

Virgo France cosmology

Subatech via APC, (2 years in September 2022)

Benoît Revenu, 21/06/2022

People

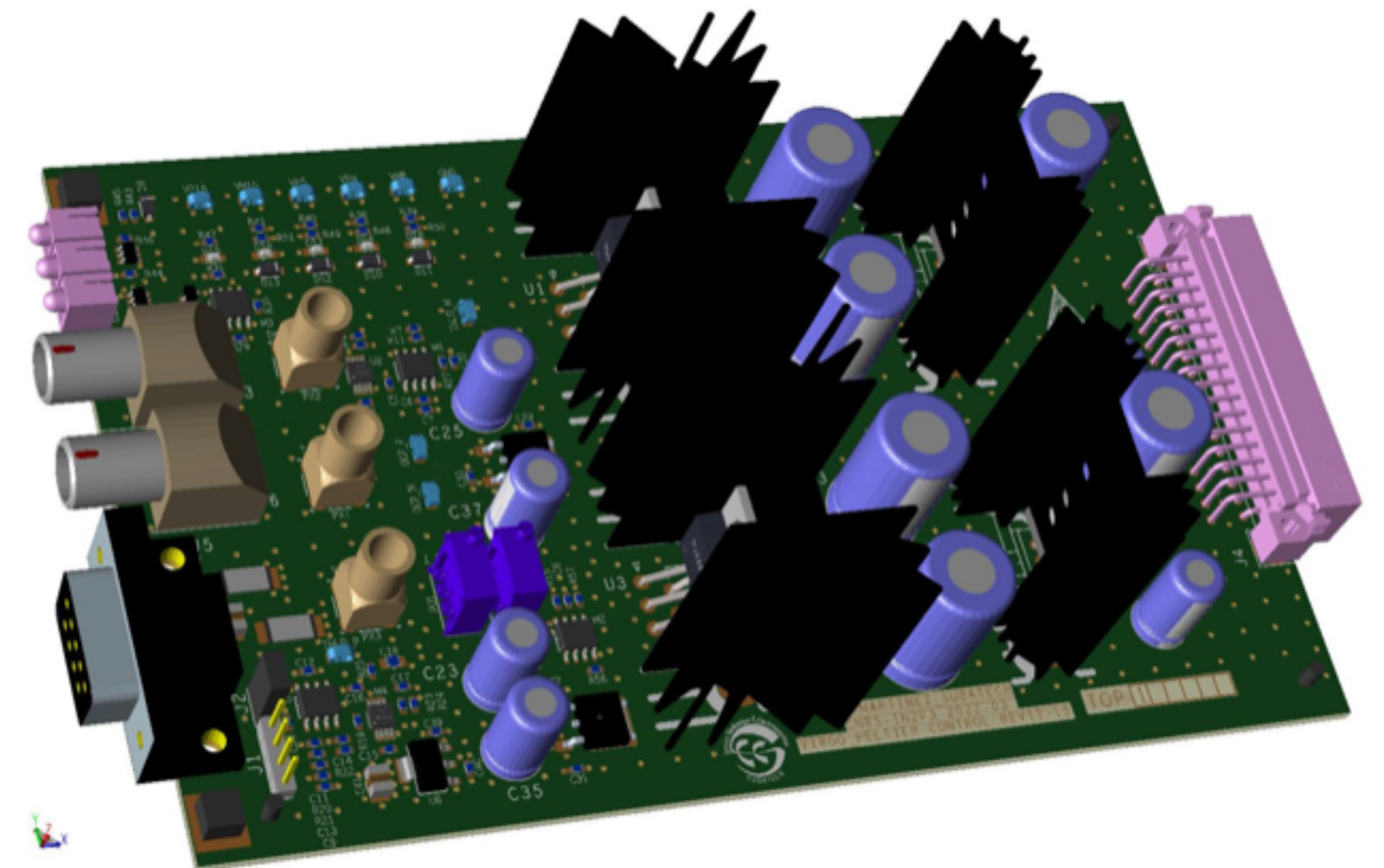
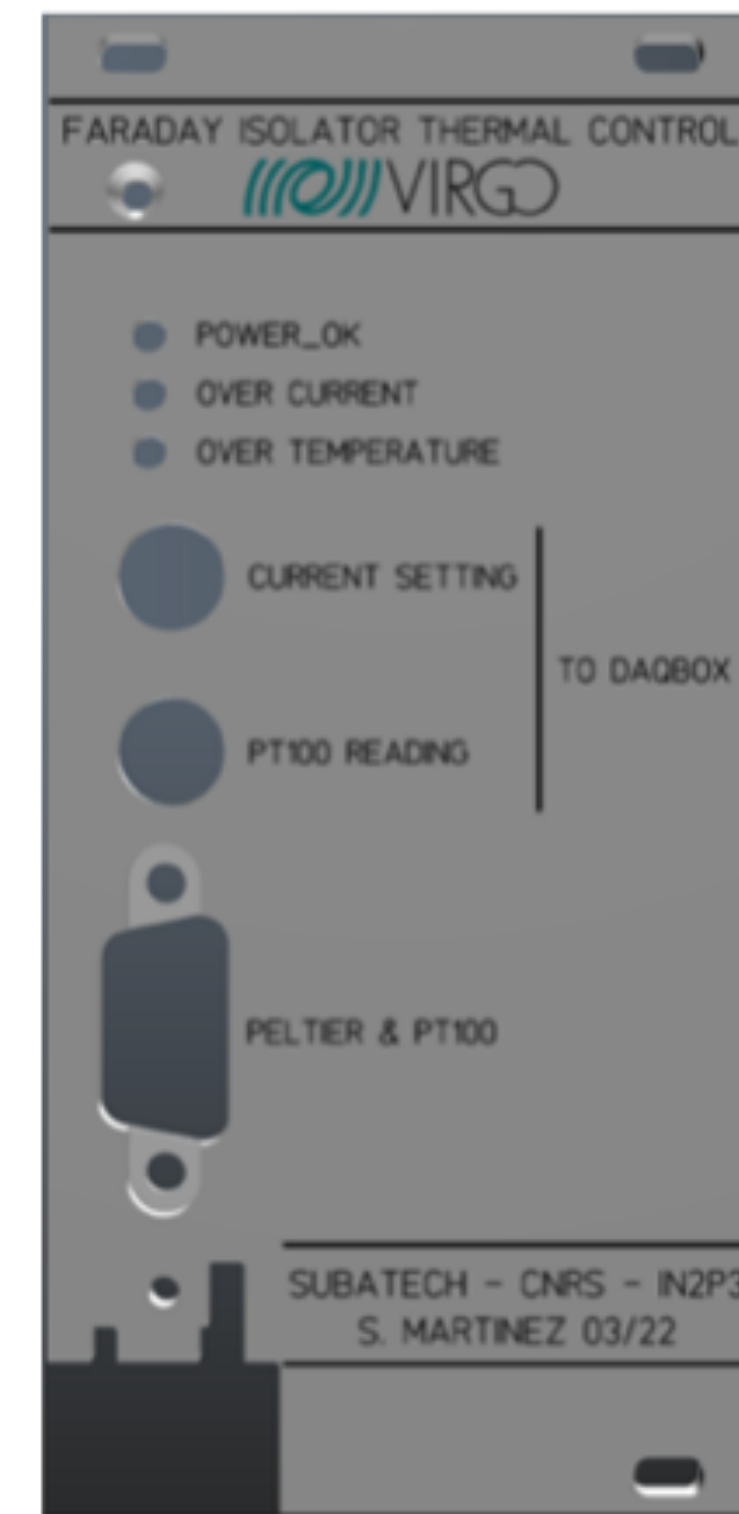
- Stéphane Martinez, 60%, engineer design and production of a board for the temperature control of the Faraday (waiting for the review to complete before installation in Virgo)
- me, researcher, 70%, cosmology

