



# LATEST RESULTS FROM THE LVK 04A OBSERVING RUN

GERGELY DÁLYA

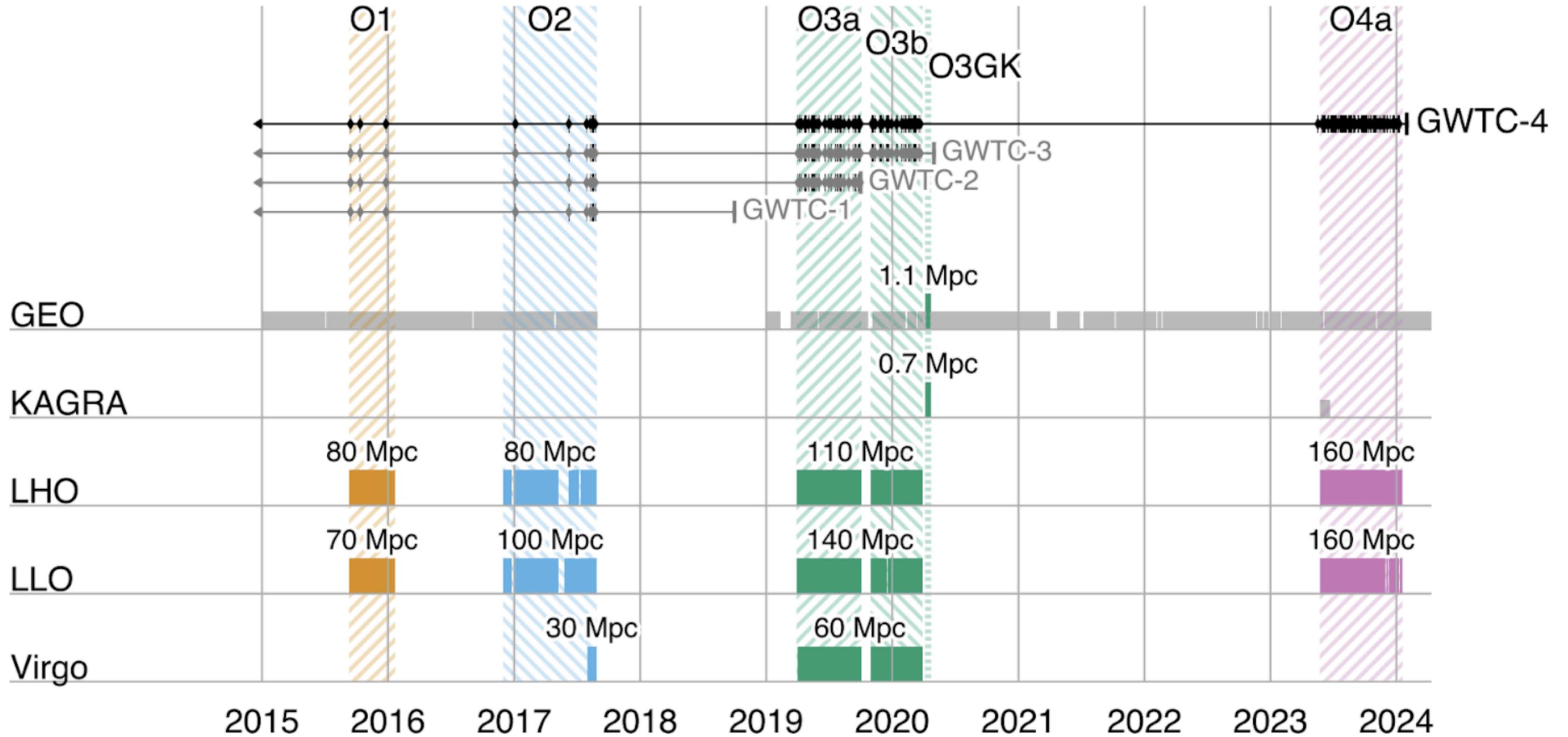
L2IT, Toulouse

For the LIGO-Virgo-KAGRA Collaboration

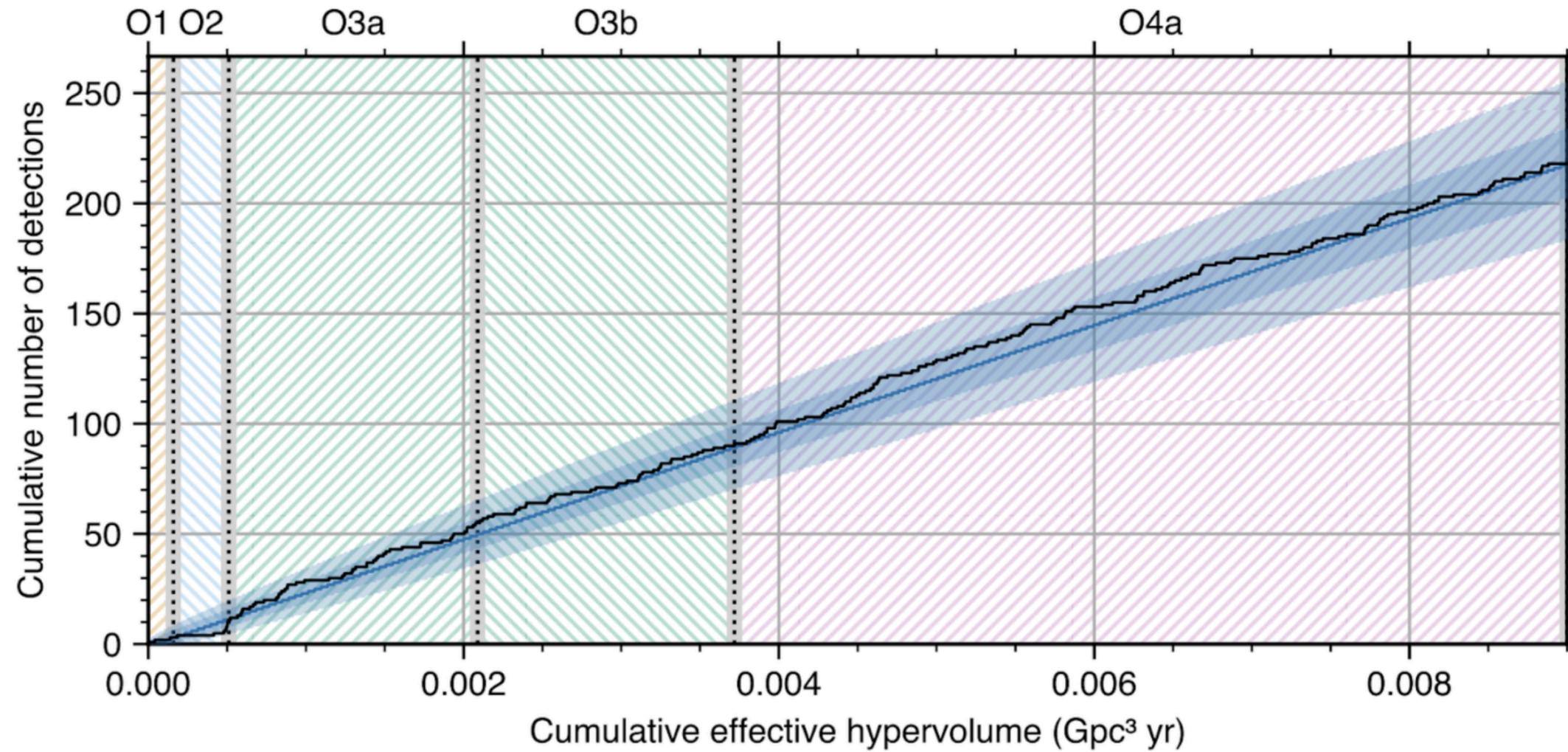
4th Astro-COLIBRI workshop

October 20, 2025

