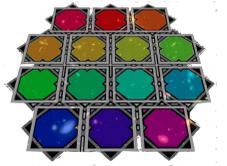




Observatori Astronòmic  
UNIVERSITAT DE VALÈNCIA

# Study of Galaxy Clustering Using the First J-PAS Data



Juan F. Vallalta<sup>1</sup>, Pablo Arnalte-Mur<sup>1,2</sup>, Vicent J. Martínez<sup>1,2</sup>, and the J-PAS collaboration

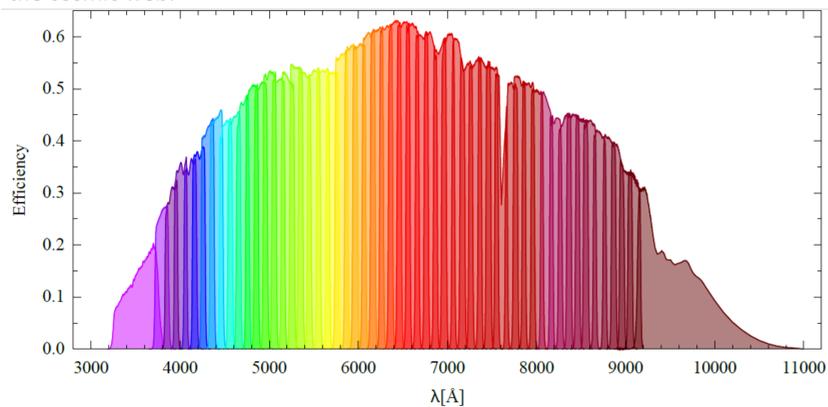
1. Department of Astronomy and Astrophysics. University of Valencia
2. Astronomical Observatory. University of Valencia

## Objectives

- Measure the projected correlation function  $w_p(r_p)$  for volume-limited J-PAS<sup>1</sup> subsamples within  $0.2 < z < 1.0$ , spanning a range of absolute-magnitude thresholds.
- Characterize the dependence on luminosity and redshift by deriving real-space clustering parameters  $\{r_0, \gamma\}$  as functions of  $M_g$  and  $z$ , and comparing them with previous spectroscopic results (VIPERS<sup>2</sup>) and photometric measurements from medium-band surveys (ALHAMBRA<sup>3</sup>).
- Quantify uncertainties by assessing the impact of the line-of-sight integration limit  $\pi_{\max}$  and estimating first-order errors in  $w_p(r_p)$  using the jackknife resampling method.
- Validate the J-PAS data products through the first clustering analysis performed with J-PAS observations, providing an internal quality-control assessment of the dataset.

## J-PAS\*

- Quasi-spectroscopic precision:  $\sigma_z / (1+z) \approx 0.003$ , achieved with a system of 56 narrow and 1 broad filter ( $R \approx 60$ ).
- Efficient alternative to spectroscopy, combining depth ( $i_{AB} \leq 22.5$ ), wide area and high photometric accuracy.
- Optimized for clustering analyses across both small and large-scale structures of the cosmic web.



## Data and Methodology

### J-PAS Internal Data Release 202406<sup>4</sup>

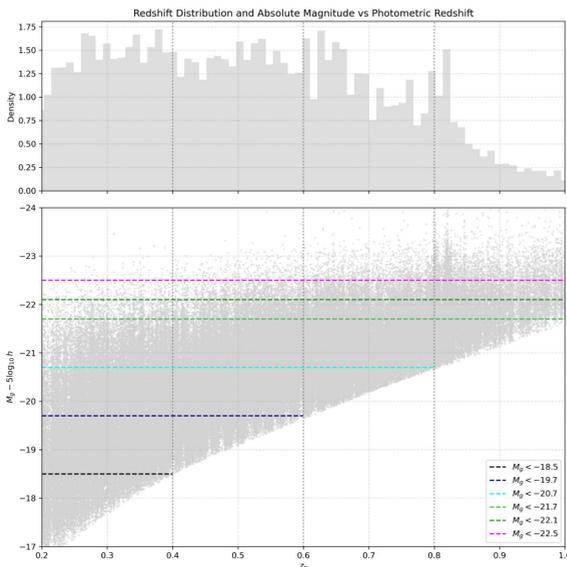
- Effective area: 27.63 deg<sup>2</sup> uniformly observed through all 57 filters across four independent J-PAS fields.
- Galaxy selection: based on XGBoost<sup>5</sup> star-galaxy classifier and photometric-redshift quality criteria, yielding a final sample of 229,854 galaxies with a median redshift of  $z_{\text{med}} = 0.48$ .

