

A Wide-field Spectroscopic Survey of Globular Clusters in the Virgo Cluster

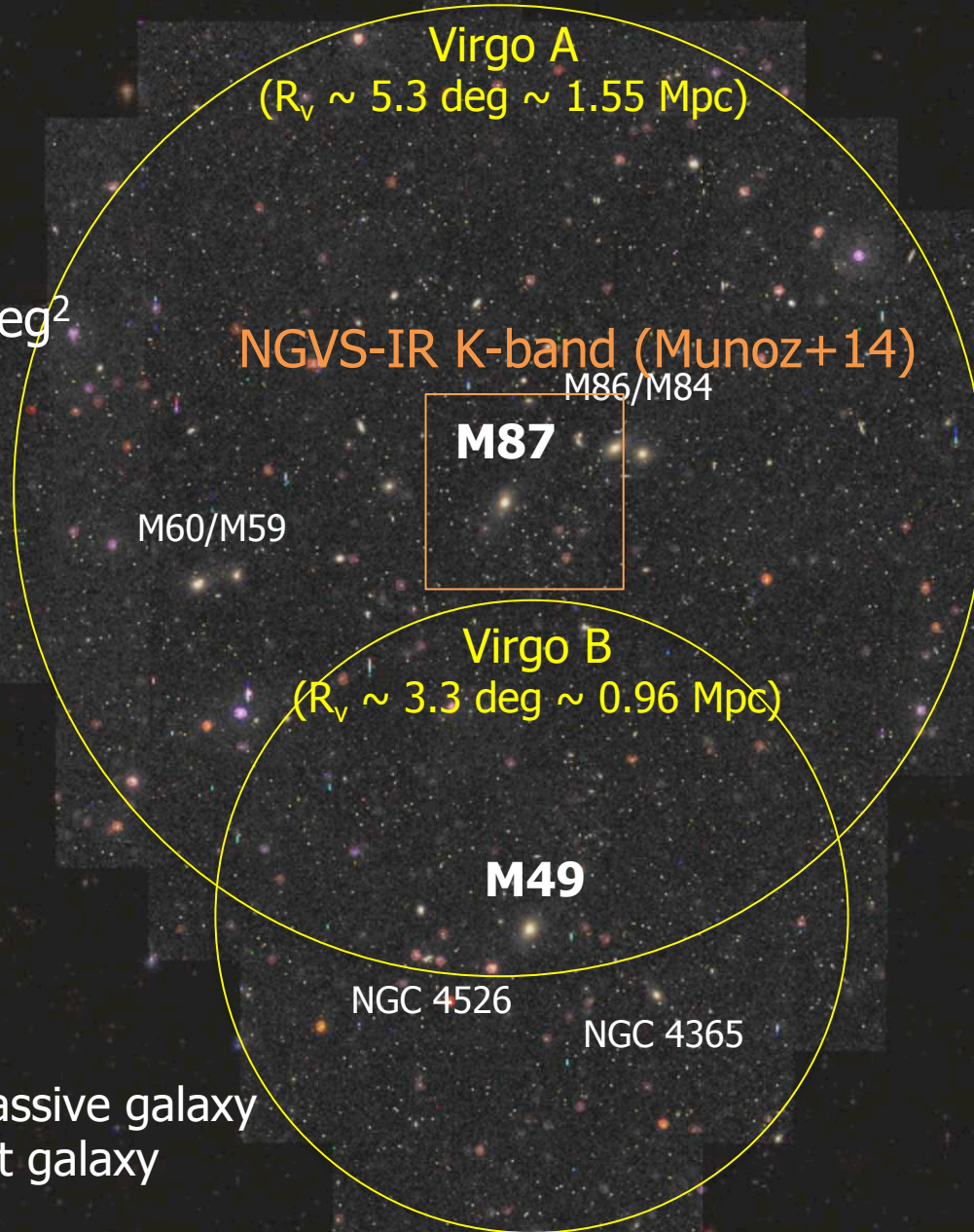
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Next Generation Virgo Cluster Survey

Ferrarese+12
CFHT/MegaCam
ugriz filters
 $g \sim 25.7$ AB mag
Covering $\sim 104 \text{ deg}^2$