# GWTC-4.0



# GWTC-4.0



**128** new candidates  
**218** candidates in total

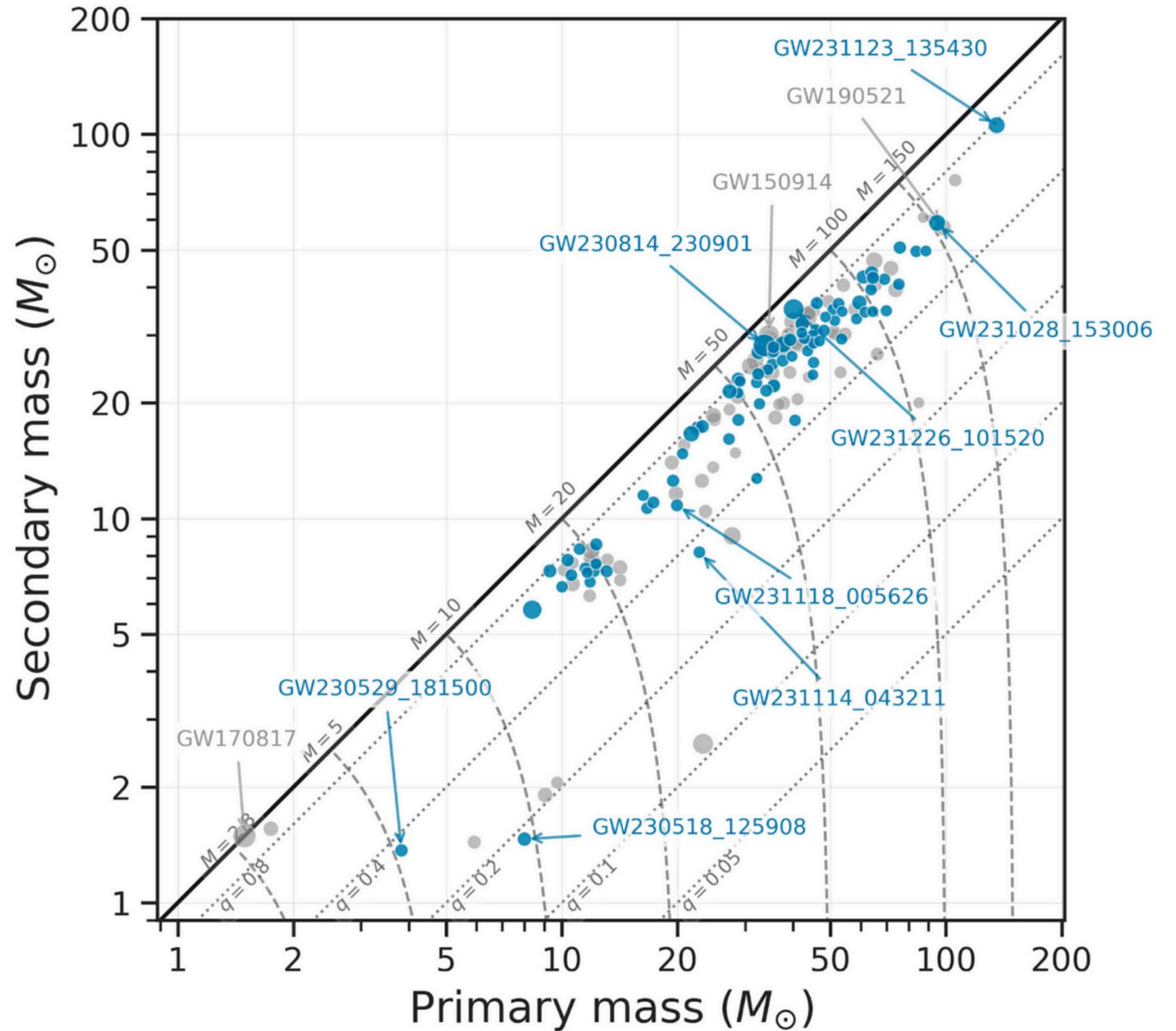
# GWTC-4.0

2 new NSBH

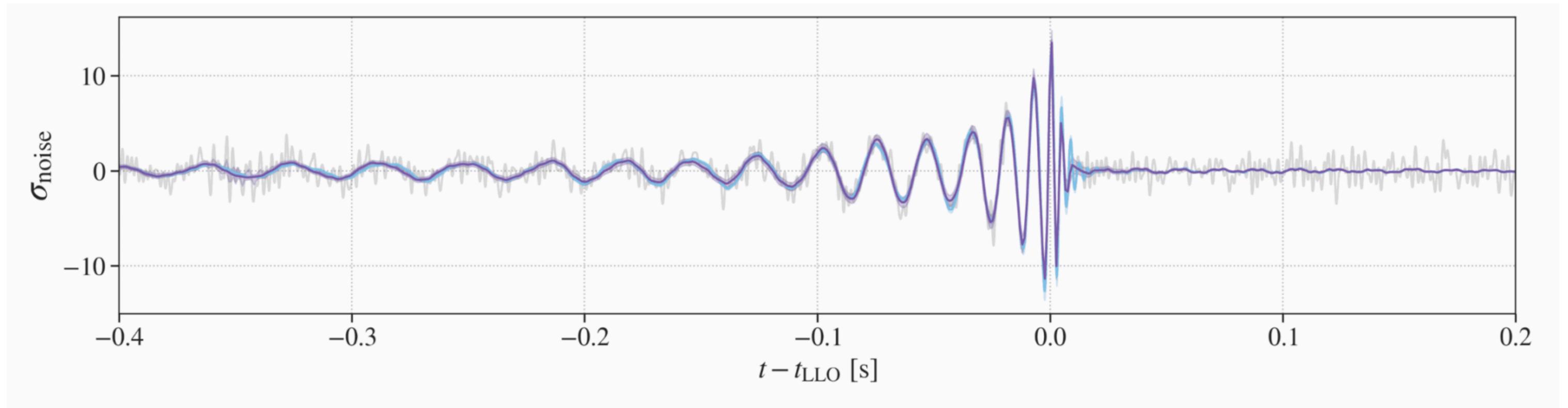
no new BNS

Largest SNR event so far: 42.4

Most massive BBH so far: 225  $M_{\odot}$