in Virgo through APC

Status LEDs

LEMO 0B.303 connectors
(DaqBox connection)

SUB-D9
Peltier and PT100 connection



Contributions

last few months work, in relation with the cosmology effort:

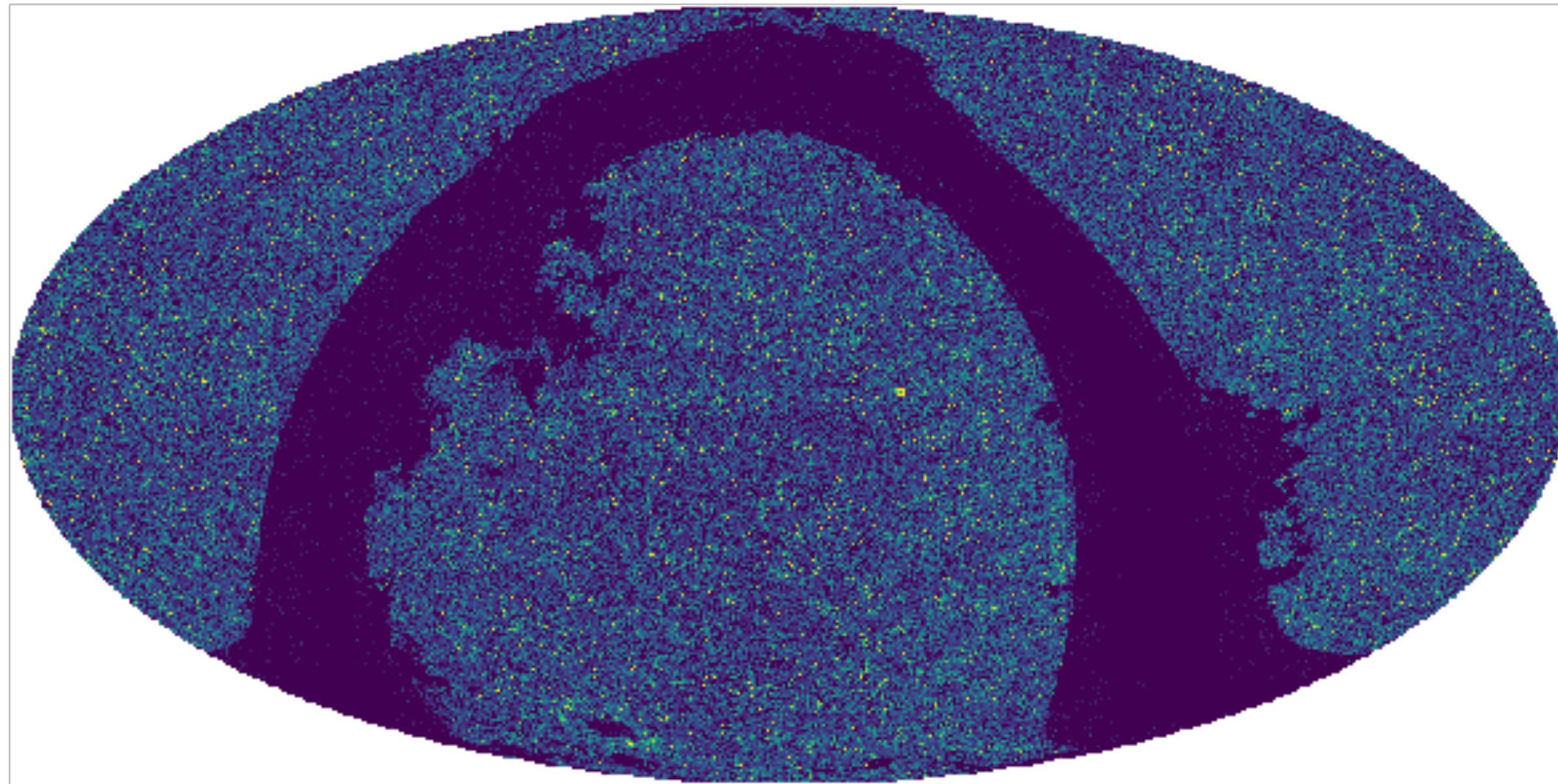
- 1) generating fake galaxy catalogs
- 2) generating fake events

