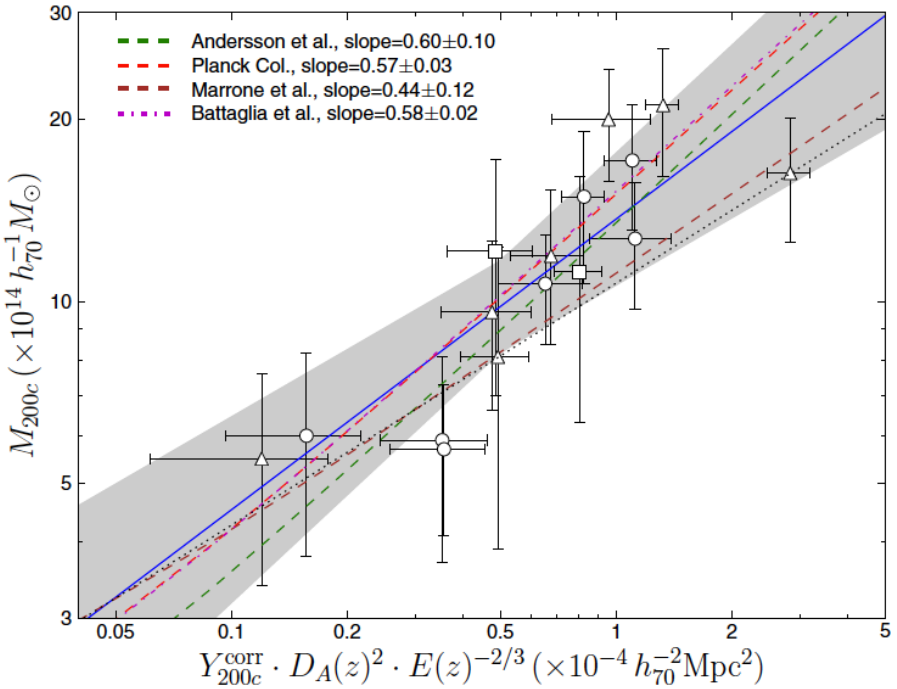
Method SGF: shifting gapper and a σ-M relation from simulations

Cristóbal Sifón
Leiden Observatory



As applied to observations of SZ-selected clusters detected by the Atacama Cosmology Telescope

Method and Simulations:
Fadda et al. (1996)
Evrard et al. (2008)

Implementation:
Sifón et al. (2013)

Outline

1) Method Summary

2) Member selection: the shifting gapper

3) Mass calibration from numerical simulations

4) Application to real data

Method SGF: shifting gapper and a σ-M relation from simulations

Method Summary:

1) Select all galaxies with v_{rest}<4,000 km/s from z_o,

where z_o is the biweight estimator of location.

2) Run the shifting gapper member selection.

3) Measure z_o and σ_{gal}, the biweight estimator of scale.

