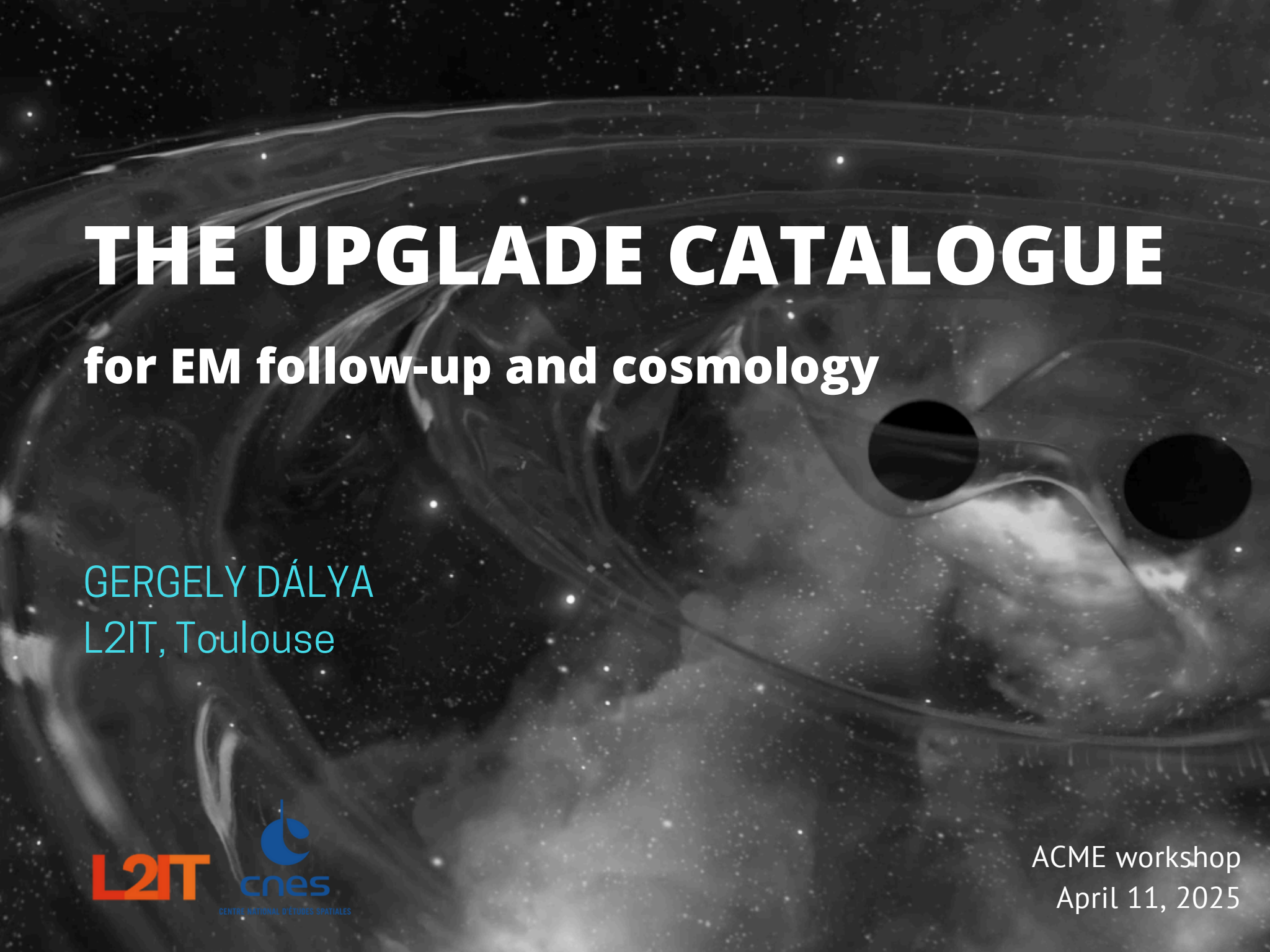


THE UPGLADE CATALOGUE

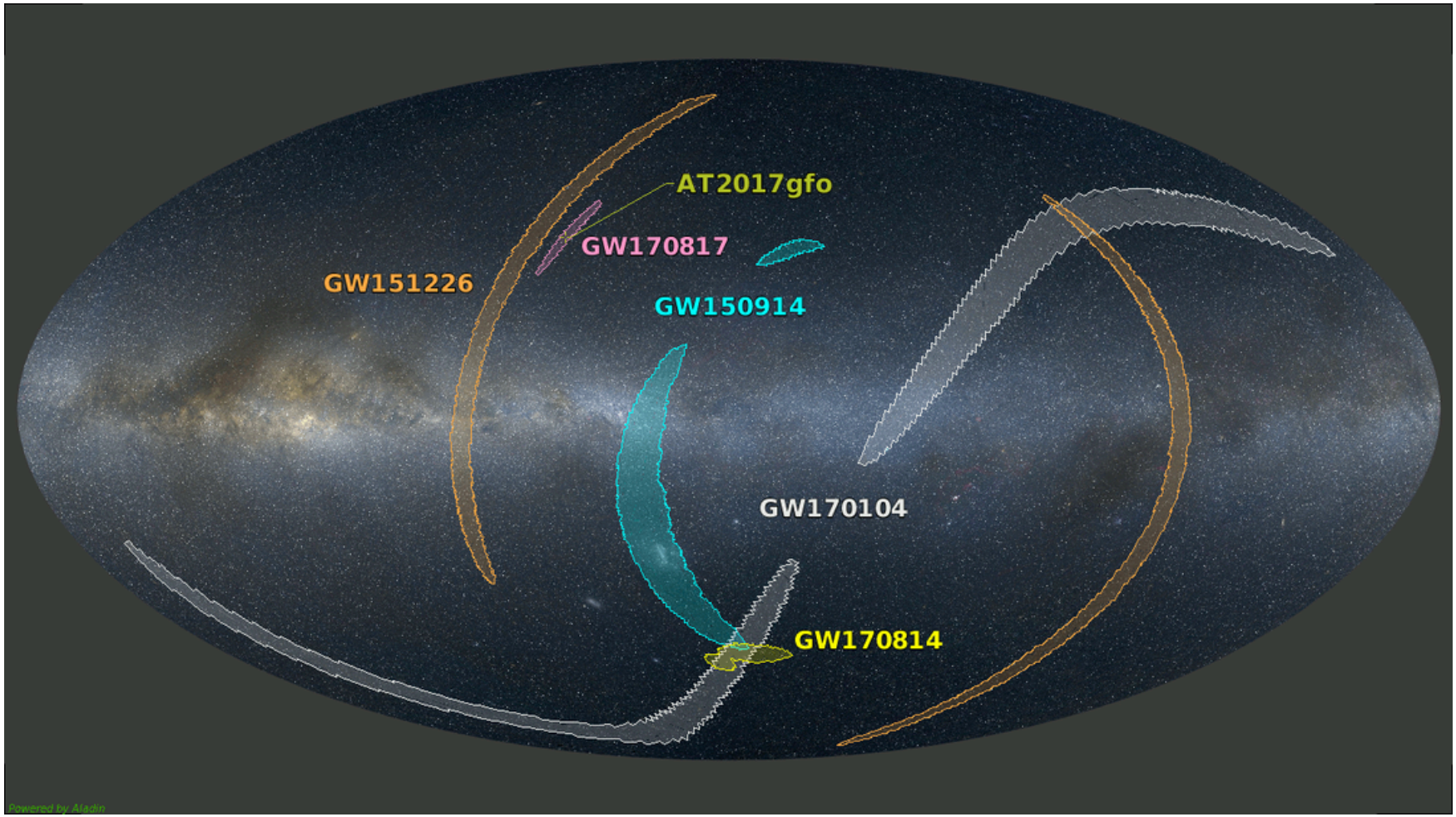
for EM follow-up and cosmology

GERGELY DÁLYA
L2IT, Toulouse

