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Mimicking the Luminosity Function Evolution

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Introduction

UpGLADE is an upcoming galaxy catalogue including more than a billion objects with spectroscopic and photometric redshift information: a complete galaxy catalogue is the key to the dark siren method. A crucial challenge in this statistical approach is addressing the incompleteness of catalogues.

We assess its luminosity function (LF) using the $1/V_{max}$ method, revealing a behaviour that could be interpreted as its evolution in redshift. While such an evolution has been investigated before for different single galaxy surveys, our work specifically aims to (i) evaluate the impact of redshift uncertainties in merging objects from different surveys, and (ii) determine whether these uncertainties could introduce significant biases in the UpGLADE luminosity function, potentially mimicking its evolution.

1 · UpGLADE

The UpGLADE contains more than 1,2 billions of galaxies, extending the GLADE+ [1] catalogue with

- Pan-STARRS
- CatWISE
- DESI
- Siena Galaxy Atlas
- SkyMapper
- SDSS

The crossmatch of different survey results in a median apparent magnitude map with various depths across the sky, see Figure 1.

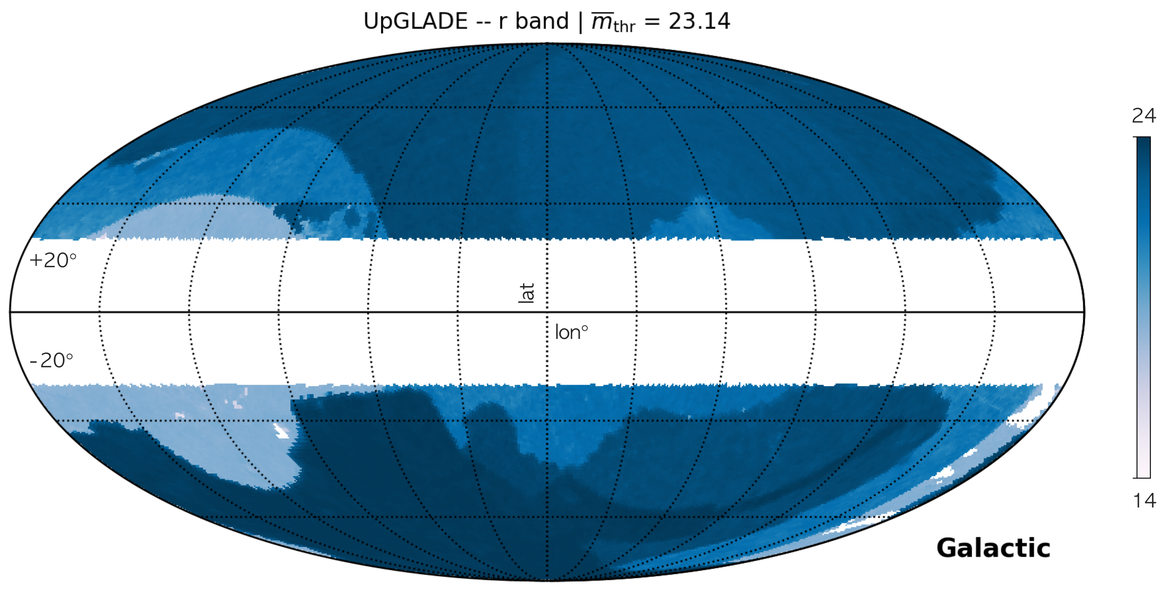


Figure 1

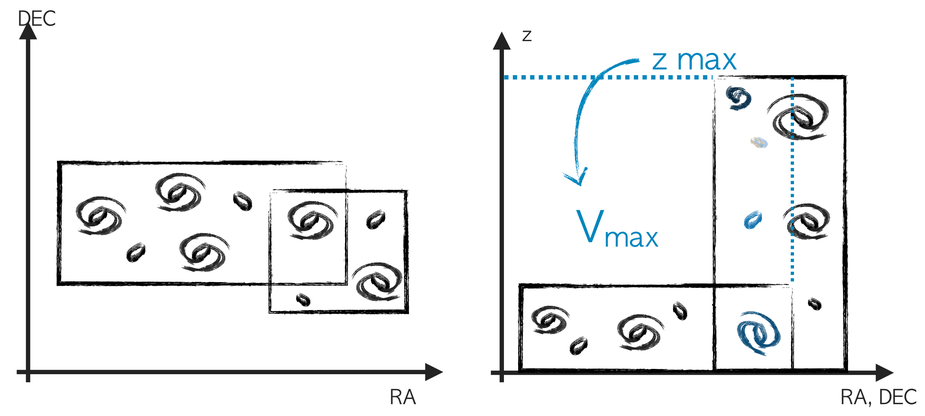
Median apparent magnitude map in r filter, cutting |b|› 20° to avoid intersection with the Milky Way region. Different colours indicate different survey depths across the sky coverage of the UpGLADE.

