



# The Role of Mass and Environment in Globular Cluster Formation

Yiqing LIU

(Peking University/Kavli Institute for Astronomy & Astrophysics, Beijing)

Eric PENG, ACS Virgo & Fornax Cluster Survey Team



# Galaxy:

the basic element in the universe

- Where does it come from?
- Where is it going to?
- What is it?

# Star & Star Cluster

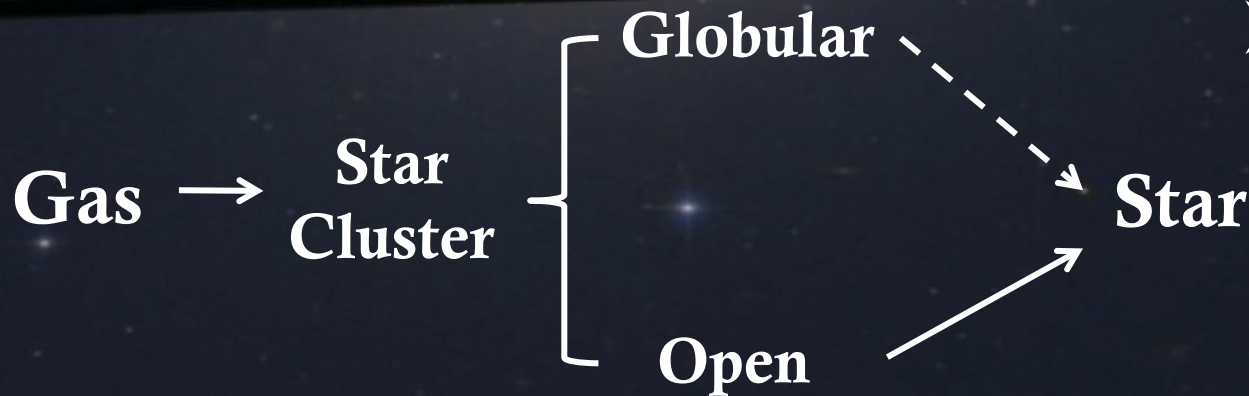
## Globular Cluster



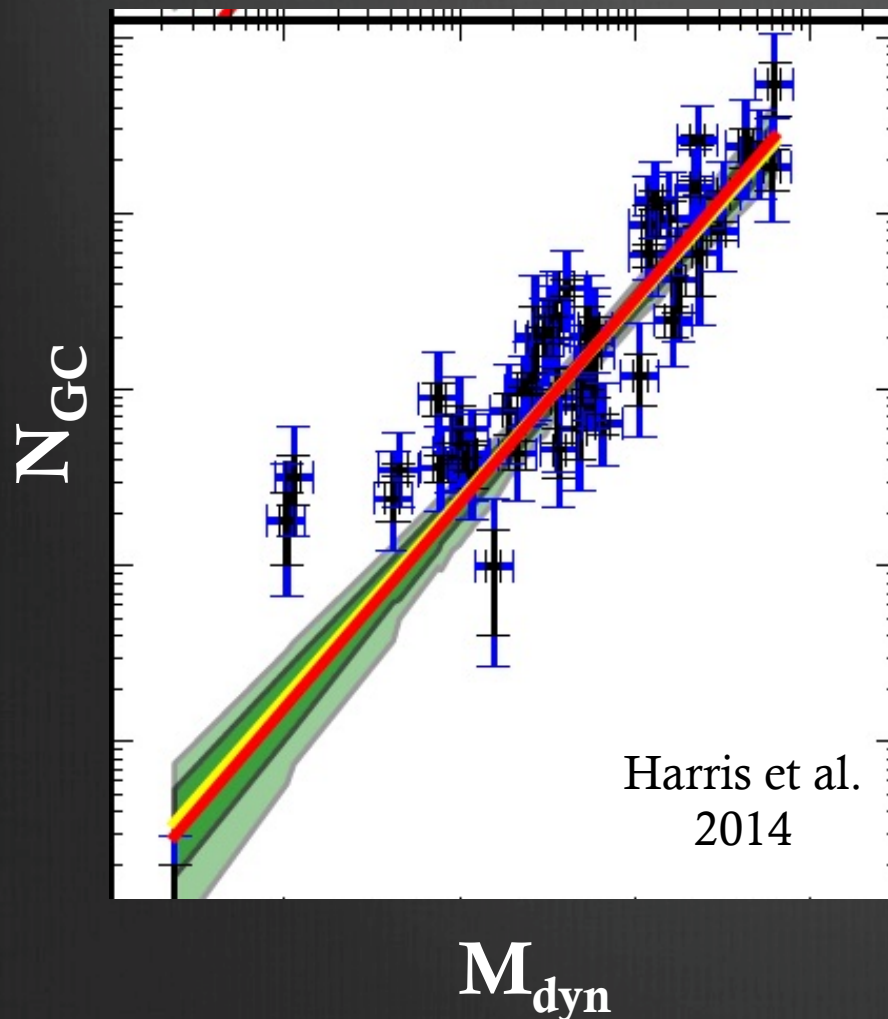
- $10^4 - 10^6 M_{\text{sun}}$
- $\sim 3 \text{ pc}$
- $\sim 10 \text{ Gyr}$

- Massive & Compact
- Old & Metal-poor

➤ How to form?



