

GLADE+: An Extended Galaxy Catalog for Multimessenger Searches with Advanced Gravitational-wave Detectors

Gergely Dályá for the GLADE team

(M. Bilicki, F. R. Bouchet, R. Díaz, L. Dobos, Z. Frei, I. S. Heng,
G. Lavaux, R. Macas, C. Messenger, S. Mukherjee, M. Pálfi, P.
Raffai, R. S. de Souza, B. D. Wandelt)



dalyag@caesar.elte.hu



June 18, 2021

Motivation:

1. Help identifications of host candidates for GW events
2. Support target selections for EM follow-up observations
3. Provide input data on the matter distribution of the local universe for cosmological simulations
4. Help identifications of poorly localized EM transients, e.g. GRBs

Cross-matching GWGC, HyperLEDA, 2MPZ, 2MASS XSC and SDSS-DR12Q

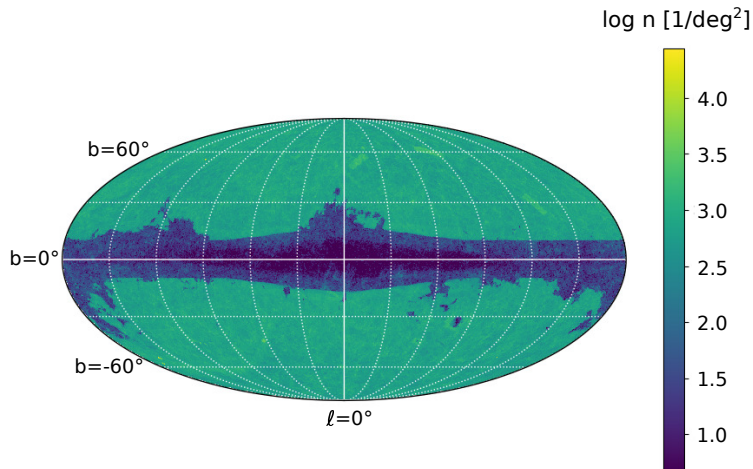
Used e.g. for GW170817, EM follow-up during O3, standard siren H_0 measurement, GRB and FRB host galaxy searches, etc.

<https://arxiv.org/abs/1804.05709>

- ▶ Cross-matching GLADE v2.4 and WISExSuperCosmos
- ▶ ~ 20 million new galaxies
- ▶ Improved precision for galaxies with photo-z
- ▶ Improved peculiar velocity estimates
- ▶ Stellar mass estimates provided \rightarrow better galaxy weighting

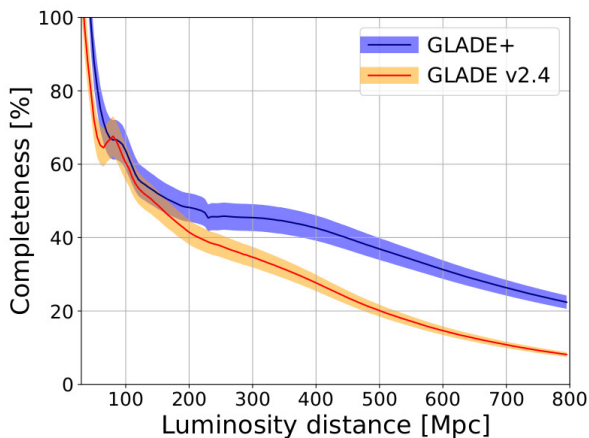
Density of galaxies

A total of ~ 22.4 million galaxies and $\sim 750\,000$ quasars.



Completeness I.

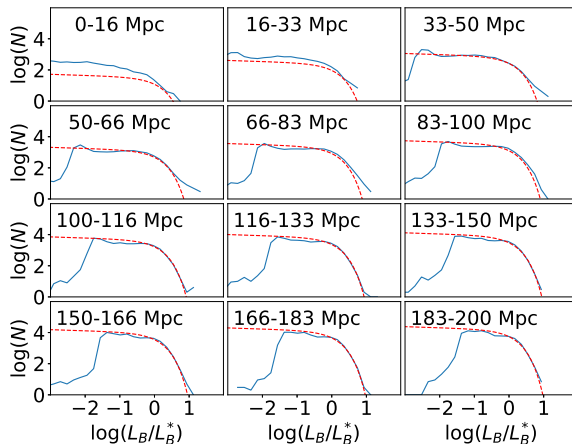
Comparing the B luminosity density to the expected value [1] of $(1.98 \pm 0.16) \cdot 10^{-2} L_{10} \text{ Mpc}^{-3}$.



[1] Kopparapu, R. K., Hanna, C., Kalogera, V. et al., 2008, ApJ, 675, 1495

Completeness II.

Dividing the galaxies into shells and comparing their integrated luminosity to that of the Schechter function¹.



¹Gehrels, N., Cannizzo, J. K., Kanner, J., et al. 2016, ApJ, 820, 136

- ▶ It is important at low z : for sources with $z < 0.05$, the peculiar velocity effect is $> 2\%$
- ▶ S. Mukherjee et al., 2021: <https://arxiv.org/abs/1909.08627>
- ▶ Bayesian Origin Reconstruction from Galaxies (BORG)
- ▶ Reconstruction of the posterior of the velocity field from large scale structure observations using a Bayesian framework
- ▶ The velocity posterior includes both the linear and non-linear velocity components

- ▶ Based on W1 magnitude [1]

$$M_*/L_{W1} = 0.65 \pm 0.07.$$

- ▶ BNS merger rates from stellar mass [2]

$$\lg(n_{GW}/\text{Gyr}) = (1.15 \pm 0.08) \lg(M_*) - (7.2 \pm 0.2).$$

- ▶ Can be used to weight galaxies for cosmology and for optimizing EM follow-up efforts

[1] Kettlety, T. et al. 2018, MNRAS, 473, 776–783

[2] Artale et al. 2019, 487, 1675–1688.

- ▶ ~ 20 million new galaxies, higher completeness in large distances
- ▶ Improved peculiar velocity correction
- ▶ Stellar mass estimates and BNS merger rates provided
- ▶ You can download the catalogue from:
`http://elysium.elte.hu/~dalyag/GLADE+.txt`
- ▶ Notes about the catalogue:
`http://elysium.elte.hu/~dalyag/GLADE+_columns.txt`
- ▶ We'll soon update the GLADE website as well
(`http://glade.elte.hu`)