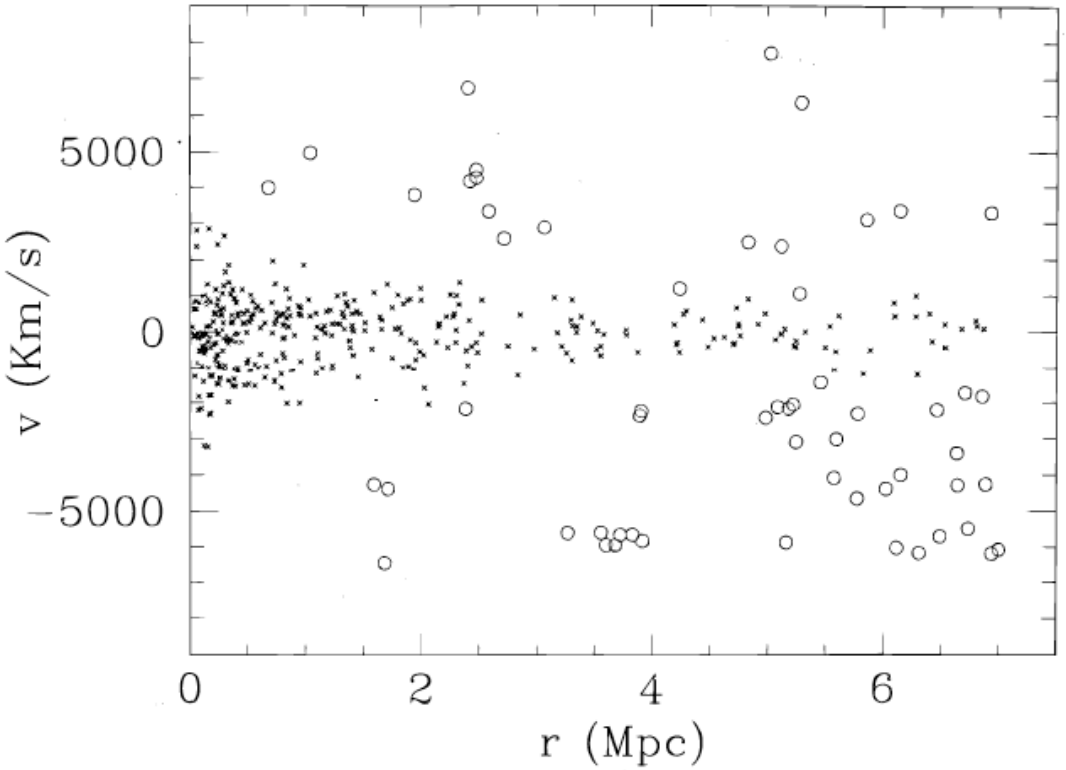
4) Use σ_{gal}-M_{200} scaling relation and use M_{200} to get r_{200}.

5) Consider only galaxies within r_{200}.

6) Repeat steps 3-5 until numbers are stable.

Method SGF: shifting gapper and a σ-M relation from simulations

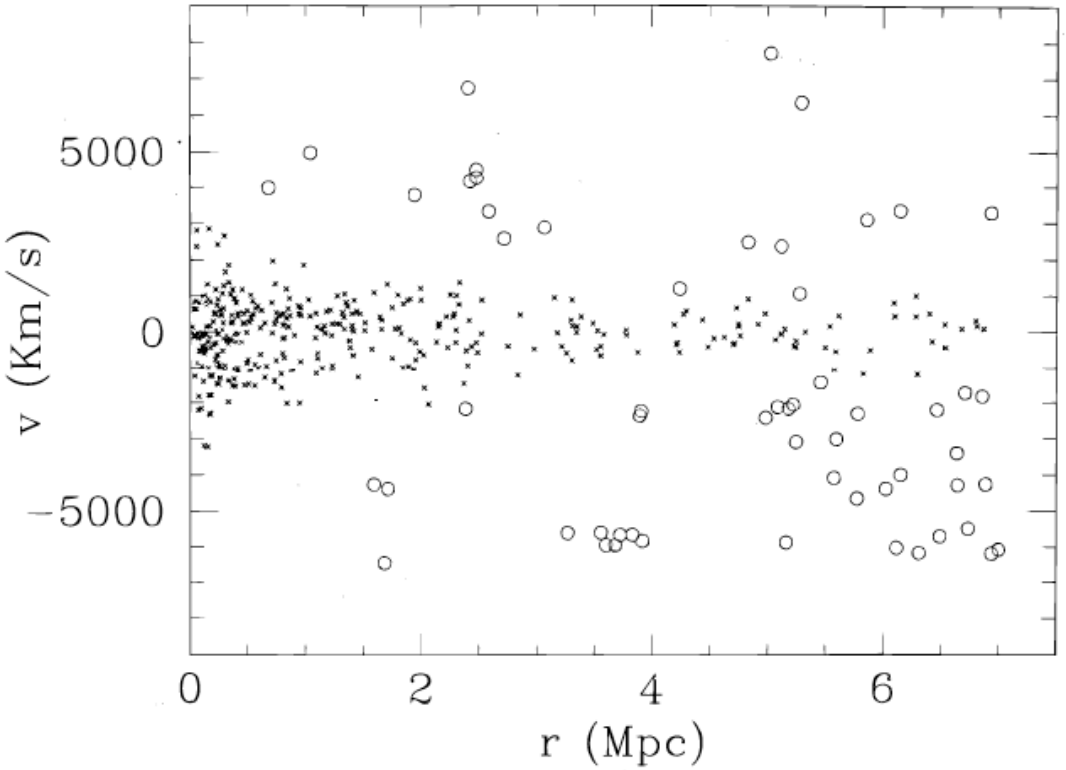
The shifting gapper:
Fadda et al. (1996)