# Globular Cluster (GC) & Galaxy

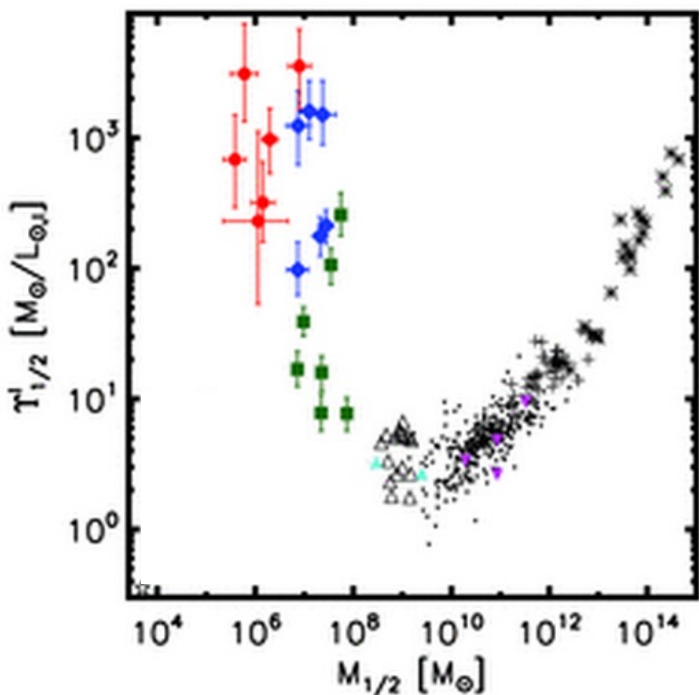


$\{M_{BH}, M_{bulge}, M_{halo}, \dots,$   
 $N_{GC}\}$



Formation efficiency?

