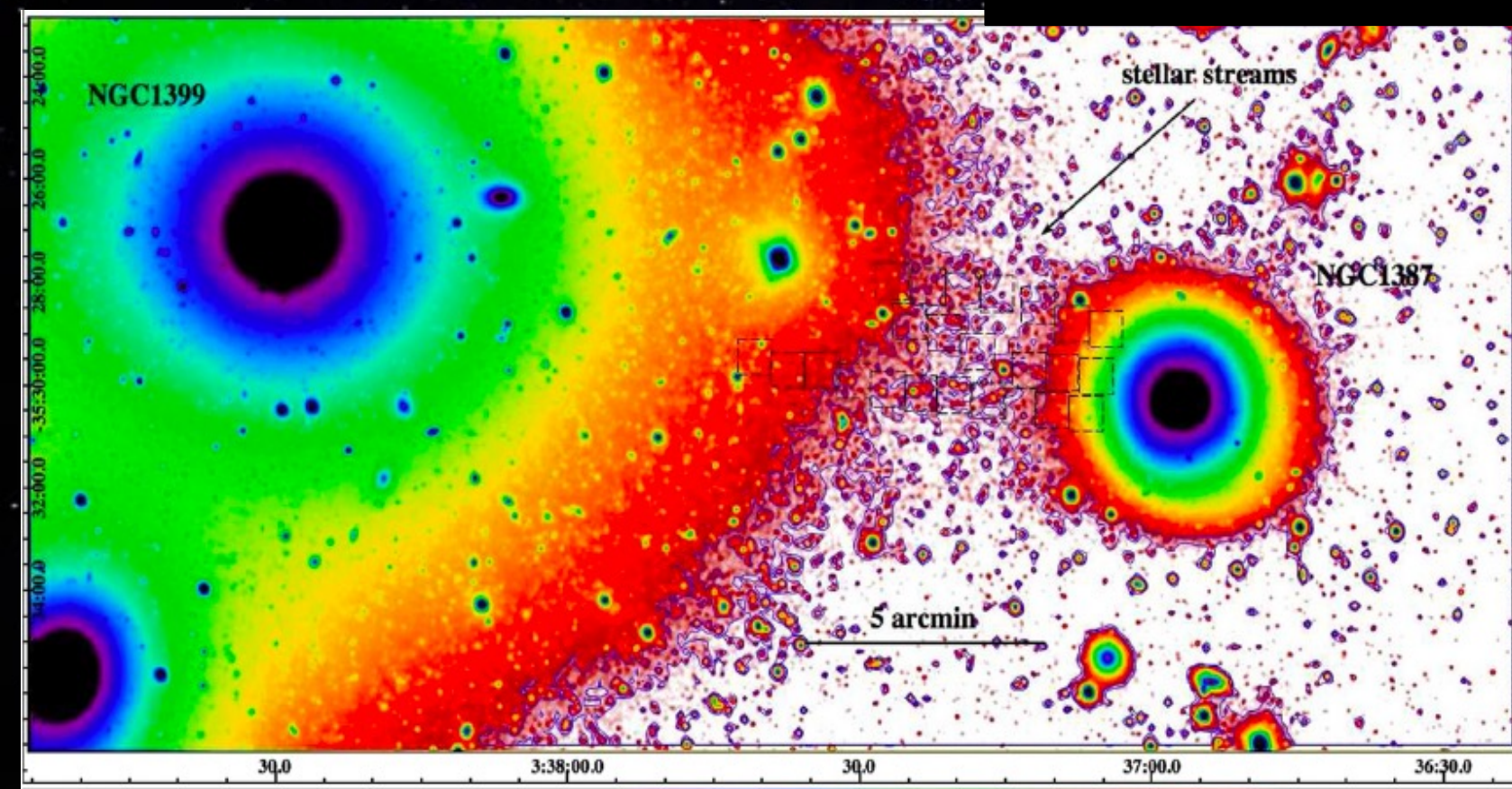


Credits : FVSS FORS2 Survey PI: Chaturvedi

- Nearest and densest Cluster
- Detailed observations and has rich GCs system
- Photometric studies have shown tidal and stellar streams

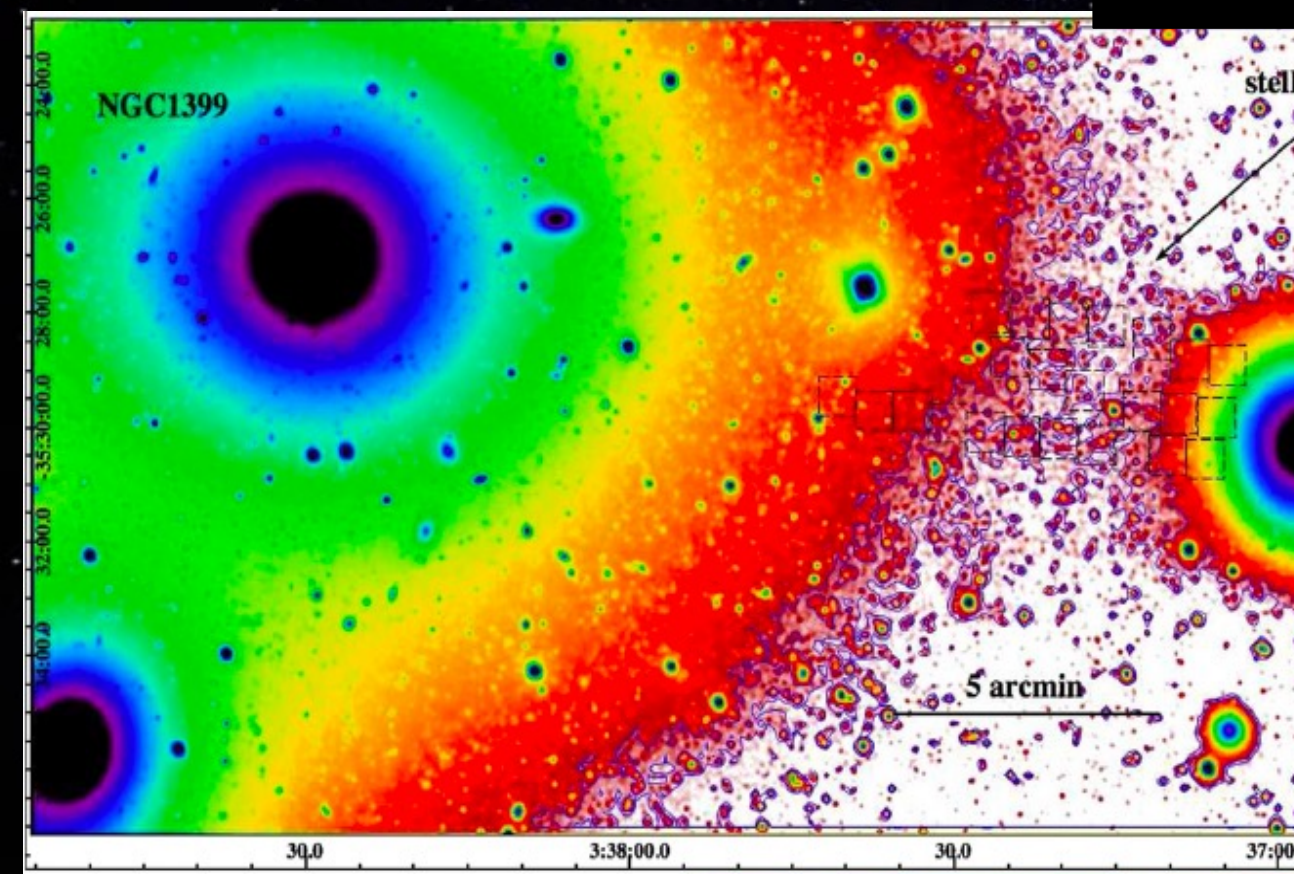


- Presence of Stellar and Tidal Streams
 - Intra-cluster GCs

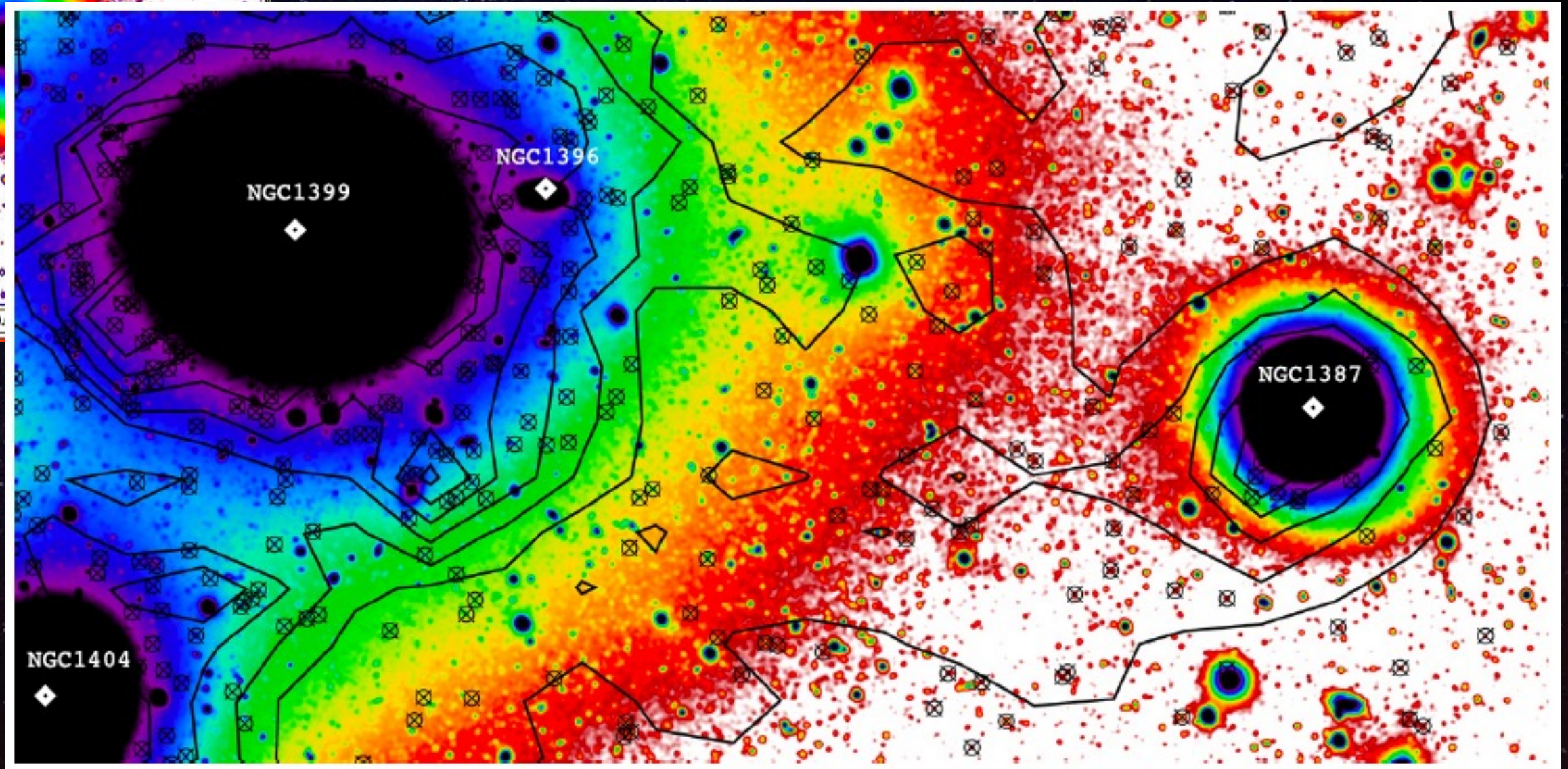


Stellar stream connecting NGC1399 and NGC 1387 (Iodice+ 2016)