- Define radial bins with Δr>250 kpc and N>15 galaxies
- Sort galaxies with increasing abs(v)
- Binding gap: 500 km/s
- Maximum gap: 1,000 km/s

Method SGF: shifting gapper and a σ-M relation from simulations

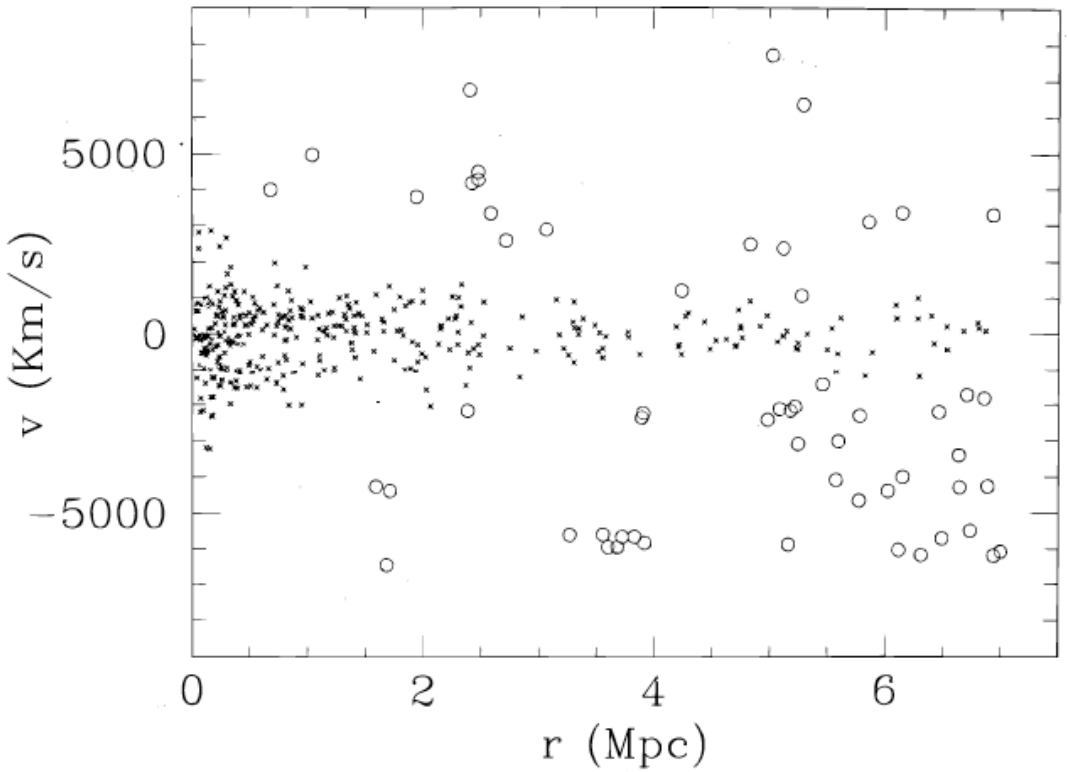
The shifting gapper:
Fadda et al. (1996)



