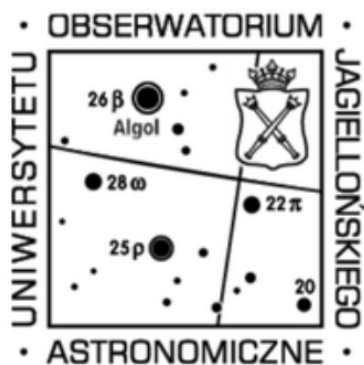


The best band in the universe!

Which galaxy property is the best indicator of environment?

U. Sureshkumar¹, **A. Durkalec**², **A. Pollo**^{1,2}, **M. Bilicki**³
and the GAMA collaboration



[1] Astronomical Observatory of the Jagiellonian University, Kraków, Poland

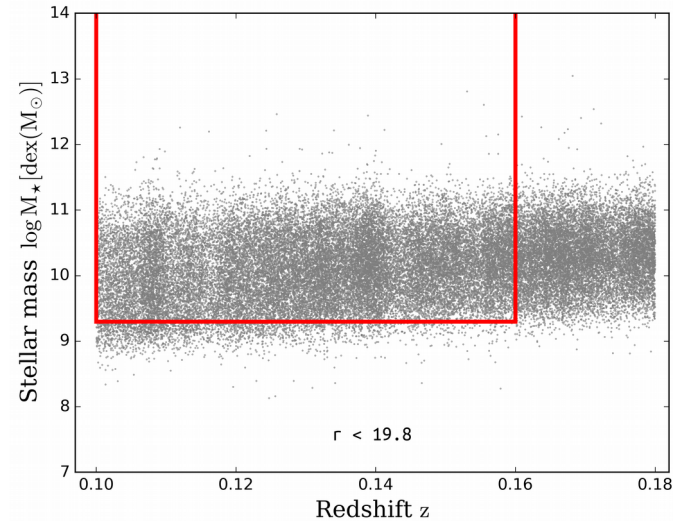
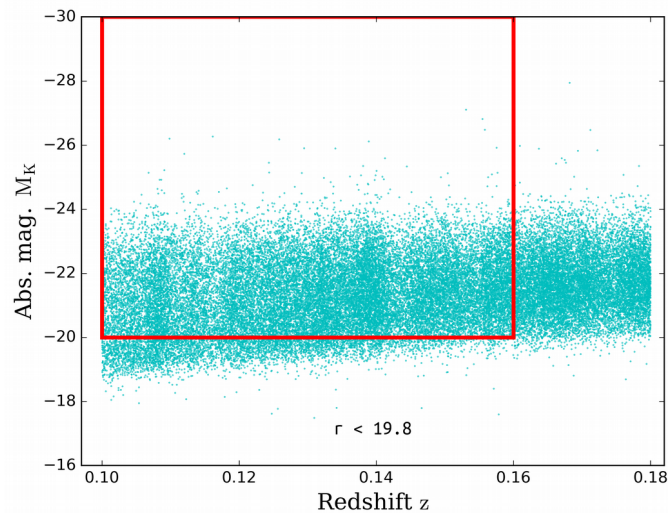
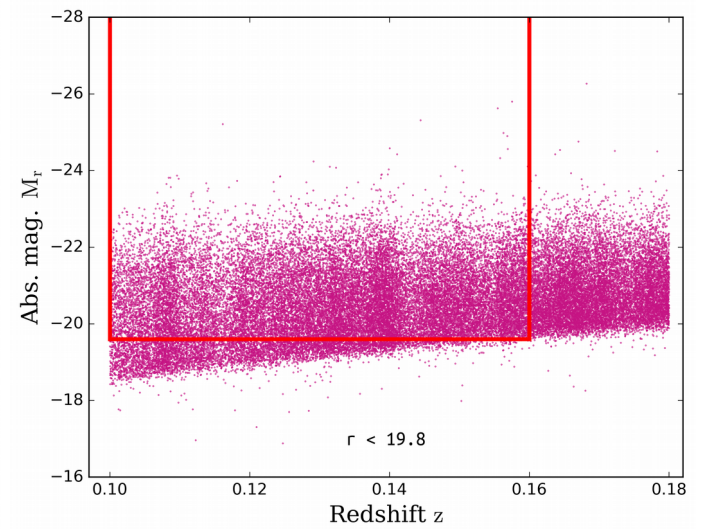
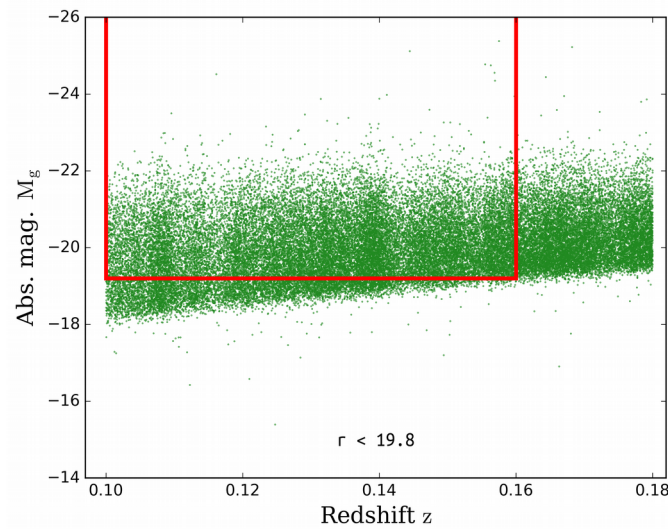
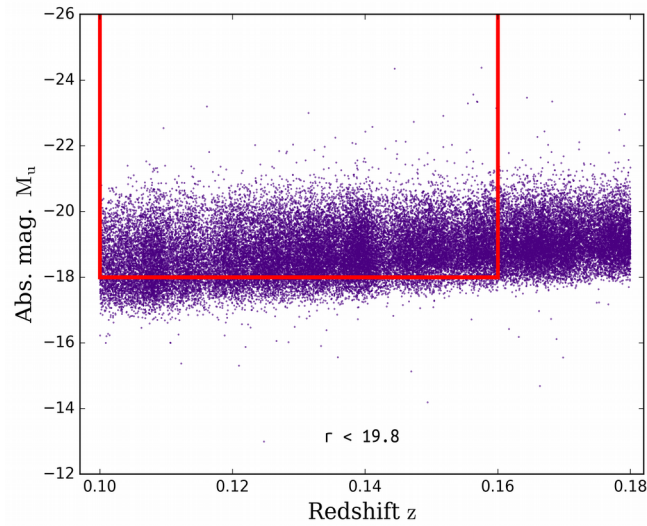
[2] National Centre for Nuclear Research, Warsaw

