

Halo Mass Recovery Comparison

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SPT Clusters Mass Calibration

(Ruel et al., in preparation, Bocquet, Bazin et al., in preparation)

We study the degree to which statistical and systematical uncertainties affect the measured velocity dispersion of SPT galaxy clusters and their subsequent estimation of dynamical mass.

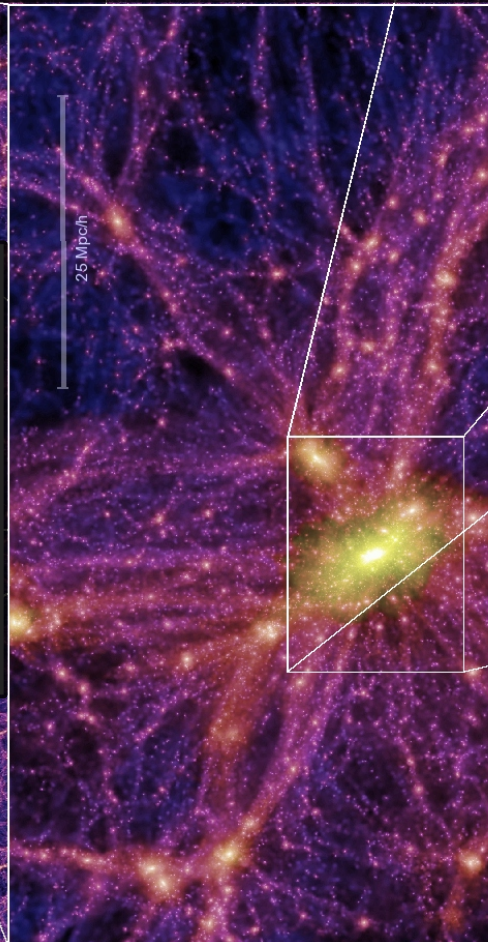
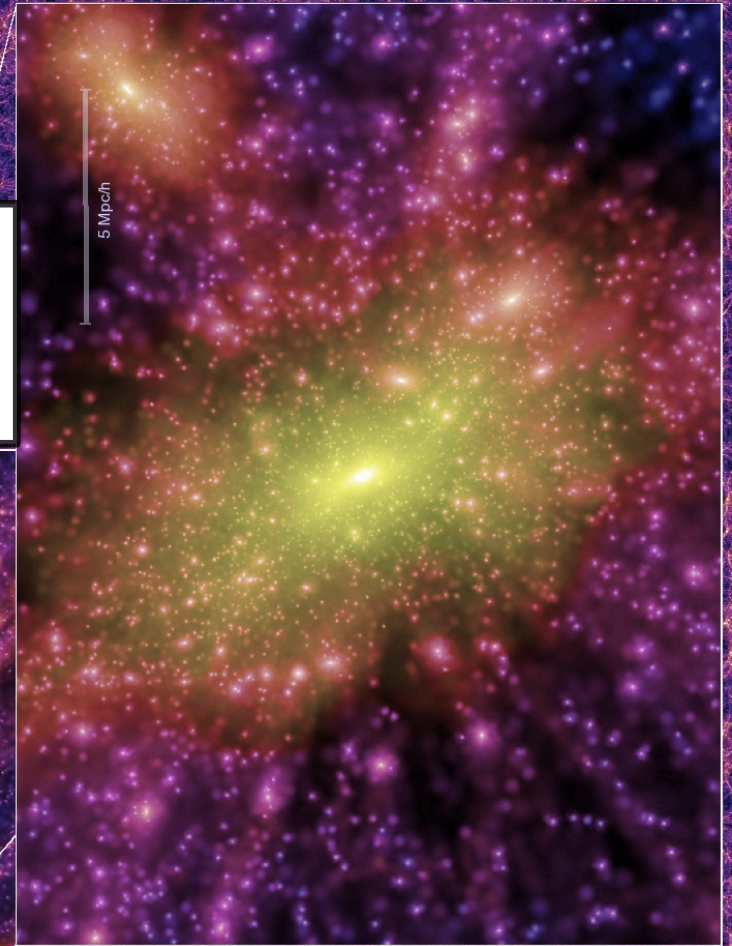
- Massive clusters (approx mass limited sample $M > 3 \times 10^{14} M_{\text{sun}}$)
- High- z (median $z=0.6$, $\sim 10\%$ above $z=1$)
- Multiple masks for each cluster for a characteristic number of ~ 25 spectroscopic members