- Presence of Stellar and Tidal Streams
- Intra-cluster GCs

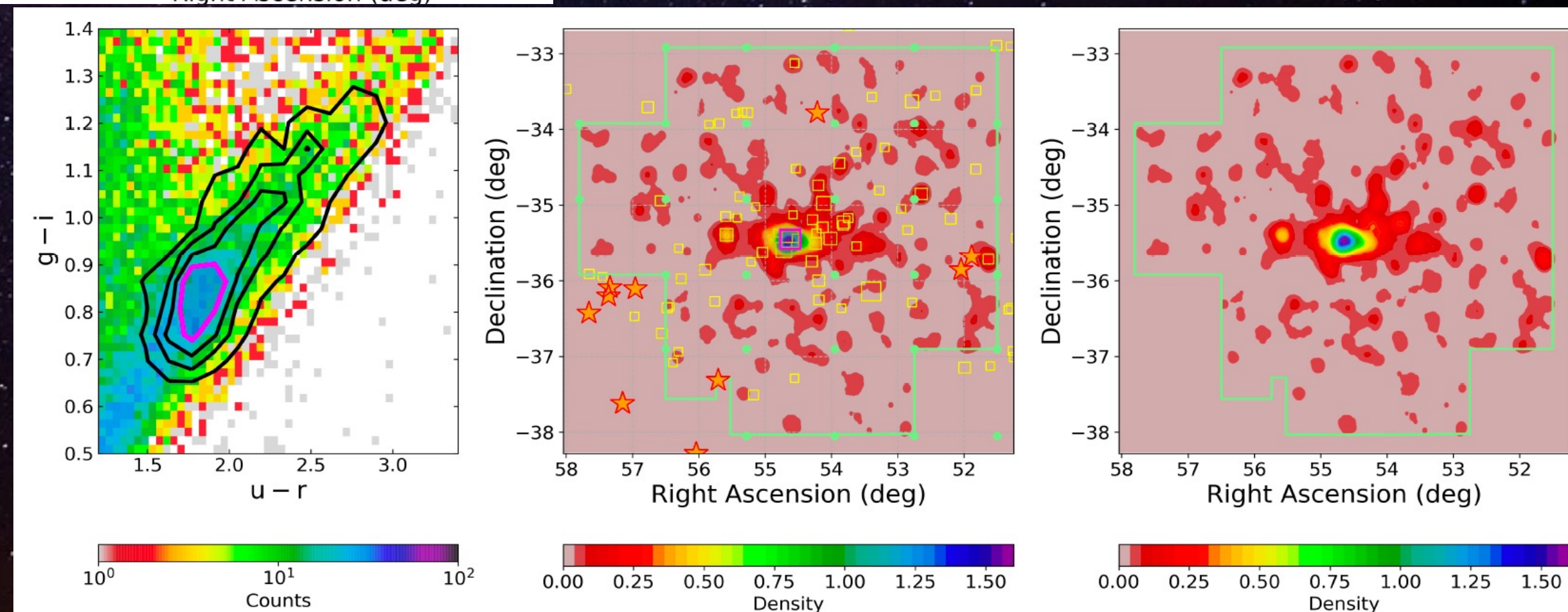
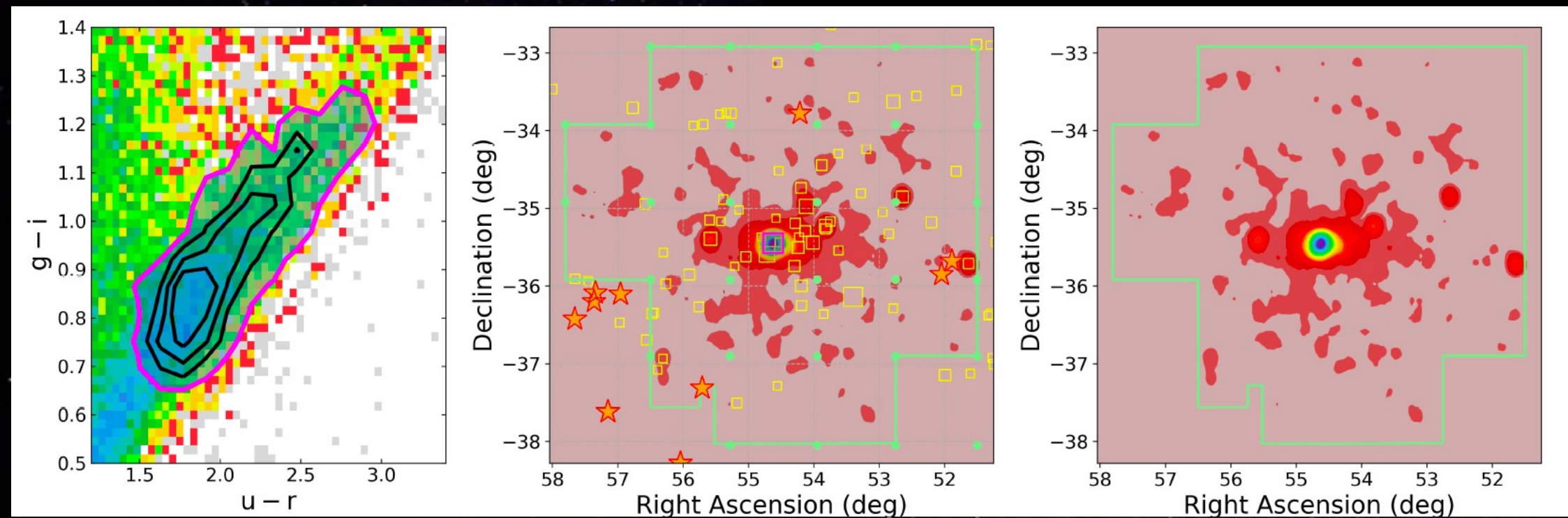


Stellar stream connecting NGC1399 and NGC 1387 (Iodice+ 2016)

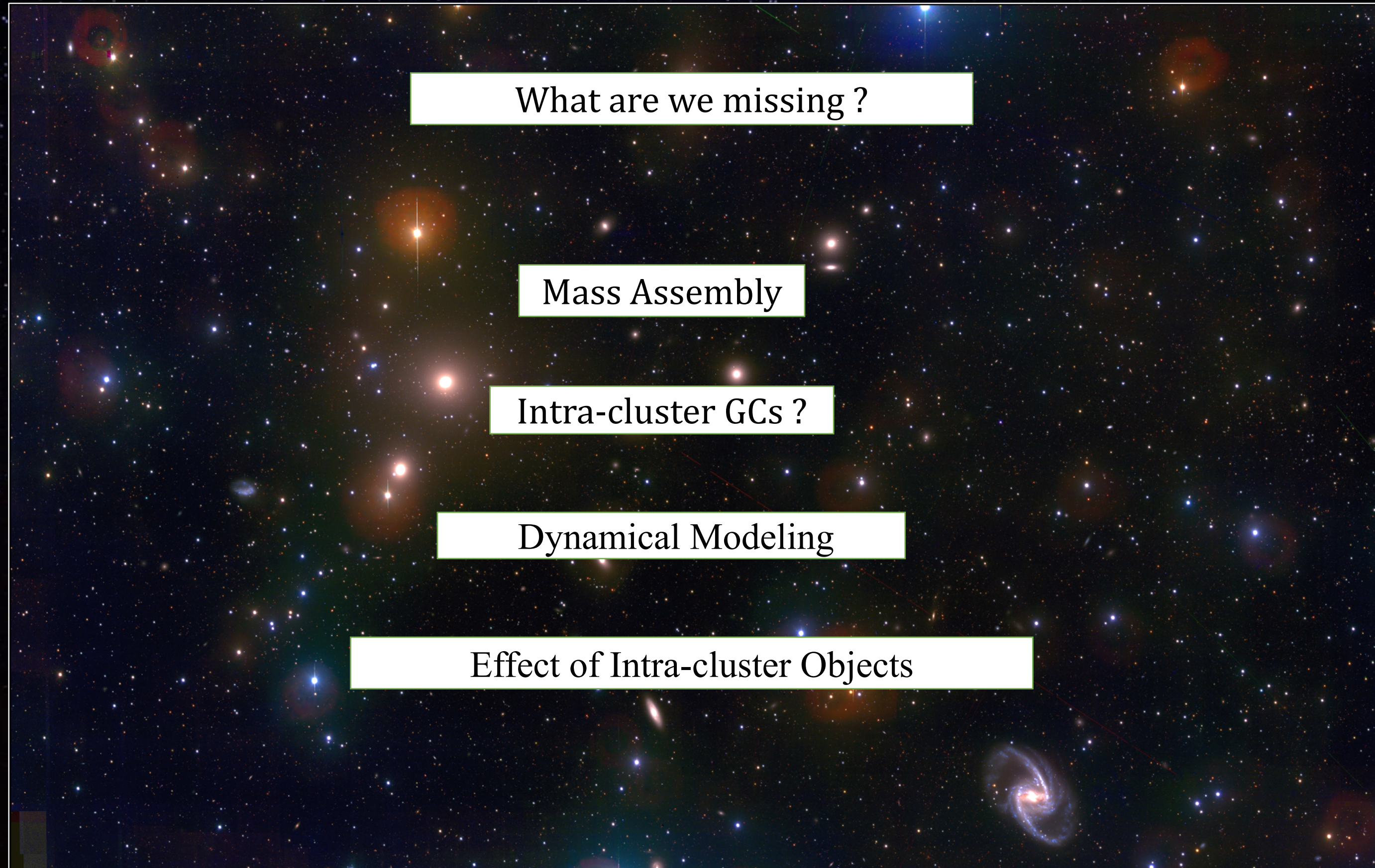


Contours of GCs over density on the FDS g band image (D'Abrusco+2016)

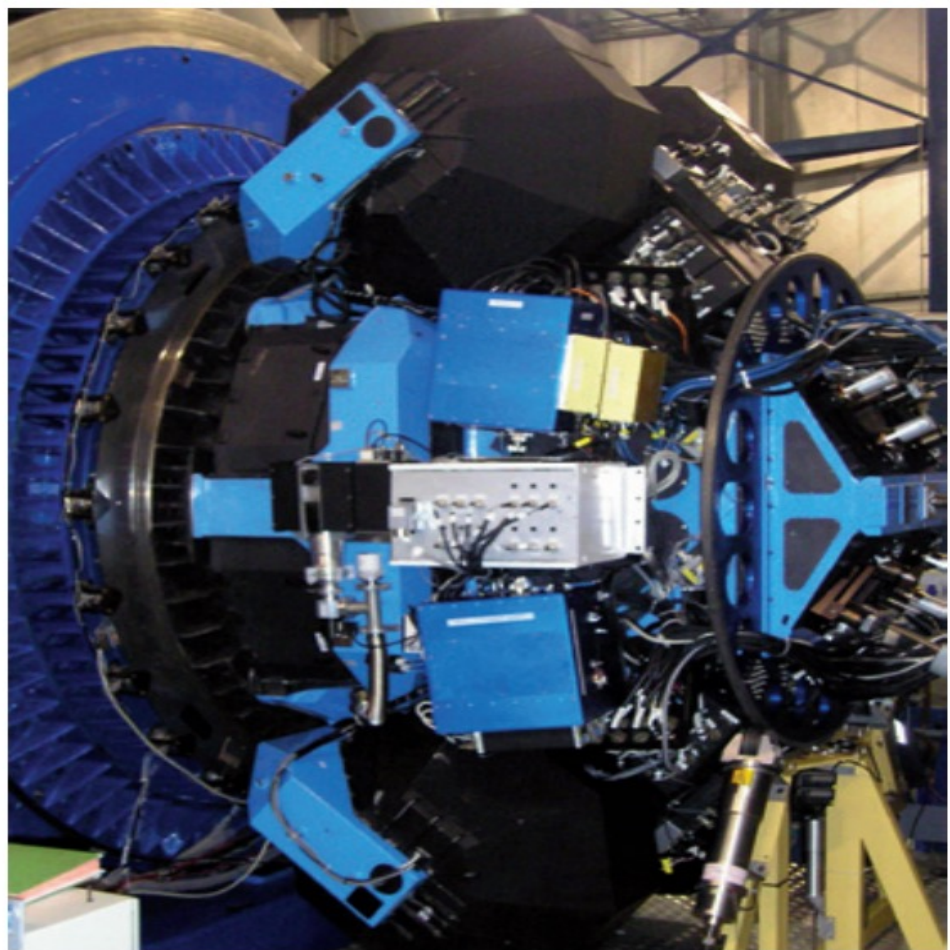
- Presence of Stellar and Tidal Streams
- Intra-cluster GCs



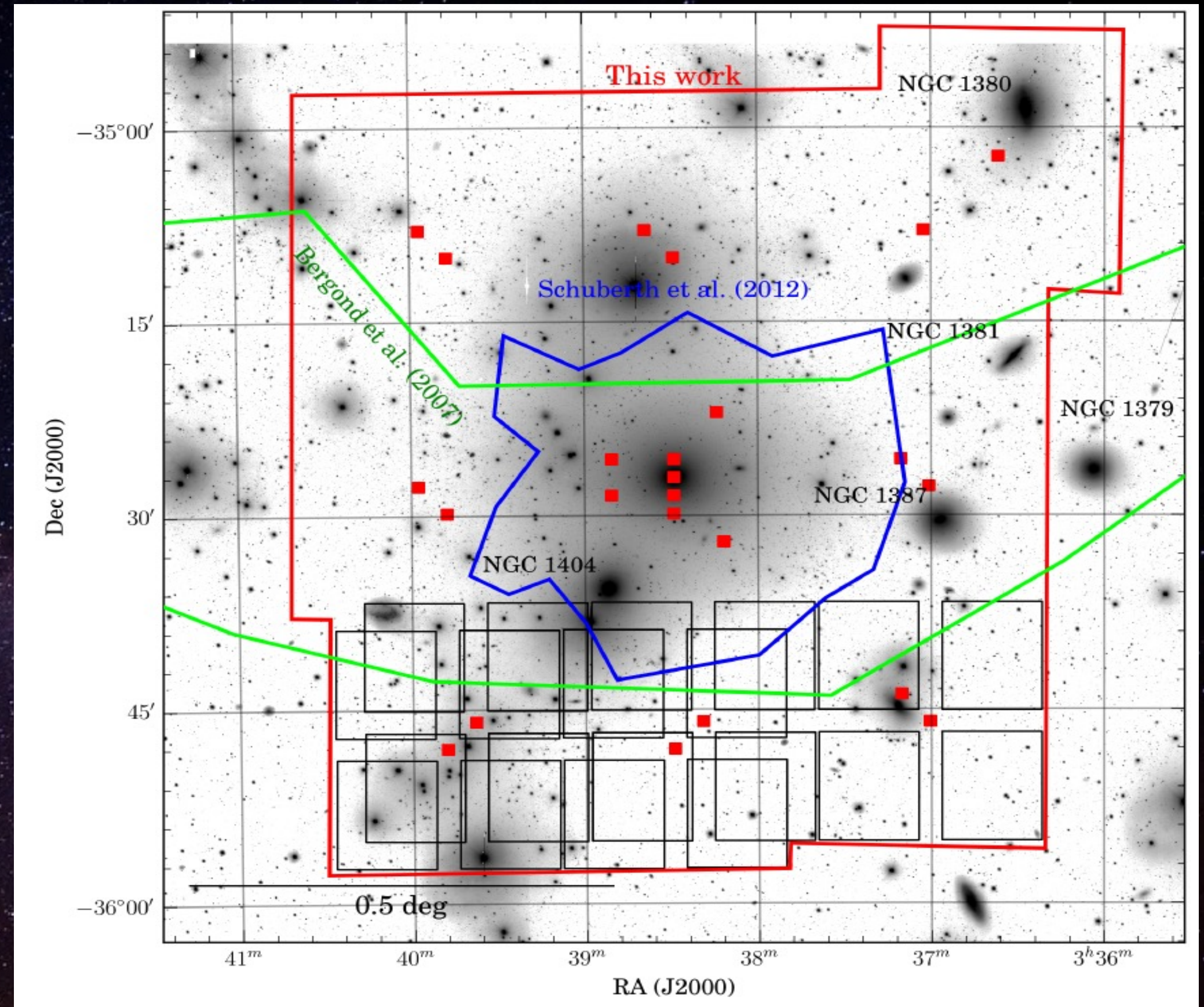
Surface density maps of GCs in the Fornax cluster from FDS survey (Cantiello+2020)



- GCs spectroscopy from VIMOS MOS/VLT
- PI: Capaccioli, coordinators: Hilker, Napolitano
- Wavelength range: 4800-10000 Å
- Around 5000 spectrum