**Mass vs.  
Environment**



Wolf et al. 2010

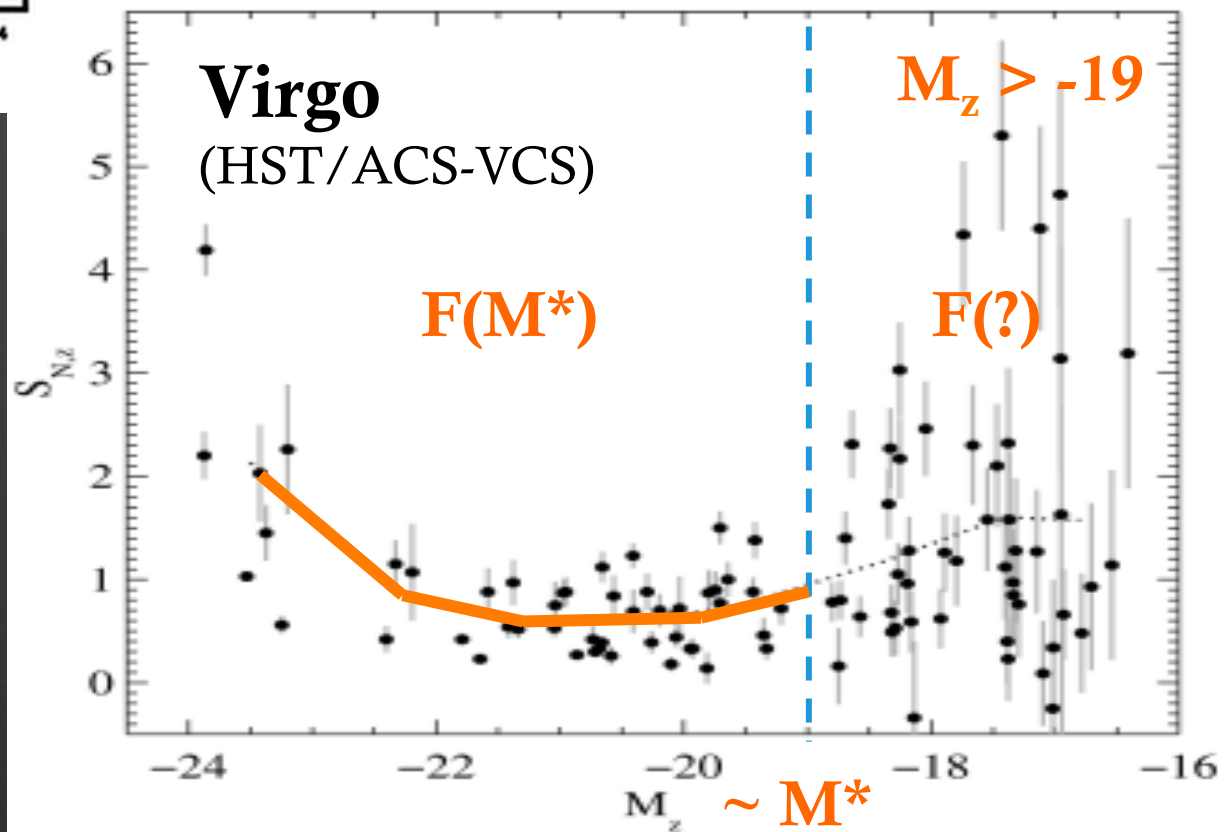
- “U-shape”
- Scatter @  $M_z > -19$

Peng et al. 2008

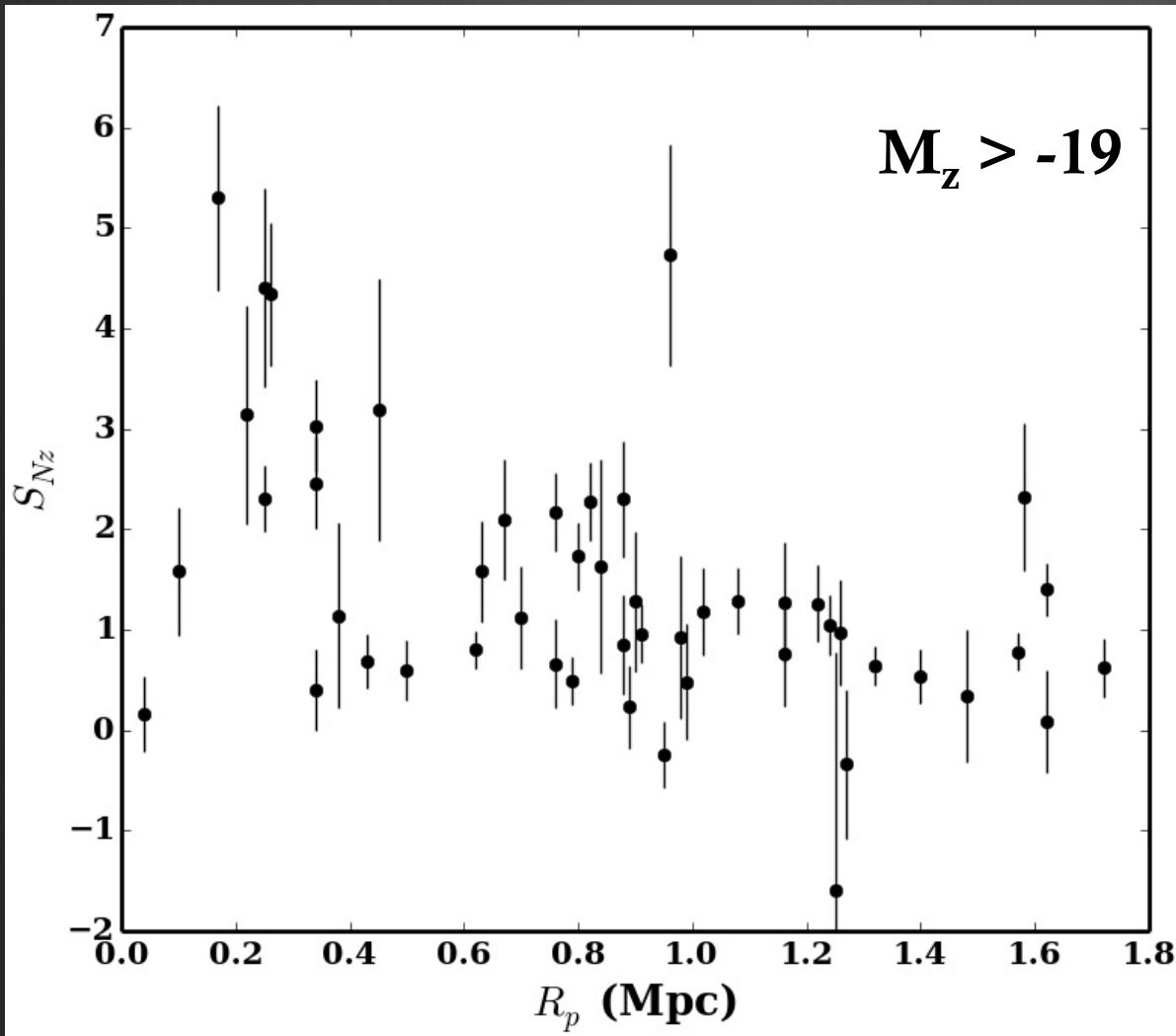
# Mass Dependence

$$S_N = N_{GC} * 10^{[0.4(M_V + 15)]}$$