2 · The $1/V_{max}$ Method

LF is the distribution in the luminosity-redshift plane, telling us how many galaxies are per unit interval in magnitude and unit redshift

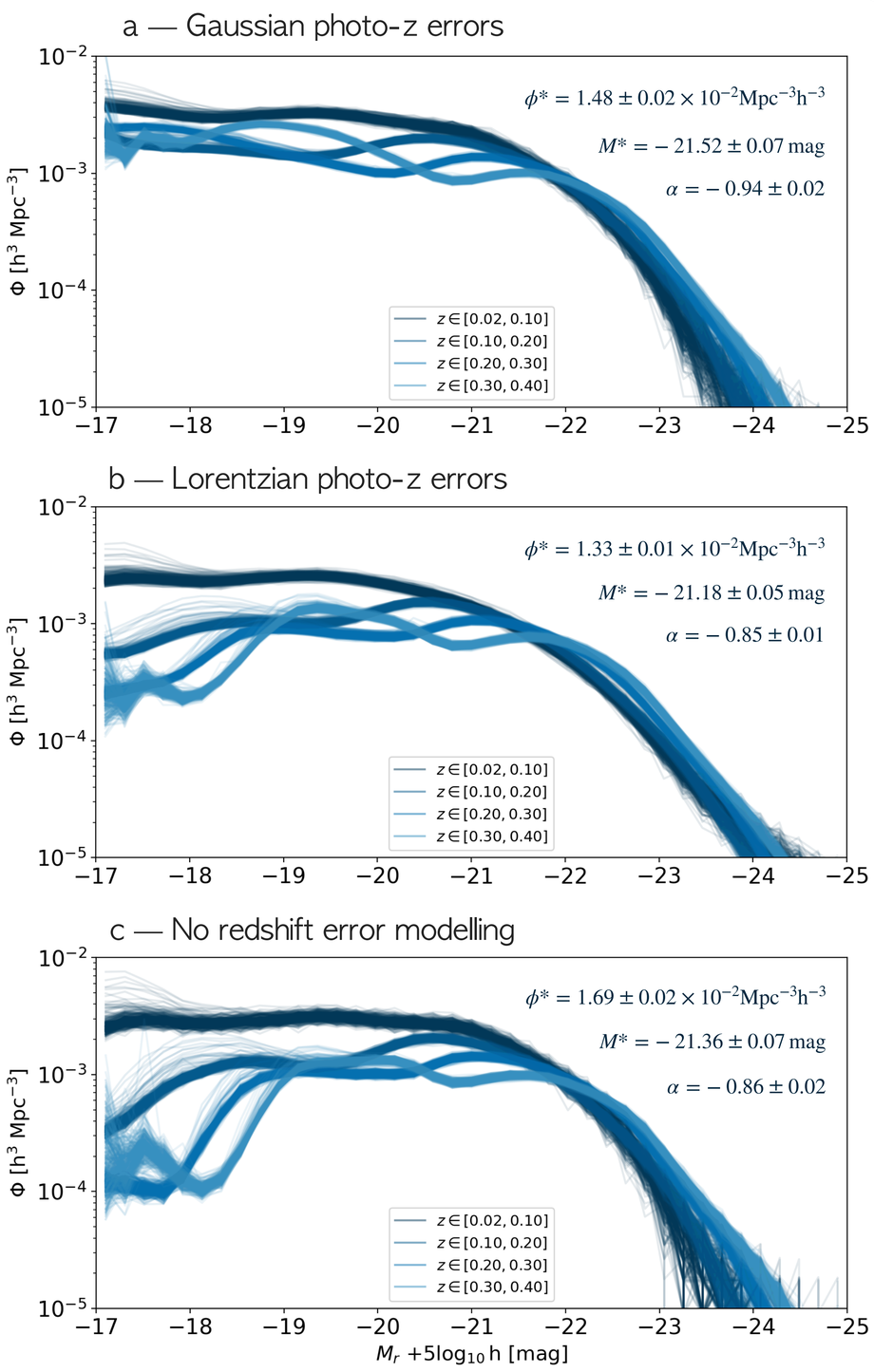
$$\Psi(M, z) = \Phi(M)\, n(z)$$

The $1/V_{max}$ method [2] accounts for the properties of various sub-catalogues, statistically weighting each galaxy with its maximum observable comoving volume.



3 · Results

We analyse the LF in the r band, pixelating the catalogue, in different redshift shells up to z=0.4, with a magnitude intervals of ΔM = 0.2, adopting a normal distribution to model the redshift uncertainties(a). To test the mimickers, we compared the results modelling the redshift uncertainties with a modified Lorentzian distribution(b) or adopting redshift with no-errors(c). The LF parameters are obtained fitting the data with a Schechter Function [3] with a non–linear least squares.



4 · Future goals

- Comparison of our results with the LF from the mock catalogue MICEcat v1 at higher redshift bins.
- Test of z-uncertainties model with a spectroscopic subsample from SDSS or DESI surveys.

REFERENCES

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