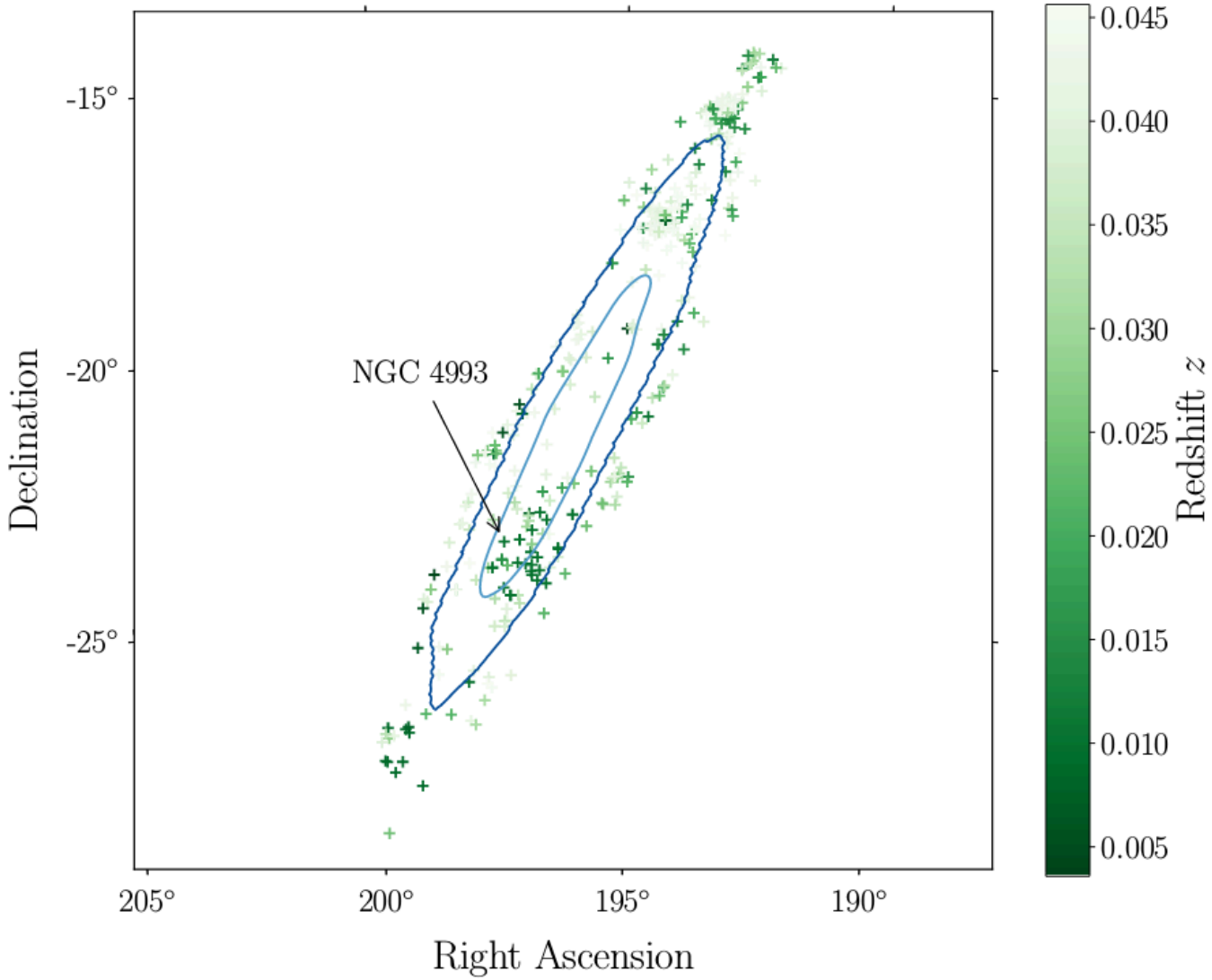
ACME workshop
April 11, 2025

MOTIVATION

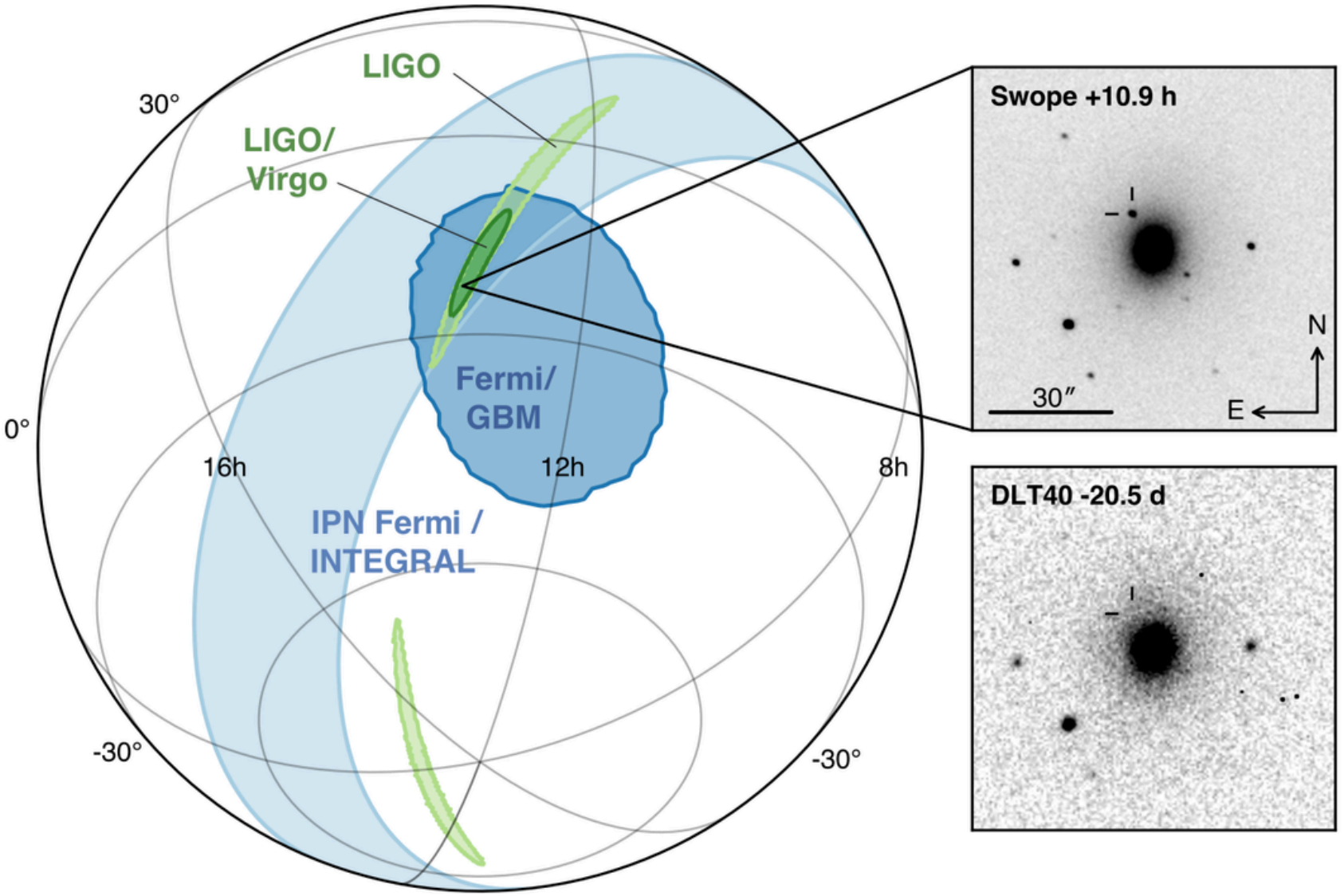
How to observe an EM counterpart?