M87: The most massive galaxy
M49: The brightest galaxy

Globular Clusters

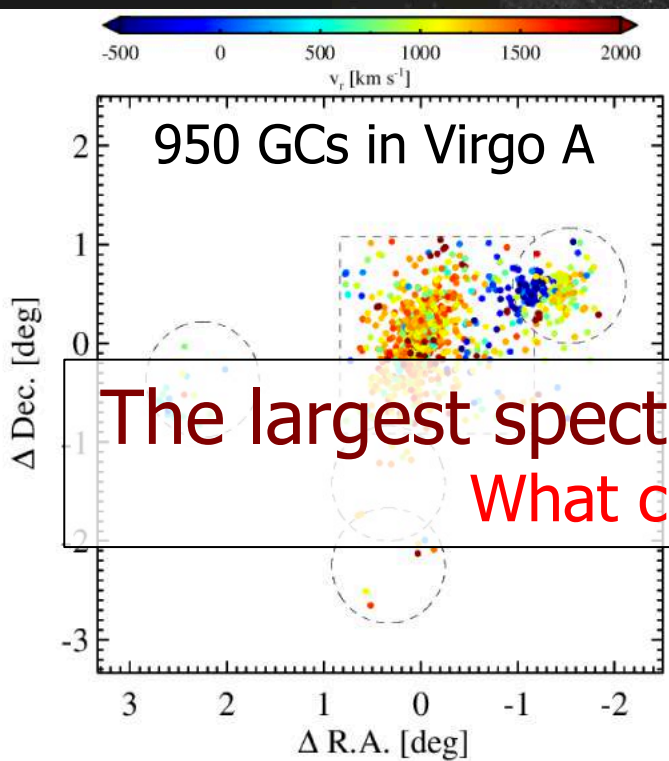
- An excellent tracer of the faint stellar halo ($> 10 R_e$)
- Fossil record keepers
 - **Kinematics** (rotation, dispersion, orbits, etc.)
 - Merging or assembly history
 - Gravitational potential and dark matter distribution
 - **Stellar population** (age, iron/ α -element abundances, etc.)
 - Star formation epoch
 - Mass of progenitors
 - Star formation timescale