# Cosmology with GWs

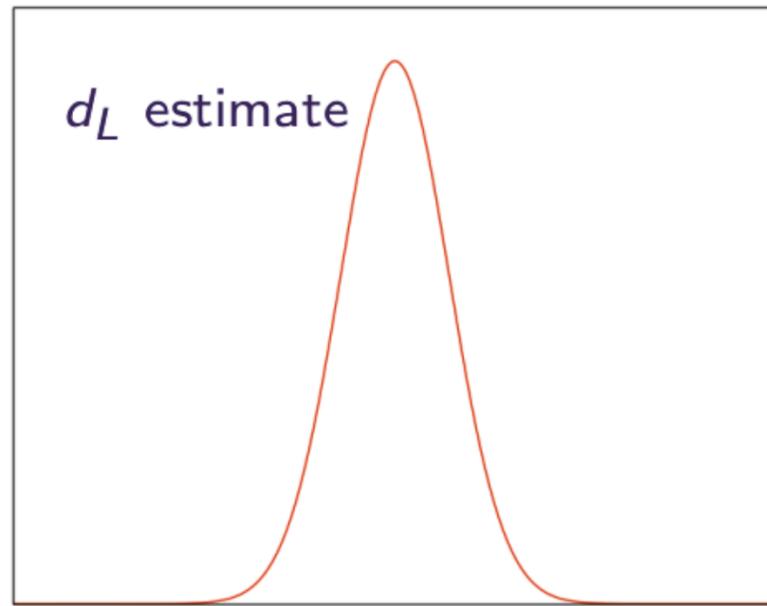


**Phase evolution**  $\Rightarrow \mathcal{M}_z$

**Amplitude**  $\propto \frac{\mathcal{M}_z}{d_L} \Rightarrow d_L$

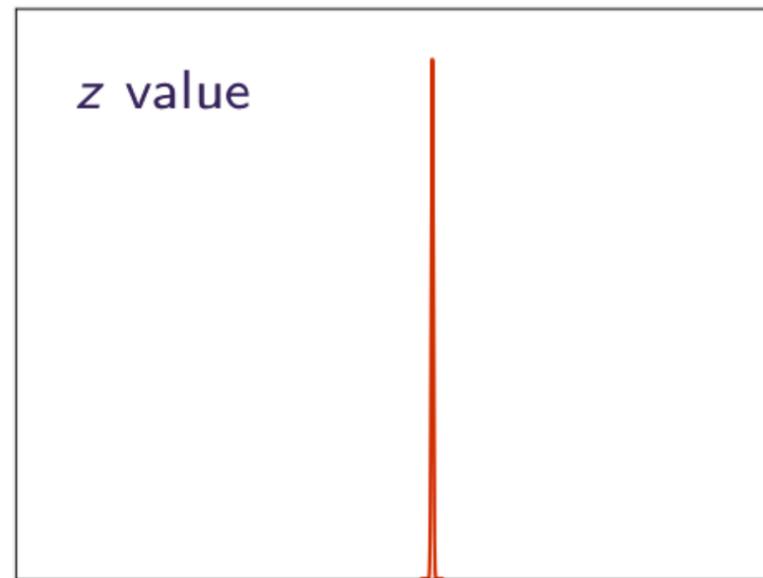
Independent of the cosmic  
distance ladder  
**Standard sirens**