POSSIBLE HOSTS

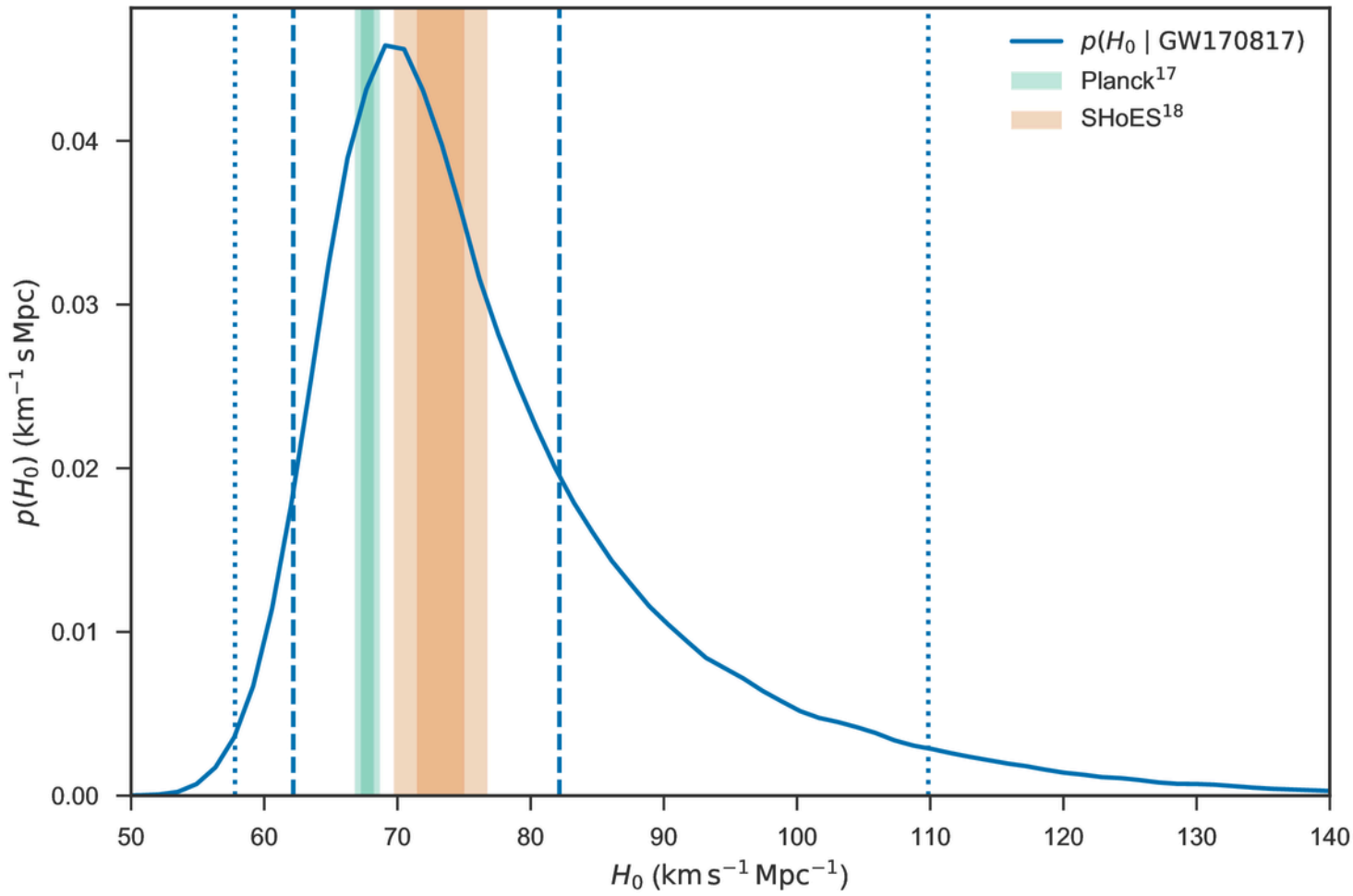


FINDING THE COUNTERPART



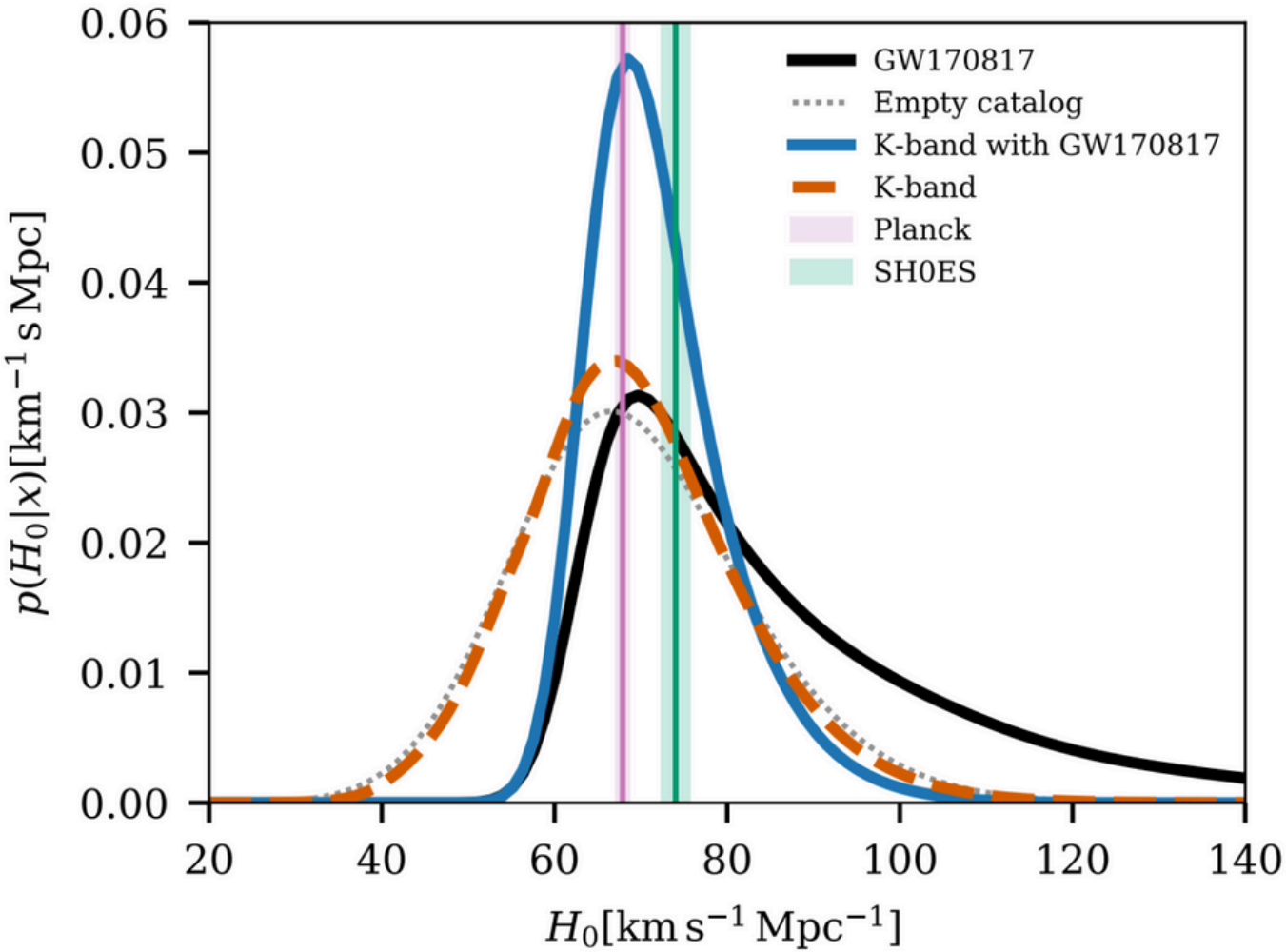
H0 FROM GW170817

Distance from GW, redshift from galaxy catalog (NGC 4993)



DARK SIREN RESULTS

Result from GWTC-3 (after O3): $68^{+8}_{-6}\ \mathrm{km\,s^{-1}Mpc^{-1}}$

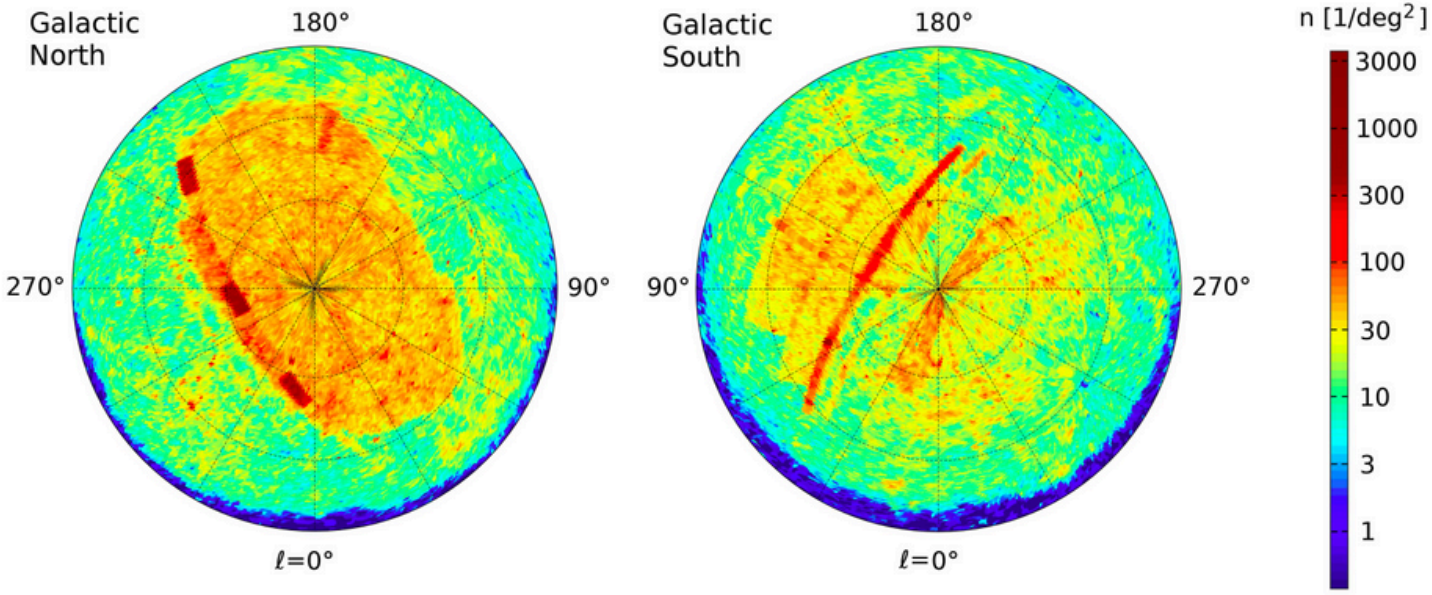


GLADE

Motivation:

- Help EM follow-up
- Provide input data on the matter distribution for cosmology
- Help identifications of EM transients, e.g. GRBs, FRBs