1. Generating fake galaxy catalogs

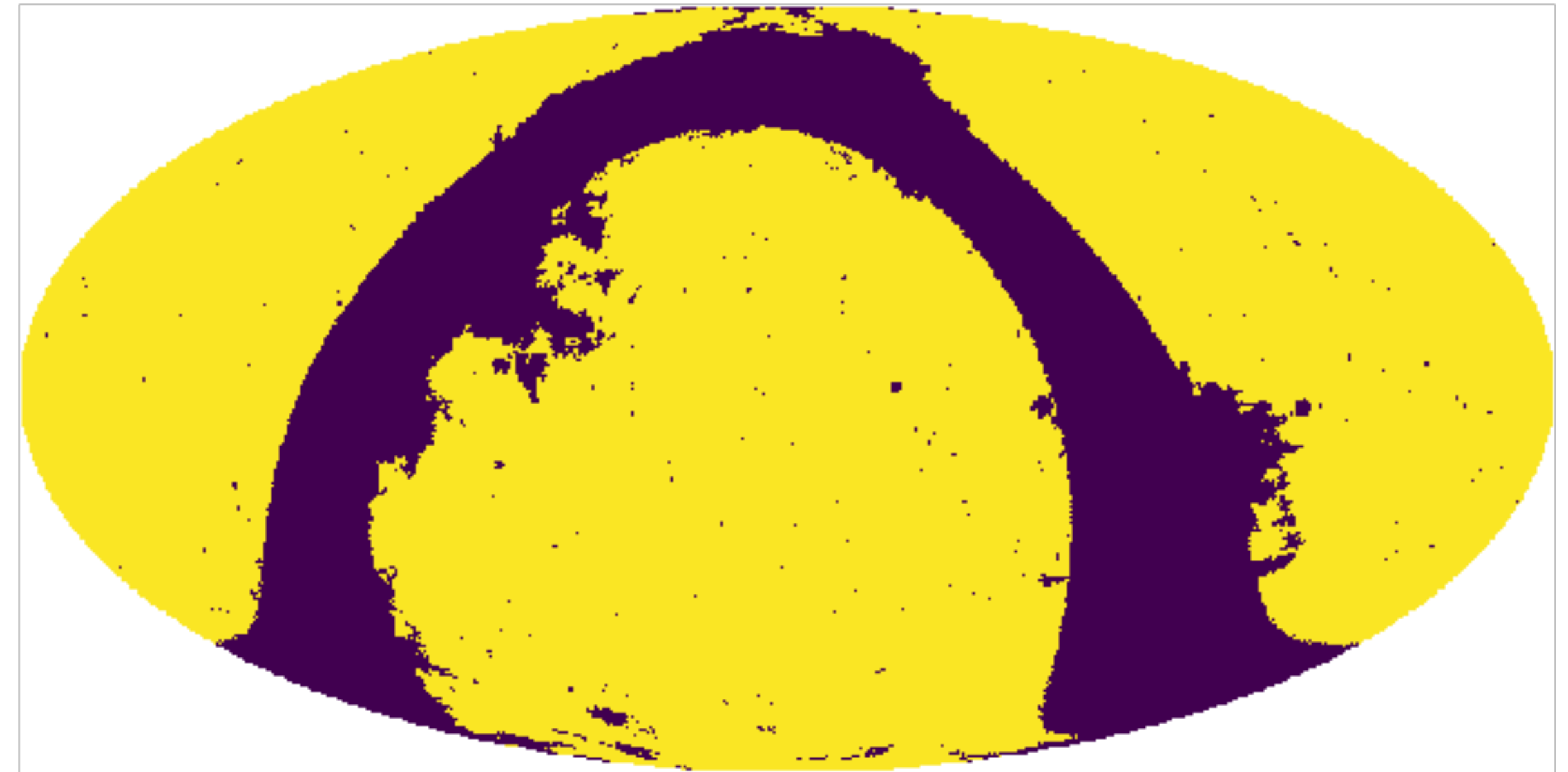
goal: generate a realistic skymap of apparent magnitude thresholds

starting point: an actual galaxy catalog, GLADE+ for instance, galaxy count = mag threshold
define the mask: sky locations where there is no coverage (galactic plane for instance)