Next Generation Virgo Cluster Survey

Spectroscopic Follow-up using MMT/Hectospec
35 configurations \sim 8000 spectra

1475 GCs are confirmed!

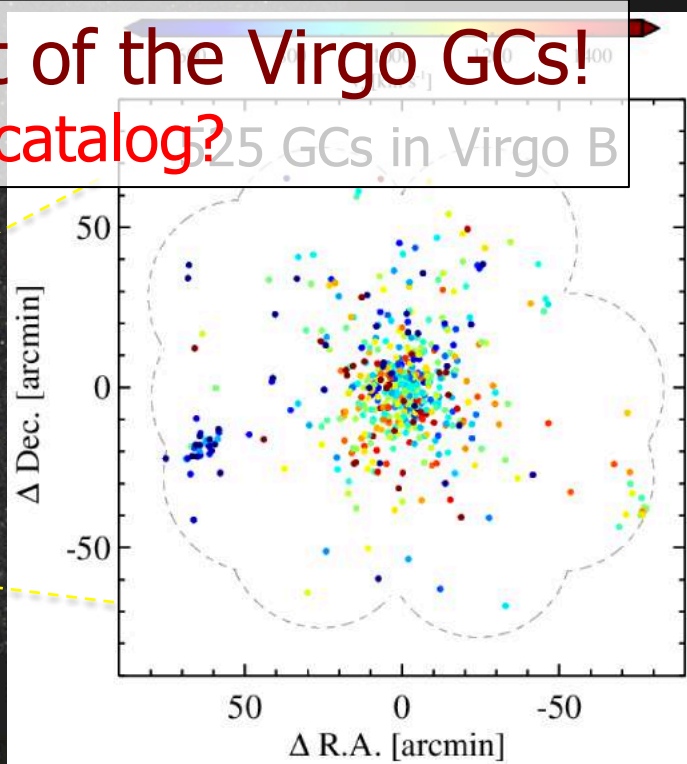
50 in Virgo A / 525 in Virgo B



MMT/Hectospec
survey region

Ko+17 survey region

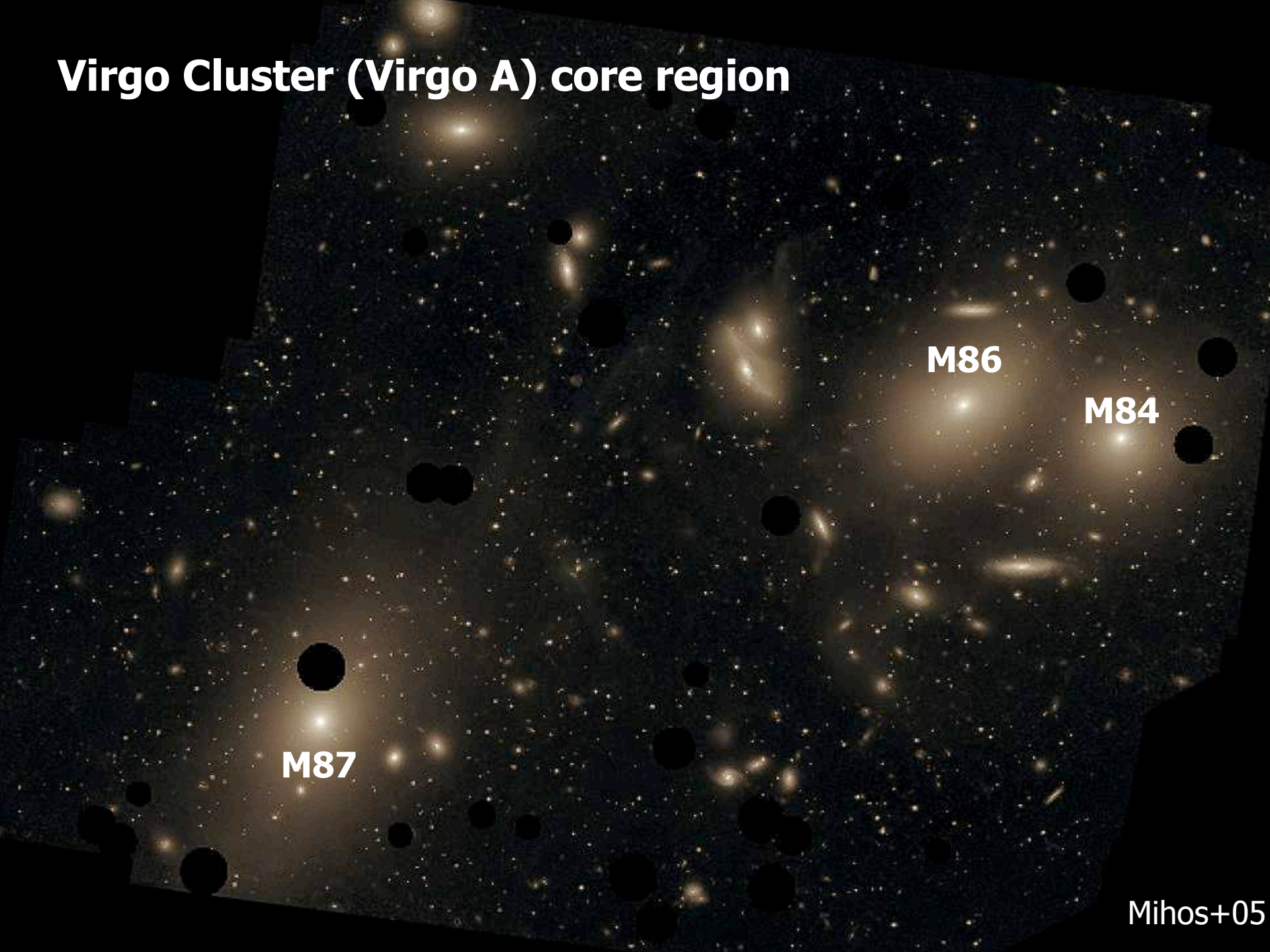
The largest spectroscopic data set of the Virgo GCs!
What can we do with this catalog?