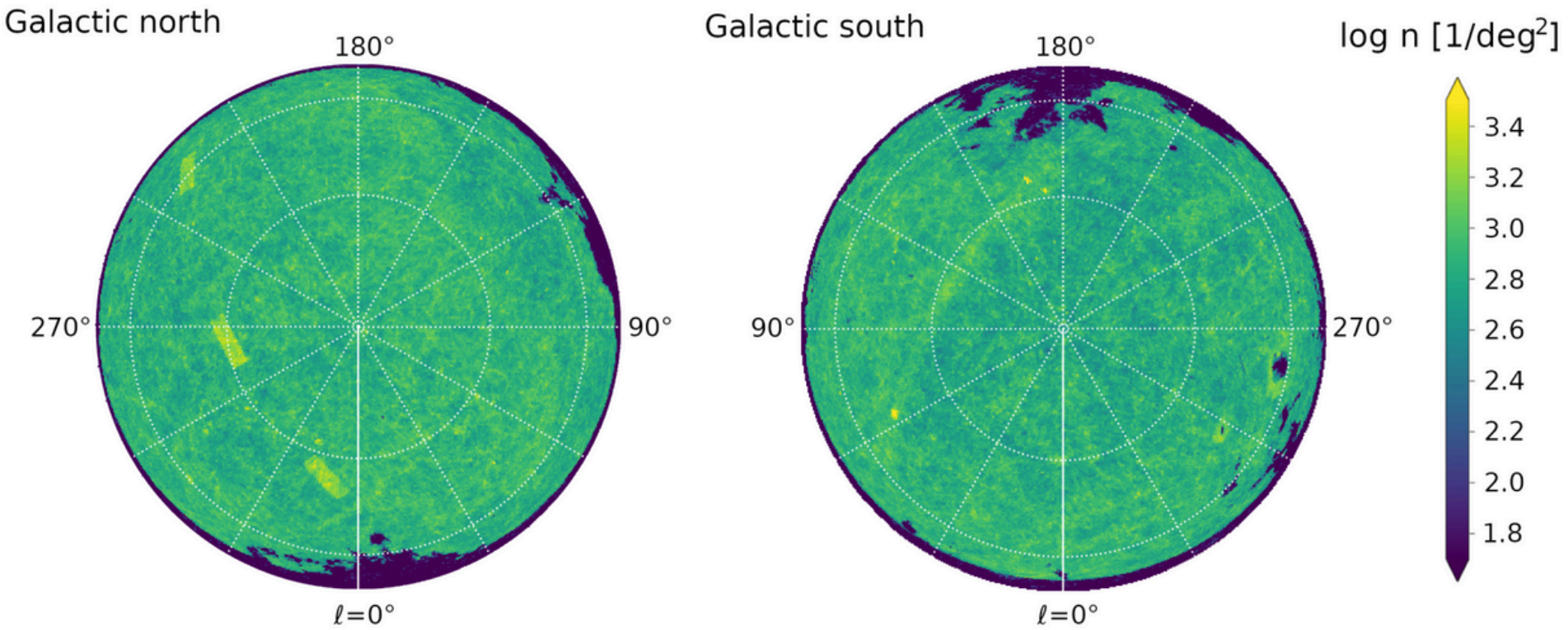
Used for e.g. GW170817, EM follow-up during O3, LVK H0 measurement, ...



Dálya et al. 2018, arXiv: 1804.05709

GLADE+

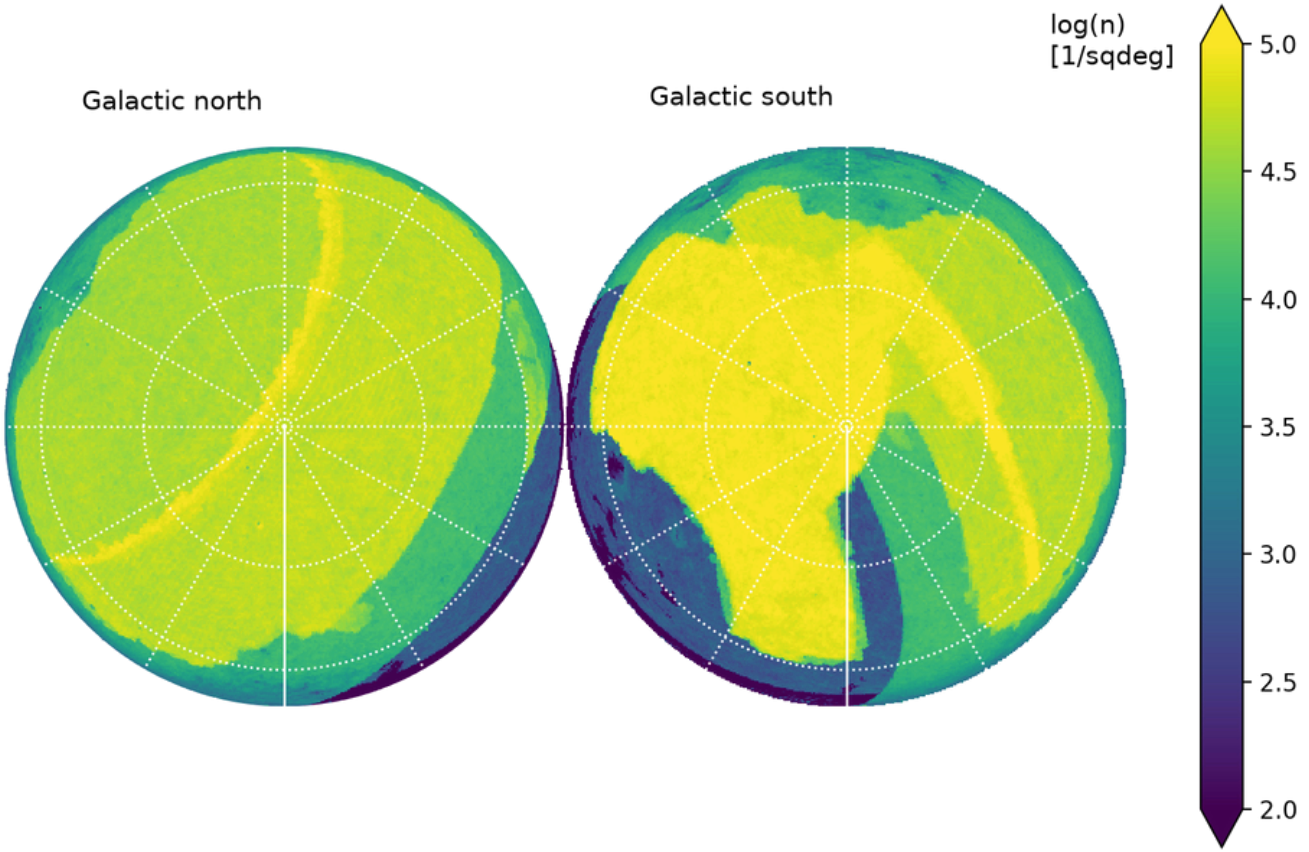
- 20 million new galaxies, improved photo-z and peculiar velocities
- Stellar mass estimates & BNS merger rates provided