Millennium Simulation (Springel et al. 2005)

$N = 2160^3$ particles

$M = 8.6 \times 10^8 h^{-1} M_{\odot}$

$L_{\text{box}} = 500 h^{-1} \text{ Mpc}$



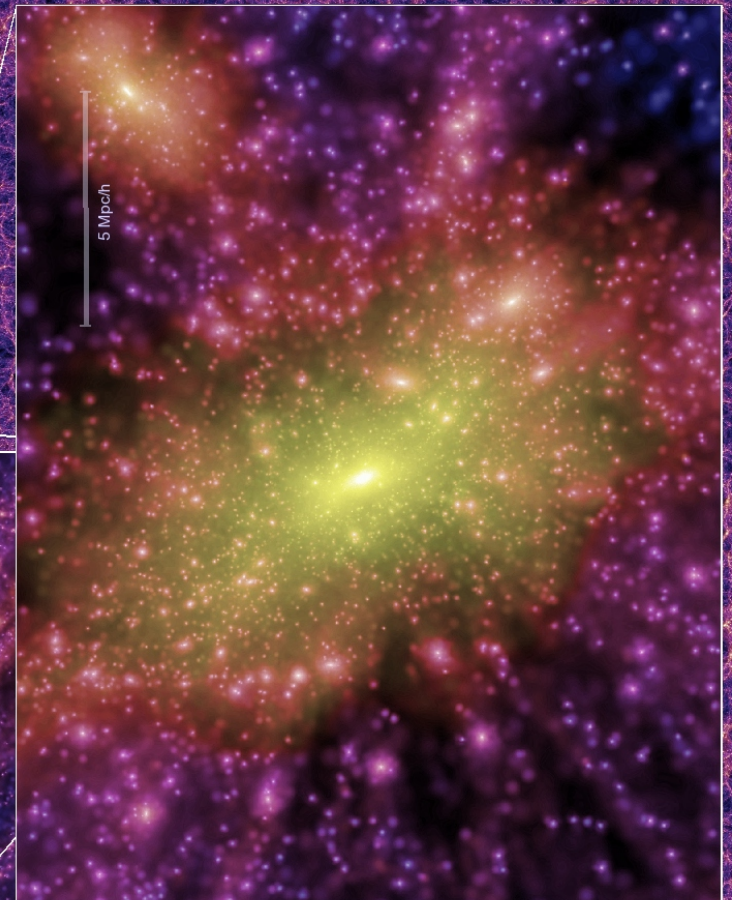
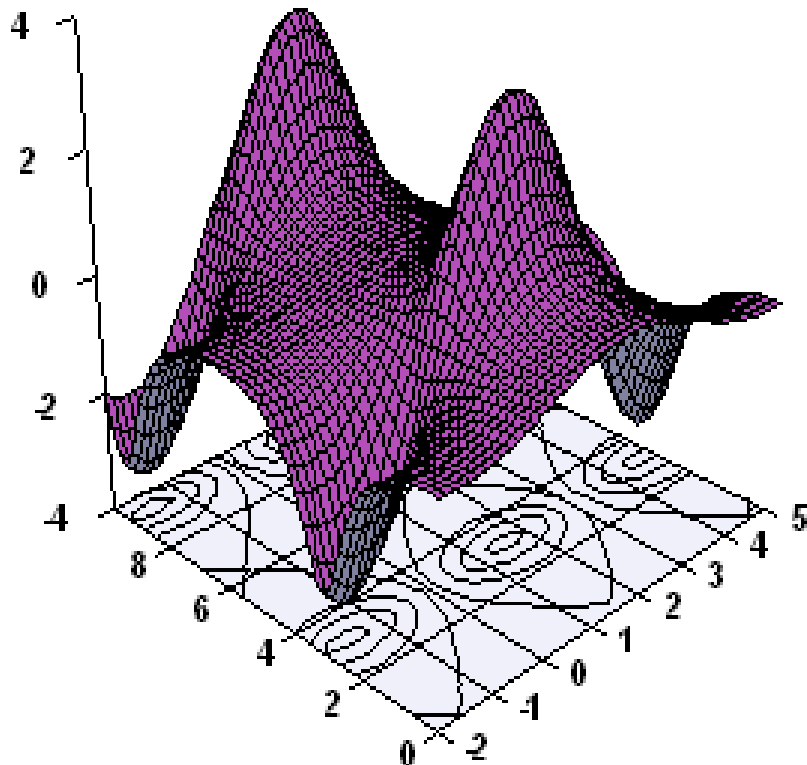
Millennium Run
10,037.6
96,000 particles
Springel et al. (2004)