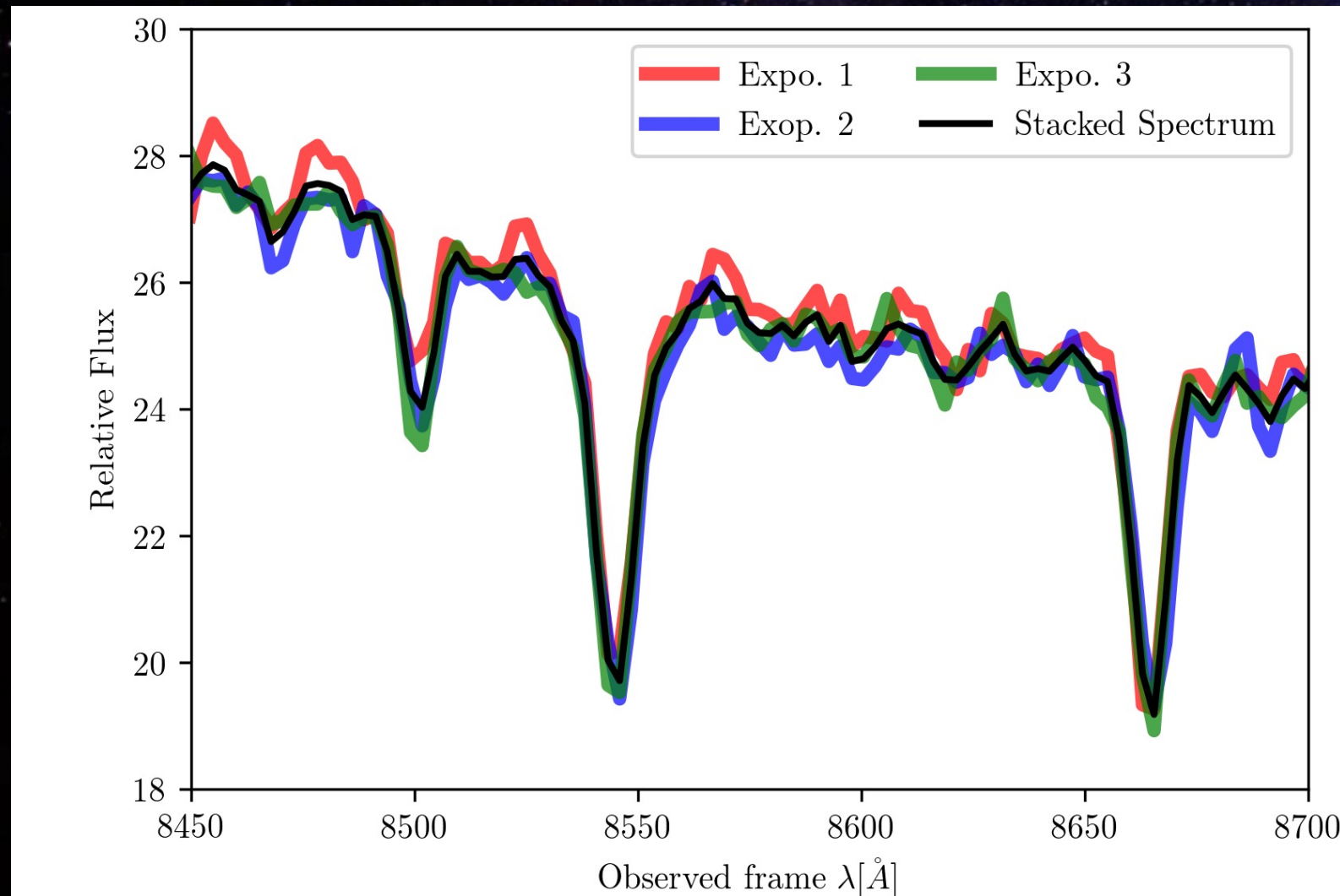


VIMOS
Spectrograph
at ESO VLT

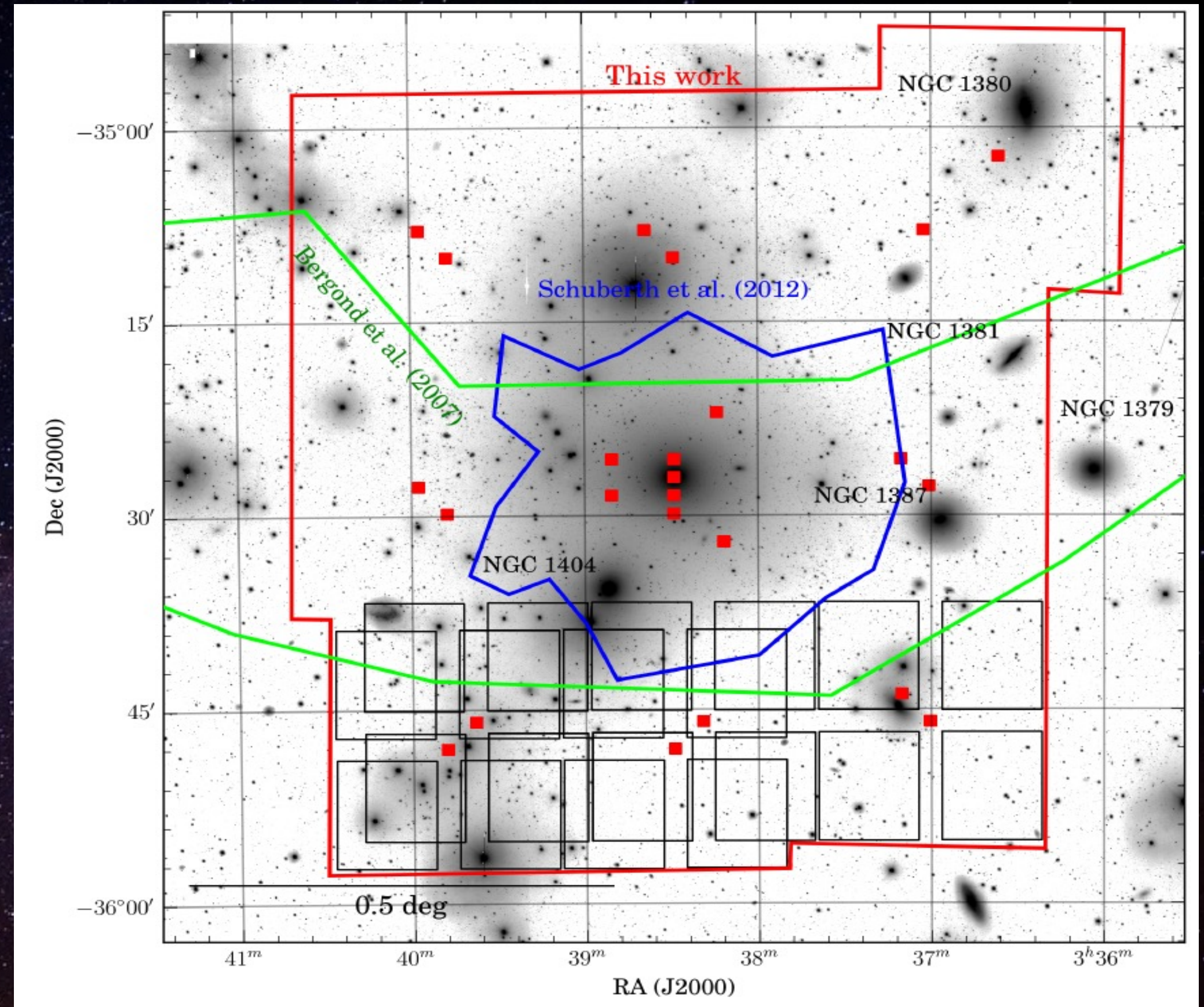


Coverage area of VIMOS pointings (Credit: Pota+ 2018)

Low recovery of GCs in previous analysis

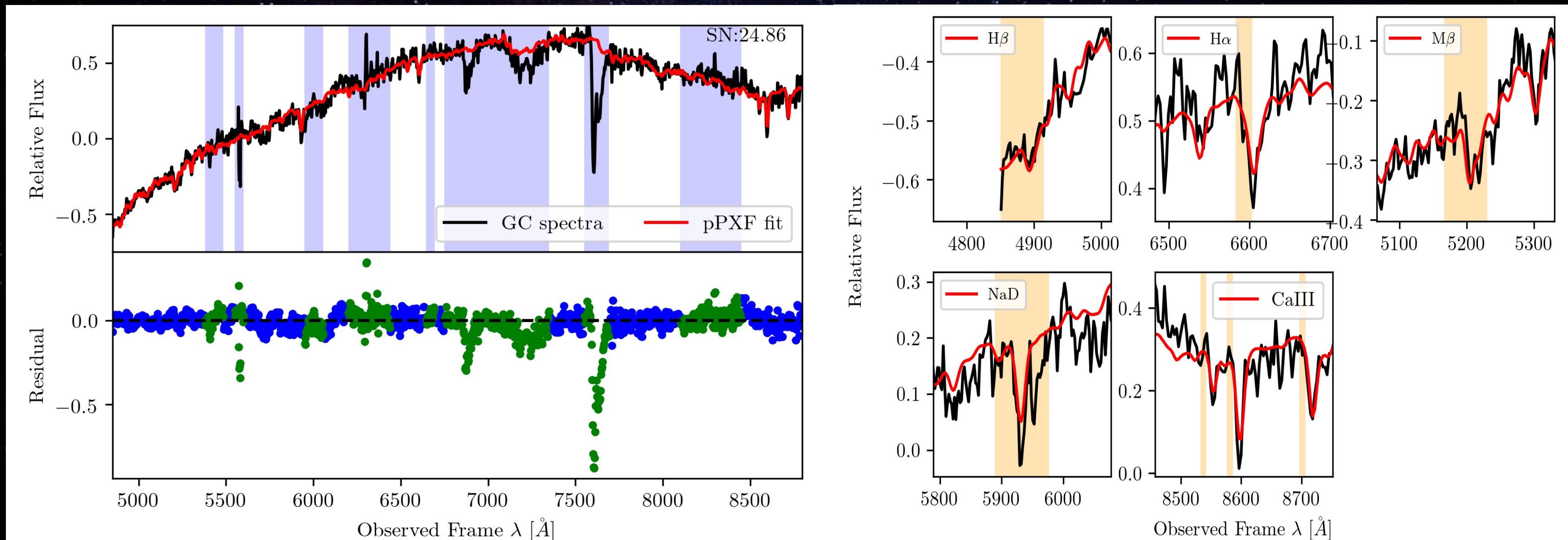


Improved version of VIMOS-Reflex pipeline



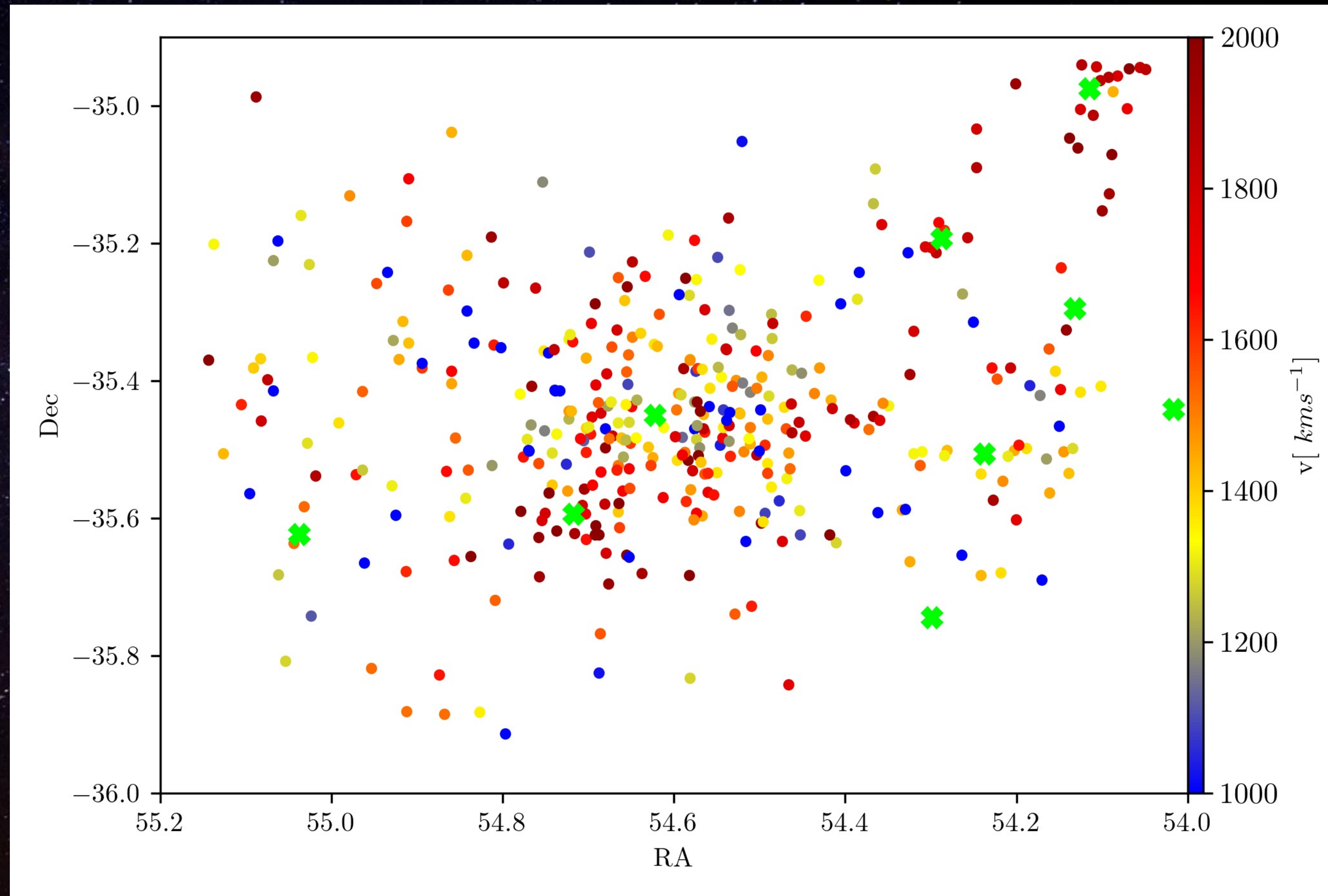
Coverage area of VIMOS pointings (Credit: Pota+ 2018)