$$\sim N_{GC} / L_{Gal}$$



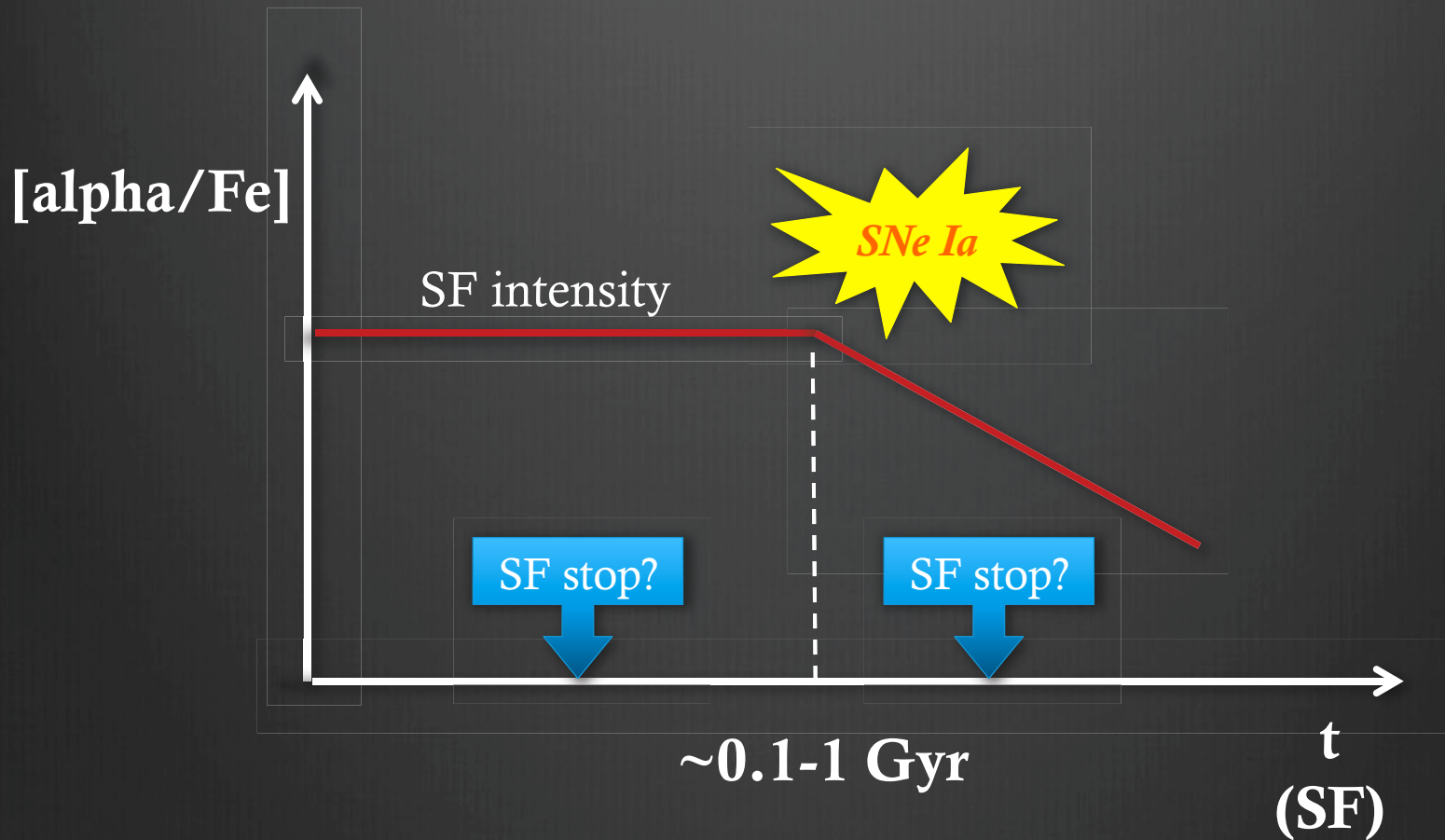
# Environmental Dependence



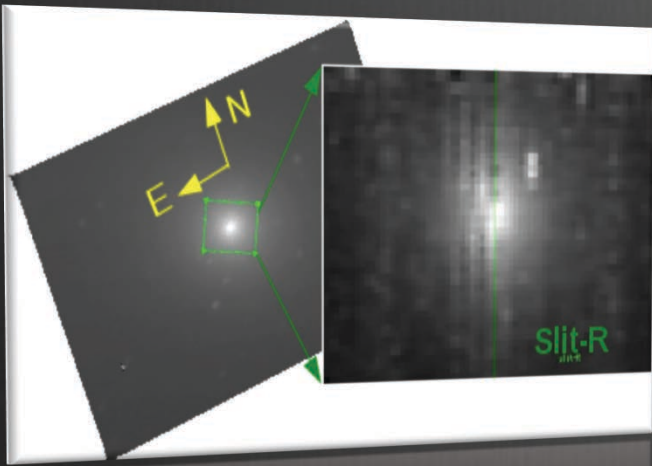
- Inner dEs – higher  $S_N$
- Inner region – higher density