GLADE+

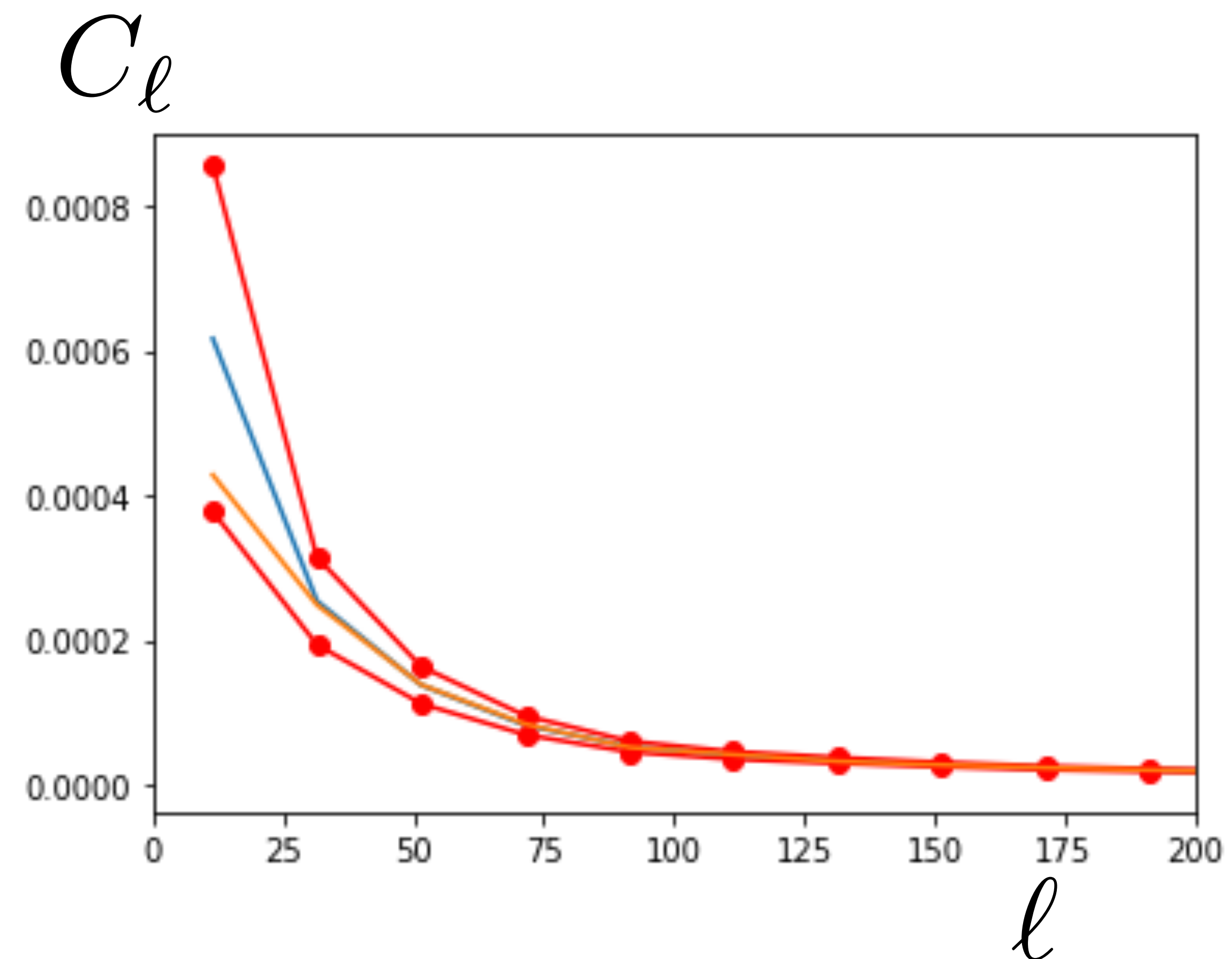
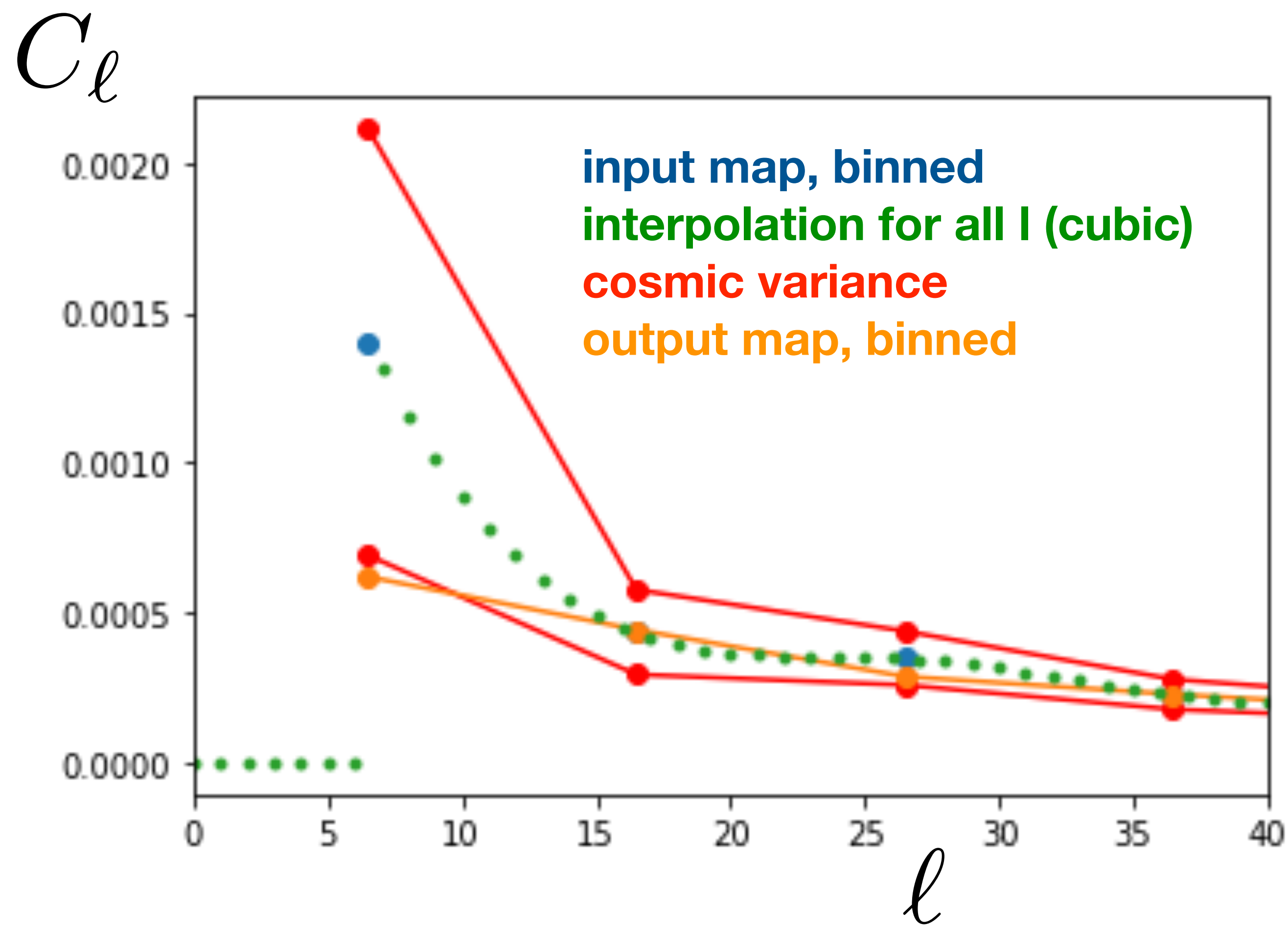