Ongoing (+Future) Projects on Virgo GCs

- **Kinematics & Dynamics**
 - Mass profile of massive early-type galaxies (e.g. Li+19 for M87)
 - **Stellar population**
 - Mean age, $[Z/H]$, and $[\alpha/Fe]$ measurements of co-added spectra
 - **Substructures**
 - Kinematic substructures associated with Virgo galaxies
 - Correlation between GC substructures and diffuse stellar light
- + Comparision with hydrodynamical simulation data

Virgo Cluster (Virgo A) core region

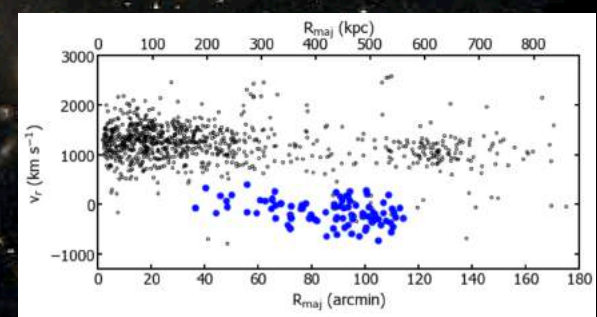
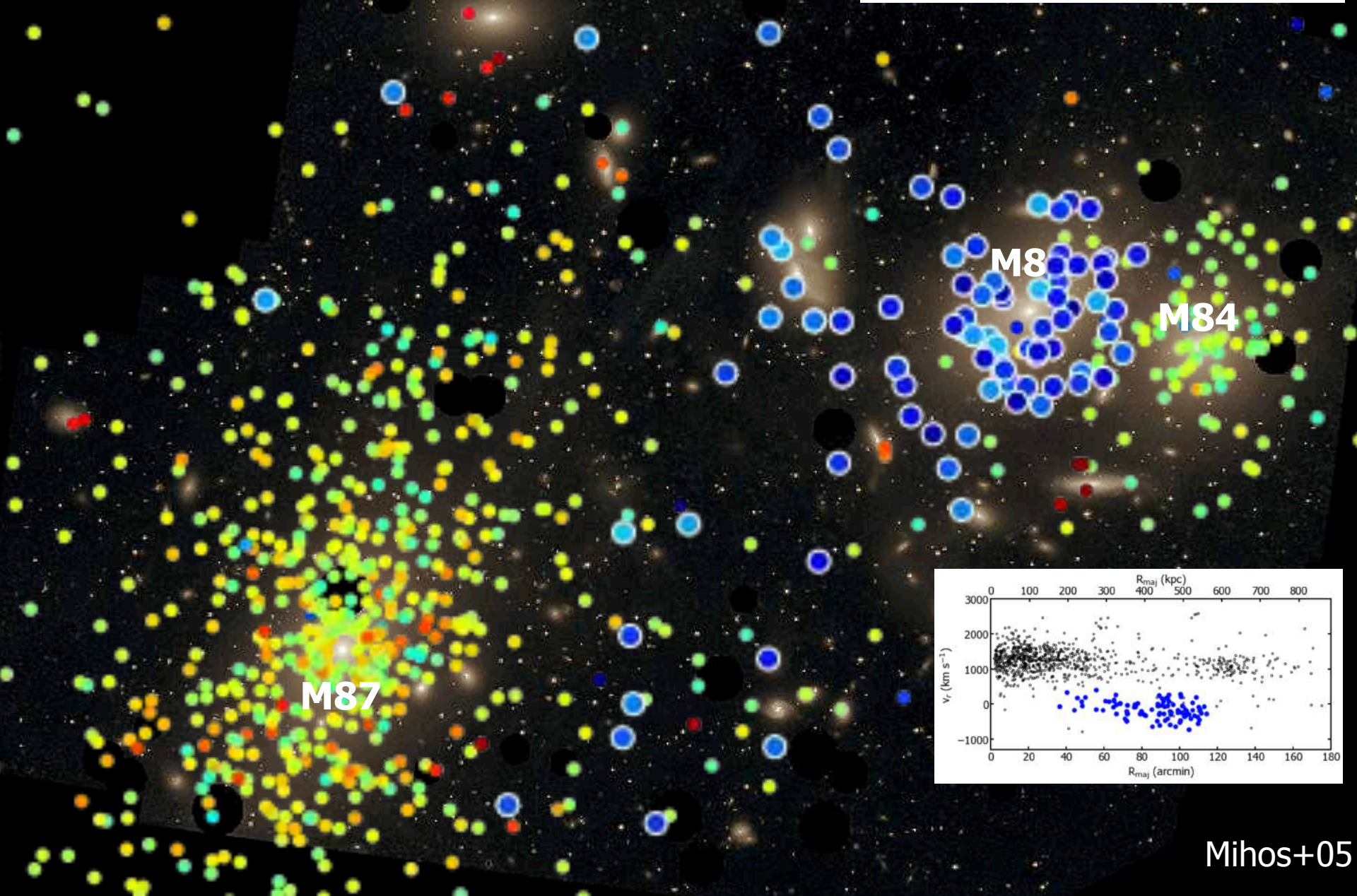
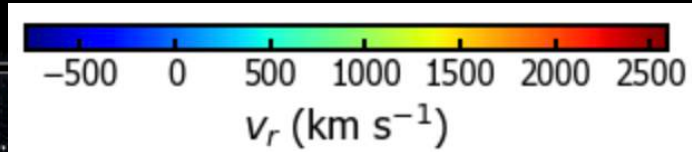