Example of Modeled Spectrum with pPXF



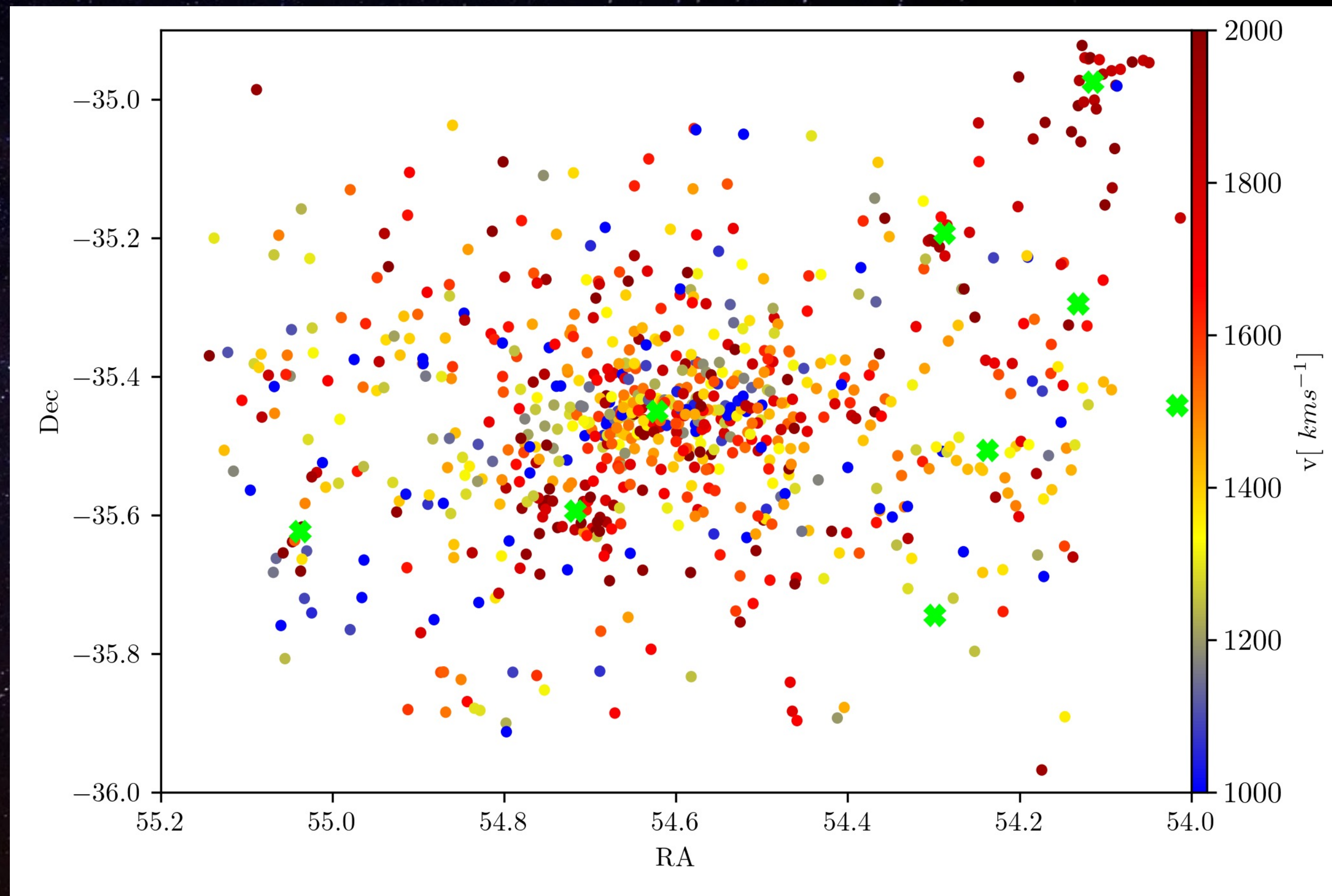
- Detected GCs: ~ 387 objects (Pota+ 2018)

Radial Velocity Map



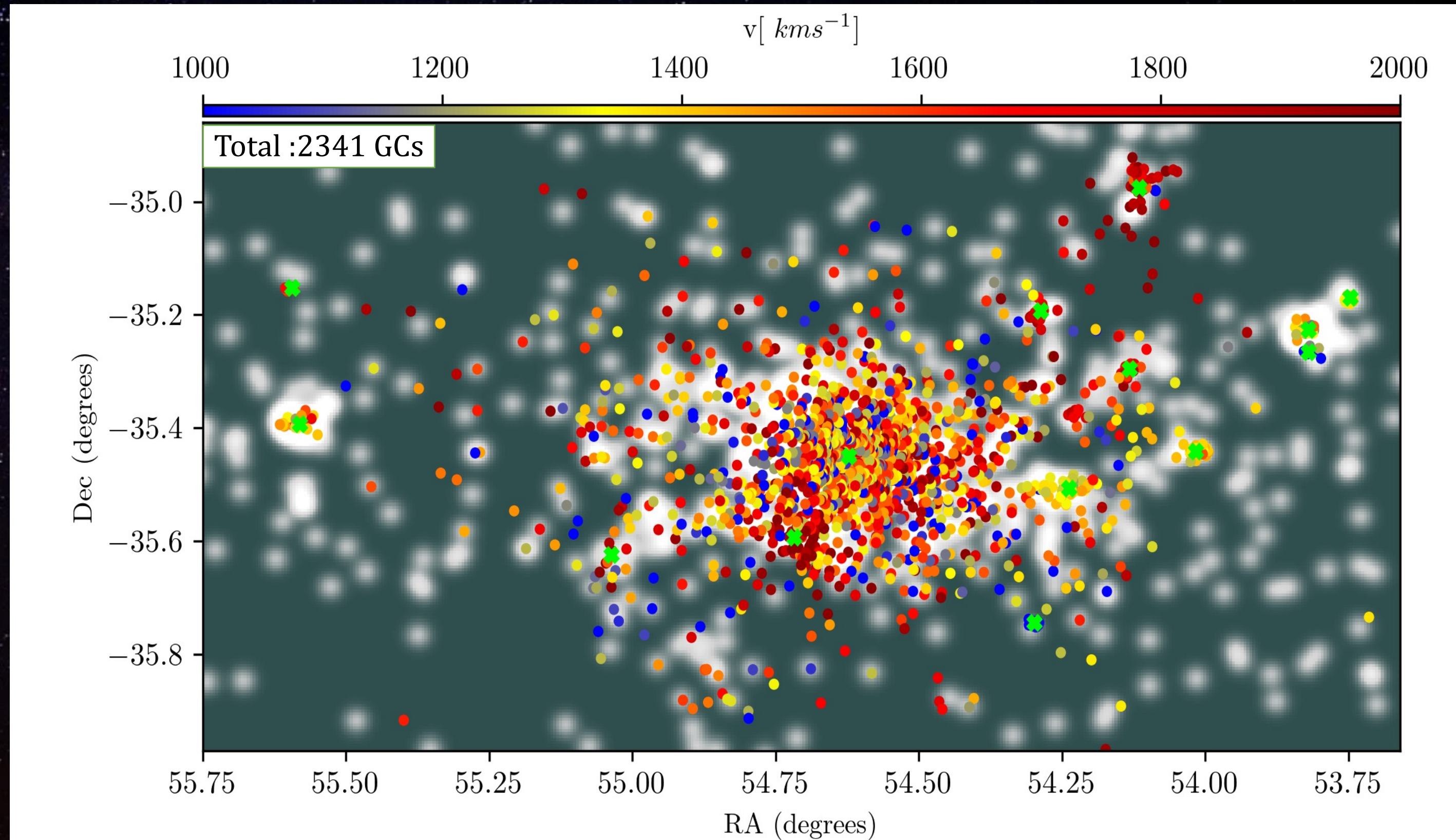
- Detected GCs: ~ 387 objects (Pota+ 2018)
- Detected GCs: ~ 777 objects (Chaturvedi+2022)

Radial Velocity Map



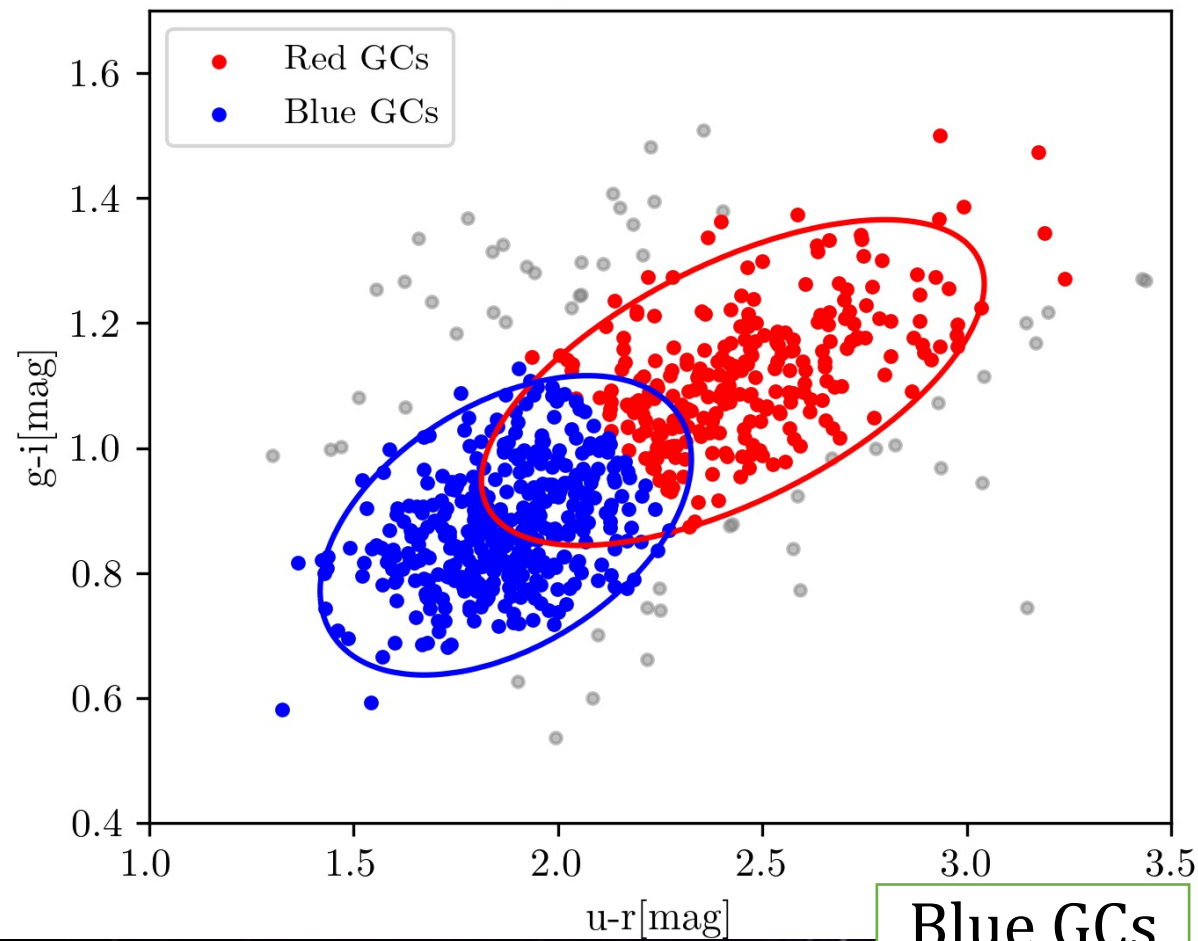
CGs distribution over photometric surface density maps (Cantiello+ 2020)

- Detected GCs: ~ 777 objects
- Produced one of the most extensive radial velocity catalog : Total 2341 GCs

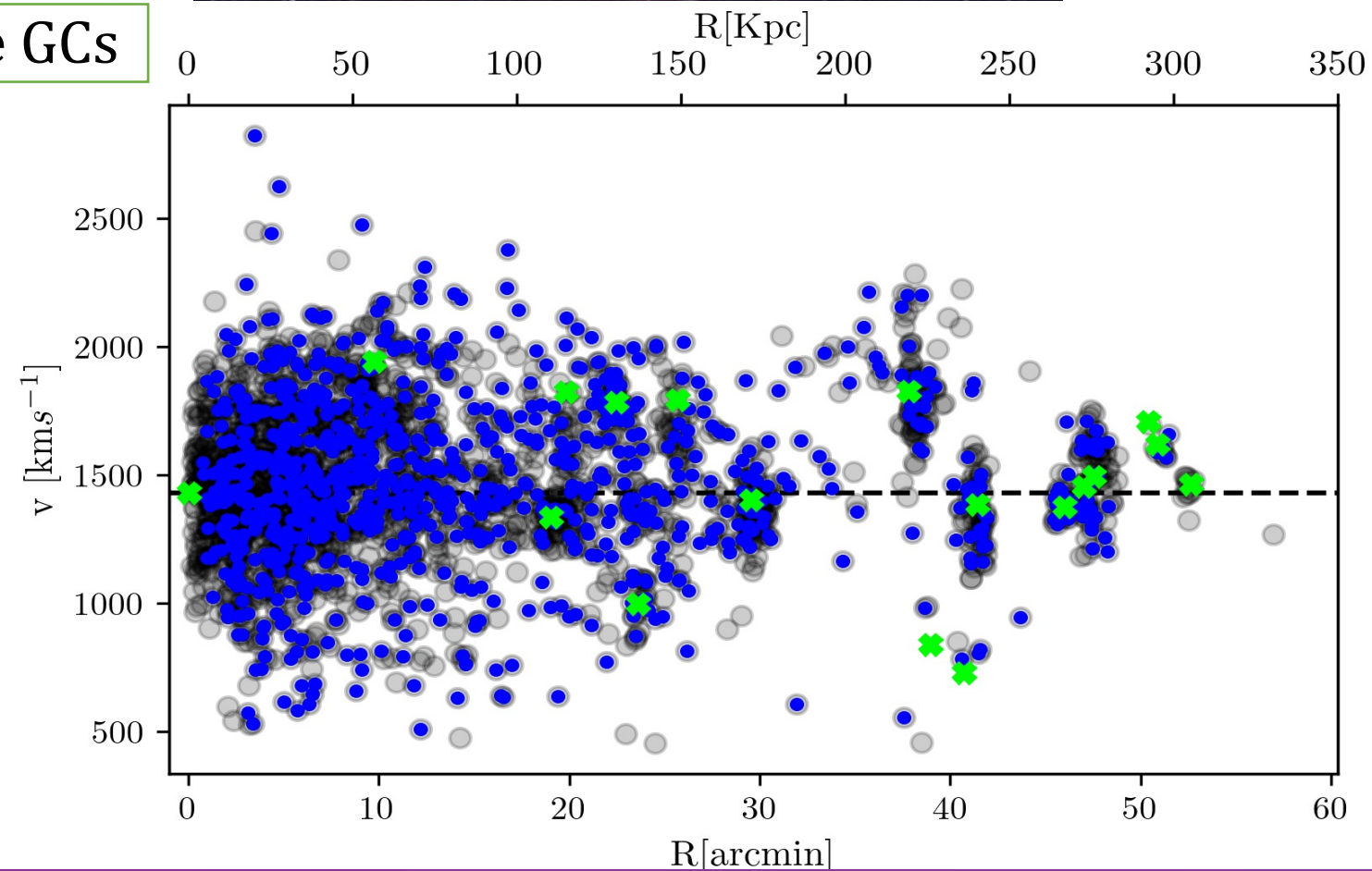


CGs samples mostly from Chaturvedi+ 2022, F3D survey Katja+ 2020 and Schubert+ 2008