mask



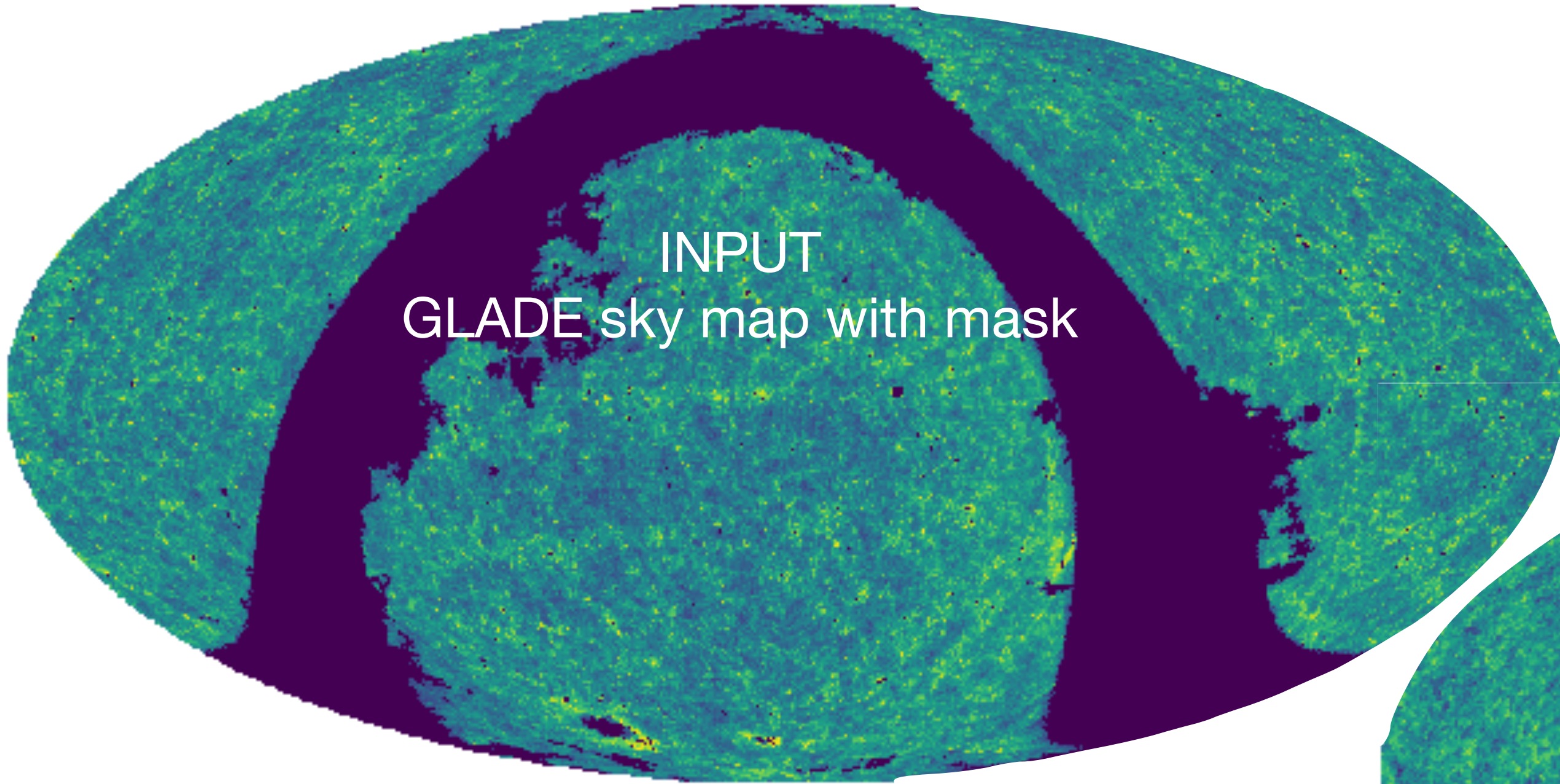
1. Generating fake galaxy catalogs

simulate a skymap with the same angular power spectrum

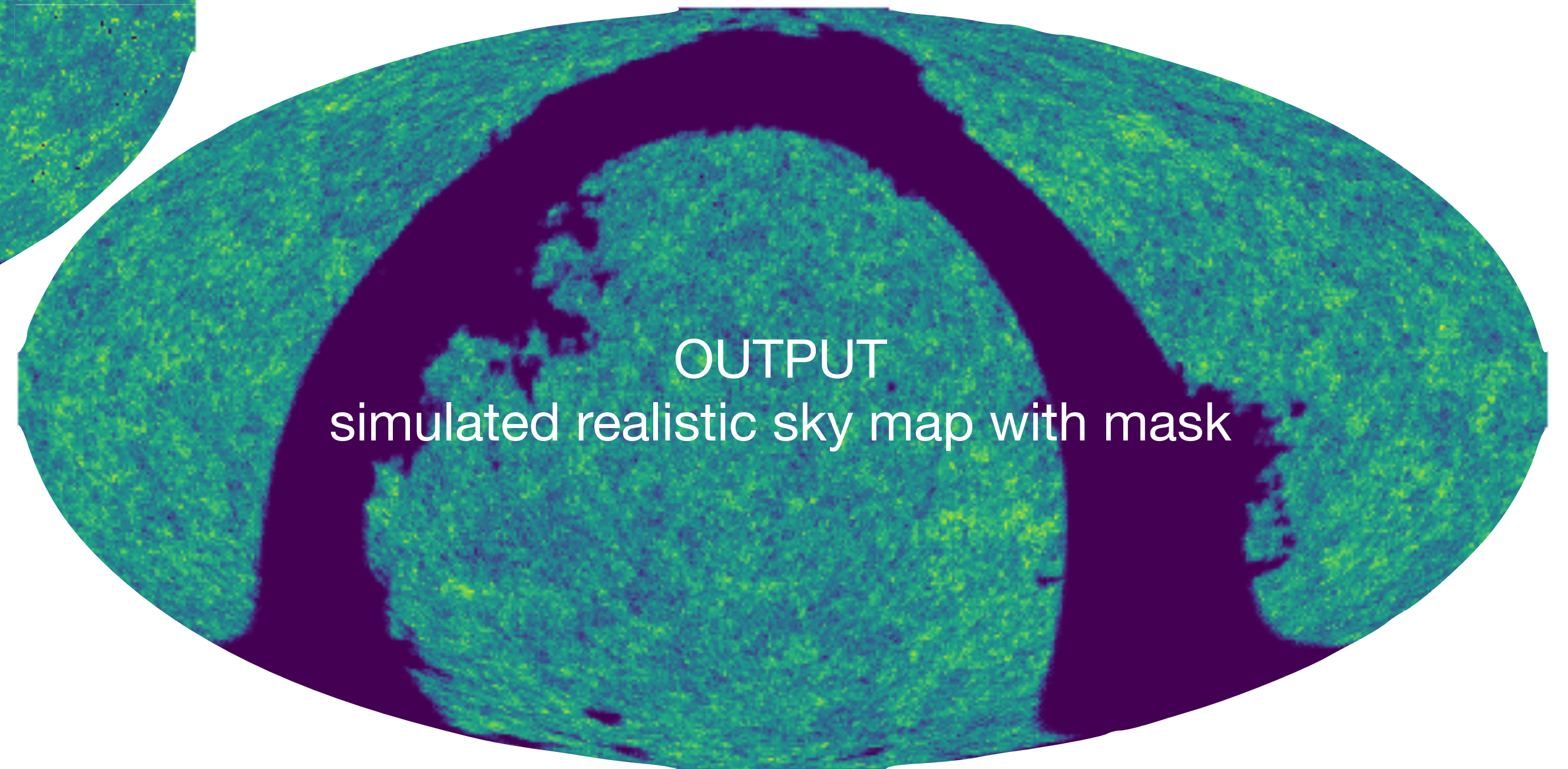


1. Generating fake galaxy catalogs

GLADE+ galaxy catalog with mask



