Redshift Space Distortions with GAMA Groups And Galaxies

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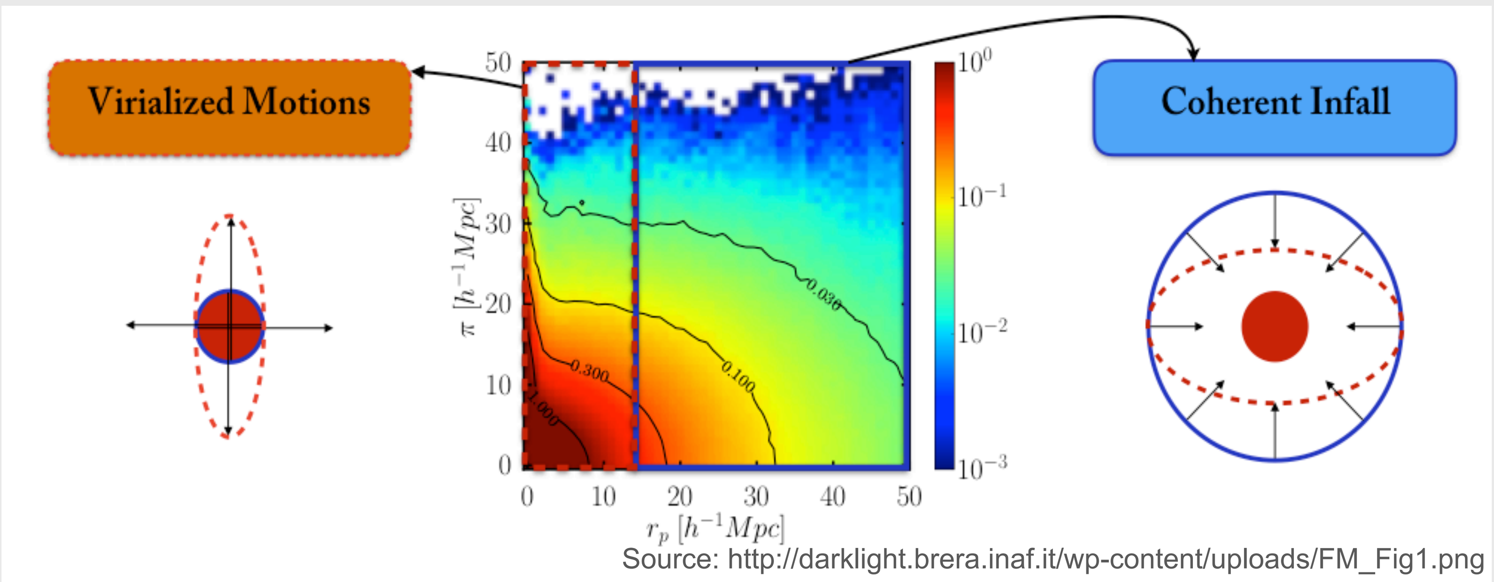
Abstract

We measure the group-galaxy **cross-correlation** using the GAMA survey data, with the **groups split into three stellar mass bins**, and **galaxies separated into red and blue samples**. By analyzing the measurements with the Redshift Space Distortion model assuming ΛCDM Cosmology, we show the robustness of the method by extracting consistent growth rate parameters, $f\sigma_8$, from the six subsamples.

Background



Source: http://darklight.brera.inaf.it/wp-content/uploads/FM_Fig1.png

Fig.1: schematic illustration of the Redshift Space Distortion effects on the 2D correlation function.

- **Redshift Space Distortion (RSD):** The true redshifts of galaxies are measured from their receding Hubble velocities. However, galaxies have **peculiar velocities** that also affect their redshifts, thus 'distort' their line of sight distances.
- **2D-correlation function (2DCF):** A function that measures the relative excess of galaxy pairs compared to the uniform distribution at a given distance along or perpendicular to the line of sight.
- **Cosmology with RSD:** On **large scales**, coherent infall of galaxies towards the gravitational potential causes an apparent **squashing along line of sight** on the 2DCF. On **small scales**, the galaxy virial velocities give rise to **elongation along line of sight** , often referred to as 'Fingers of God' (**Fig.1**).