# Standard siren cosmology



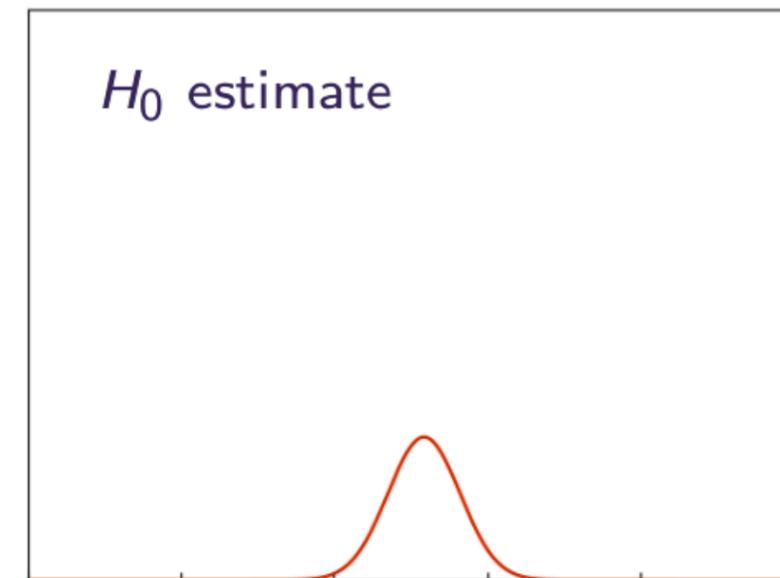
Lum. dist. from GW

+

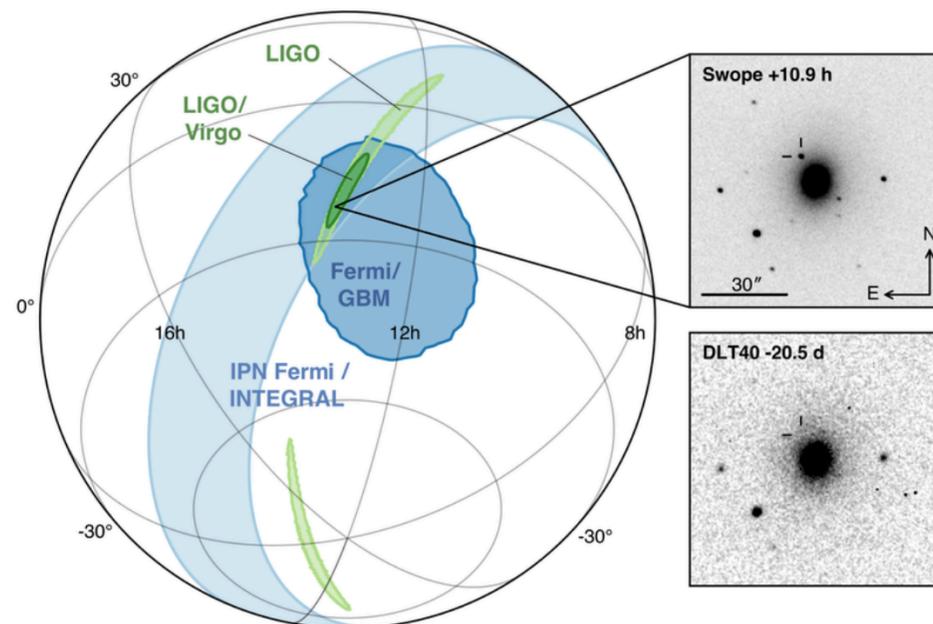


Identified host galaxy

⇒



Unimodal  $H_0$  estimate



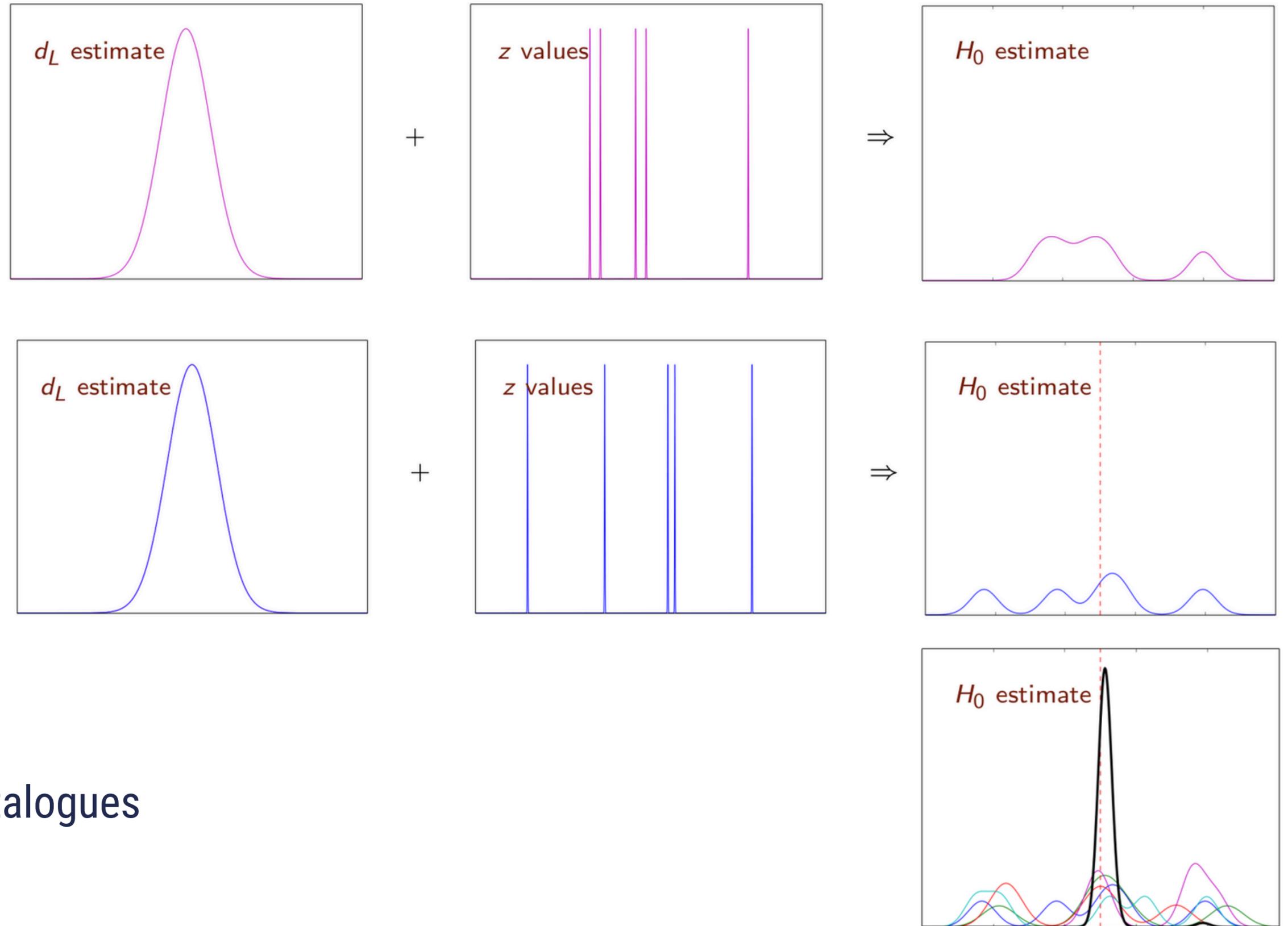
GW170817 + NGC 4993

$$70^{+12}_{-8} \frac{\text{km}}{\text{s Mpc}}$$

# Dark sirens

## No counterpart:

Use all possible hosts  