M87

M86

M84

Virgo Cluster (Virgo A) core region



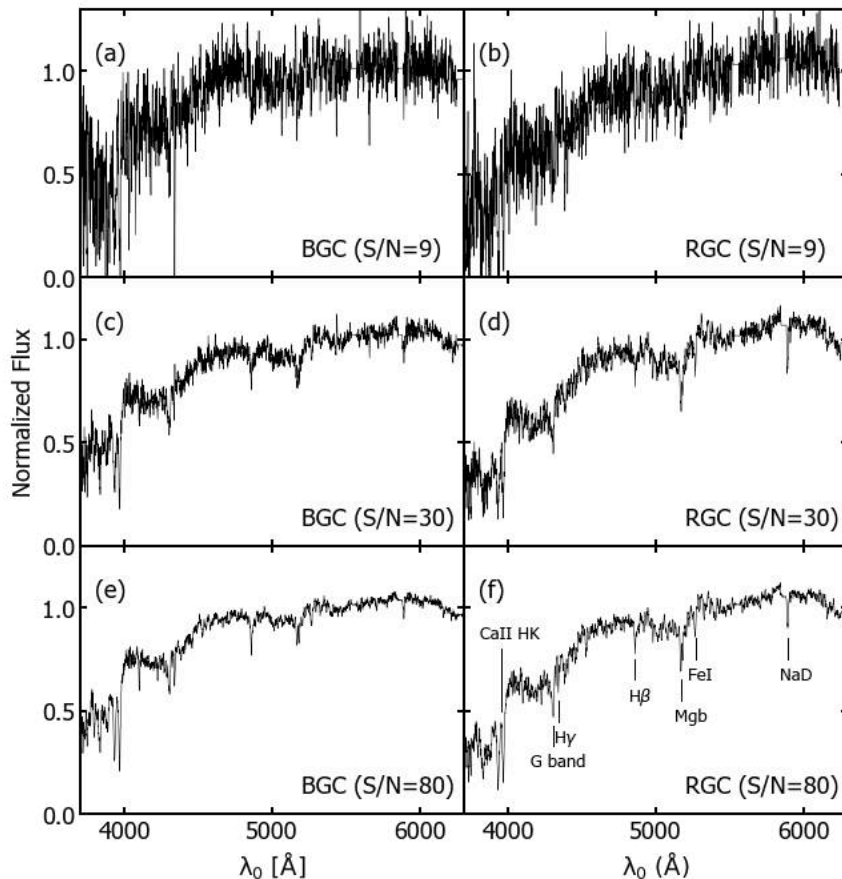
Stellar Population Analysis

Lick indices

EZ_Ages (Graves & Schiavon 08)

+ SSP models

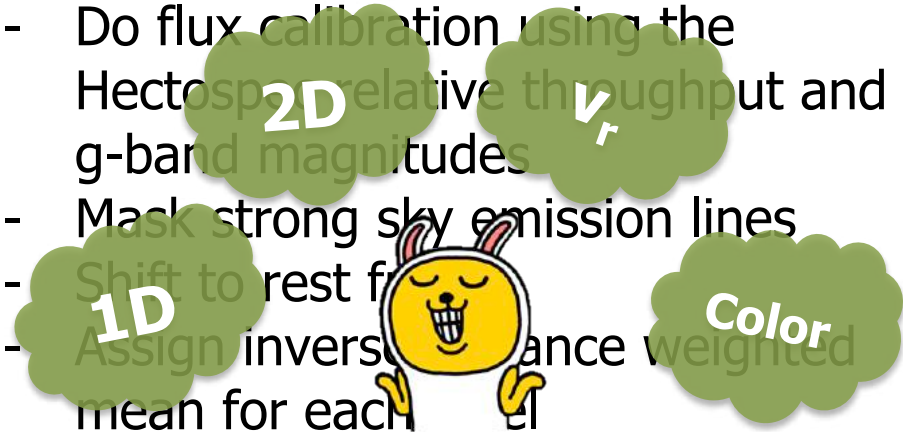
χ^2 minimization method (Proctor+04)