Dálya et al. 2022, arXiv: 2110.06184, **glade.elte.hu**

UPGLADE

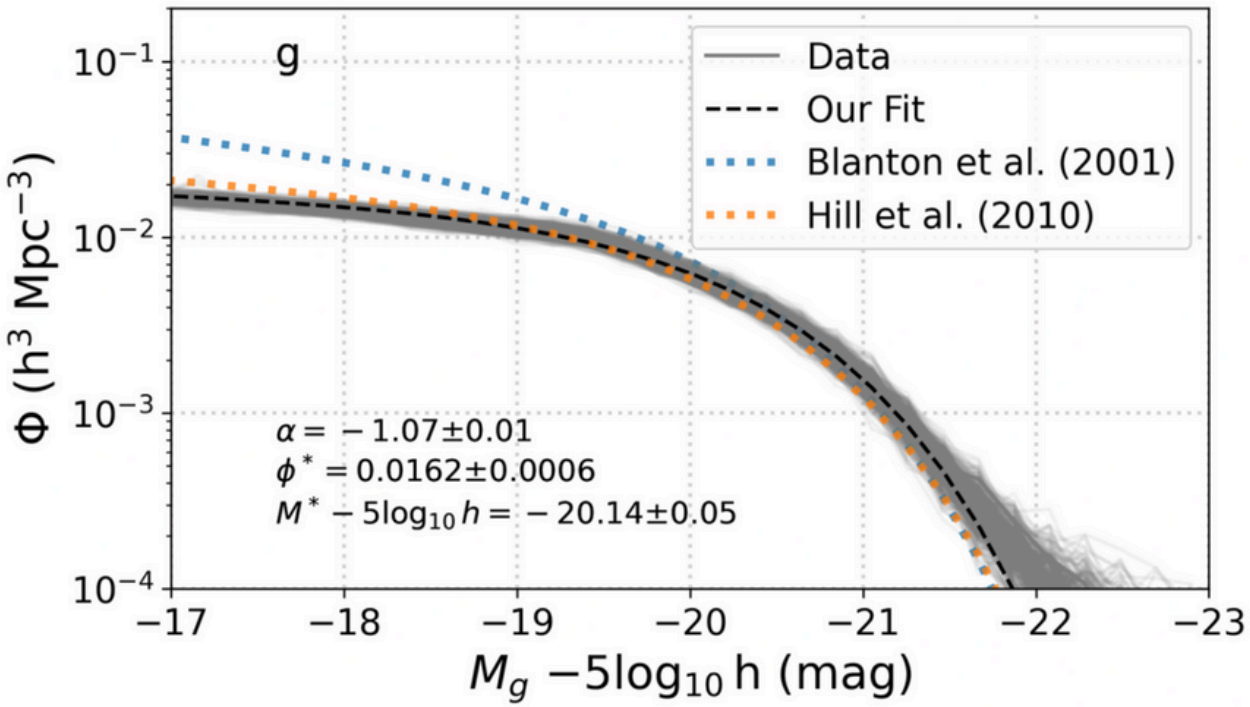
- 2 orders of magnitude more galaxies (1.3 billion)
- Legacy Survey + SGA, Pan-STARRS, CatWISE, SDSS, SkyMapper
- More photometric bands
- More accurate peculiar velocities, stellar masses, SFRs



COMPLETENESS

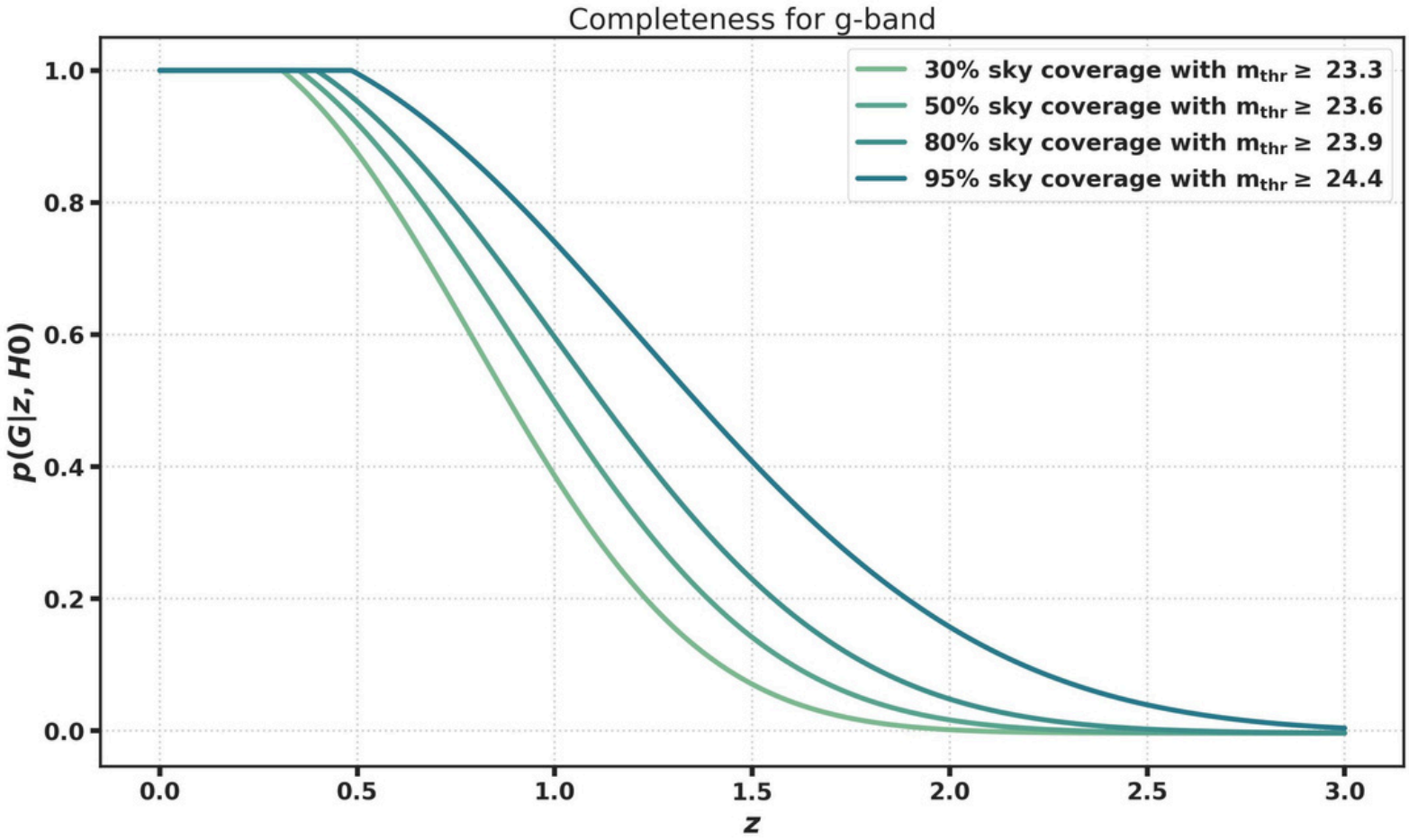
Schechter function: the number of galaxies per luminosity (magnitude) interval

$$\mathrm{d}n(L) = \ln(10)\phi^* \left(\frac{L}{L^*}\right)^{\alpha+1} \mathrm{e}^{-L/L^*} \mathrm{d}\left(\log_{10} L\right)$$