- Define radial bins with Δr>250 kpc and N>15 galaxies
- Sort galaxies with increasing abs(v)
- Binding gap: 500 km/s
- Maximum gap: 1,000 km/s

Method SGF: shifting gapper and a σ-M relation from simulations

The shifting gapper:
Fadda et al. (1996)



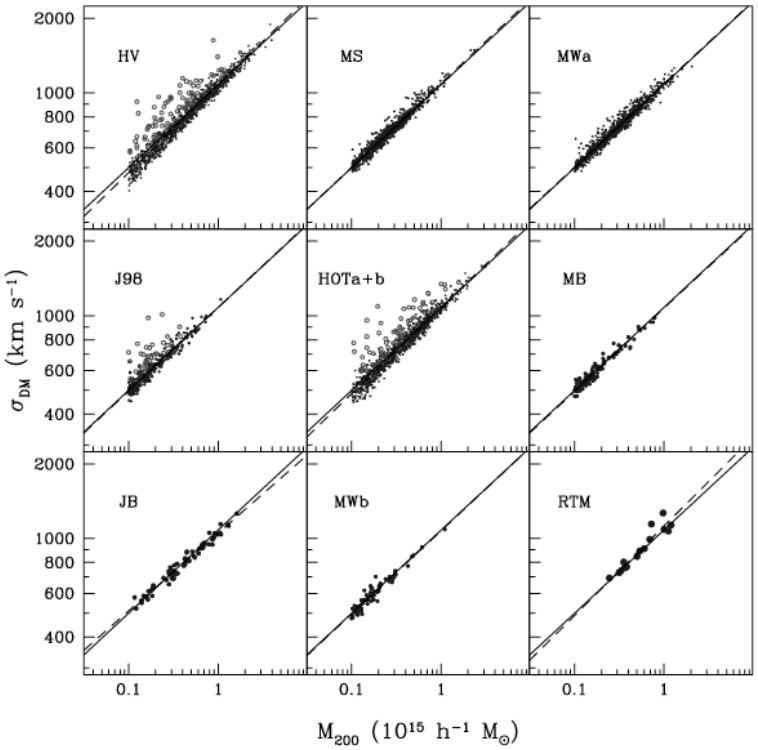
- In a diagram like this, members and non-members are mostly quite distinct
- Need a reasonable number of members (below which it becomes a simple sigma-clipping)
- If well sampled, shows the "trumpet" shape we expect

However:

- Gives a discrete v_{max} profile
- Is susceptible to poor sampling, can give quite crazy results

Method SGF: shifting gapper and a σ-M relation from simulations

The σ-M relation:
Evrard et al. (2008)



- N-body simulations, averaged over a variety of cosmologies

$$M_{200c} = \frac{10^{15}}{0.7 h_{70}(z)} \left(\frac{\sigma_{\rm DM}}{\sigma_{15}} \right)^{1/\alpha} M_\odot$$

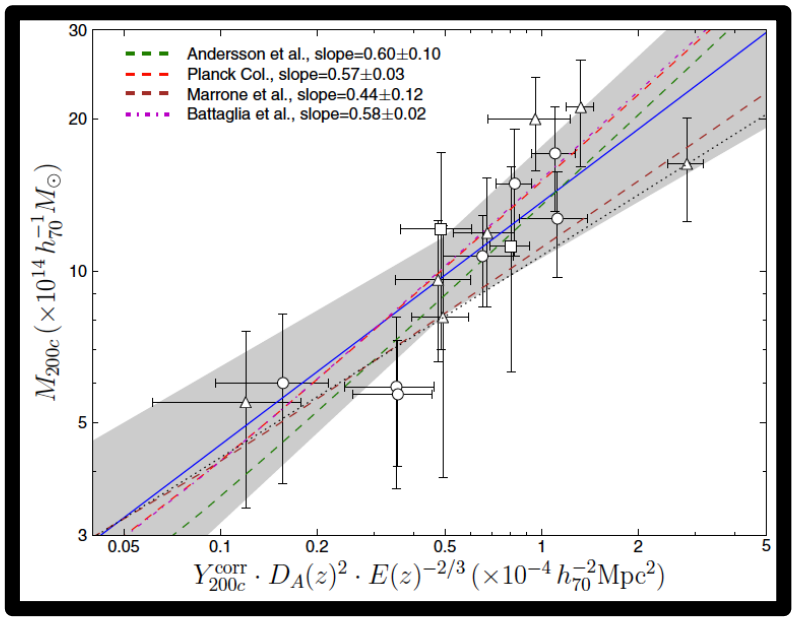
$$\sigma_{15} = 1082.9 \pm 4.0 \ {\rm km\,s^{-1}}$$
$$\alpha = 0.3361 \pm 0.0026$$