Peng et al. 2008  
Liu et al. in prep

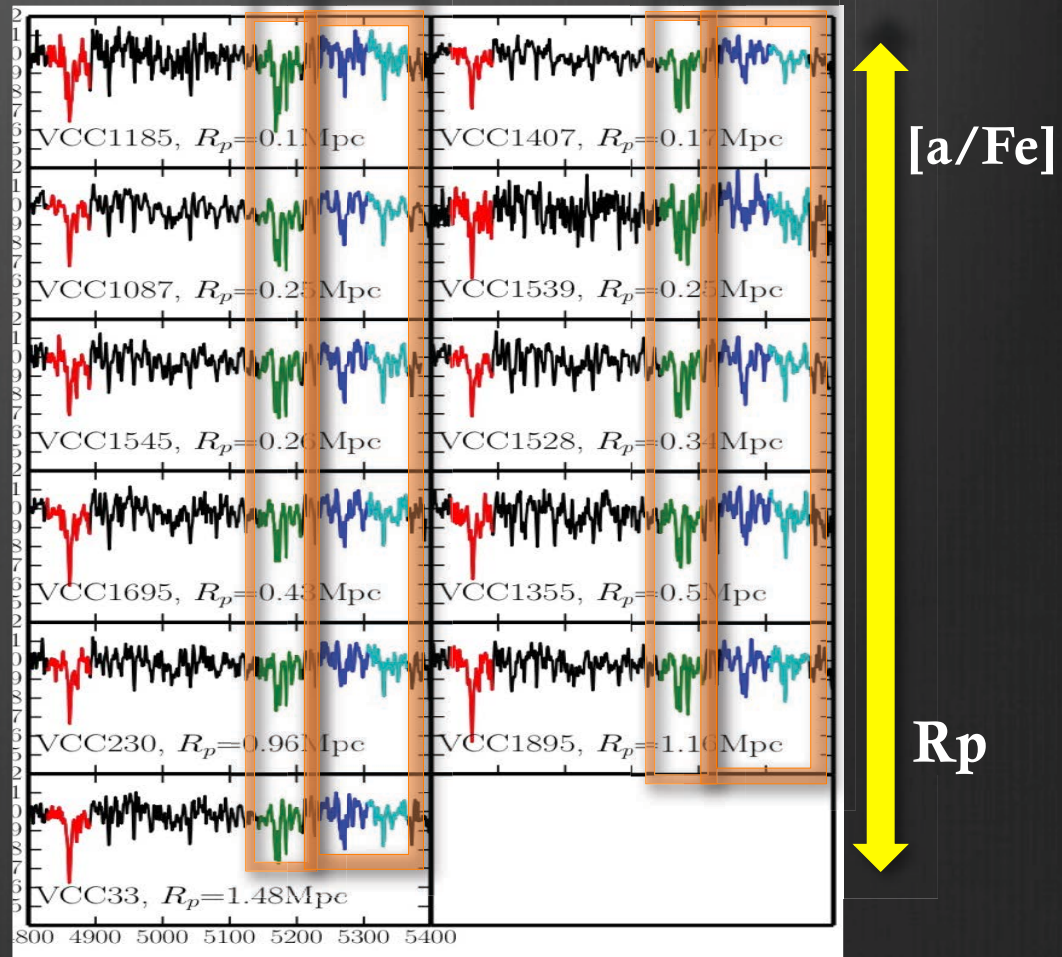
# $[\alpha/\text{Fe}]$ : a clock of SF



# Measure $[\alpha/\text{Fe}]$



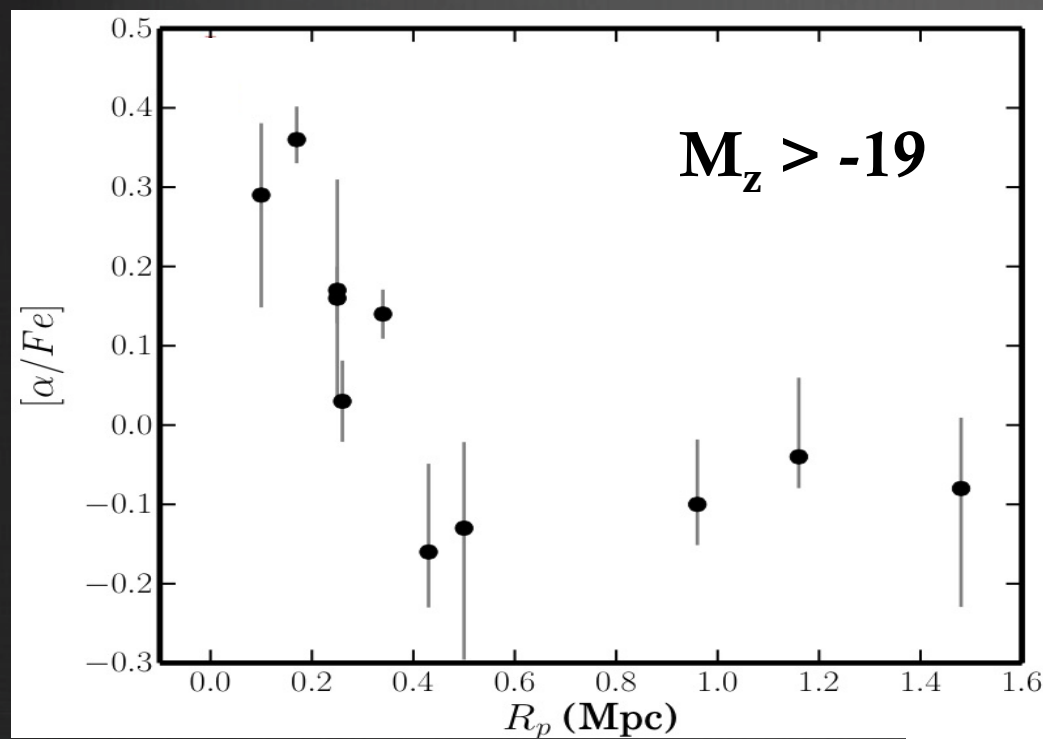
- Gemini GMOS-IFU
- Combine all fibers
- Exclude nuclei
- Lick indices + SSP (TMB03)



Liu et al. in prep

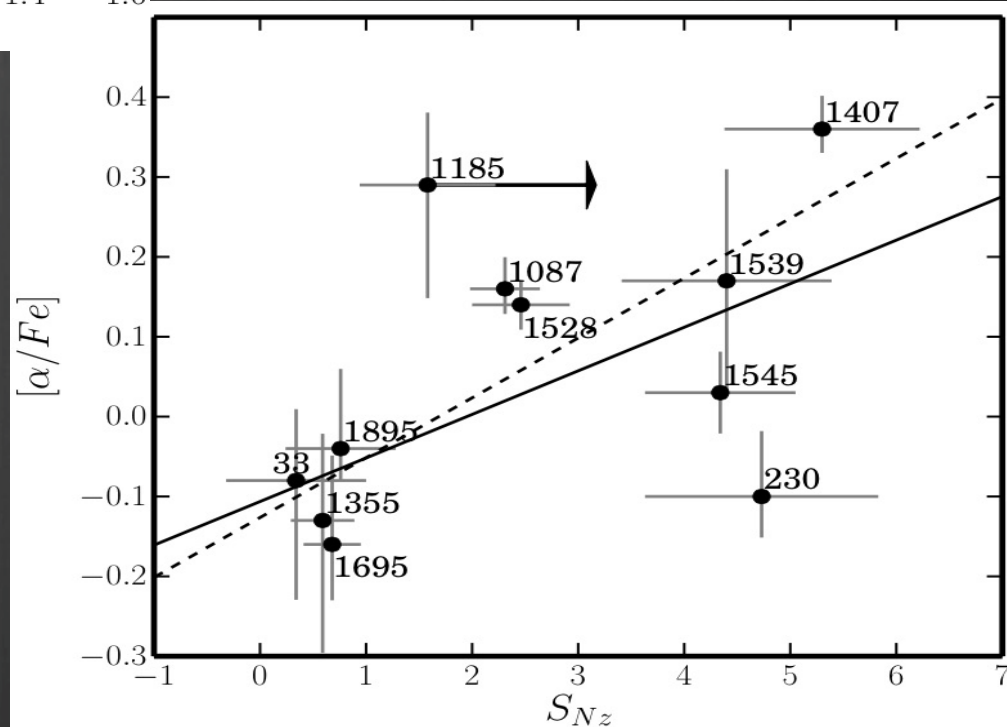
# Results

- Density  $\sim [\alpha/\text{Fe}] \sim S_N$
- Star formation intensity  $\sim$  GC formation efficiency