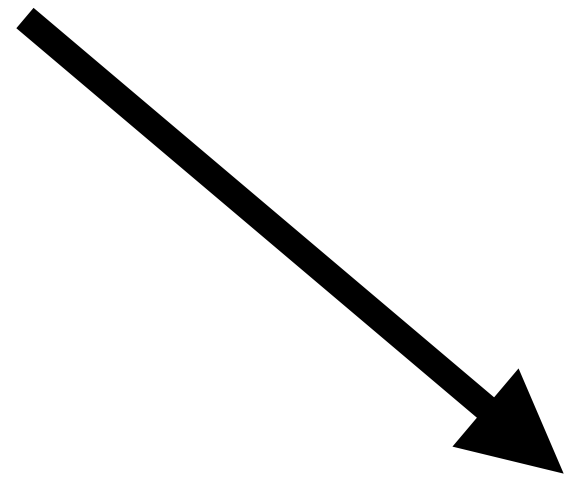
Mollweide view



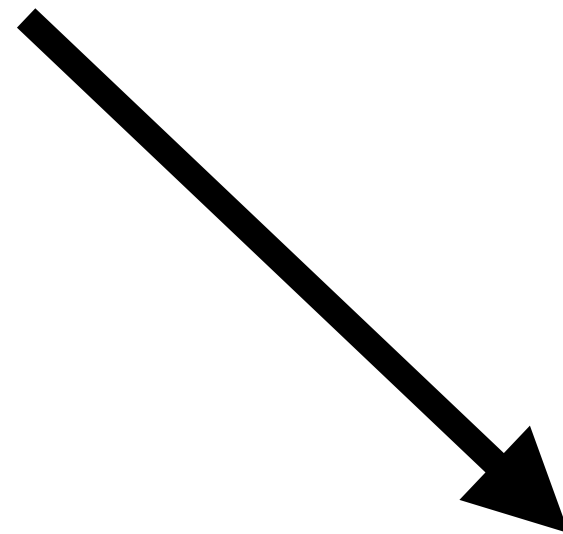
2. Generating fake events: GWUniverse

team: Christos, Suvodip, Federico, myself

Cosmo WG



subgroup Cosmological pipelines development and validation
coordinators: Rachel, Christos, Simone