Median spectral S/N = 9

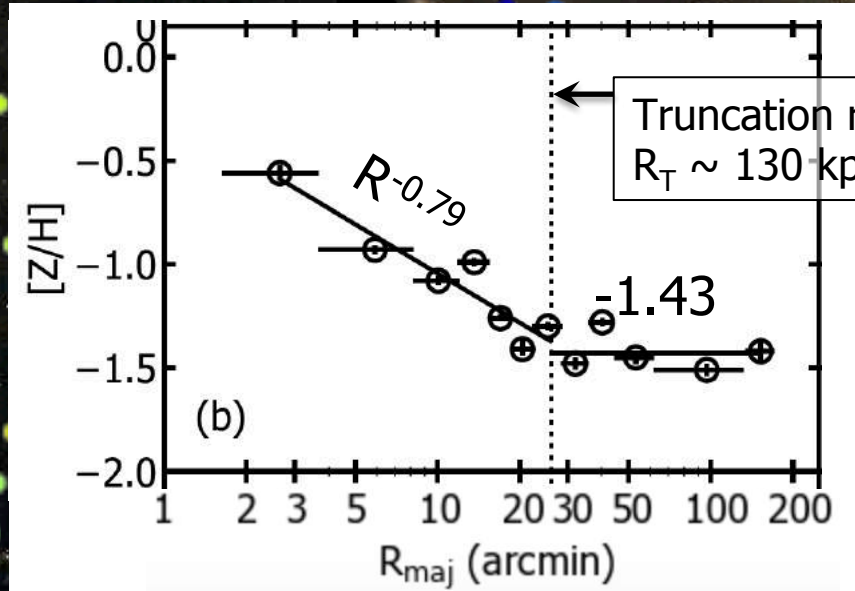
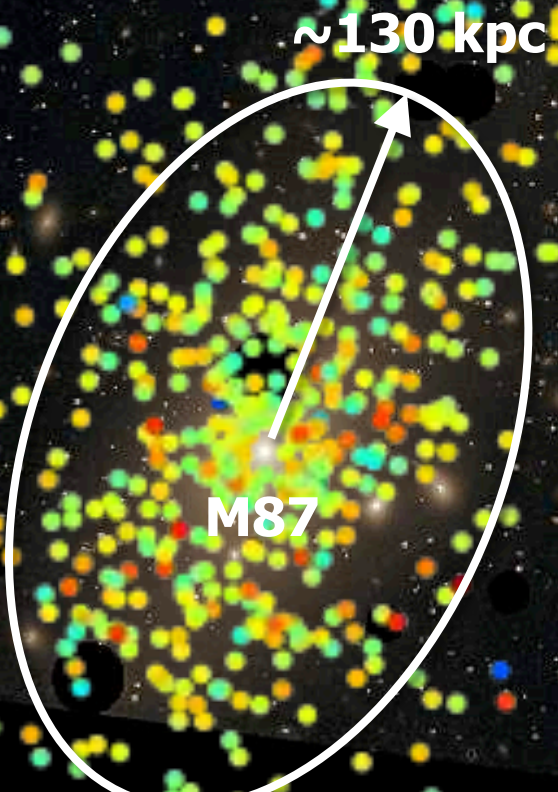
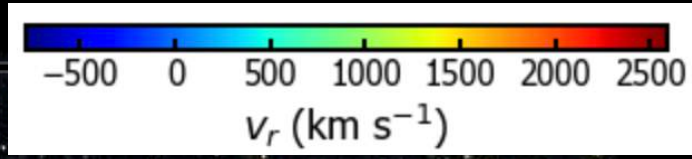
Stacking analysis