Liu et al. in prep

✧ Environment affects early star & GC formation



# Environmental Dependence: How Much?

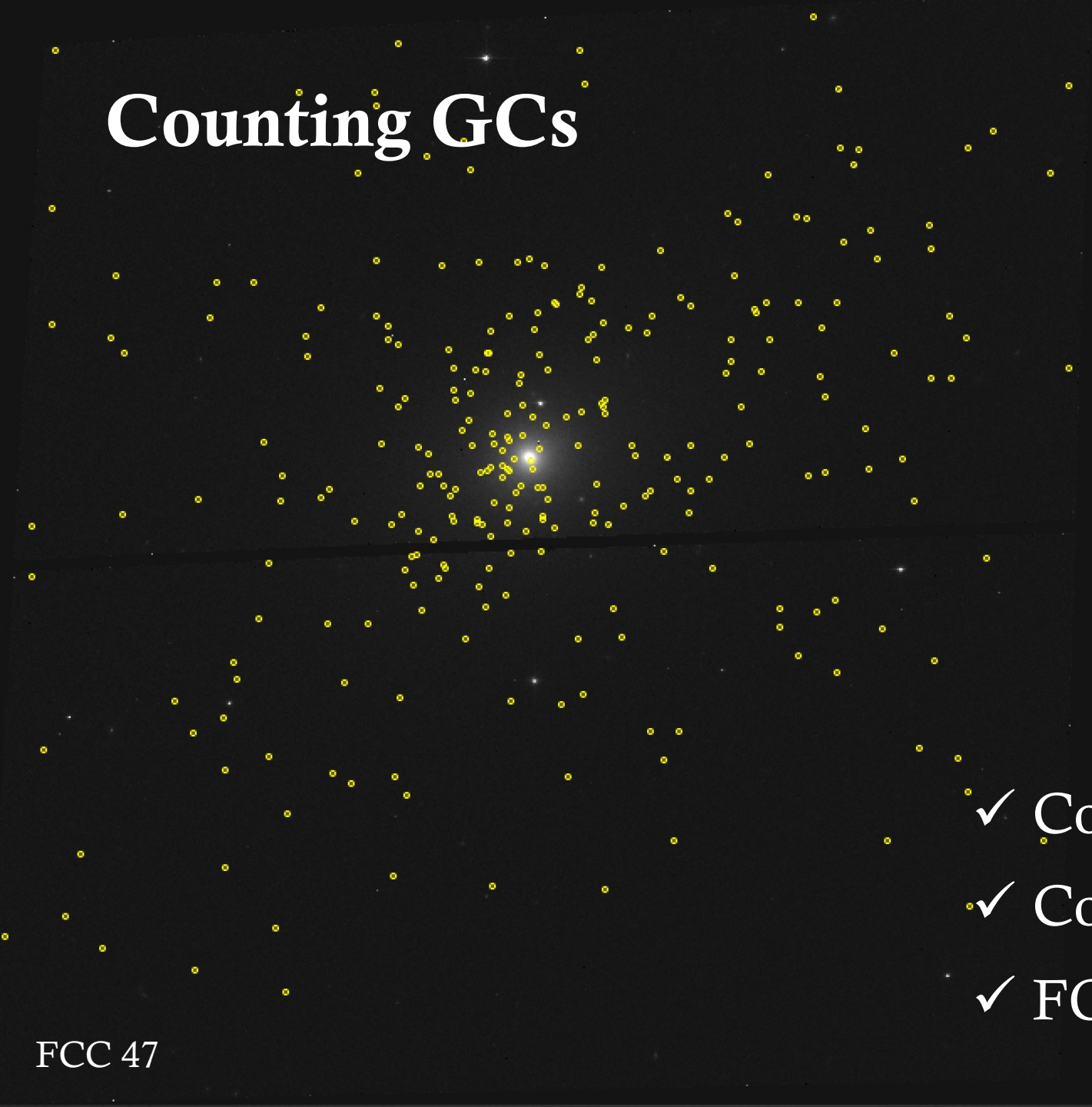
Virgo Galaxy Cluster

- More massive
- Dynamically younger

Fornax Galaxy Cluster

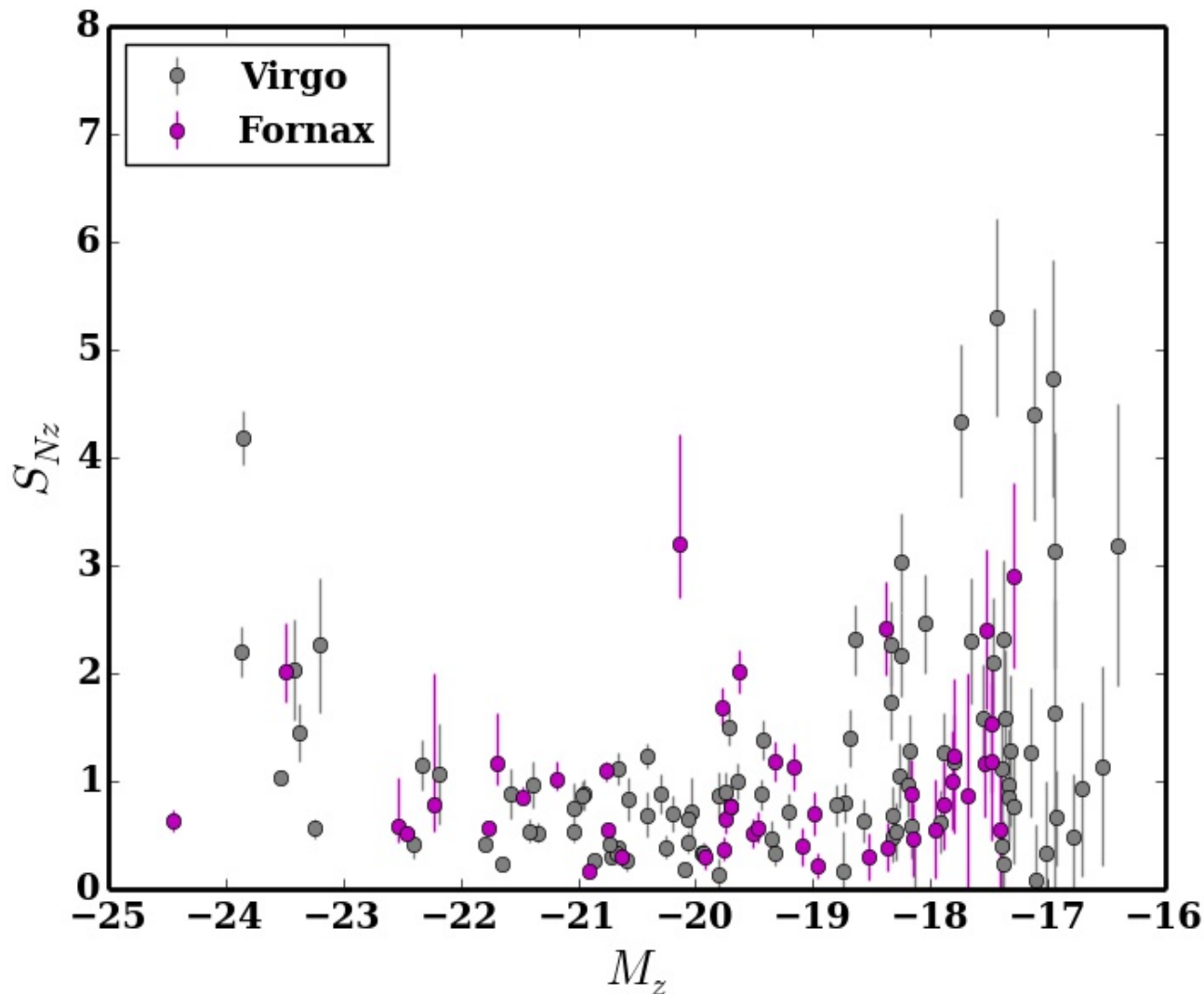
- Less massive
- Dynamically older

# Counting GCs



- ✓ Completeness