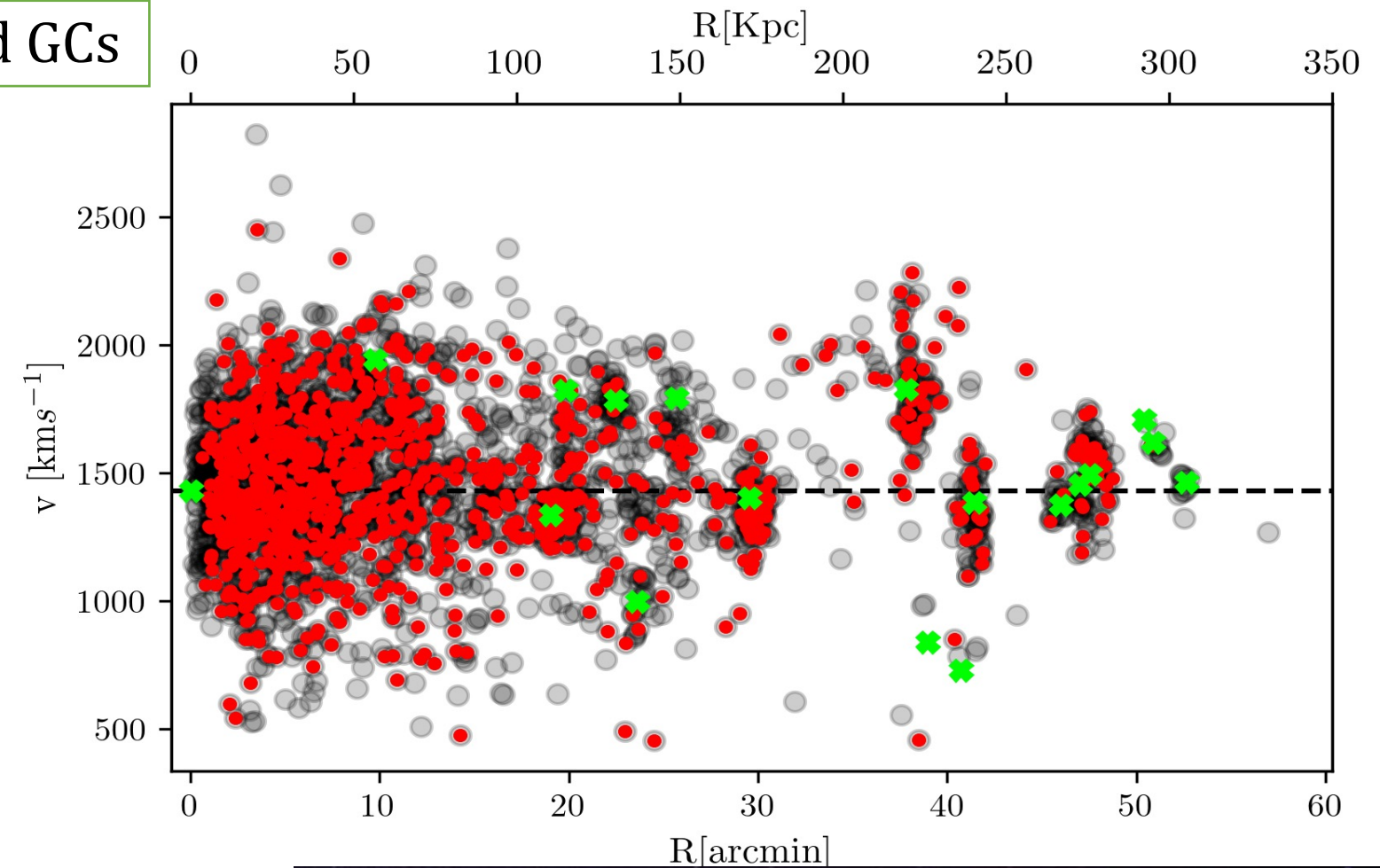
Bivariate Guassian projection for sep. Red and Blue GC