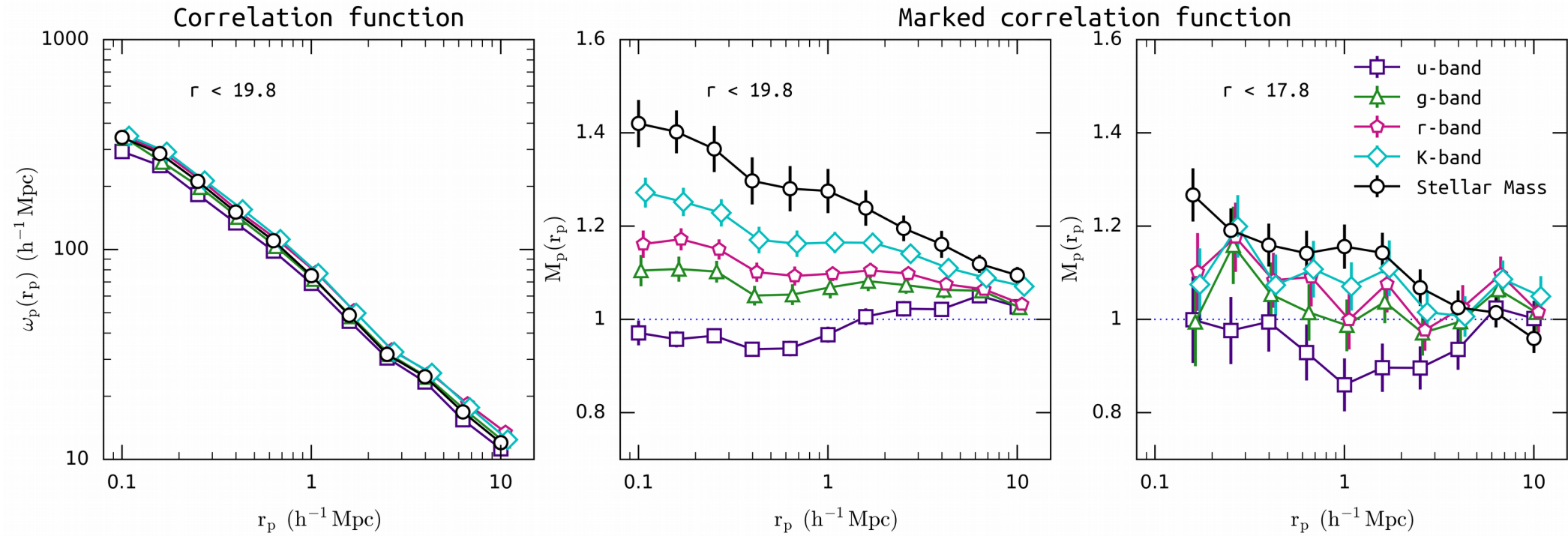
[3] Center for Theoretical Physics, Polish Academy of Sciences, Warsaw

Marked correlation function

(Environmental dependence of galaxy properties)

u-, g-, r-, K-band luminosities, stellar mass





- **Stellar mass is better correlated with environment than luminosity.**
- **Luminosity in K-band can be a better tracer of stellar mass than any other bands.**
- **Dependence on survey flux limit has to be further explored...**

Thank You!