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Semi-analytic models (SAM)

SUBFIND (Springel 2001)



Semi-analytic models (De Lucia & Blaizot 2007) reproduce galaxy populations with physical or observational motivated “recipes” from the analysis of the properties of merger tree of haloes.

Our sample of simulated clusters:

$$M_{vir} > 10^{14} M_{\odot}$$

z	N_{clus}
-----	------------

0.00	3133
0.09	2953
0.21	2678
0.32	2408
0.41	2180
0.51	1912
0.62	1635
0.75	1292
0.83	1152
0.91	1020
0.99	867
1.08	702
1.17	552

We fit the relation between the 3D velocity dispersion of all the galaxies within R_{vir} and the mass M_{vir} :

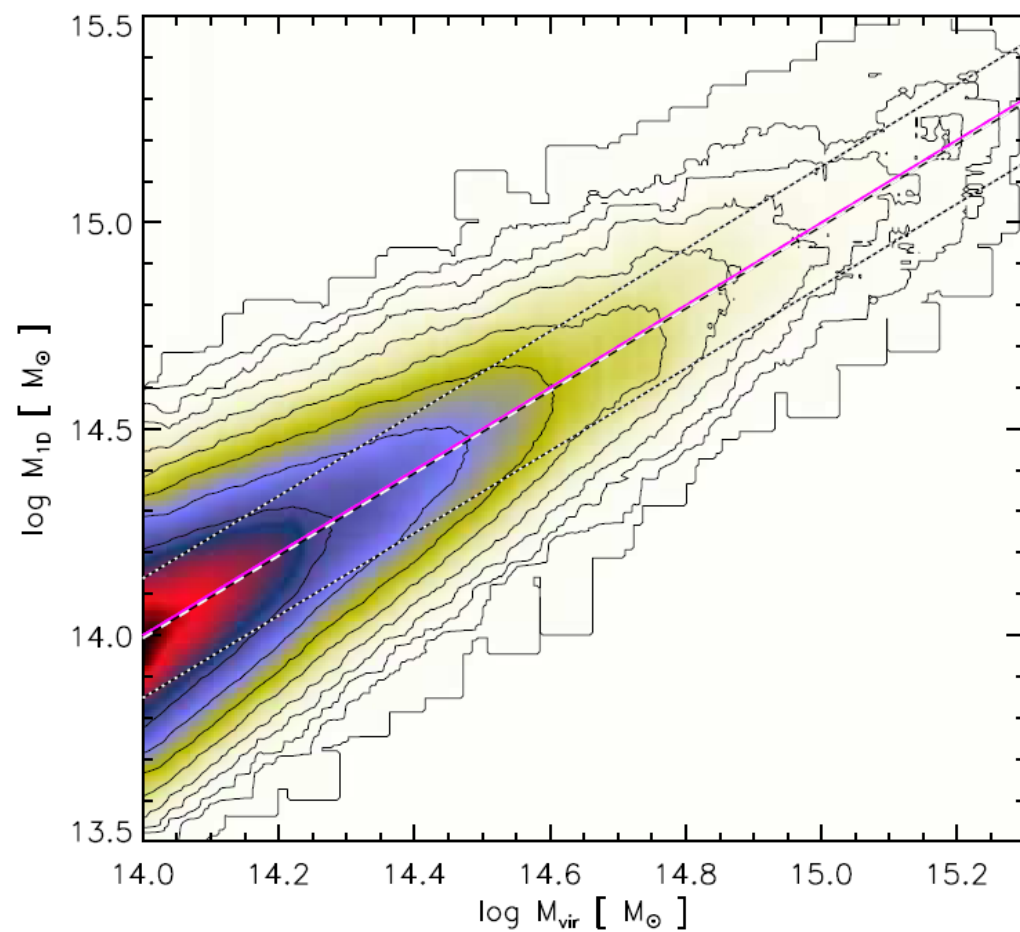
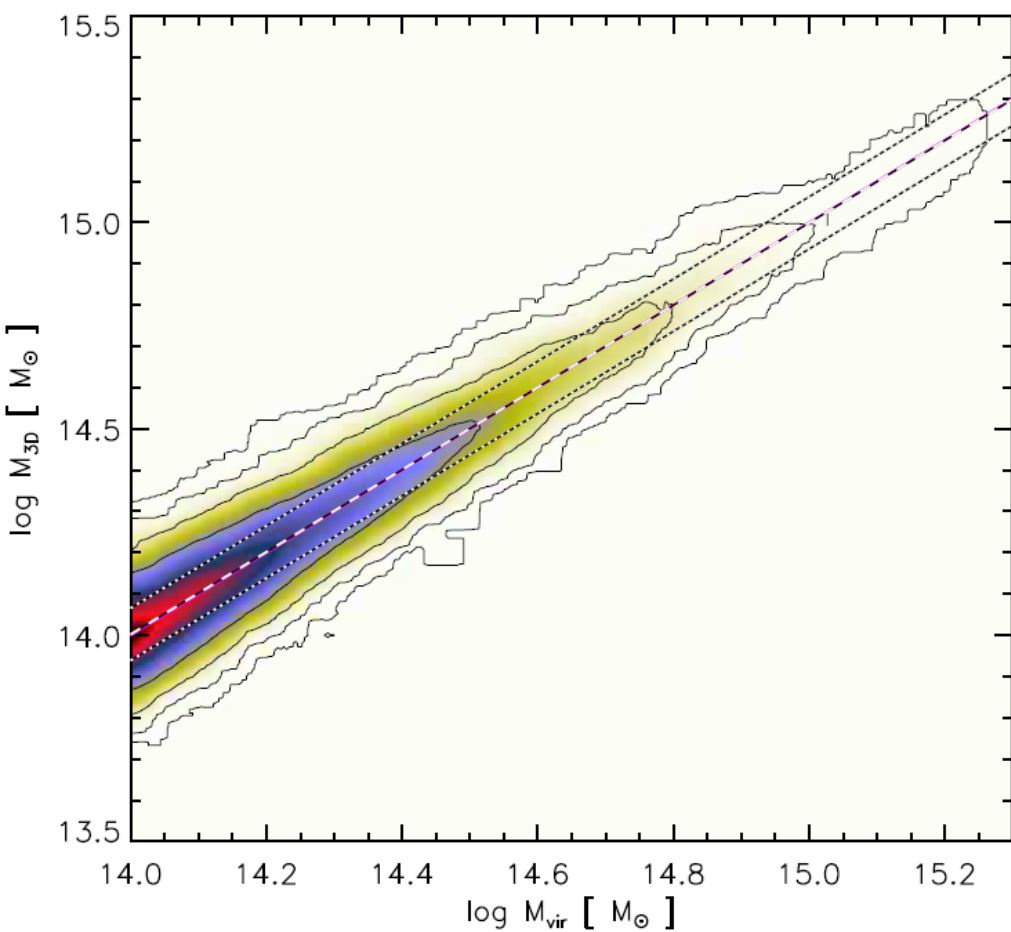
Three parameters plus scatter