from a galaxy catalogue



## Challenges:

- Incomplete galaxy catalogues
- Photometric redshifts

# Spectral sirens

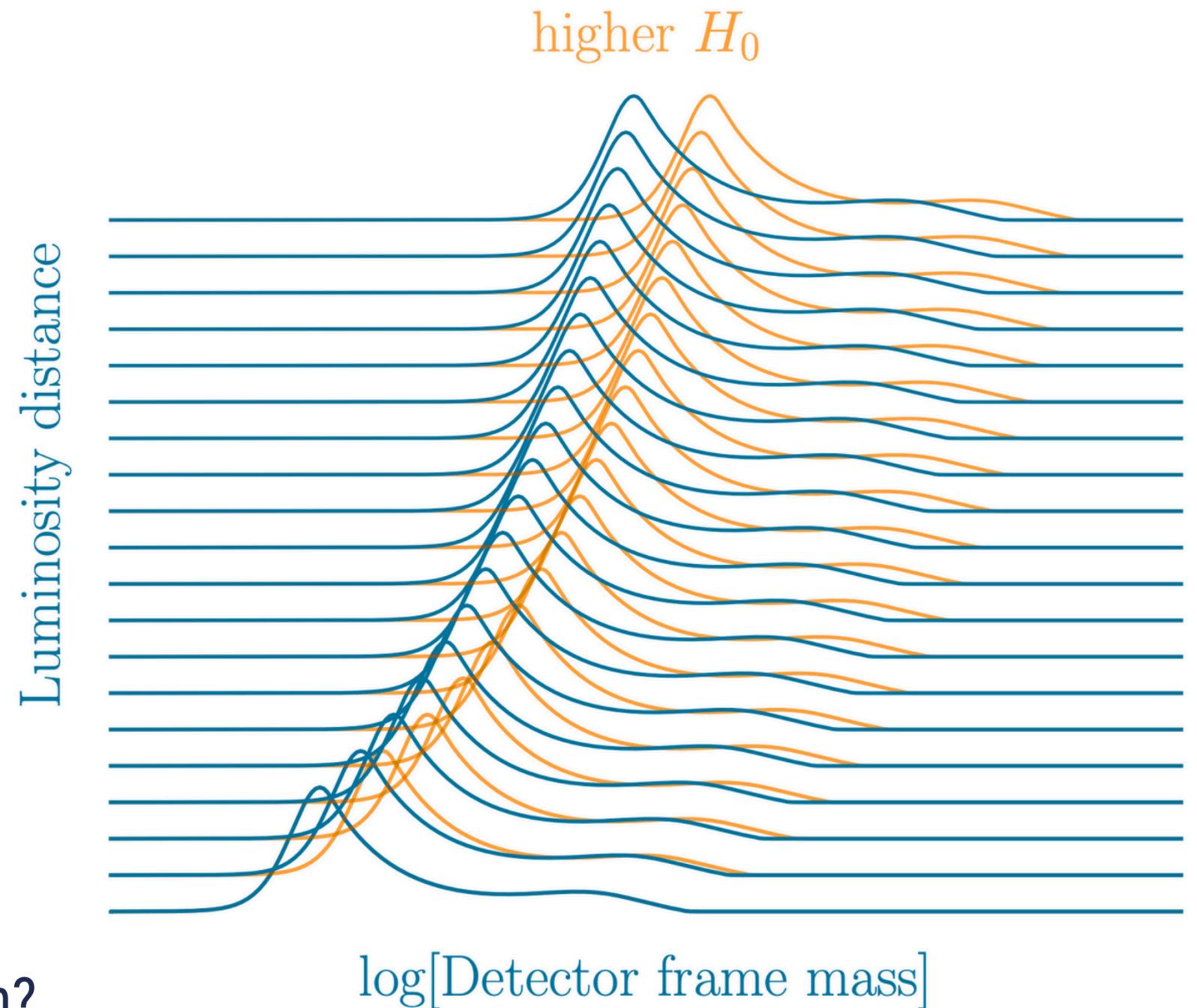
We detect the **redshifted masses**

$$m_{\text{det}} = (1 + z) m_{\text{source}}$$

A feature in the mass spectrum will be shifted differently at different luminosity distance slices