- ✓ Contamination
- ✓ FOV correction

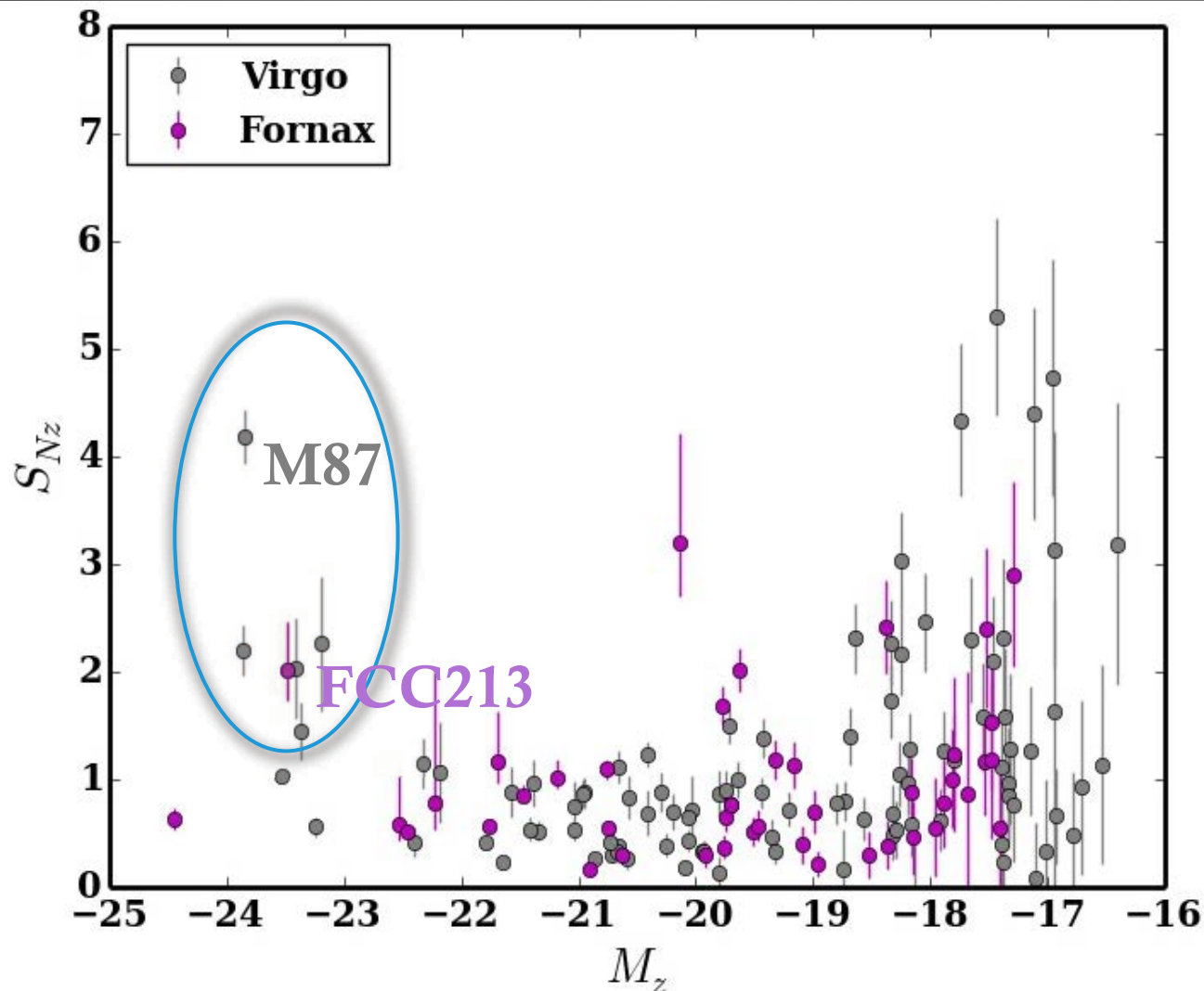
# Mass vs. Environment



- Similar “U-shape” & scatter in two clusters
- cD & low-mass: lower  $S_N$  in the Fornax

Liu et al. in prep

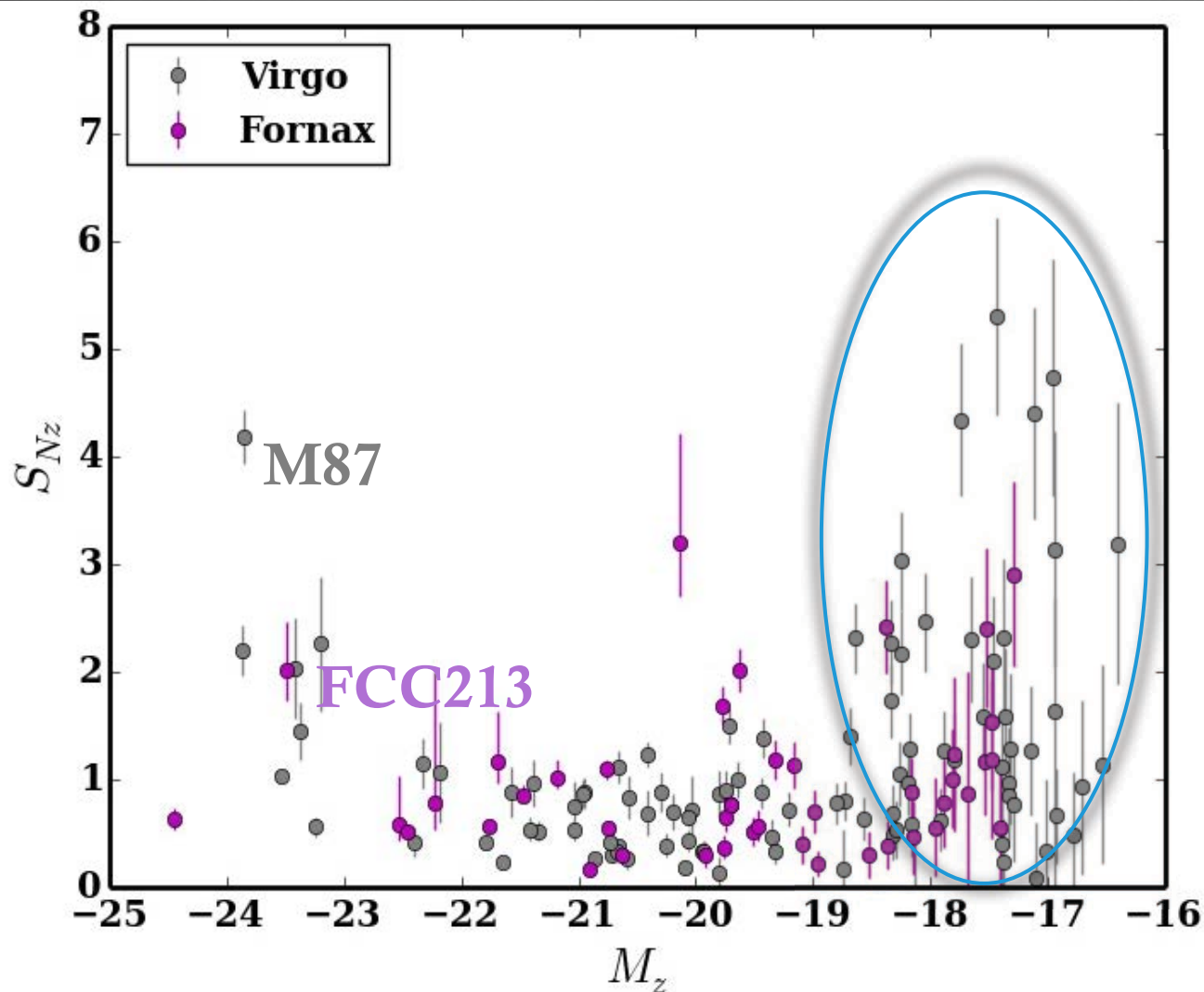
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Liu et al. in prep