COMPLETENESS

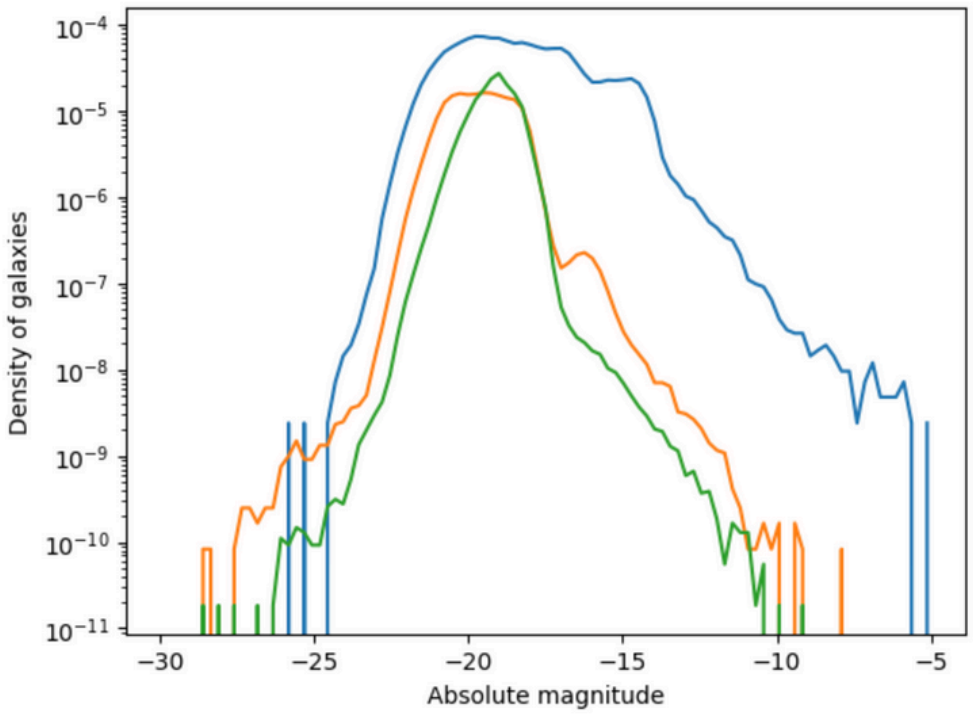
- Anisotropy: 1/Vmax weighting
- Taking into account redshift uncertainties

