The $\sigma$ Function of the Massive Clusters A2029 & Coma

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In the $\Lambda$CDM cosmology

Cosmology

DM structure

Baryonic physics
What Probes Dark Matter?

- Luminosity
- Stellar Mass

→ Determined by baryonic process

\[ \alpha = -1.9 \] (CDM)

NGVS LFs - Ferrarese et al. (2016)
What Probes Dark Matter?

- Central velocity dispersion ($\sigma$)
- directly proportional to the DM potential well!

Simulation

Evrard et al. 2008

Observation

Zahid et al. 2016

Virial mass

Virial mass
Galaxy clusters

- Many members ($N_{\text{galaxy}} \sim 1000$)
- Essentially at the same distance, density environment

★★ The best controlled sample for statistical analysis

★★ How about velocity dispersion function (VDFs) in clusters?

A2029; $z = 0.078$

Coma, $z = 0.023$
Data & Membership

- **A2029 at $z = 0.078**
  - MMT/Hectospec
  - $N_{\text{mem, caustic}} \sim 1000$

- **Coma at $z = 0.023$**
  - SDSS DR12
  - $N_{\text{mem, caustic}} \sim 1200$
Here are the VDFs in clusters!
Cluster VDFs vs. Field VDFs

Coma + A2029

Lower limit of cluster VDF

N (R_d < 2.0 Mpc)

log \sigma (km s^{-1})

- Sheth et al. (2003): SDSS DR4
- Choi et al. (2007): SDSS DR5
- Montero-Dorta et al. (2016): BOSS
Sampling issue: missing low $\mu$ galaxies

Early-type classification

Different corrections

Environmental effects

![Graph showing the distribution of galaxies in Coma and A2029 with different corrections from Sheth et al. (2003), Choi et al. (2007), and Montero-Dorta et al. (2016).]
Summary

- Velocity dispersion function of clusters for the first time!
- More cluster VDFs are coming!
- Different shape of the Cluster VDFs compared to the field VDFs