The GAMA survey

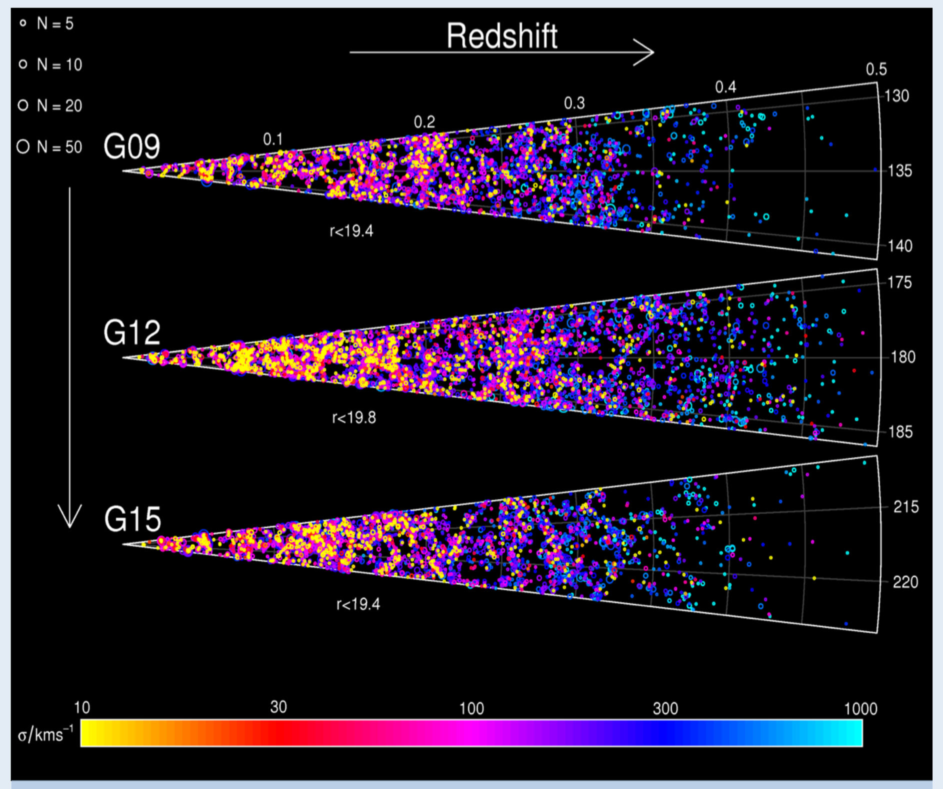


Fig.2: galaxy groups in the three main GAMA survey fields. We use galaxies and groups between redshifts $0.1 < z < 0.3$.

The GAMA (Galaxy And Mass Assembly) survey is a **spectroscopic** survey with high completeness (**Fig.2**). Galaxies are split into red and blue samples according to their **bimodality** in $g - i$ colour. In general, blue galaxies have more **star forming** activities are and **younger**, while red galaxies are **quenched** and **older**.

Group masses

Groups are split into three mass bins, corresponding to the top 10%, intermediate 50%, and lowest 40% in **total stellar mass**. The total stellar mass is **calibrated with the weak lensing mass** of the groups, using the luminosity-mass relation.

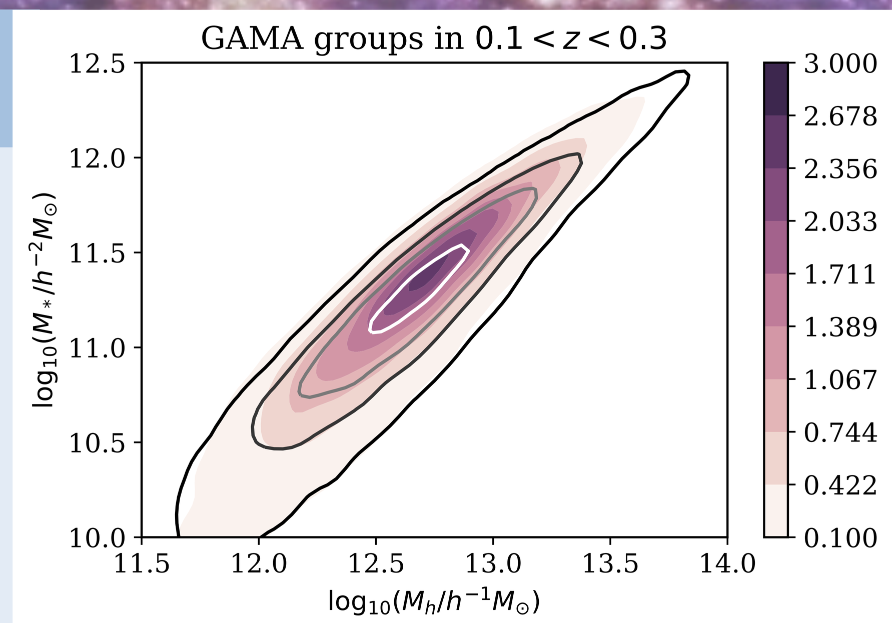


Fig.3: calibration of the group total stellar mass against weak lensing mass in GAMA.