### Sample data selection

- Galaxies divided into four redshift bins: [0.2–0.4], [0.4–0.6], [0.6–0.8] and [0.8–1.0].
- Absolute magnitude cuts:  $M_g = \{-18.5, -19.7, -20.7, -21.7, -22.1\}$ , ensuring volume-limited samples across all redshift intervals.

## Mask and random catalogue

- Angular mask: provided by the J-PAS collaboration, defining the survey footprint and effective area.
- Radial selection: galaxy density  $N(z)$  modelled with a quadratic fit.
- Random catalogues generated with MANGLE, matching the  $N(z)$  distribution and containing 50× more points to reduce Poisson noise.



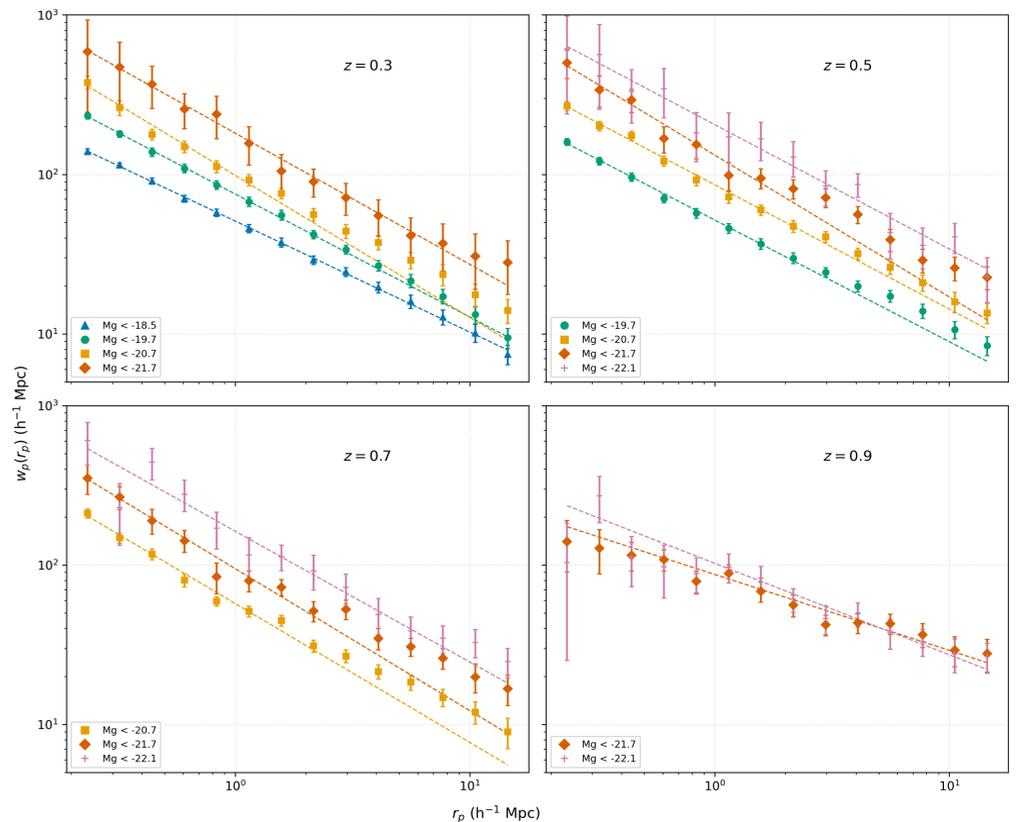
## Correlation function

- Two-point correlation function computed using the Landy–Szalay estimator.
- Projected correlation function  $w_p(r_p)$  obtained by integrating up to  $\pi_{\max} = \{50, 100, 150\} h^{-1}$  Mpc and fitted with a power-law model to derive  $r_0$  and  $\gamma$ .
- Uncertainties estimated via the jackknife resampling method across the four independent J-PAS fields.

