

H_0 measurement: what comes next?

Archisman Ghosh
Nikhef, Amsterdam

GR 22 / Amaldi 13
2019 July 09



Plan of the talk

- Highlights from previous talks
- A few items not explicitly covered in previous talks
- FAQ: projections?
- Caveats for upcoming H_0 measurements . . .

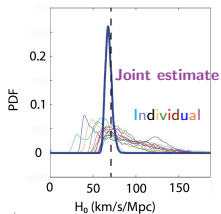
H_0 -counterpart: expectations

Abbott et al. Nature 551 #7678, 85-88 (2017)

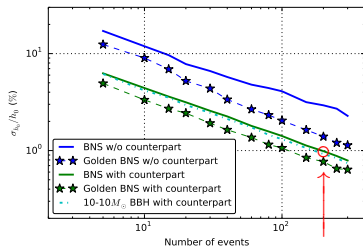
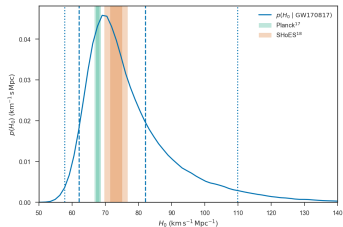
From 14% to $\sim 1\%$...

Nissanke et al. (2010)

Nissanke et al. (2013)



Precision: $\sigma_{H_0}/H_0 \sim 1/\sqrt{N}$



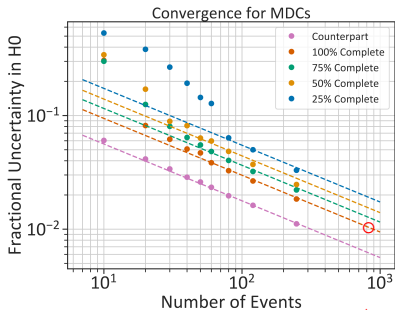
Chen et al.: arXiv 2017

H_0 -statistical: simulations

A few key features from the “statistical” **MDC**:

- Performed at BNS distances
- With galaxy catalogs about 10 times sparse
- $\mathcal{O}(10 - 100)$ galaxies per event

H_0 -statistical: results on simulations

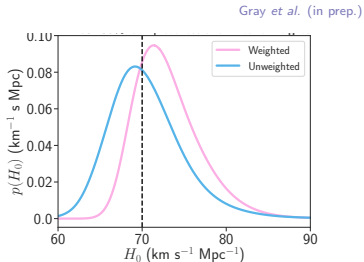


Gray *et al.* (in prep.)

Cosmology Working Group: Ajith, Brady, Chen, Dattier, Del Pozzo, **Fishbach**, Gair, Ghosh, **Gray**, Hendry, Holz, **Magaña-Hernandez**, Messenger, **Qi**, Samajdar, **Sur**, Van Den Broeck, Veitch, . . .

H_0 -statistical: results on simulations

Luminosity weighting of galaxies:



B-band: star formation rate

K-band: total mass

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H_0 -statistical: results on simulations

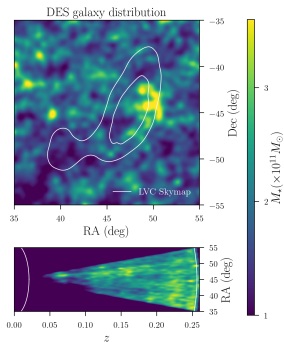
Galaxy clustering:

With clustering, improvement by a factor of ~ 2.5 .

Chen *et al.* (2018)

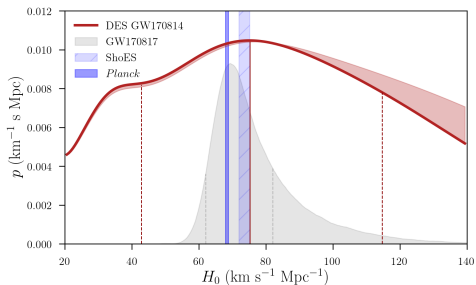
H_0 -statistical with GW170814

- **DES Y3 “gold” catalogue:** thoroughly surveyed GW170814 sky region.



$\mathcal{O}(77,000)$ galaxies in 90% region

Soares-Santos *et al.* (2019)



- **First realistic application**

Immediate caveat: population properties in selection function

From previous talk,

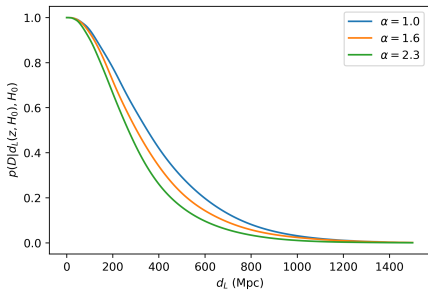
$$p(x_{\text{GW}}|D_{\text{GW}}, H_0) = \frac{p(x_{\text{GW}}|G, H_0)}{p(D_{\text{GW}}|G, H_0)} p(G|D_{\text{GW}}, H_0) + \frac{p(x_{\text{GW}}|\bar{G}, H_0)}{p(D_{\text{GW}}|\bar{G}, H_0)} p(\bar{G}|D_{\text{GW}}, H_0)$$

Denominator: detection efficiency or selection function

depends of the population of compact binaries

Exponent of power-law mass distribution $M^{-\alpha}$

Fig: Rachel Gray & LVC Cosmology Group



Towards a precise and accurate GW measurement of H_0

Thorough understanding of systematic effects is crucial

- Peculiar velocity flows (EM)
- Uncertainties in galaxy catalogues (EM)
 - Photometric measurements of redshifts
 - Estimates of luminosities for weighting
- Selection effects (GW and EM)
- GW calibration uncertainties (GW)

ampl. < 4%

systematic?