$$M_{dyn} = \left(\frac{\sigma_v}{A \times h_{70}(z)^C} \right)^B 10^{15} M_{\odot}$$

Variable	Best value	Statistical uncertainty
A	939	0.55
B	2.91	0.0021
C	0.33	0.0019

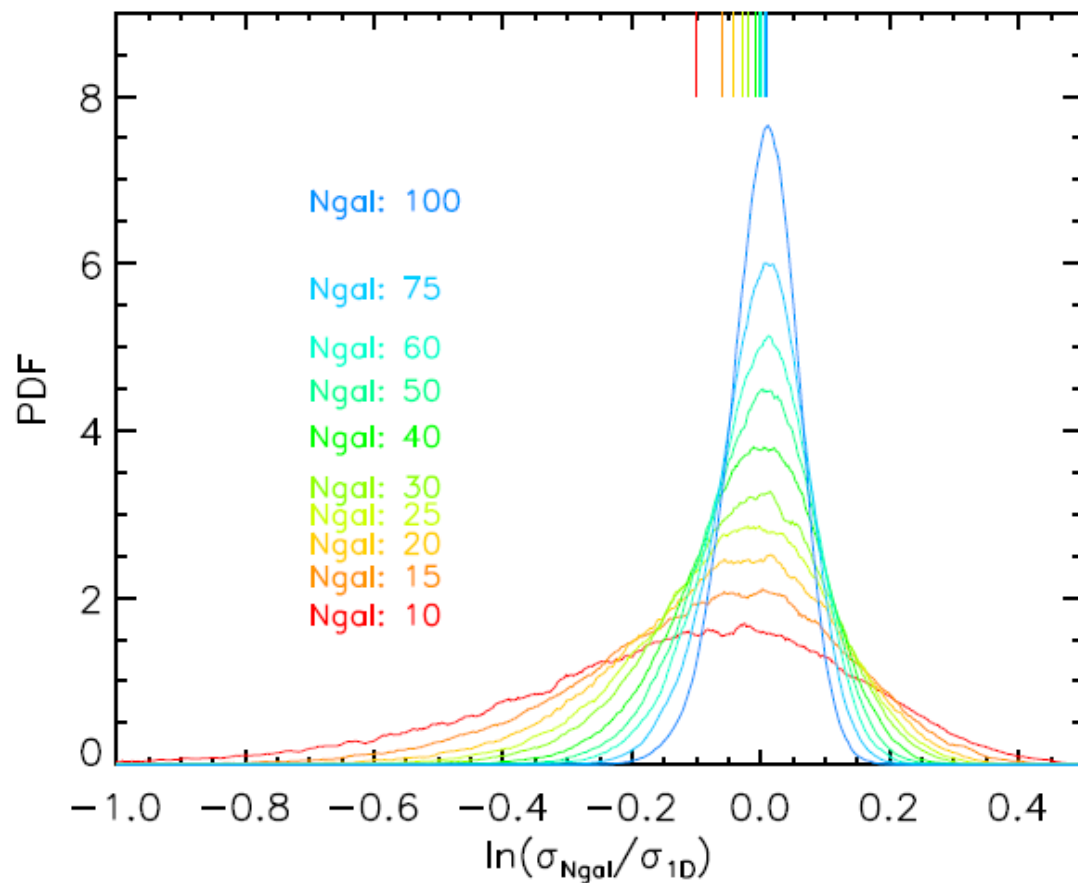
We investigate the effects of:

- **Triaxiality**
- Luminosity segregation in red sequence selected galaxies
- Interlopers



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We fit for the first moment (bias)

$$\langle \ln(\sigma_{Ngal}/\sigma_{1D}) \rangle = 0.05 - 0.51/\sqrt{Ngal}$$

and second moment (scatter)

$$\sigma_{\ln(\sigma_{Ngal}/\sigma_{1D})} = -0.037 + 1.047/\sqrt{Ngal}$$

We investigate the effects of:

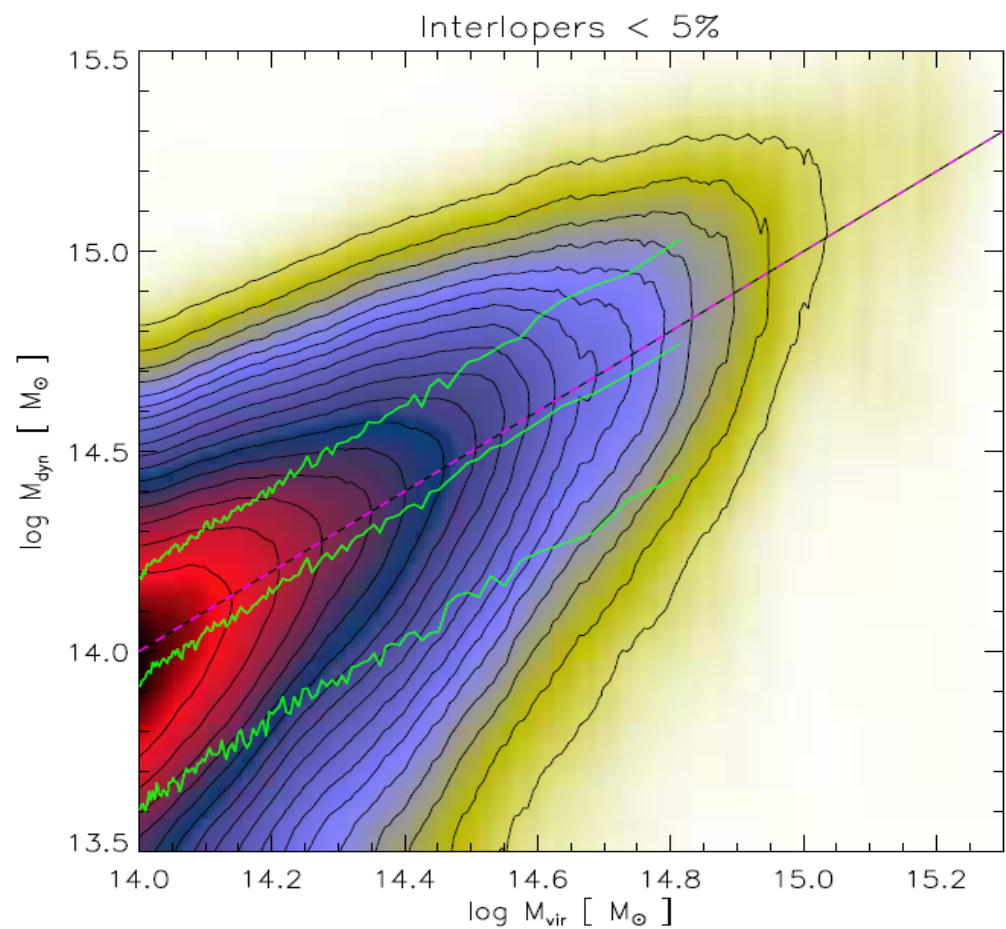
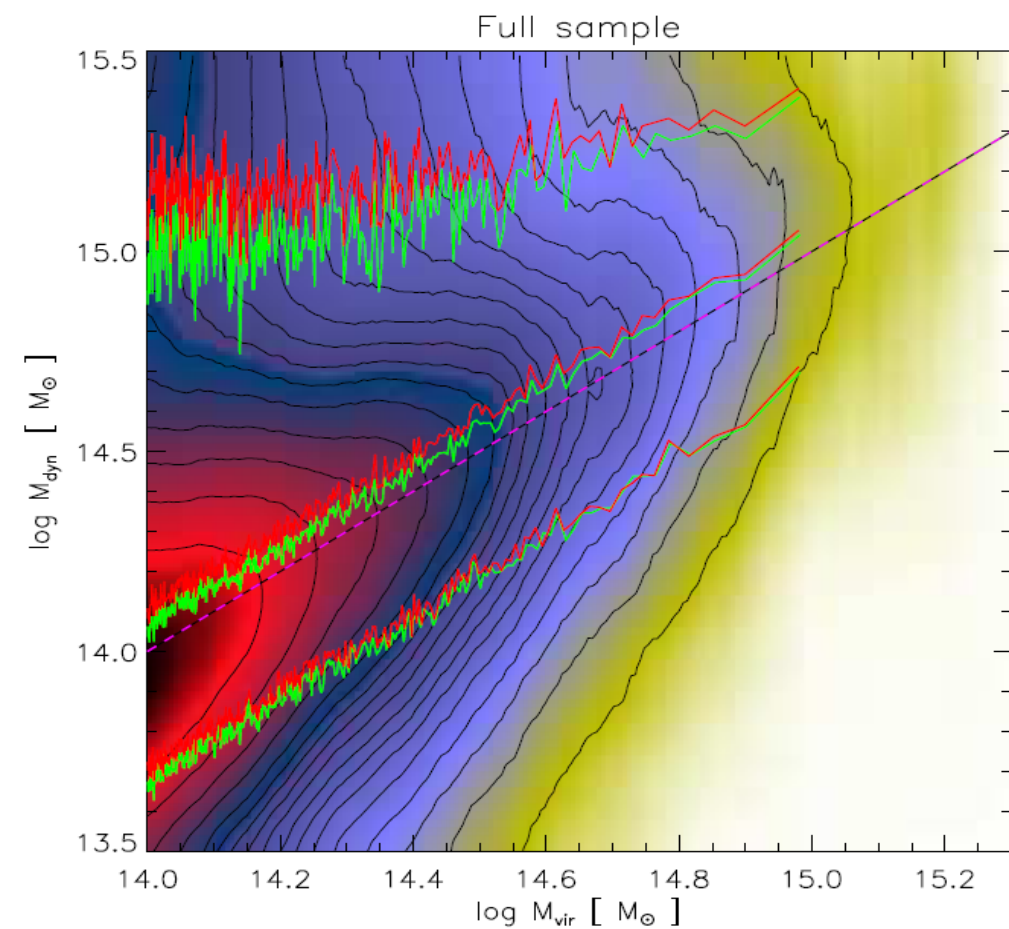
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TABLE 4
PARAMETER SPACE EXPLORED FOR THE MOCK OBSERVATIONS.