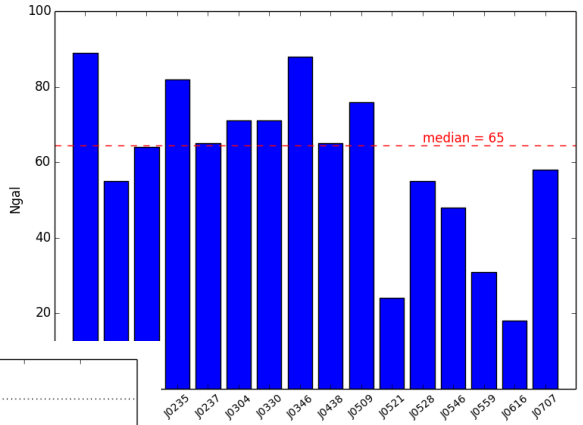
$$b_v \equiv \frac{\sigma_{\rm gal}}{\sigma_{\rm DM}} = 1$$

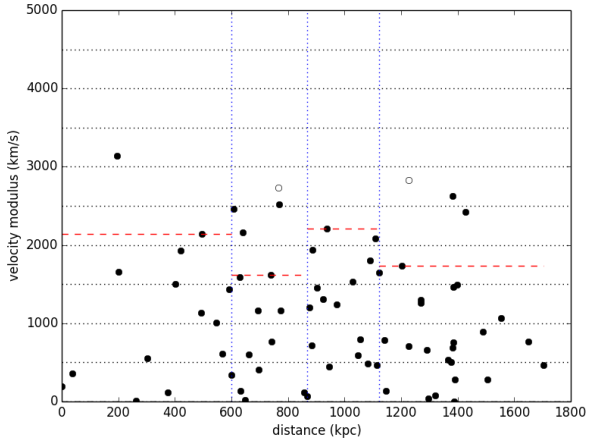
- Assume that galaxies are unbiased tracers of mass
- Calibrated for isolated, massive (>$10^{14}M_o$) clusters

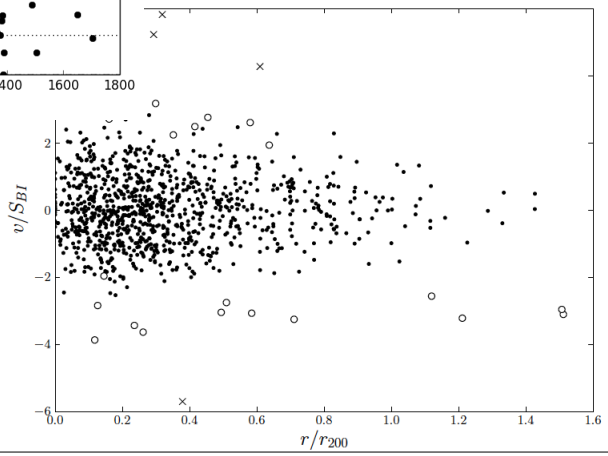
Method SGF: shifting gapper and a σ-M relation from simulations

Application to real data:









At least, the masses are consistent with what we could expect

Fadda et al. (1996), Evrard et al. (2008), Sifón et al. (2013)