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Mimicking the Luminosity Function Evolution

UpGLADE is an upcoming extensive galaxy catalogue which will include more than a billion objects from various non-independent surveys, providing redshift information, which is fundamental for gravitational-wave (GW) cosmology –particularly for Hubble constant inference using dark sirens and galaxy catalogue. Moreover, UpGLADE will play a crucial role in multi-messenger astronomy by supporting GW follow-up campaigns and targeting possible electromagnetic counterparts.
Addressing the intrinsic incompleteness of galaxy catalogues is a key challenge in the statistical approach to GW cosmology, although assessing the completeness of UpGLADE is not trivial because it consists of multiple flux-limited samples covering different patches of the sky. This problem is tackled by analysing the luminosity function of the cross-matched catalogue using the Vmax method, which has been specifically adapted to account for its heterogeneity. The study reveals a behavior that could be interpreted as an evolution of the luminosity function over different redshift ranges. Our work aims to evaluate the impact of redshift uncertainties in the UpGLADE luminosity function, potentially mimicking its evolution.
Preliminary results suggest that redshifts error models may introduce systematic biases in the derived luminosity function, with implications for cosmological analyses. These findings motivate the use of a mock catalogue to interpret our results and provide a comparative framework, ultimately enhancing the reliability of UpGLADE for getting unbiased estimates of the Hubble constant.

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