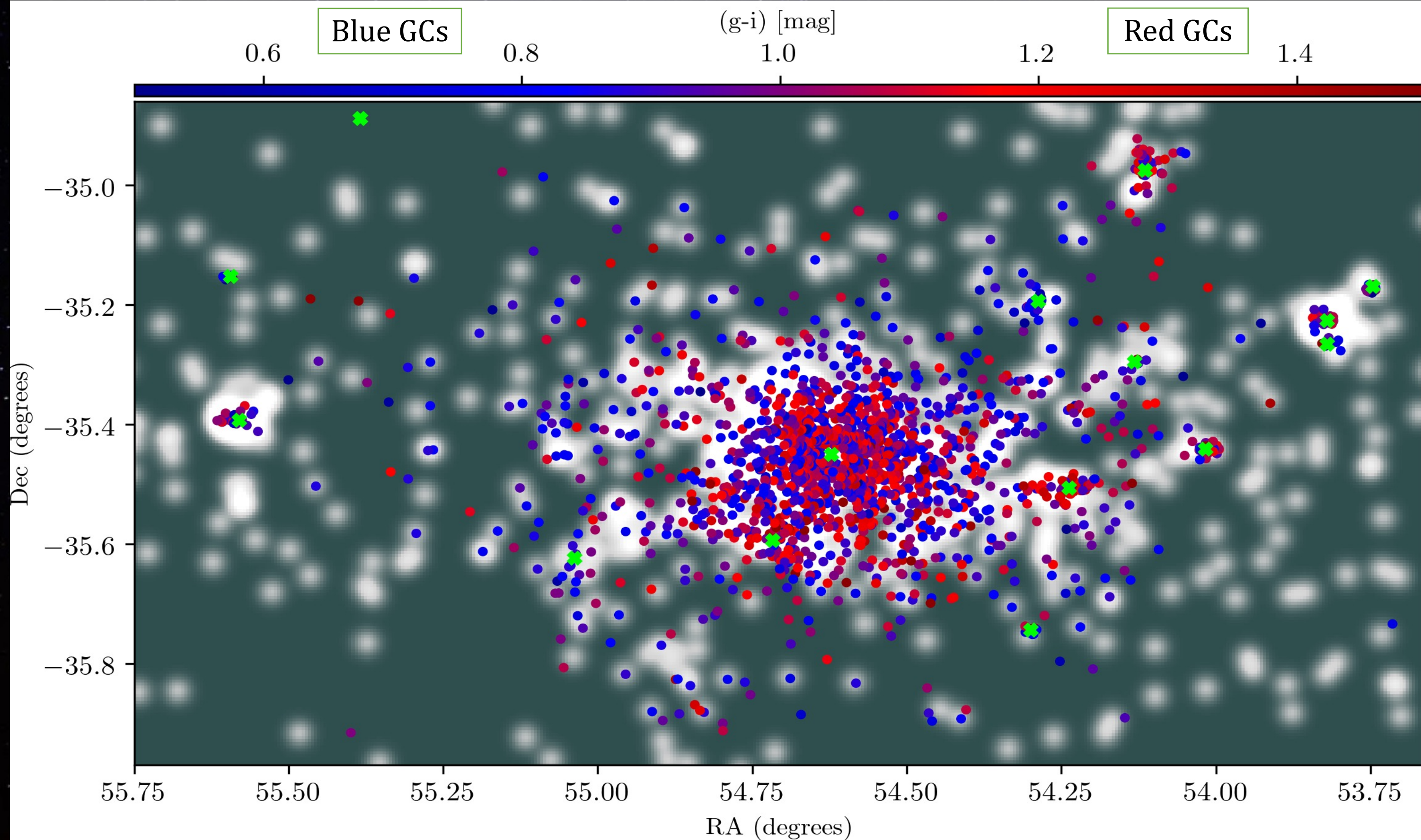


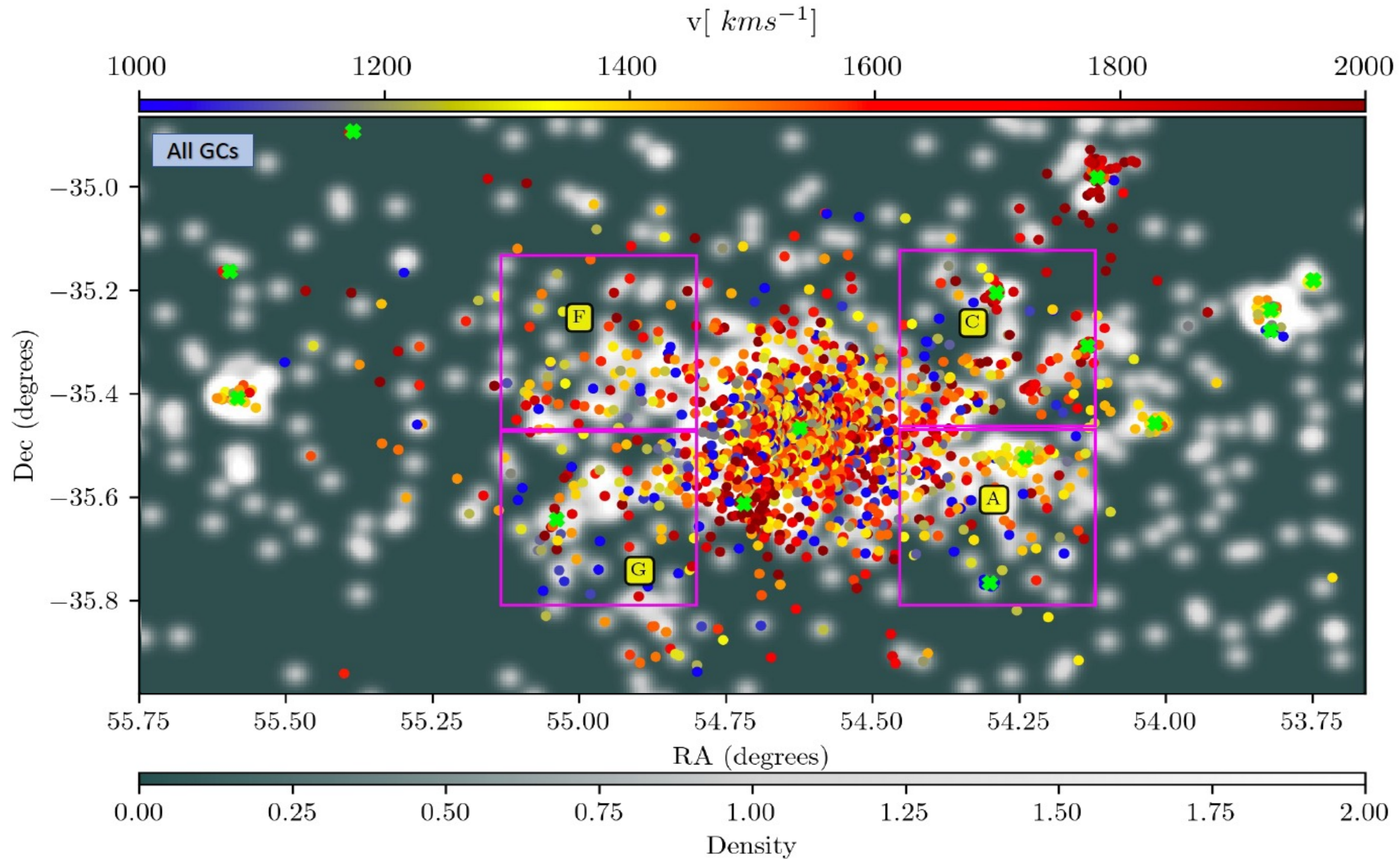
Blue GCs



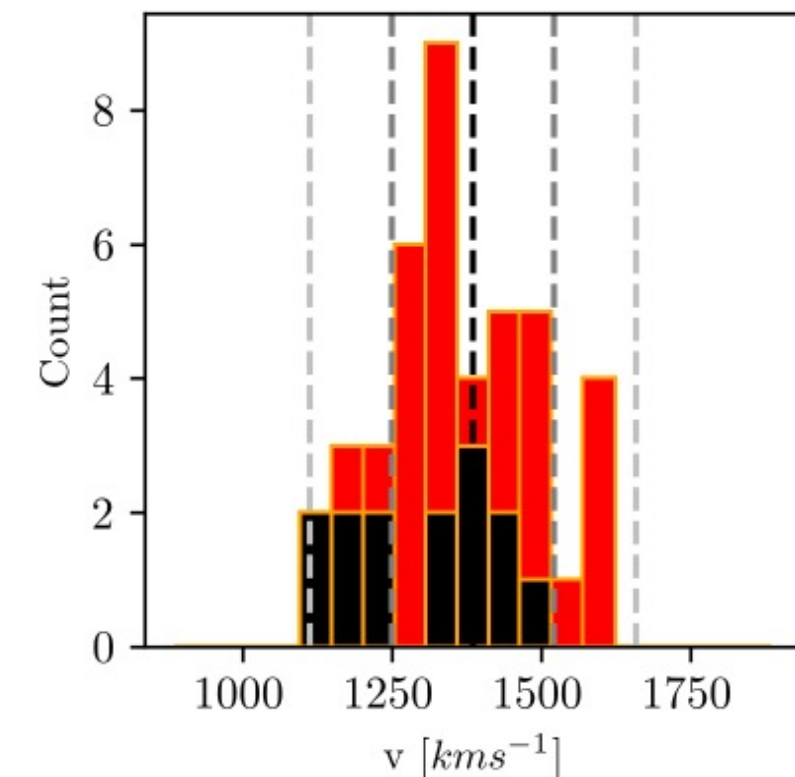
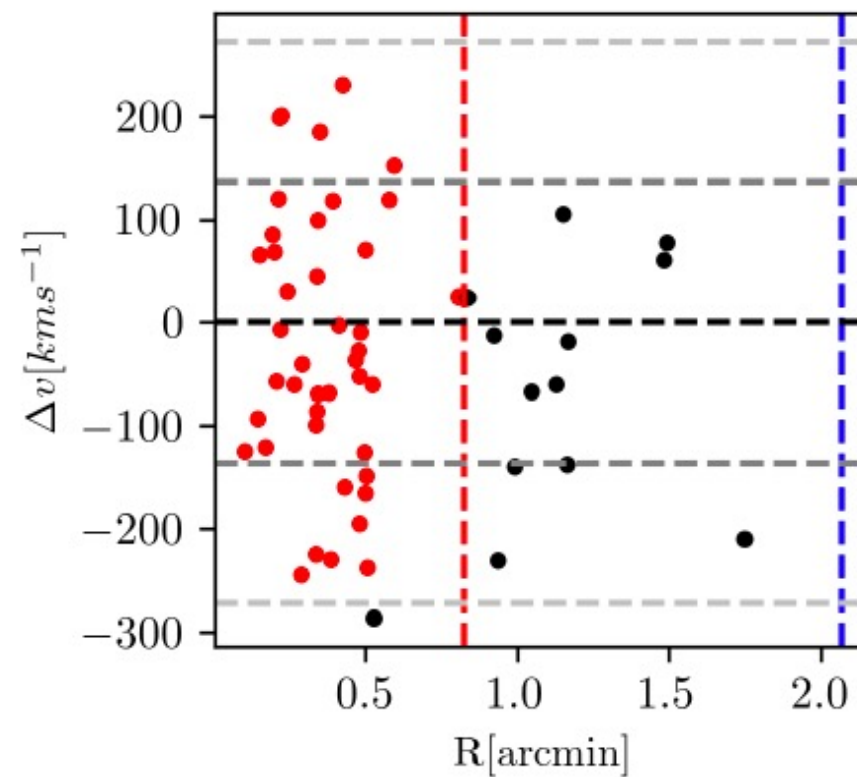
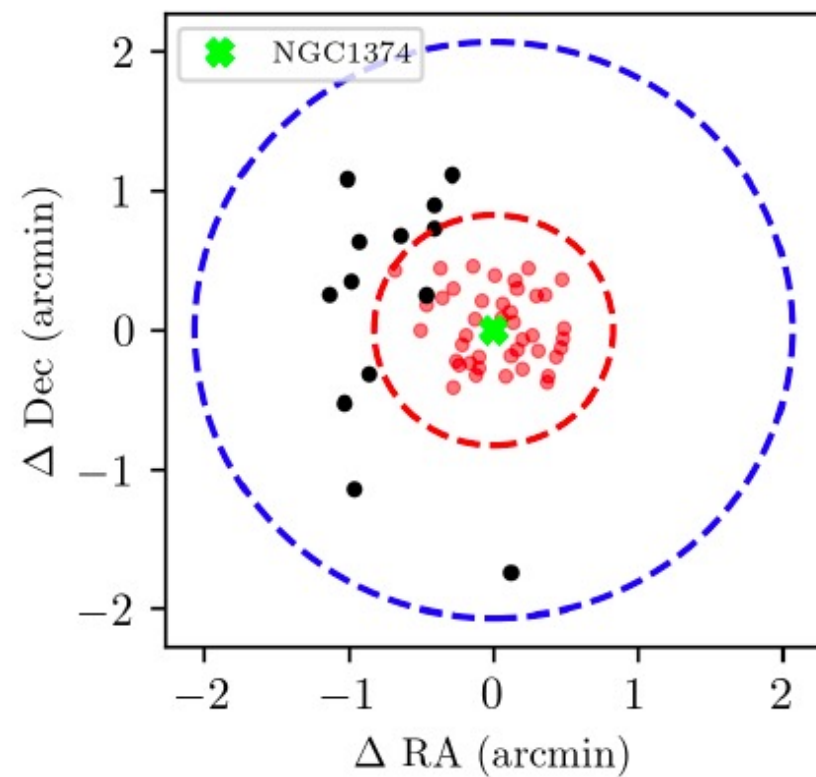
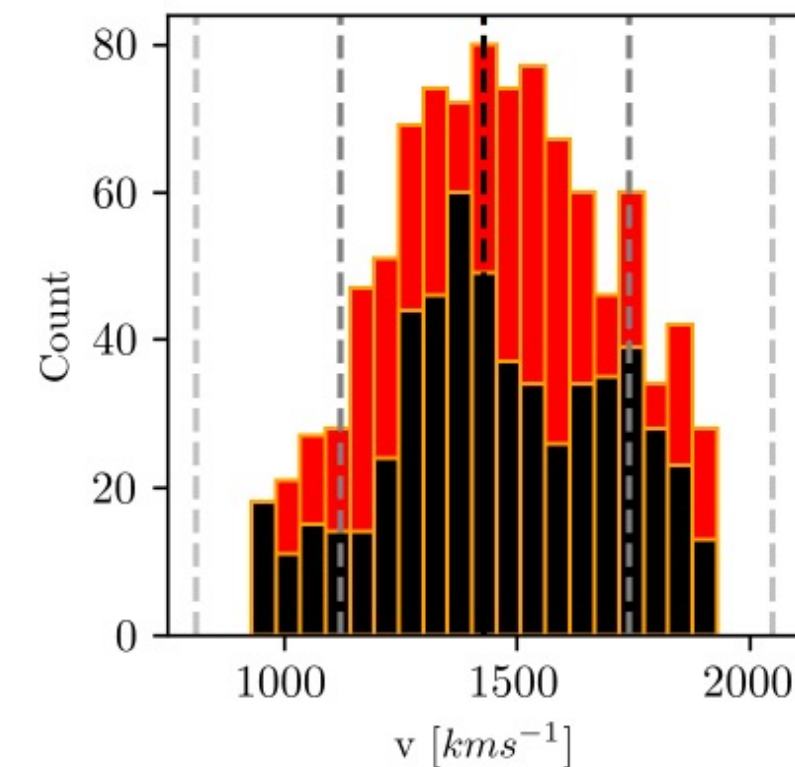
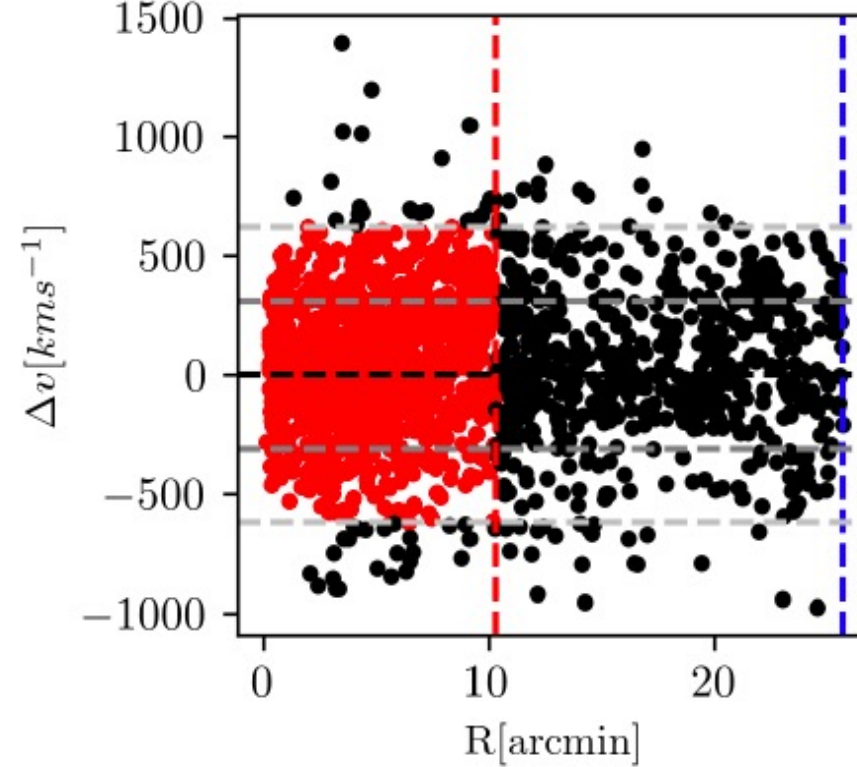
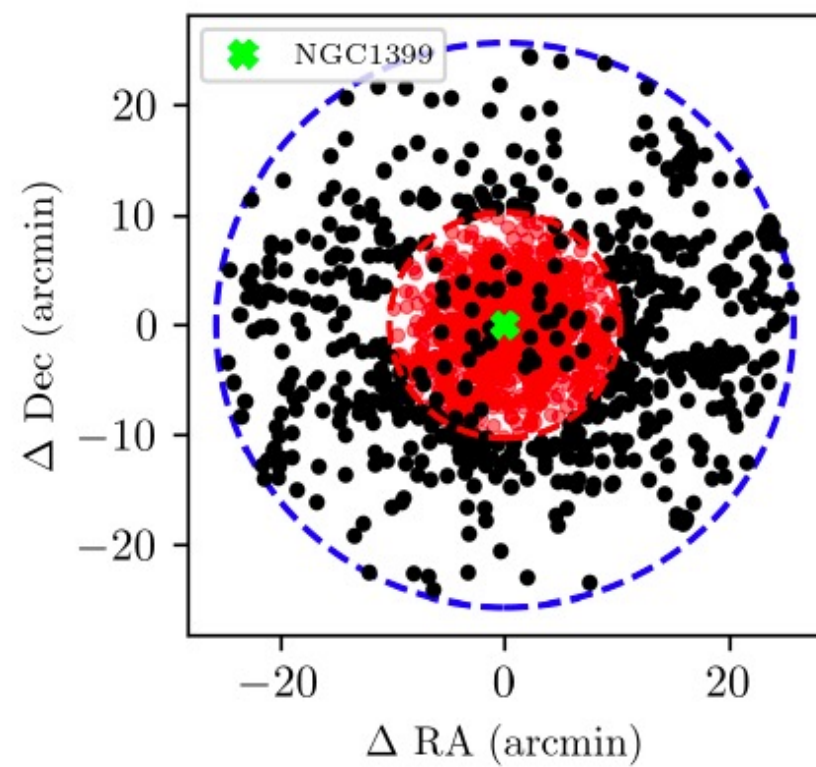
Red GCs