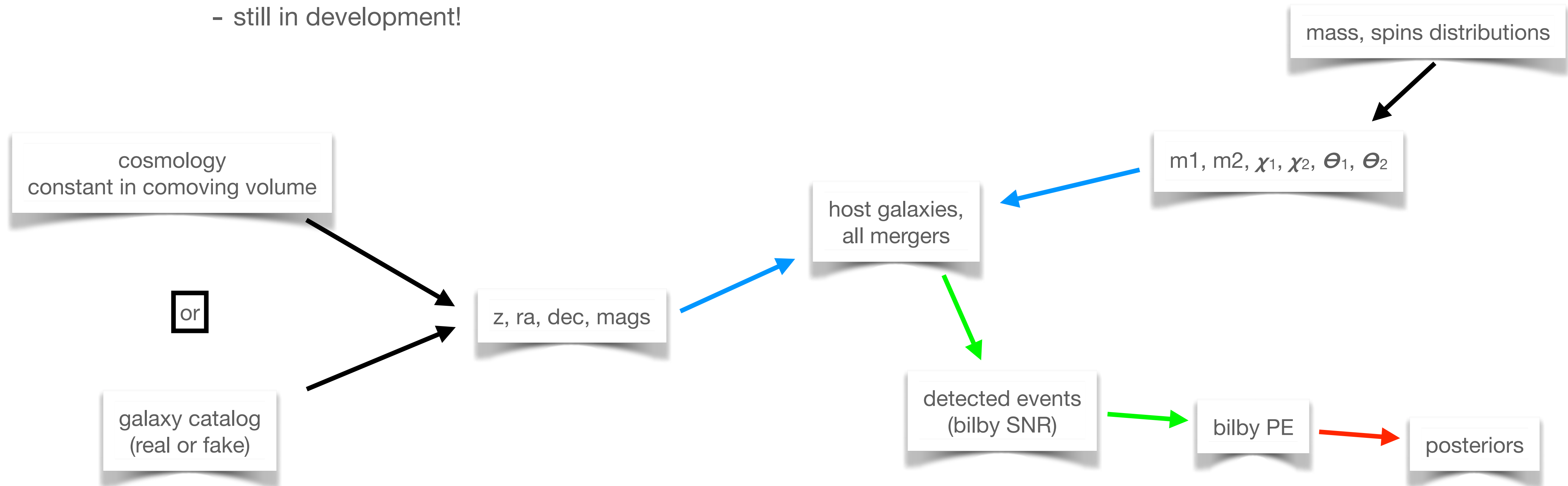
GWUniverse dedicated meetings:
all wednesdays 3PM CEST

2. Generating fake events: GWUniverse

team: Christos, Suvodip, Federico, myself

in the scope of the preparation of O4, we made a code that allows to generate posteriors for many scenarios:

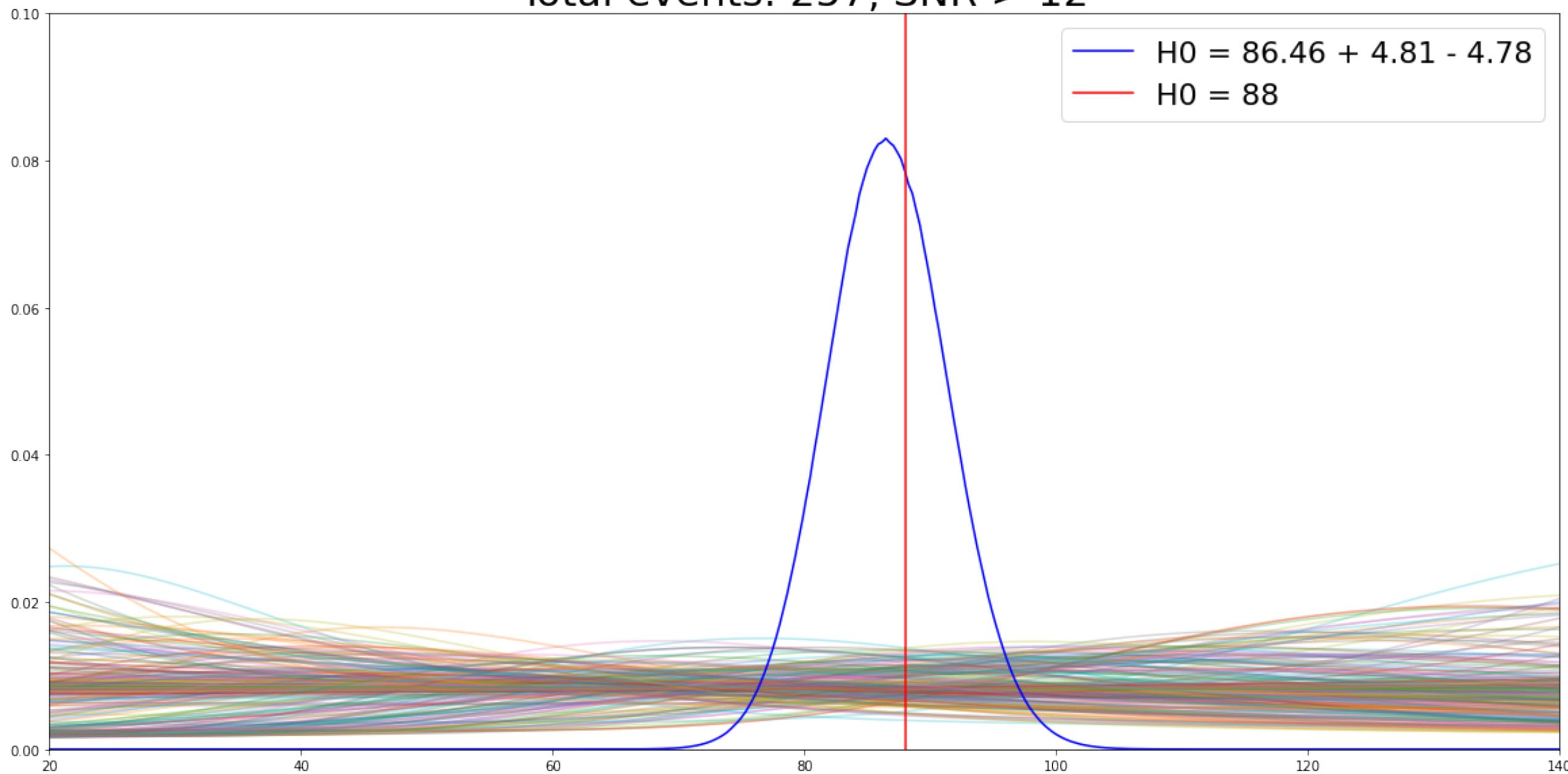
- any cosmology (but flat)
- mass models (PL, PL+peak, multi-peaks, z-evolution...)
- spin models (heavier mass has more spin, uniform, gaussian, correlation with q following arxiv:2106.00521...)
- merger rate (Madau-Dickinson,...)
- still in development!