- Do flux calibration using the Hectospec relative throughput and g-band magnitudes
- Mask strong sky emission lines
- Shift to rest frame
- Assign inverse variance weighted mean for each filter



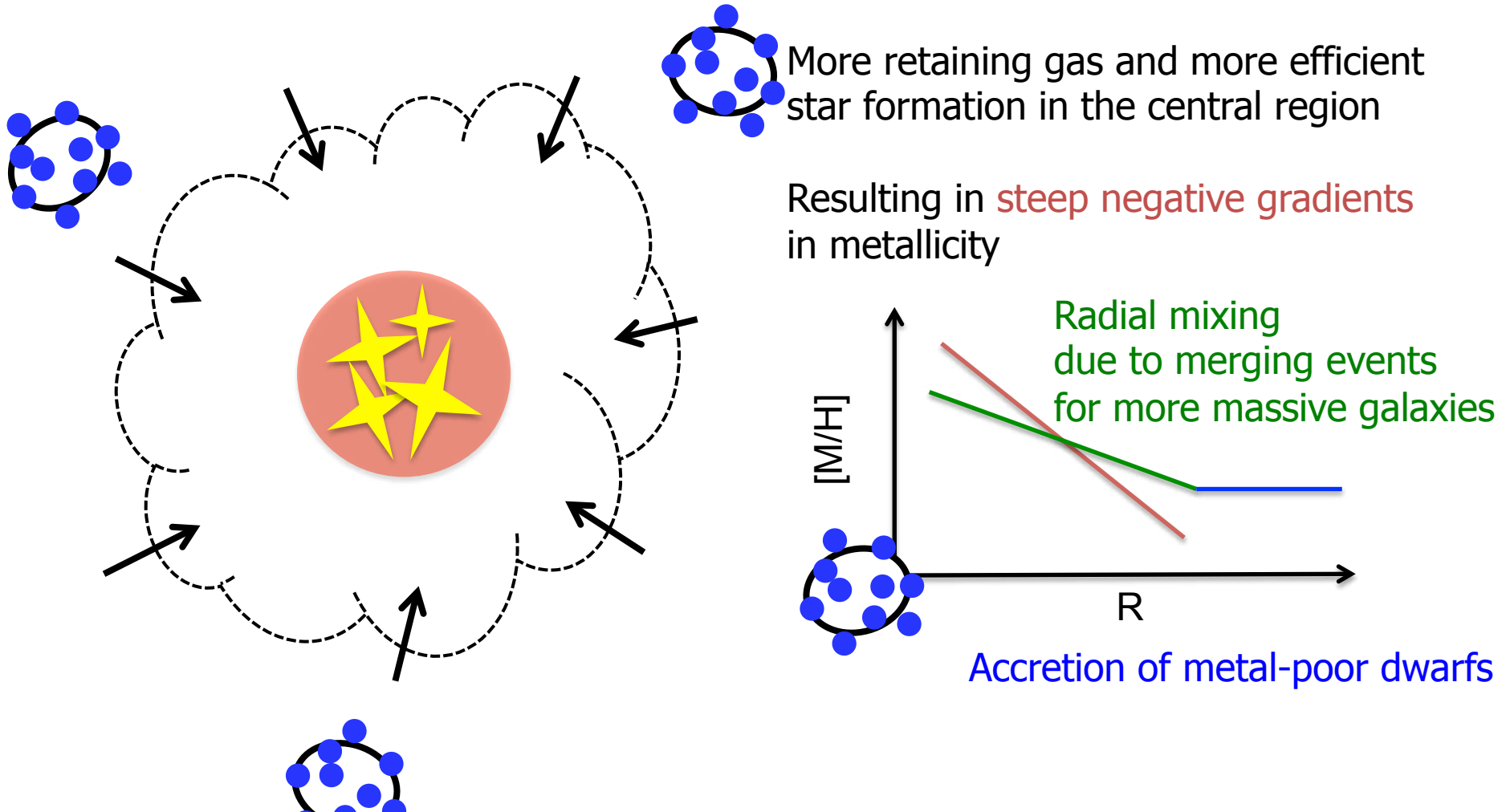
Stacking analysis

Lick indices + SSP models



Metallicity Gradients in Massive ETGs

In situ dissipative collapse & Accretion of low-mass galaxies



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