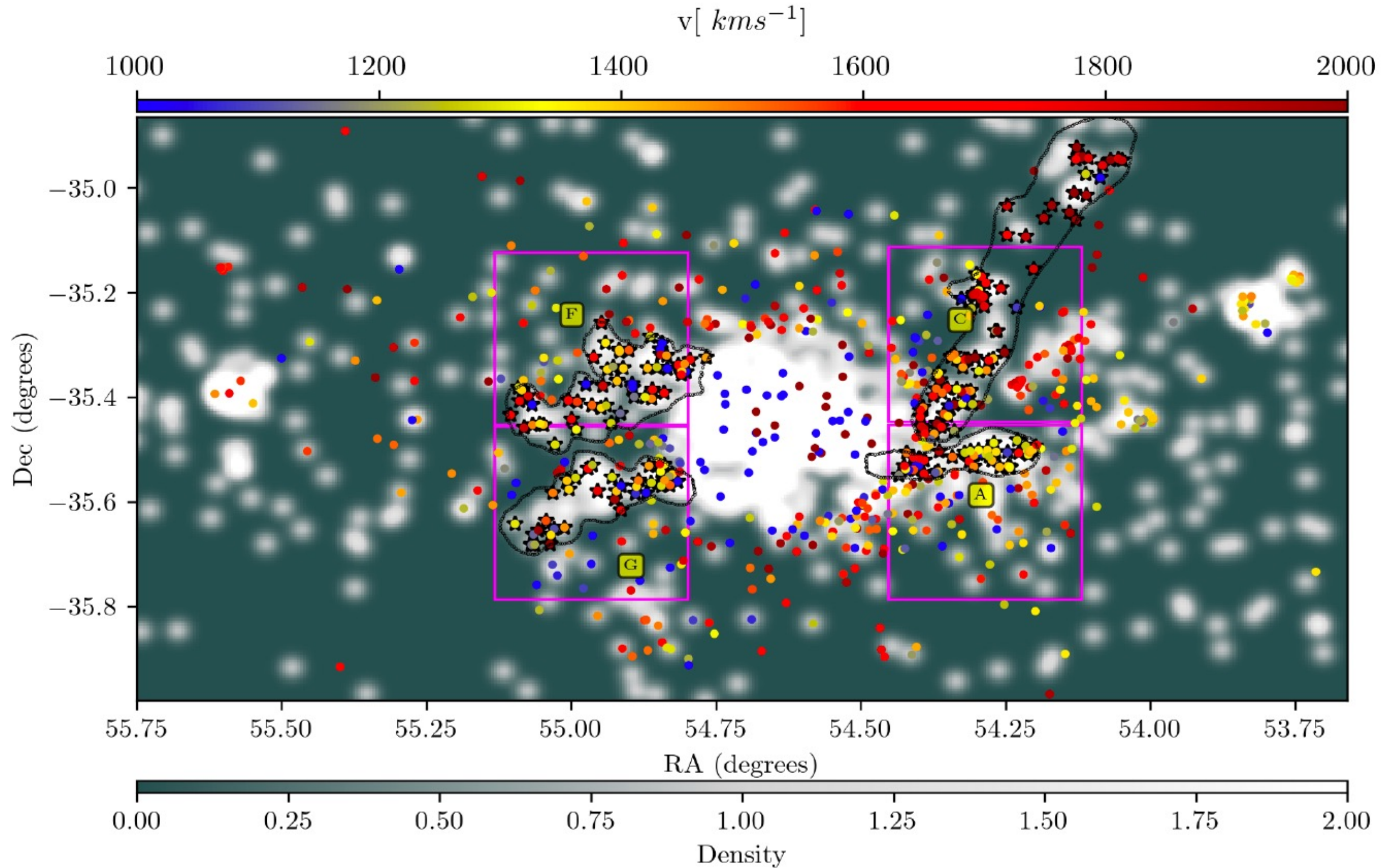






Selecting intra-cluster GCs





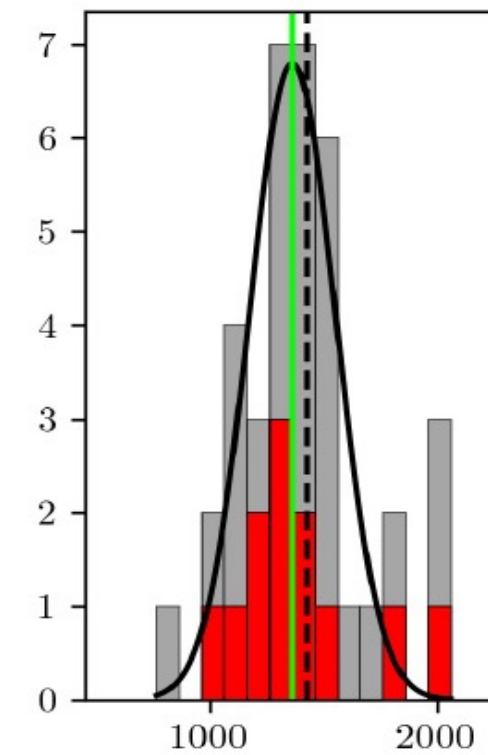
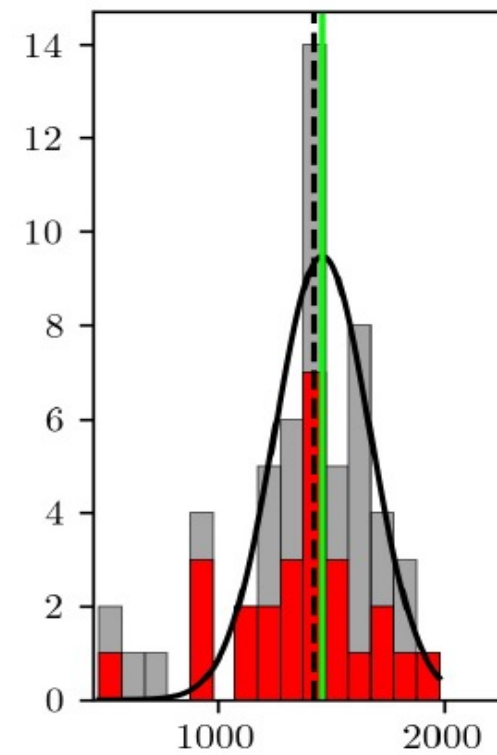
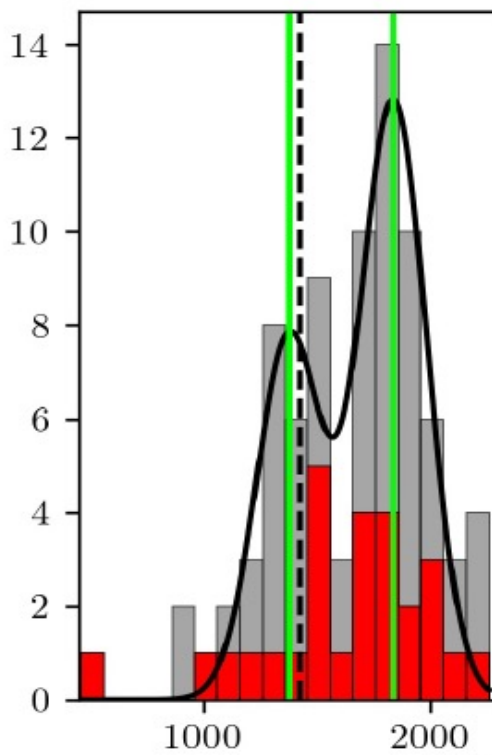
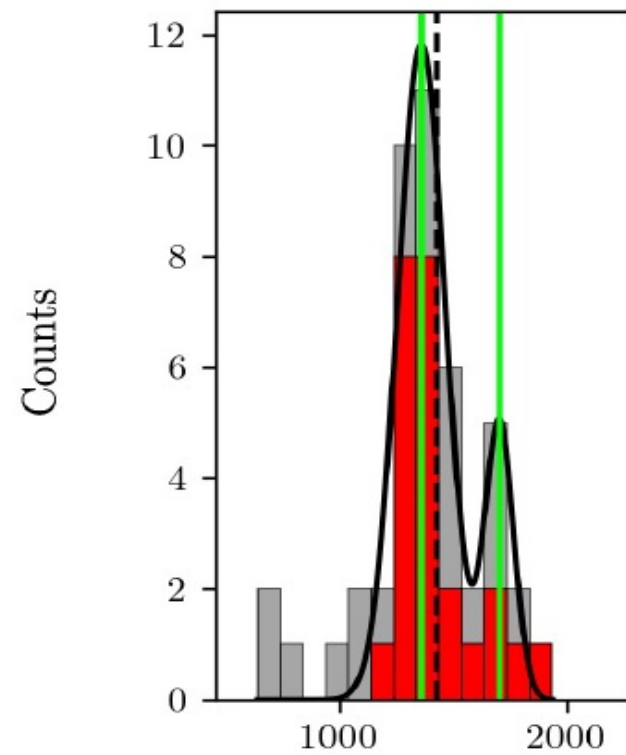
Radial velocity

Stream A

Stream C

Stream F

Stream G



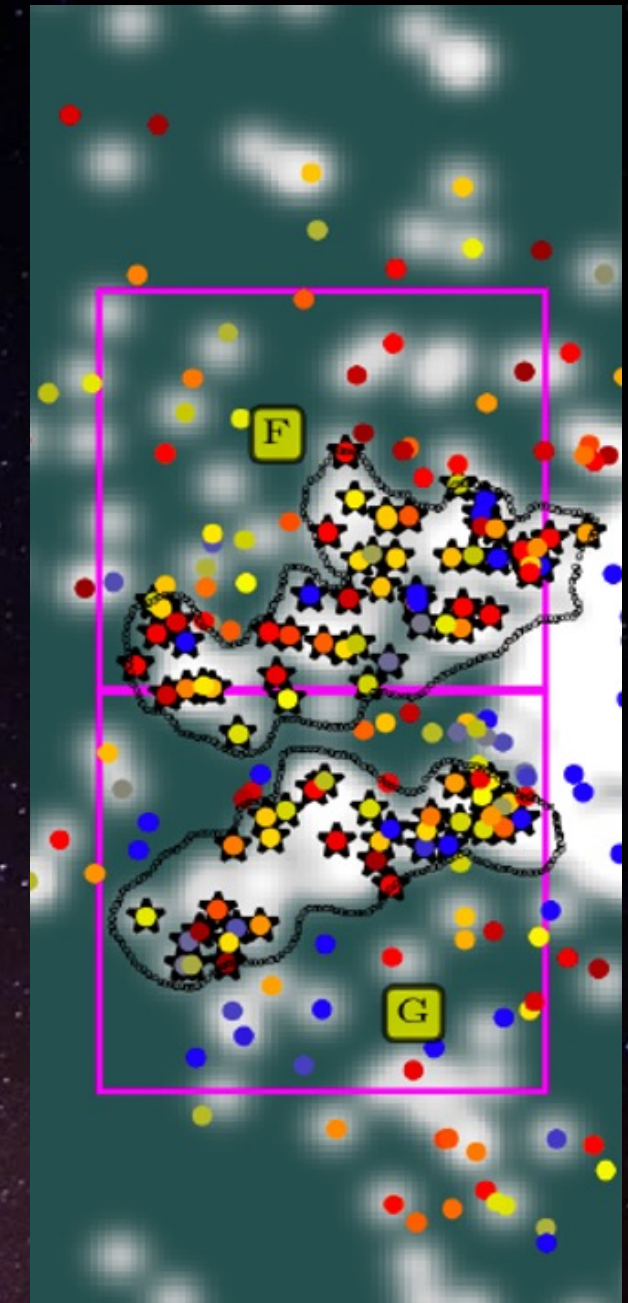
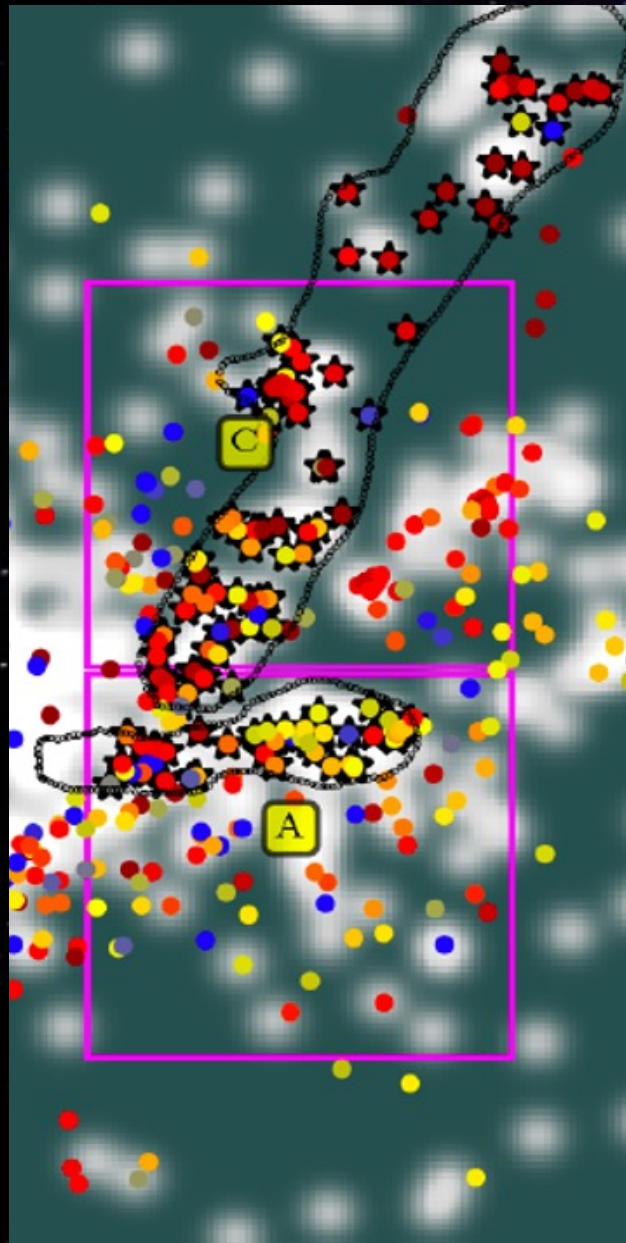
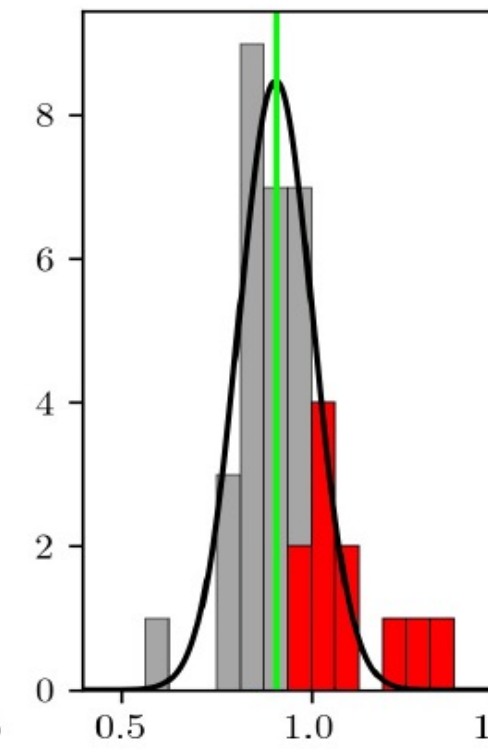
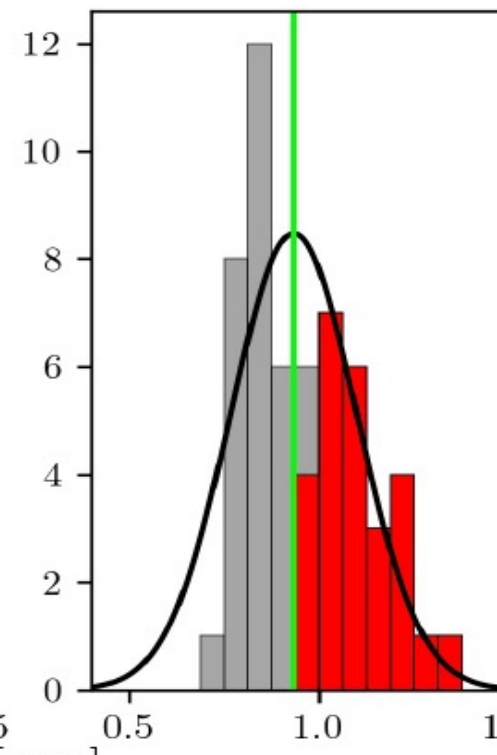
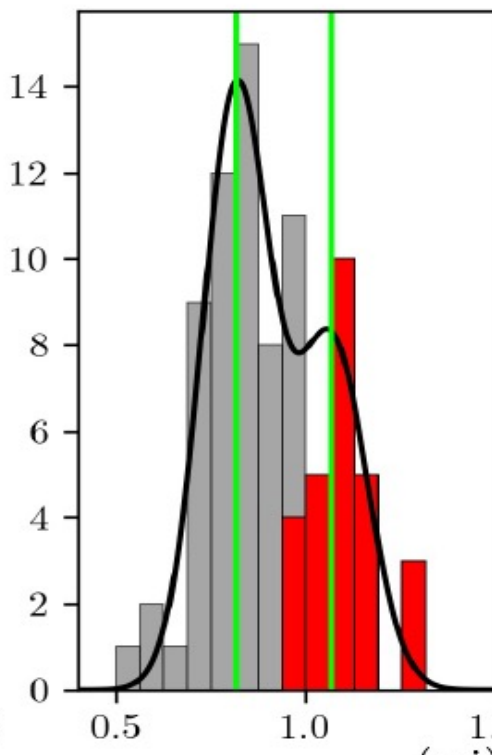
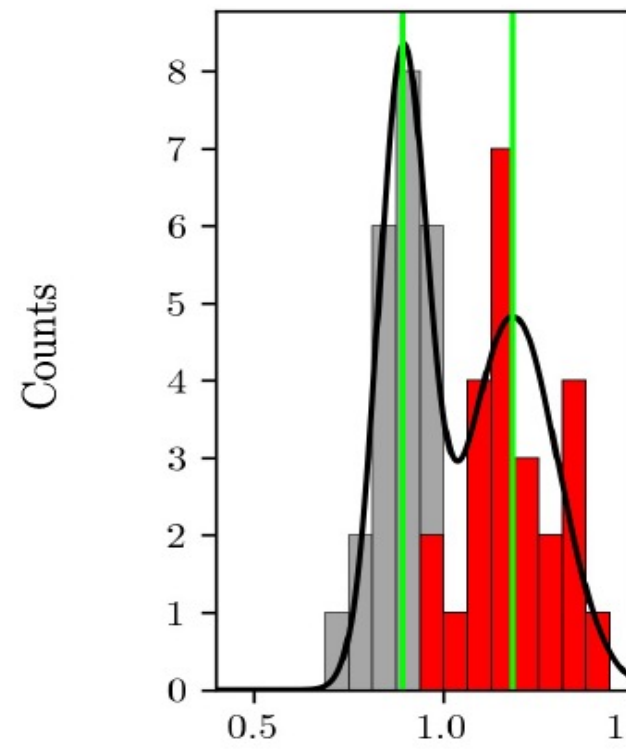
g-i color-diff