a [R_{\perp}/r_{vir}]	N_{gal} #	z	M_{vir} [$10^{14} M_{\odot}$]
0.2	10	0.00	1.0
0.4	15	0.09	2.0
0.6	20	0.21	4.0
0.8	25	0.32	6.0
1.0	30	0.41	8.0
1.2	40	0.51	10.0
1.4	50	0.62	20.0
1.6	60	0.75	
1.8	75	0.83	
2.0	100	0.91	
2.2		0.99	
2.4		1.08	
		1.17	

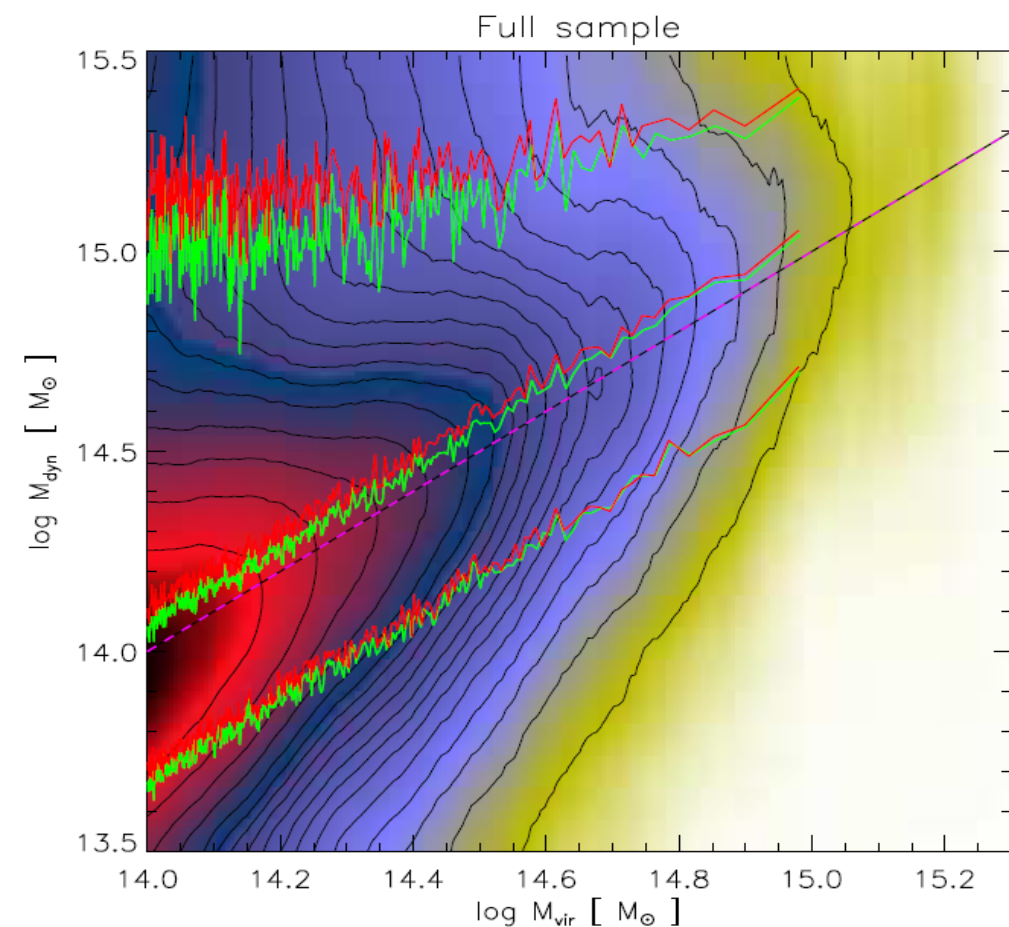
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Effect of interlopers depends on selection and the interloper rejection technique!!

The background of the slide is a complex, fractal-like pattern representing the cosmic web. It consists of a dense network of thin, purple and yellow lines that form a web of filaments and nodes, set against a dark purple background. This pattern is visible behind the white text box and the bottom right citation box.

In our case:

Previous knowledge of:

- Cluster position
- Photometric redshift
- Initial guess of M200 and R200
- Limited by small number of spectroscopic redshifts
- Multiple masks minimize sampling problems

Algorithm:

Red sequence selection of galaxies within 1Mpc and 4000 km/s

Beers et al. (1990) robust estimation of velocity dispersions + Iterative three-sigma clipping algorithm

Used
$$M_{dyn} = \left(\frac{\sigma_v}{A \times h_{70}(z)^C} \right)^B 10^{15} M_{\odot}$$
 to estimate AS1

Used also $\langle \ln(\sigma_{Ngal}/\sigma_{1D}) \rangle = 0.05 - 0.51/\sqrt{Ngal}$ to estimate AS2

No further analysis on the impact of interlopers