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MOTIVATION

Observed galaxies trace an underlying network of gravitationally dominant dark matter. Clustering of luminosity-selected and stellar mass-selected samples is not identical, especially at higher redshifts ($z > 2$) [1]. In this project, we investigate the following questions:

- How are stellar mass and luminosity correlated with the environment of galaxies and dark matter?
- Is the correlation similar for all the photometric bands?
- Which photometric band is the better tracer of stellar mass?
- Does the flux limit of the survey affect the observed environmental dependence?

We use the marked correlation function as a tool to answer the above questions using Galaxy and Mass Assembly (GAMA) data.

TWO-POINT & MARKED CORRELATION FUNCTION

Two-point correlation function (CF) $\xi(r)$ measures the excess probability of finding another galaxy at a distance r from a given galaxy, relative to a random distribution.

Marked Correlation Function (MCF) is a better probe to understand how different galaxy properties affect clustering [2]. A 'mark' can be any measurable property of a galaxy.

The two-point marked correlation function is defined as the ratio of weighted CF (W) to the unweighted CF (ξ).

$$M(r) = \frac{1 + W(r)}{1 + \xi(r)}$$

The weighted CF is obtained by weighting each galaxy by the ratio of its mark to the mean mark of the whole sample.

DATA: GALAXY AND MASS ASSEMBLY (GAMA) AND SAMPLE SELECTION

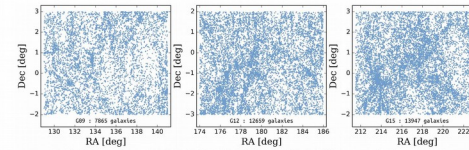
Sky regions

G09, G12, G15

Number of galaxies

34471

The samples we selected are volume-limited, but also absolute magnitudes in u,g,r,K-bands and stellar mass are used for the selection. The same is done for different apparent magnitude cuts to compare the dependence of MCF on flux limits. An example with r-band is shown below:



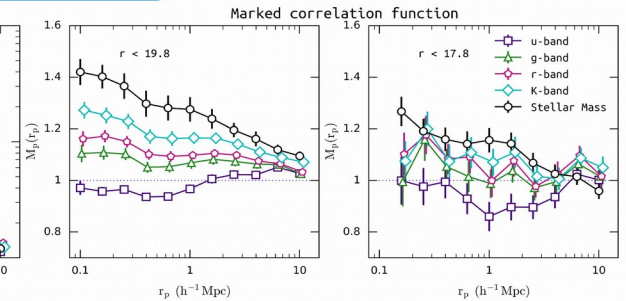
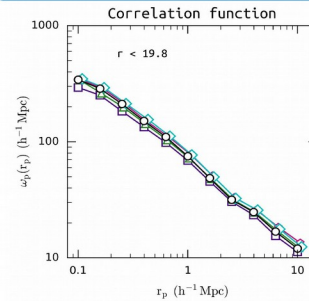
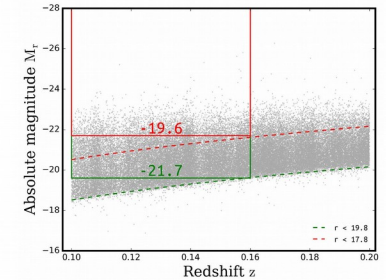
Spatial distribution of equatorial GAMA galaxies in the redshift range of $0.1 < z < 0.16$

Redshift range
0.1 – 0.16

Flux limit
 $r_{\text{petro}} < 19.8$

Properties we use

- Absolute magnitudes in u, g, r, K bands
- Stellar mass



The left panel shows the two-point CF measured for the volume-limited samples, where the central panel shows the MCF measured for the same samples. While we do not observe almost any difference in CF (as the samples are almost identical), different photometric bands trace the structure of small scale in a clearly different way, with redder (K) passband being the best (but not perfect) proxy of stellar mass.

The central panel shows the MCF for $r < 19.8$, whereas the right panel shows MCF for $r < 17.8$. The stellar mass MCF and luminosity MCF tend to approach each other as the survey gets shallower. The reason is that the massive, but low-luminosity galaxies drop out of the sample (mass incompleteness effect). We plan to study this further with the SDSS survey.

CONCLUSIONS

- Stellar mass is better correlated with environment than luminosity, regardless of the wavelength.
- Luminosity in K-band can be a better tracer of stellar mass than any other bands in all flux limits.
- Luminosity in u-band is the worst tracer of stellar mass, as it is an indicator of star formation rate.

REFERENCES

- [1] Durkalec, A., Le Fèvre, O., Pollo, A., et al. 2018, A&A, 612:A42
- [2] Skibba, R., Sheth, R., Croton, D., et al. 2013, MNRAS, 429:458

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