RSD model

- We adopt the model in **Mohammad et al. (2016)**. Linear scale is described by the Kaiser term:

$$P^s(k,\mu) = [b_{\rm gal} + f\mu^2][b_{\rm grp} + f\mu^2]\,P(k)$$

- The Fingers of God is modeled by a convolution along the line of sight with an exponential pairwise velocity profile φ:

$$\xi^s(r_p,\pi) = \int_{-\infty}^{\infty} \xi_{\rm lin}\left(r_p, \pi - \frac{v}{aH(a)}\right)\phi(v)dv$$

Measurements

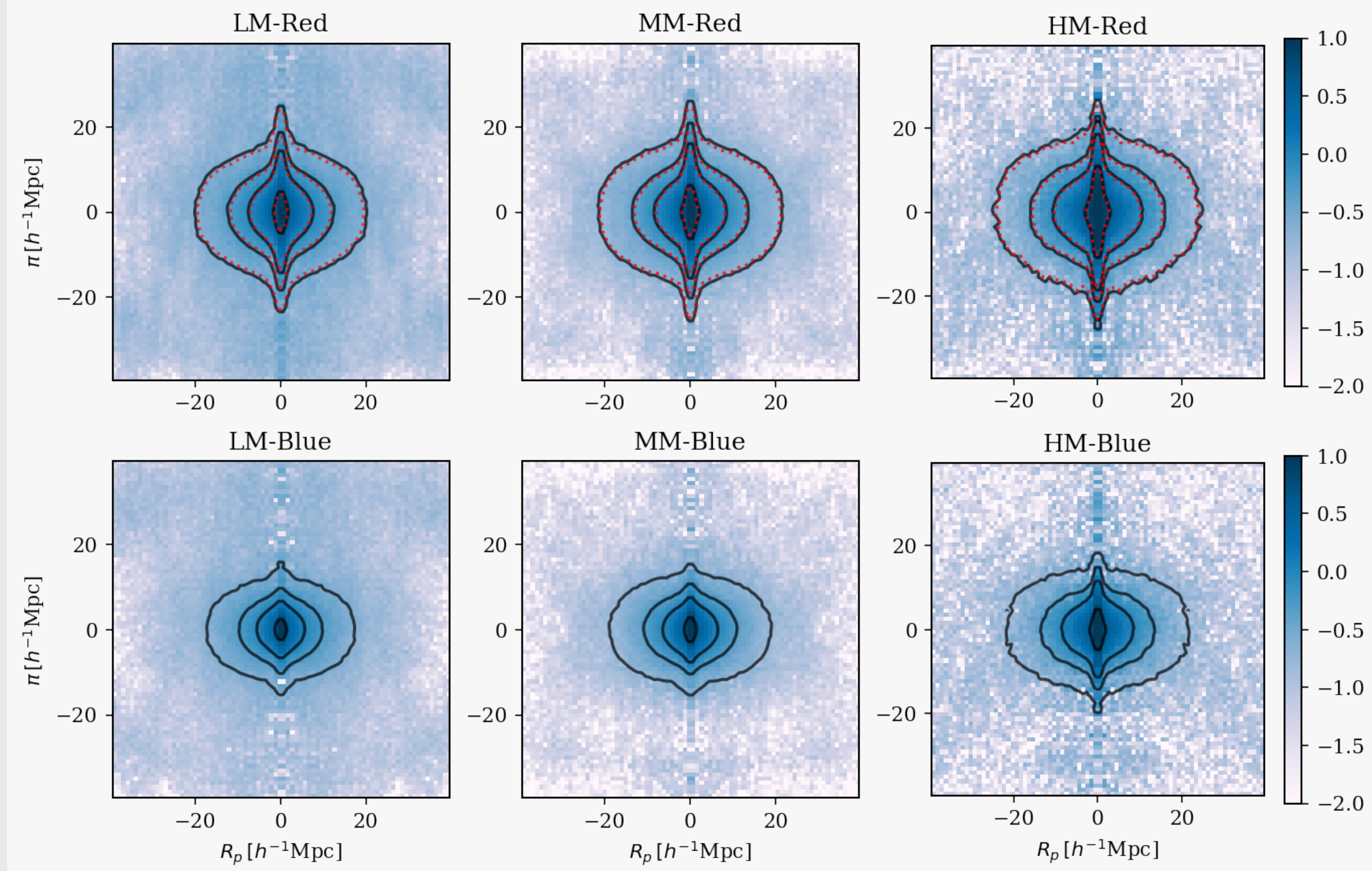


Fig.4: 2D group-galaxy cross-correlations, with groups in low (LM), medium (MM), and high (HM) mass bins, and red and blue galaxies.