2. Generating fake events: GWUniverse

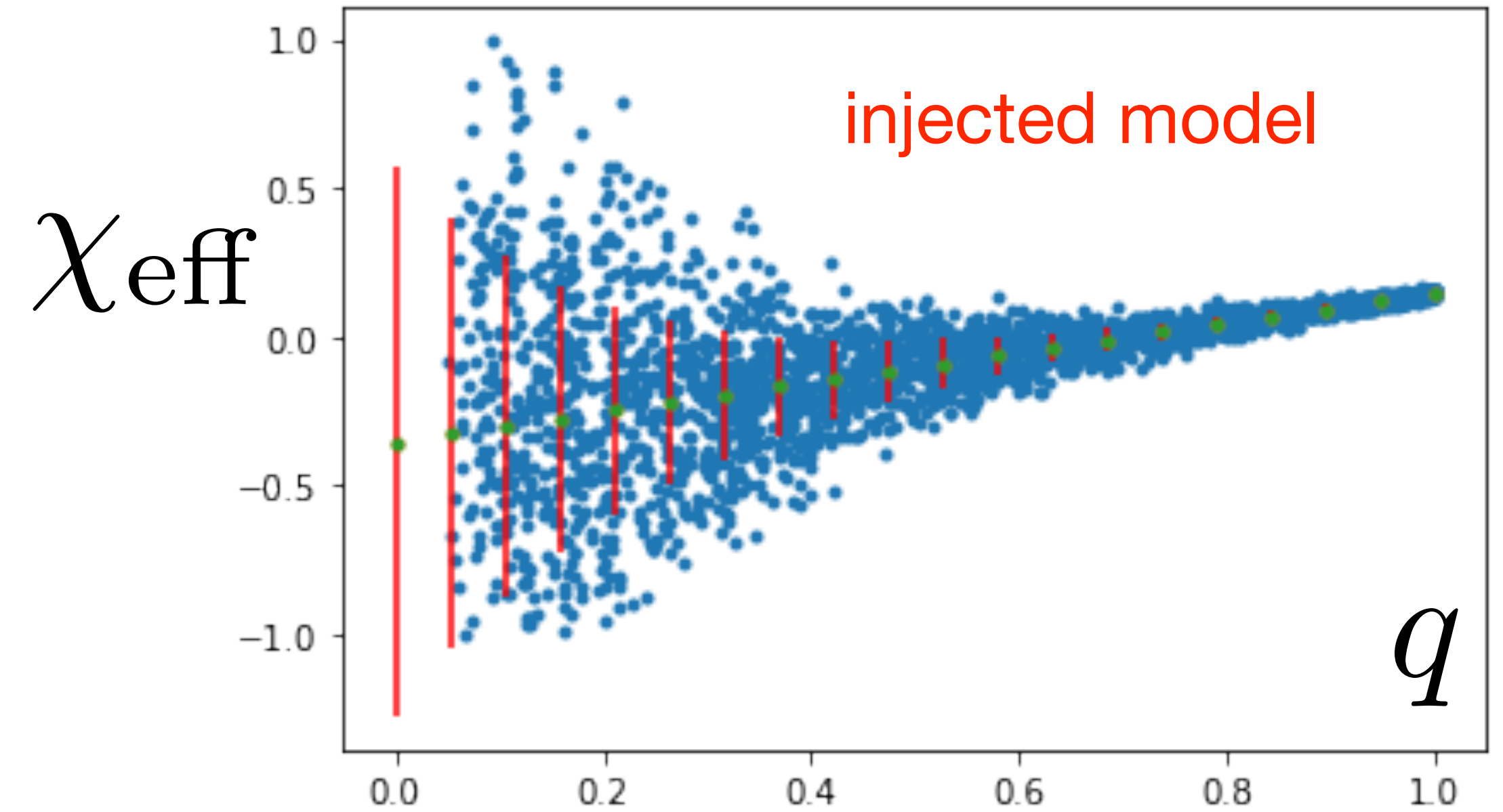
code validation (unblinded):

Total events: 257, SNR > 12



example of a custom spin model: [arxiv:2106.00521](https://arxiv.org/abs/2106.00521)

$$p(\chi_{\text{eff}}|q, \mu_{\chi,0}, \sigma_{\chi,0}, \alpha, \beta) \propto \exp \left[-\frac{(\chi_{\text{eff}} - \mu_{\chi}(\mu_{\chi,0}, \alpha, q))^2}{2\sigma_{\chi}^2(\sigma_{\chi,0}, \beta, q)} \right]$$



2. Generating fake events: GWUniverse

team: Christos, Suvodip, Federico, my self

double blind analysis:
we defined 5 cases to run

1. Vanilla-scenario: Hubble constant+power-law+peak (without z evolution)+no-spin+merger-rate (no z evolution)
2. Redshift-dependence-scenario-A: Hubble constant+power-law+peak (z evolution)+no-spin+merger-rate (z evolution)
3. Redshift-dependence-scenario-B: Hubble constant+power-law+alternative-model (z evolution)+no-spin+merger-rate (z evolution)
4. Redshift-dependence-scenario- Ω_m+w_0 : Hubble constant+ Ω_m+w_0 +power-law+peak (z evolution)+no-spin+merger-rate (z evolution)
5. Redshift-dependence-scenario-spin: Hubble constant+power-law+peak (z evolution)+spin+merger-rate (z evolution)

randomly choose the values of the parameters (H_0 , w_0 , evolution...)
4 teams will run 10 sets of each case, ie 50 sets of posteriors per team
then random choice of some sets (blinded), provided to the analysis team

analysis team: reconstruct all parameters and in the end, unblind to compare with the true injected values

GWUniverse not fully tested yet!

Future plans

- full validation of GWUniverse, make it public + paper
- contribute to review of pipelines and analyses for O4 cosmo
- make the Subatech group develop (PhD student in oct 2023?)