Stream A

Stream C

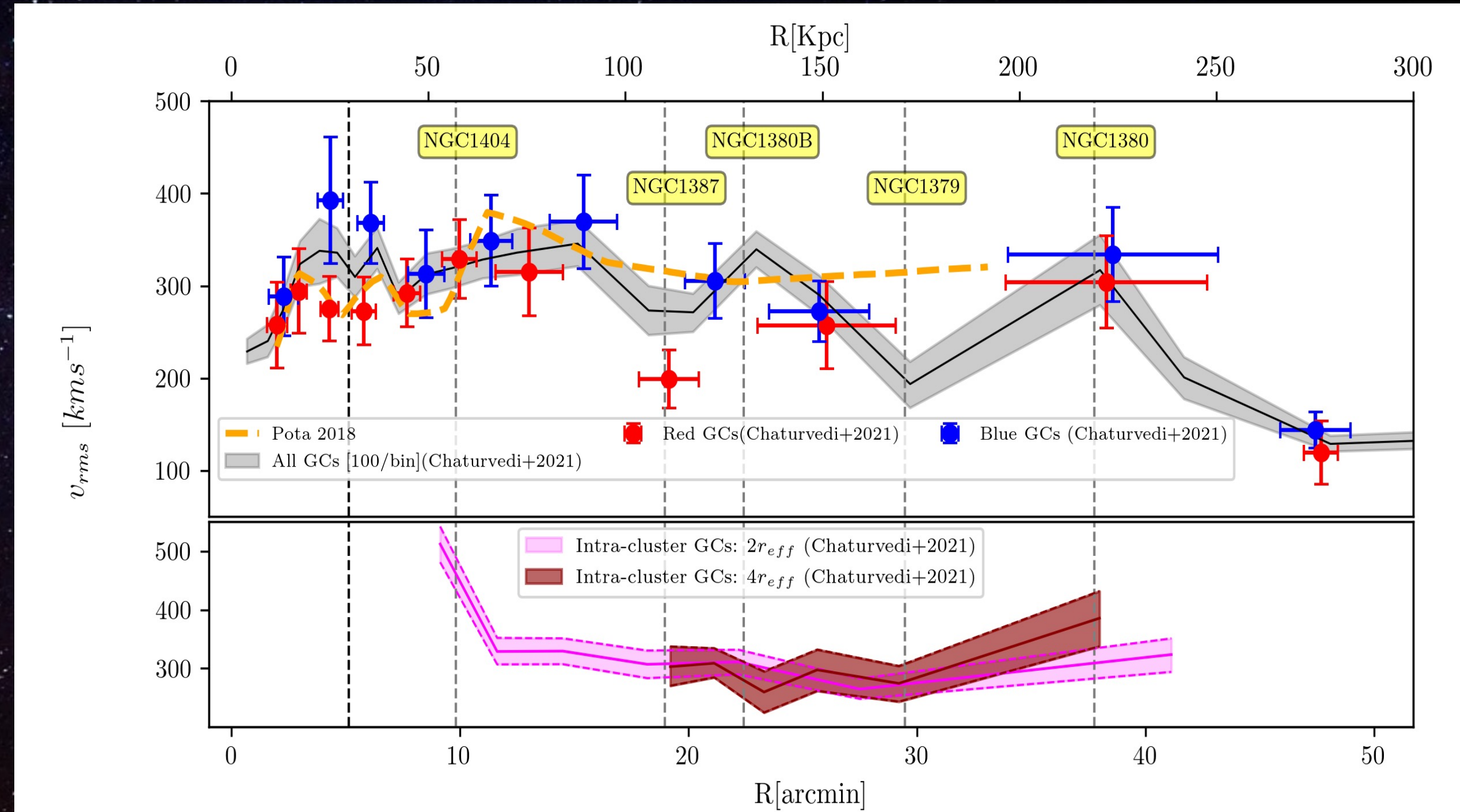
Stream F

Stream G



Velocity dispersion profile

Velocity dispersion profile flattens at ~ 58 kpc, suggesting that the cluster potential starts to dominate from this radius.



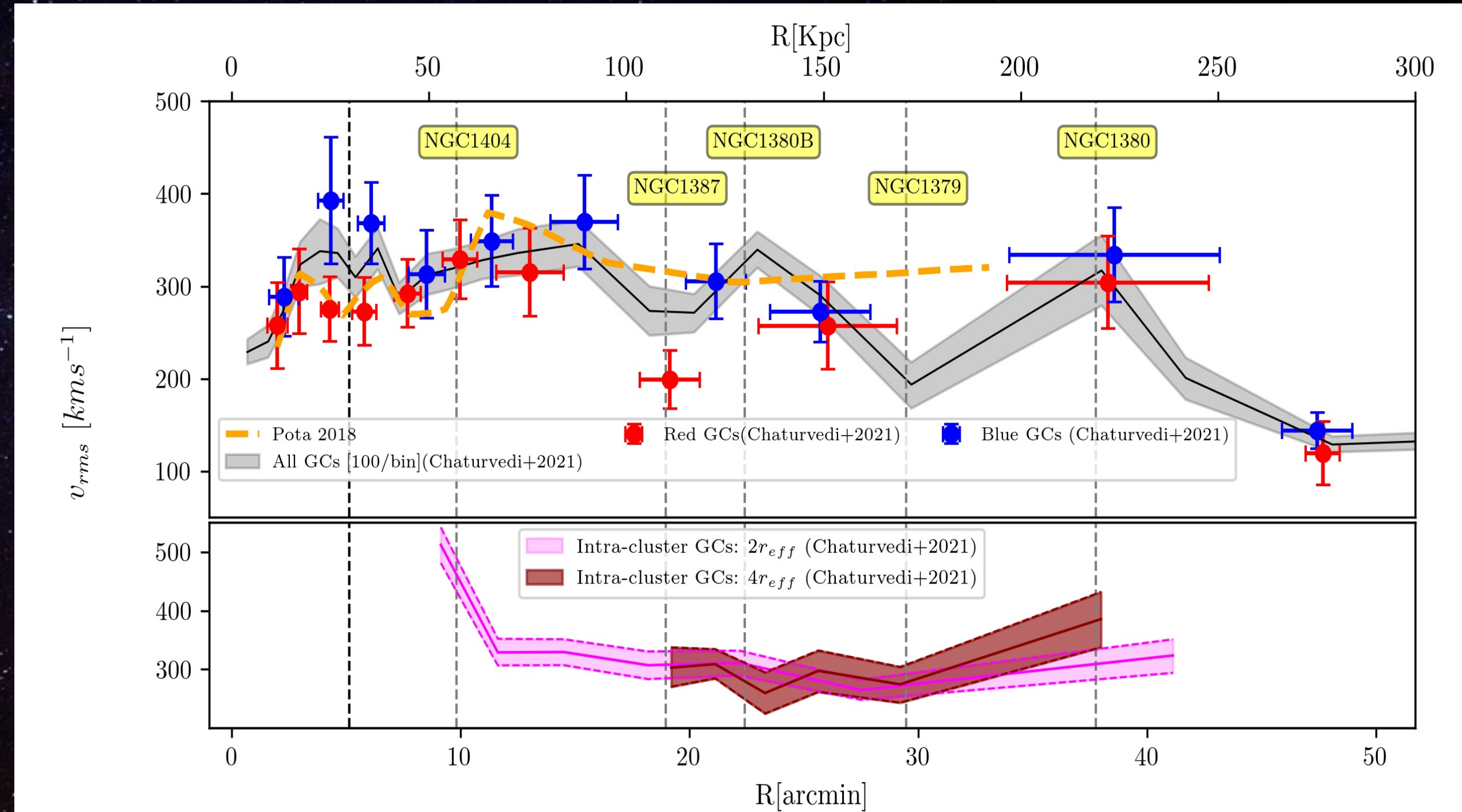
Velocity dispersion profile

Velocity dispersion profile flattens at ~ 58 kpc, suggesting that the cluster potential starts to dominate from this radius.

Discrete Chemo-dynamical modelling (Watkins+ 2013, 2016)

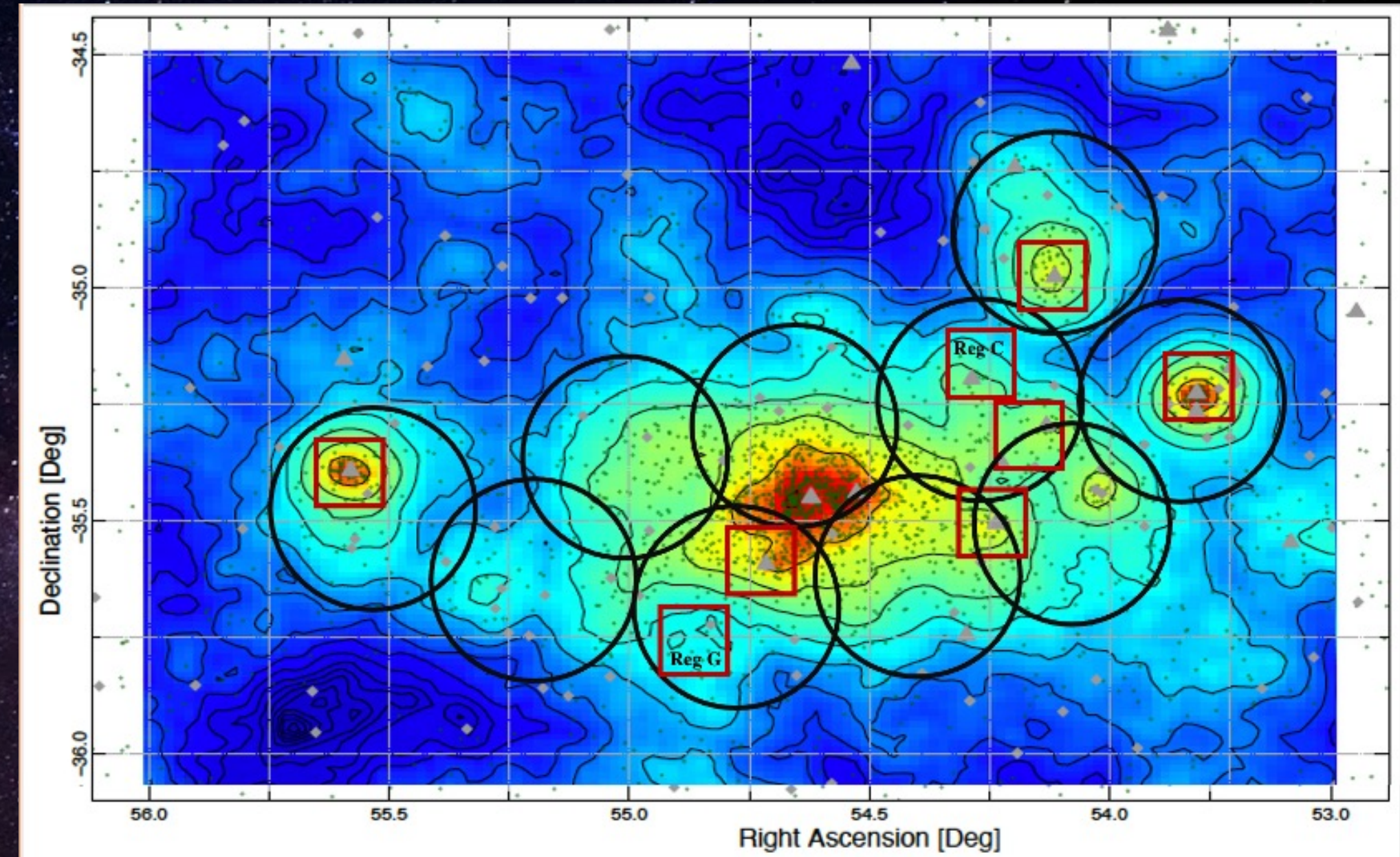
- Liekelihood MCMC Approach
- Effect of Intra-cluster GCs
- Mass-estimate + DM halo properties

Chaturvedi et. al 2022 (in prep A&A)



Fornax Cluster VLT Spectroscopic Survey

- Identify and characterize the substructures.
- ESO VLT FLAMES and FORS2 Observations.
- 70 % observations are done.
- Derive metallicity of intra-cluster GCs.
- Perform the chemo-dynamical mass-modelling and other advanced methods.



Approved VLT FLAMES and FORS2 observations, PI: Chaturvedi

- Produced one of the most extensive radial velocity catalog (total 2341 GCs).
- Metal-poor (blue) GCs dominate the Fornax intra-cluster regions.
- Substructures identification and kinematical characterization.
- Velocity dispersion profile flattens at ~ 58 kpcs, suggesting that the cluster potential starts to dominate from this radius.
- For details : Chaturvedi et. al 2022, A&A
- GCs radial velocity catalog is available at CDS
Fornax globular clusters : J/A+A/657/A93