## Challenges:

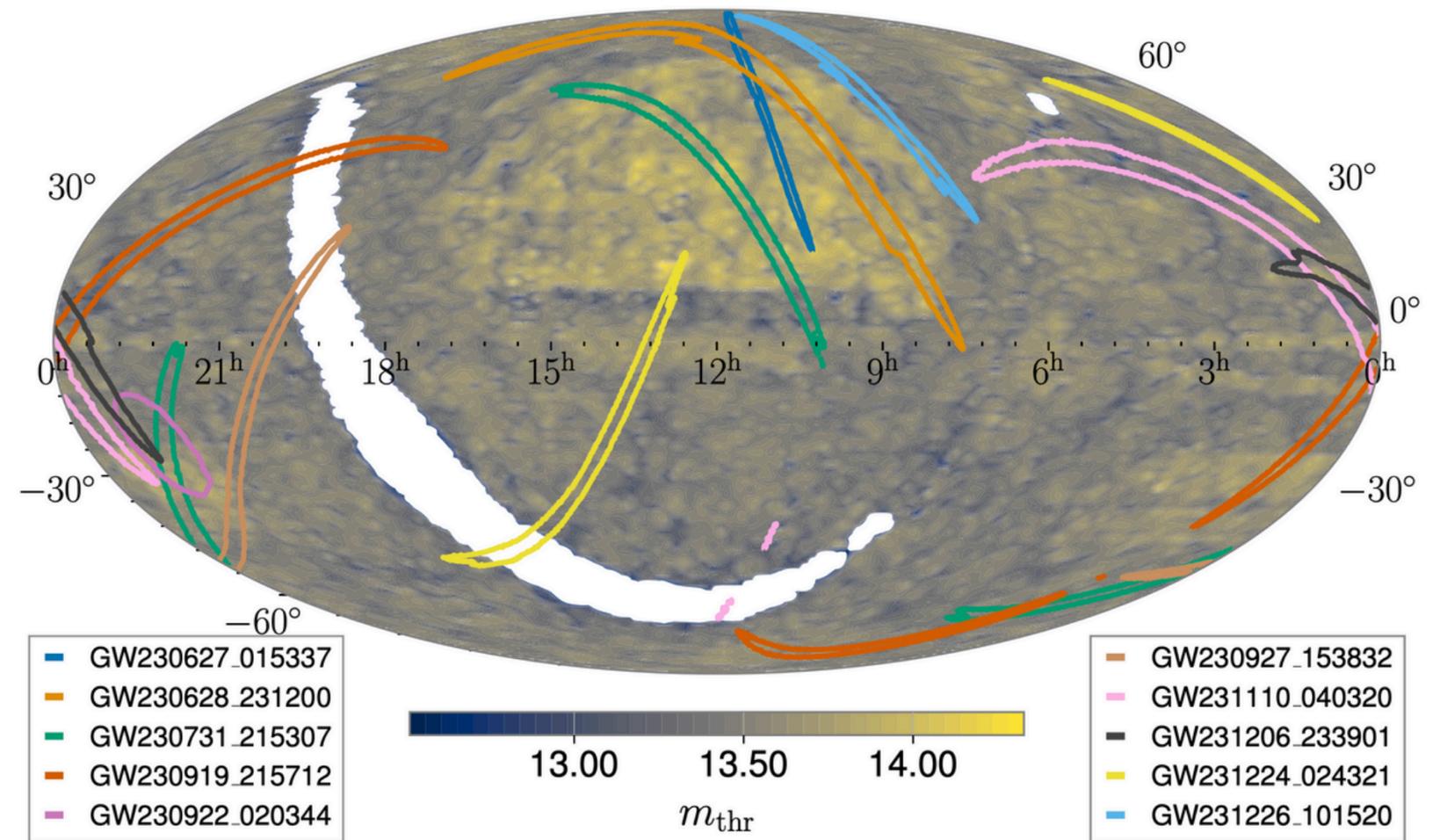
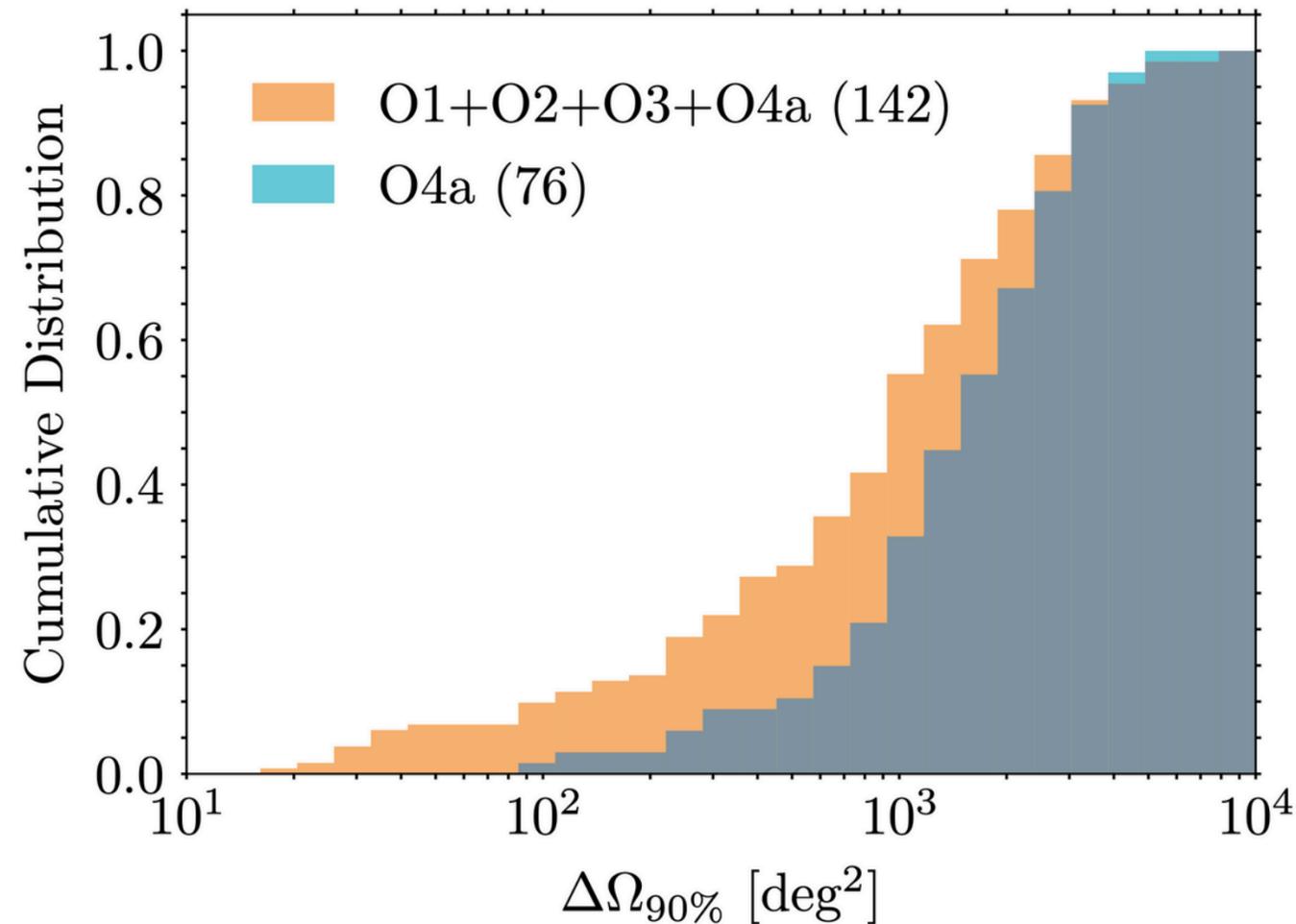
- What is the true source-frame population?
- Population evolves with redshift?