Red galaxies and **heavier groups** show **stronger signals** overall, and **larger 'Finger of God'** at small scales. This is expected because the random virial velocity is larger for higher mass groups, and red galaxies are found to associate with larger groups and are more clustered than blue galaxies.

Conclusion

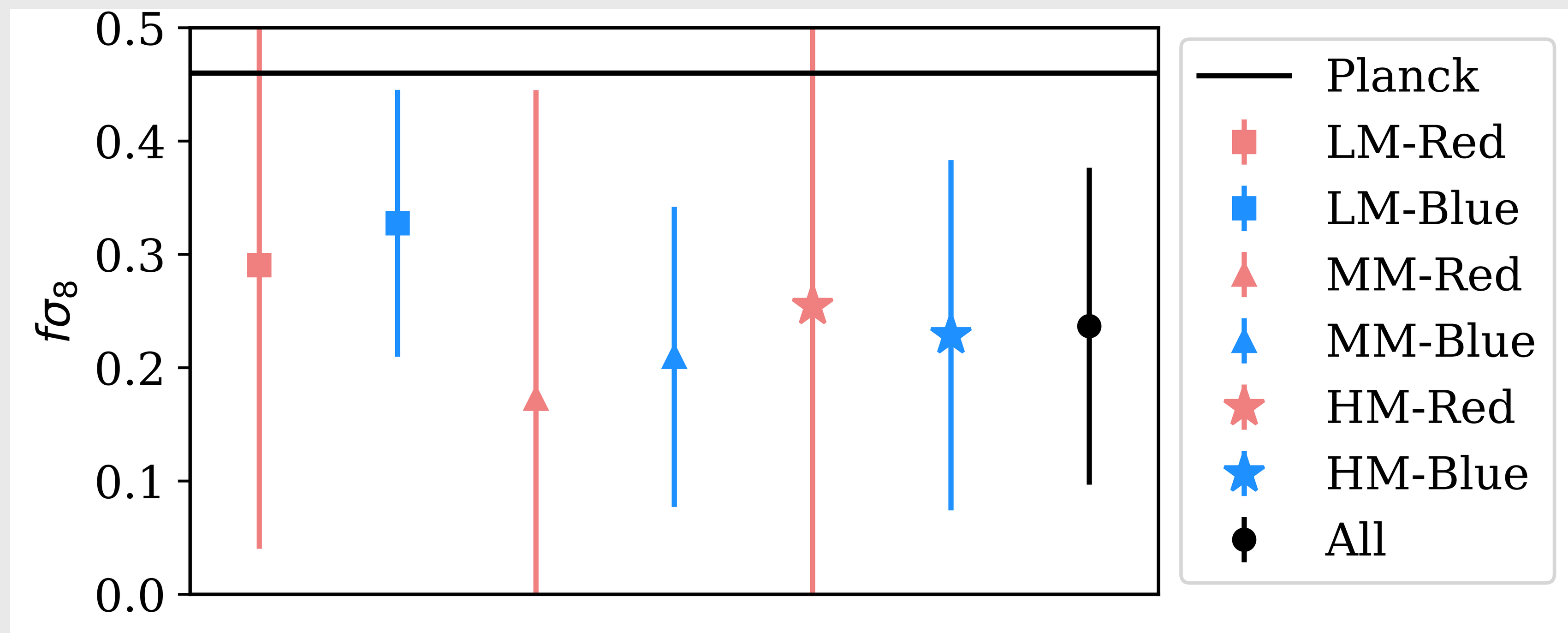


Fig.5: the growth rate, $f\sigma_8$, extracted from the six subsamples. The measurements are **consistent** with each other as well as with the current ΛCMB model from the Planck measurement.