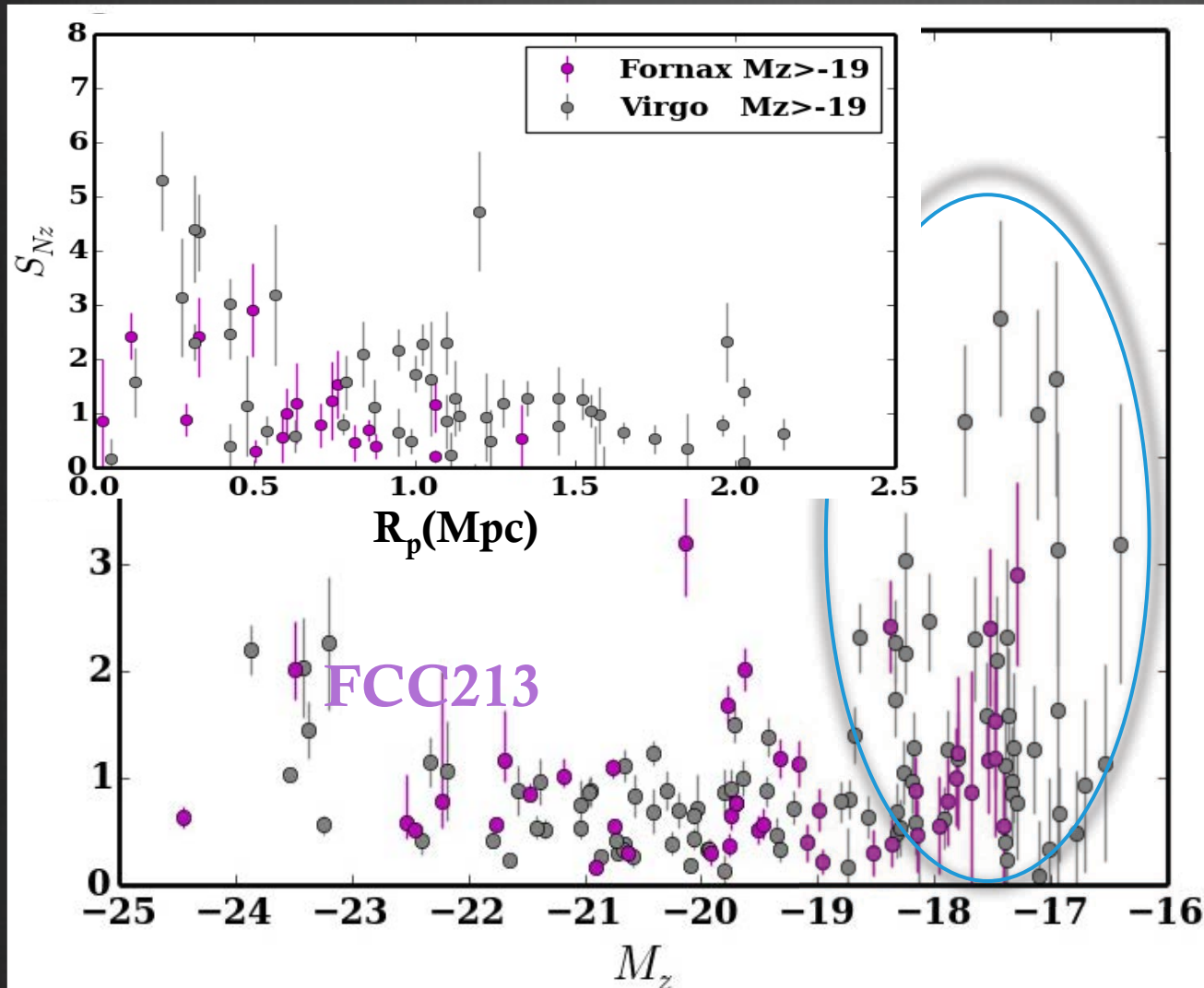
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- Similar “U-shape” & scatter in two clusters
- cD & low-mass: lower SN in the Fornax
- ✧ Env. – cluster halo: Important

Liu et al. in prep

# Conclusions

- Environment plays an important role in star and GC formation of low-mass galaxies.
- Early star formation are more intense in denser environments.
- GC specific frequencies are less extreme in Fornax (a lower mass galaxy cluster).