# GWTC-4.0 cosmology

Using **142 CBCs**, GW170817 + 141 dark sirens (FAR < 1 / 4 years )

**GLADE+** galaxy catalogue, K-band, with or without luminosity weighting

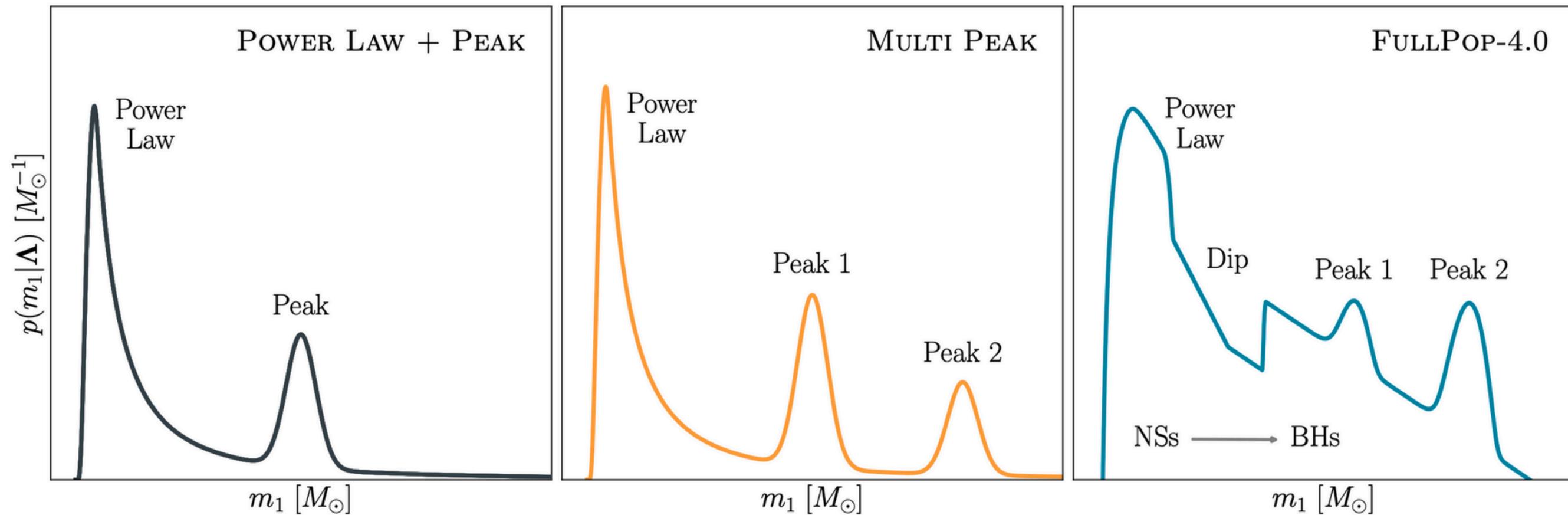


# GWTC-4.0 cosmology

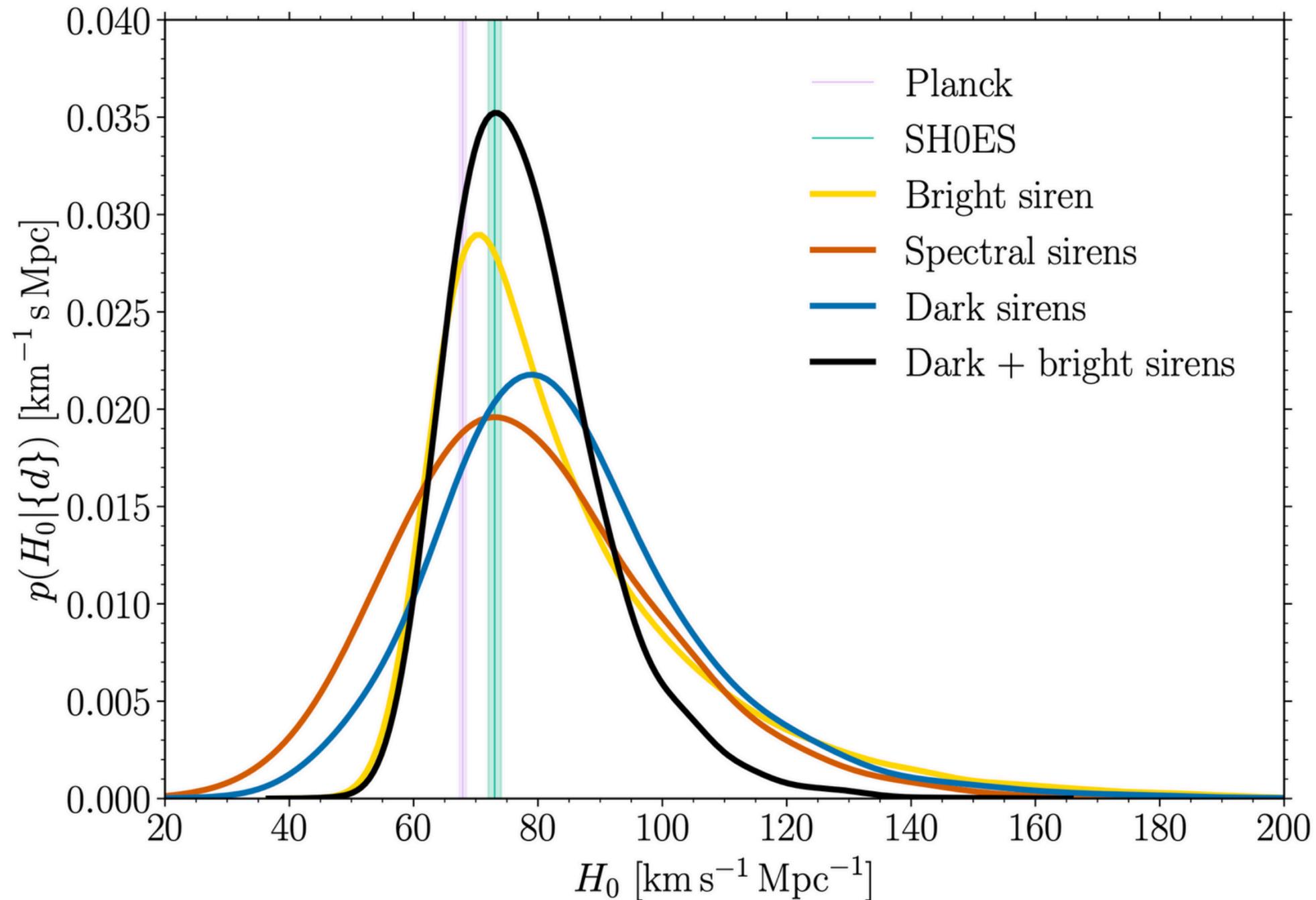
Joint estimation of  $H_0$  and population properties

Mass model covering **all types of events**

Two pipelines: *gwcsmo* and *icarogw*



# GWTC-4.0 cosmology



## GW170817:

$$H_0 = 78.4^{+25.7}_{-12.0} \text{ km s}^{-1} \text{ Mpc}^{-1}$$

## Dark sirens only:

$$H_0 = 81.6^{+21.5}_{-15.9} \text{ km s}^{-1} \text{ Mpc}^{-1}$$