## Acknowledgments

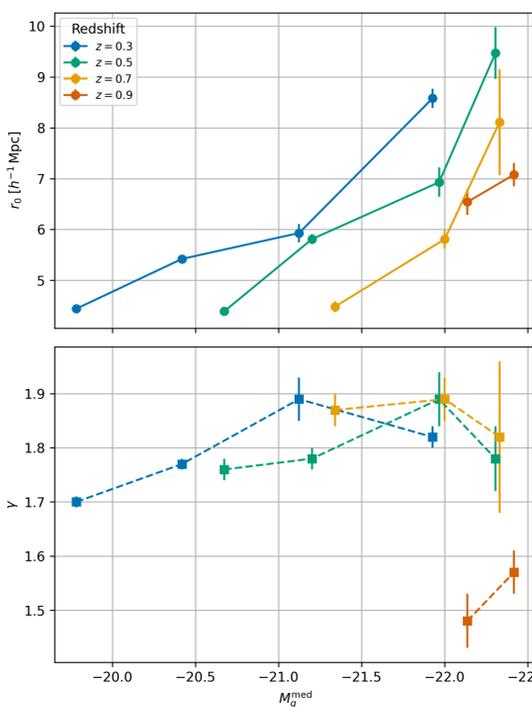
This work is part of the research Project PID2023-149420NB-I00 funded by MICIU/AEI/10.13039/501100011033 and by ERDF/EU, and is also supported by the project of excellence PROMETEO CIPROM/2023/21 (TOSCA) of the Conselleria de Educación, Universidades y Empleo (Generalitat Valenciana), and from the MICIU with funding from the European Union NextGenerationEU and Generalitat Valenciana in the call Programa de Planes Complementarios de I+D+i (PRTR 2022) Project (VAL-JPAS), reference ASFAE/2022/025.

## Clustering Results



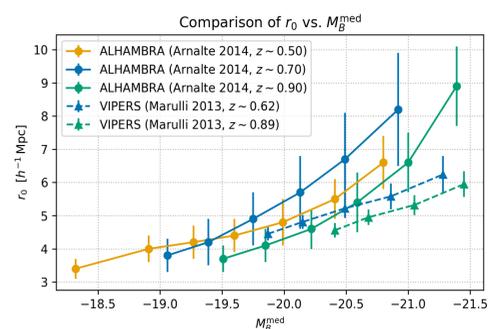
### Projected Galaxy Correlation Function $w_p(r_p)$

- Measures the excess probability of finding galaxy pairs at transverse separation  $r_p$  relative to a random distribution.
- Displays an approximate power-law behaviour ( $\gamma \approx 1.7-1.9$ ) within  $0.2 \leq r_p \leq 17 h^{-1}$  Mpc.
- Brighter galaxies exhibit a higher clustering amplitude ( $r_0$ ) across all scales.



### Comparison with Previous Surveys: ALHAMBRA and VIPERS

- ALHAMBRA: 174,633 galaxies over 2.38 deg<sup>2</sup> in the range  $0.35 \leq z \leq 1.25$ .
- VIPERS:  $\approx 55,000$  galaxies over  $\approx 24$  deg<sup>2</sup> in the range  $0.5 \leq z \leq 1.1$ .
- Both surveys show an increase of the correlation length ( $r_0$ ) with luminosity, consistent with the trend observed in this work.



### Luminosity Dependence of the Correlation Parameters $r_0$ and $\gamma$

- The correlation length  $r_0$  increases with luminosity across all redshift bins ( $0.2 \leq r_p \leq 17 h^{-1}$  Mpc).
- At fixed  $M_g$ ,  $r_0$  grows toward lower  $z$ , indicating that brighter galaxies inhabit more massive halos and are more strongly biased.
- The slope  $\gamma$  remains roughly constant ( $\approx 1.7-1.9$ ) with both  $z$  and luminosity, showing only mild variations ( $\Delta\gamma \leq 0.1$ ) within uncertainties.

## Conclusions & Future Work.

- J-PAS successfully reproduces established clustering trends, confirming the high precision of its photometric redshifts and the reliability of its survey design for large-scale structure studies.
- Results support the luminosity-dependent bias expected in  $\Lambda$ CDM, with brighter galaxies exhibiting stronger clustering across all scales.
- Future work will exploit the expanding J-PAS dataset to constrain galaxy-halo connections and refine cosmological parameters through multi-scale clustering analyses.

## References

- 1: Bonoli, S., Marin-Franch, A., Varela, J., et al. 2021, A&A, 653, A31
- 2: Marulli, F., Bolzonella, M., Branchini, E., et al. 2013, A&A, 557, A17
- 3: Arnalte-Mur, P., Martínez, V. J., Norberg, P., et al. 2014, MNRAS, 441, 1783
- 4: Vázquez-Ramió et al. (in prep.)
- 5: Jeakel et al. (in prep.)