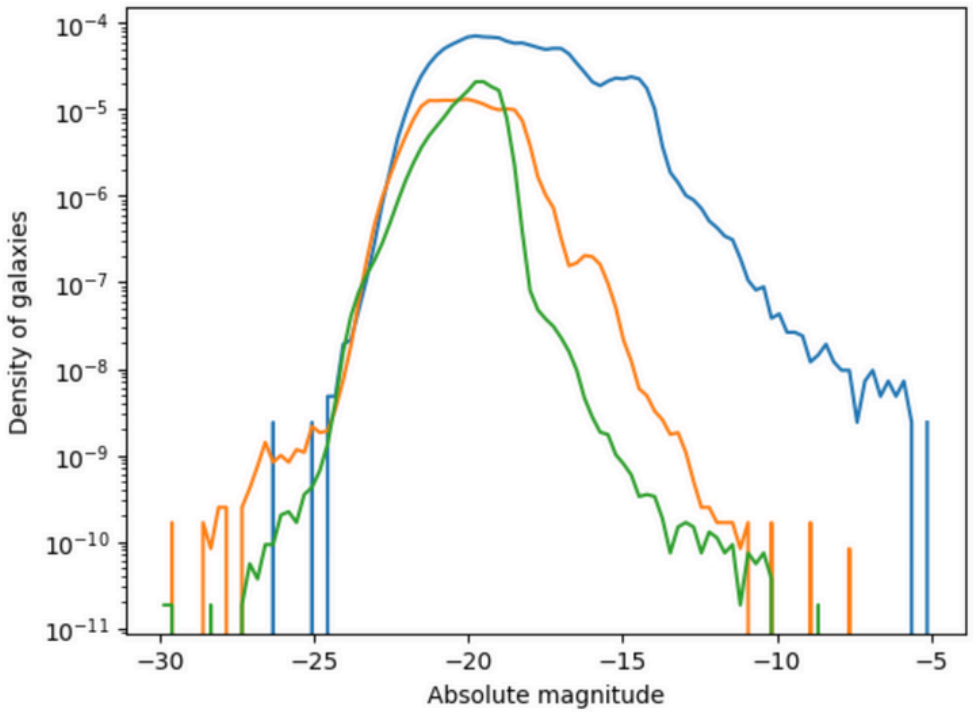


K CORRECTIONS

Magnitude formula with interstellar extinction and K correction

$$m - M = -5 + 5 \log_{10} d_{\mathrm{L}} + A + k$$

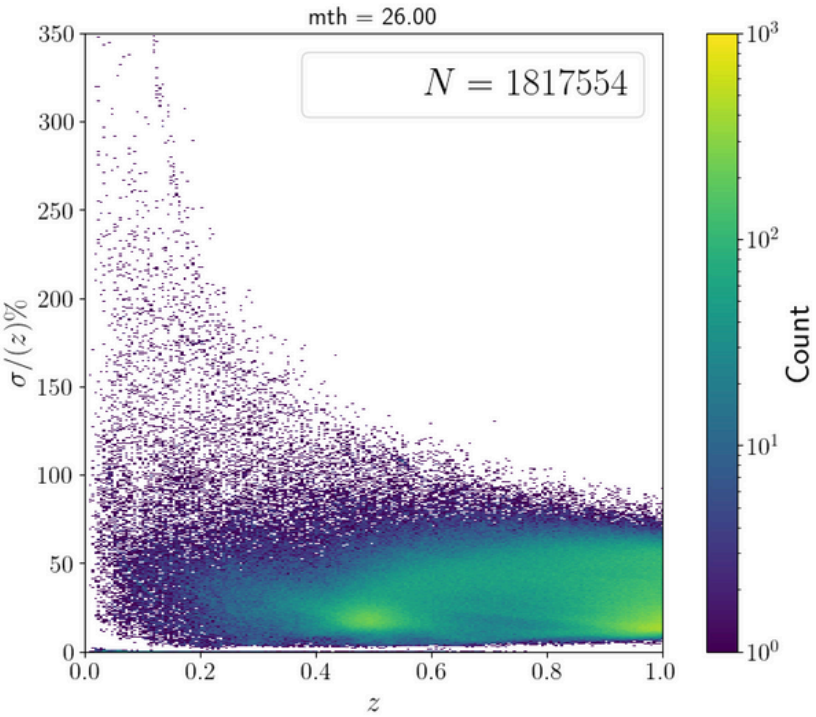


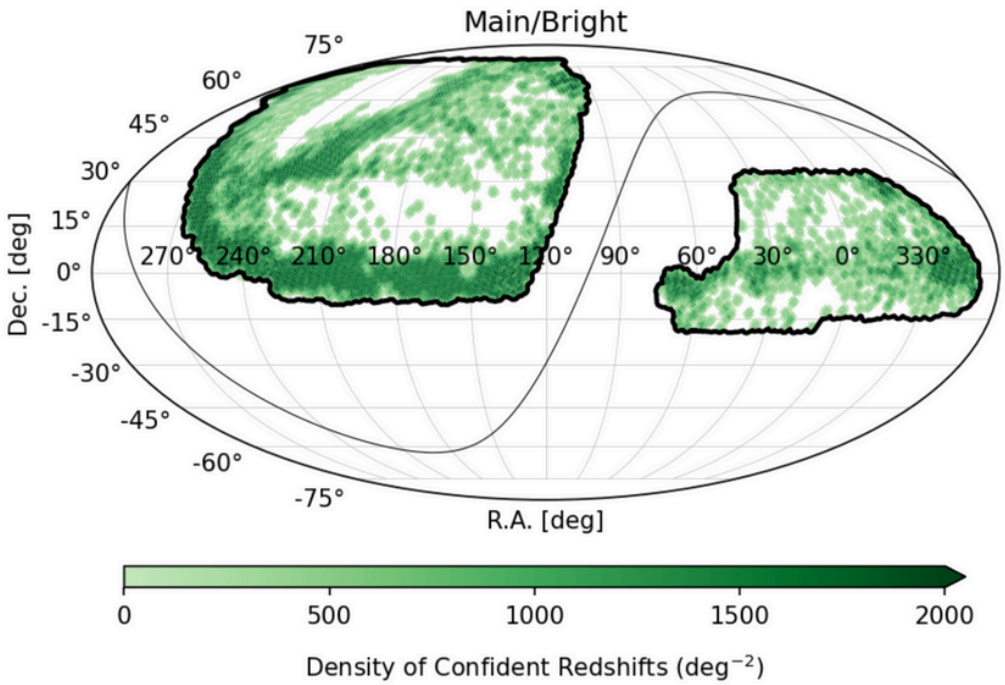


Kcorrect package, now entirely in python

PHOTO-Z UNCERTAINTIES

- Most of the galaxies don't have spectro-z: large z uncertainties…
- DESI DR1 happened recently: ~13M spectroscopic redshifts!





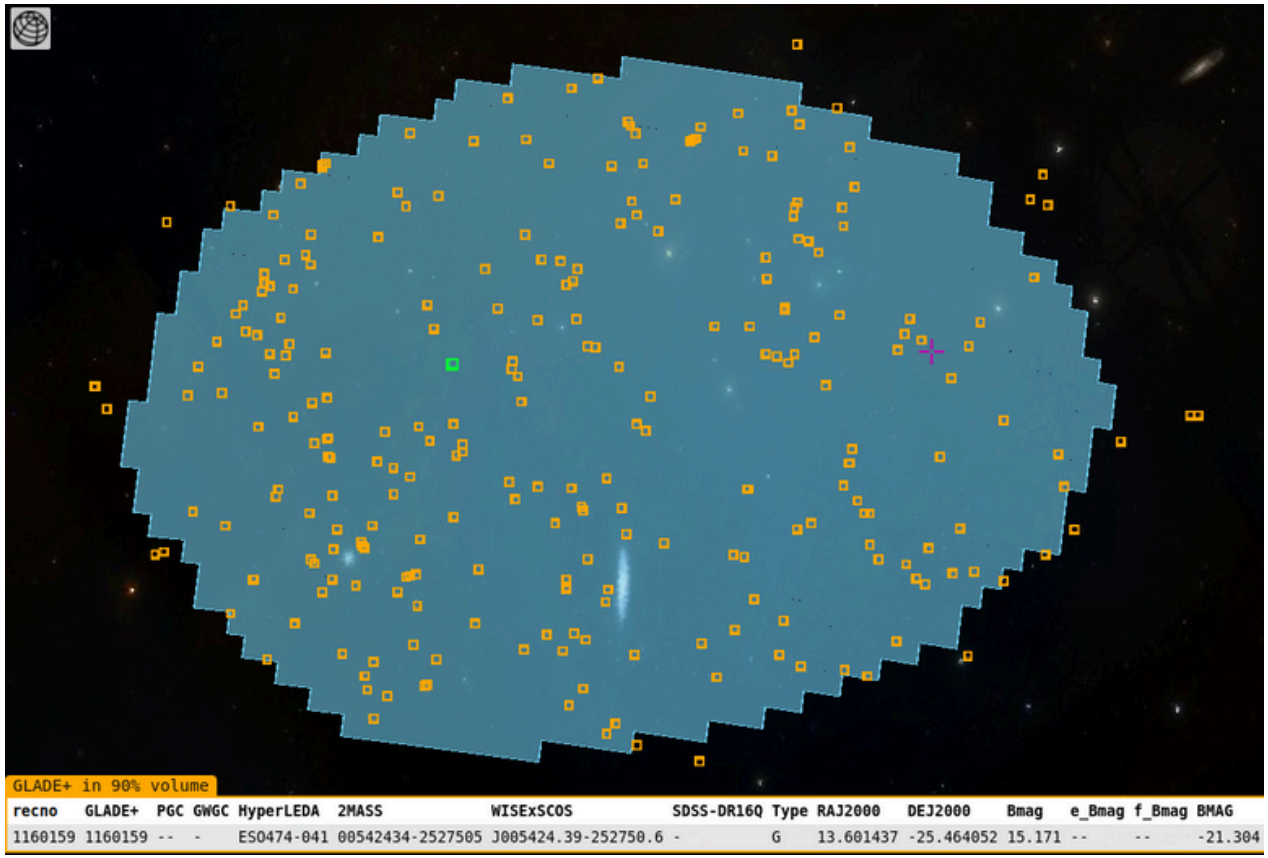
DATA ACCESS

- PostgreSQL database on the LVK server
- Very fast and efficient parallel querying
- Other datasets (PS, GLADE+) are linked to it, so specific cuts are easy to make
- Easy to link and cross-match other catalogues as well
- Some LVK skymaps are also linked: query healpix indices and then galaxies
- We are working on linking it to GraceDB to make it publicly accessible for all GW events

Stay tuned for the paper and GraceDB access soon!

GLADENET

- Interactive web tool to evaluate the completeness of a given detection
- Optimizing follow-up observations → galaxy discoveries?



Brozzetti, Dálya et al., 2024, A&A, **virgo.pg.infn.it/gladenet/catalogs/**

GLADIATOR

Facilitate observations for both EM follow-up & dark siren comsology

Submit your newly discovered galaxies!

A dynamically growing catalogue, driven by GW observations & the astronomical community