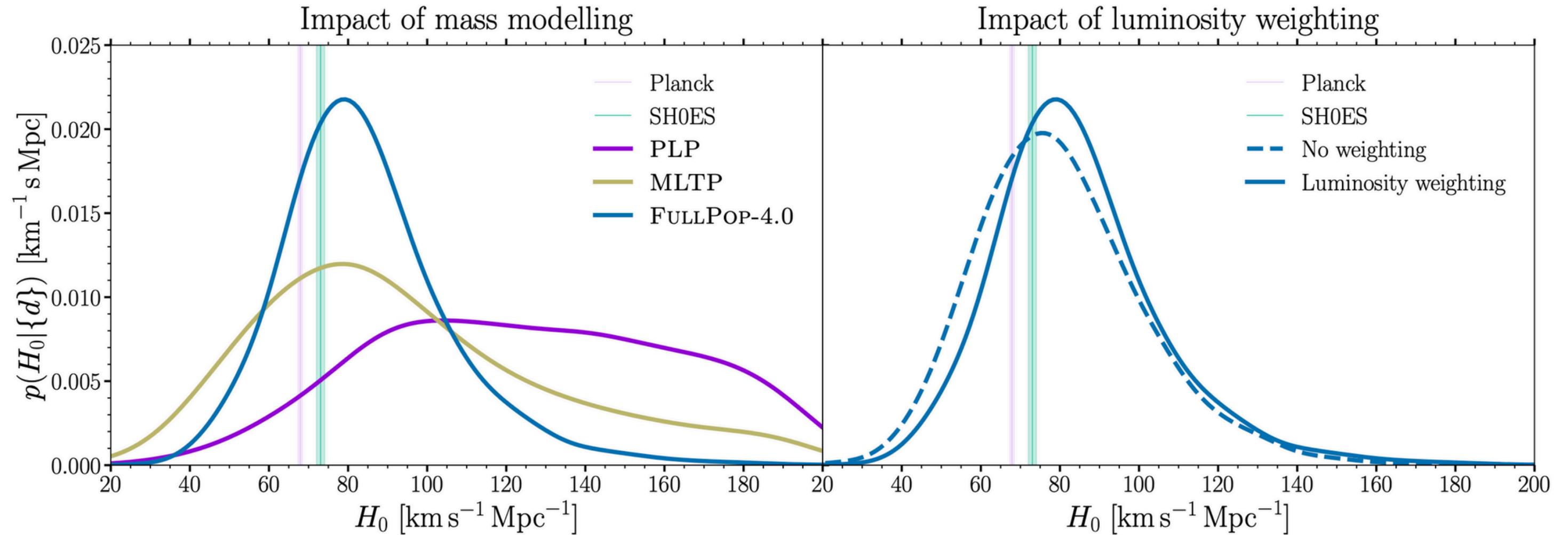
## Spectral sirens only:

$$H_0 = 76.4^{+23.0}_{-18.1} \text{ km s}^{-1} \text{ Mpc}^{-1}$$

## Combined:

$$H_0 = 76.6^{+13.0}_{-9.5} \text{ km s}^{-1} \text{ Mpc}^{-1}$$

# GWTC-4.0 cosmology



**PLP mass model** does not describe the data properly anymore

**Luminosity weighting** does not have a large effect at this point

# Conclusions

- $H_0$  estimate consistent with previous results, but with **improved methodology**
- Need for **improved galaxy catalogues** covering higher redshifts
- Virgo did not participate in O4a, stay tuned for **O4b results!**

