

Computing needs for parameter estimation

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*(with **lots** of help from Harsh Narola, Peter Pang, and Thibbeau Wouters)*

Computing needs: CBC sources in simulated noise in ET

Bayesian inference -> likelihood computation $\sim 10^6 - 10^8$ times for single analysis.

Single likelihood -> evaluate single waveform.

BNS waveform ~ 90 mins long, $f_{\text{low}} \sim 5$ Hz -> 10^7 CPU hours. [Smith et al., Phys.Rev.Lett. 127 \(2021\) 8, 081102](#)

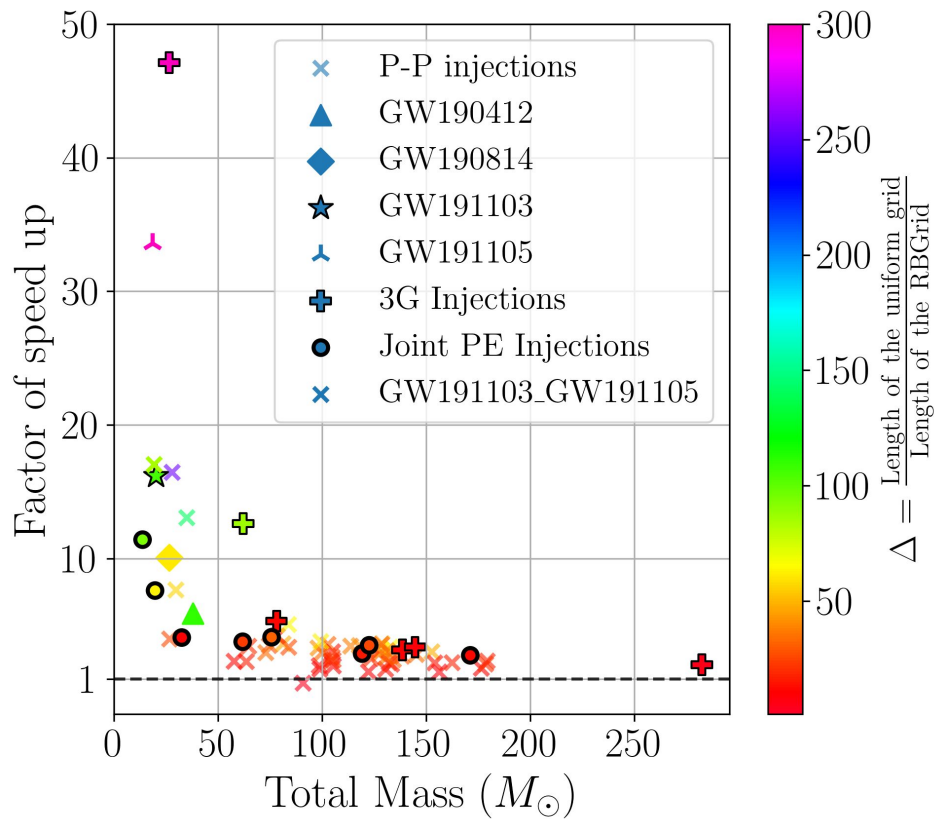
	# of detections	SNR_{net}	# with $\text{SNR}_{\text{net}} > 250$	# with $\text{SNR}_{\text{net}} > 100$	# with $\text{SNR}_{\text{net}} > 50$	# with $\text{SNR}_{\text{net}} > 20$
BBH						
Low rate	53756	$81.1^{+94.2}_{-57.3}$	3069 (5%)	20605 (35%)	40063 (68%)	52239 (89%)
Median rate	85725	$81.3^{+93.9}_{-57.5}$	4972 (5%)	33148 (39%)	63958 (75%)	83333 (97%)
High rate	137225	$81.5^{+94.2}_{-57.4}$	7860 (6%)	53419 (39%)	102766 (75%)	133460 (97%)
BNS						
Low rate	98898	$19.2^{+22.1}_{-4.9}$	17 (0.017%)	298 (0.30%)	2712 (2.7%)	44350 (48%)
Median rate	396793	$19.1^{+22.0}_{-4.8}$	73 (0.018%)	1257 (0.32%)	10659 (2.7%)	177296 (45%)
High rate	1004525	$19.1^{+22.1}_{-4.8}$	196 (0.020%)	3255 (0.32%)	27135 (2.7%)	448610 (45%)

ET+2CEs, in 1 year of simulated data. [Samajdar et al., Phys.Rev.D 104 \(2021\) 4, 044003](#)

Starting frequency: 5Hz

	BNS (PhenomD_NRTidalv2)	BBH (GW150914 like and XPHM)
Run Time x 16 CPUs	~13 hours	~8 days
Network SNR	~53	~260

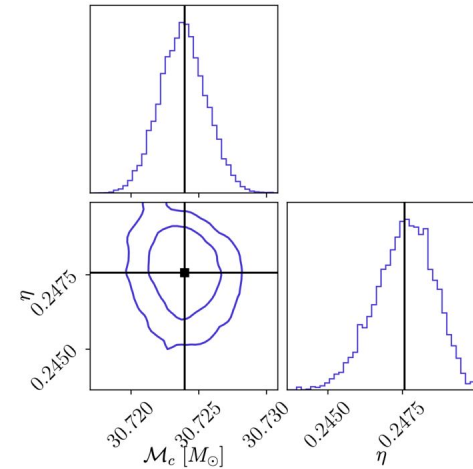
Paper and codebase: [Narola \(2023\)](#), [Relativebilbying](#)



MCMC with jim

Starting frequency: 5Hz

	BNS GW170817-like PhenomD	BBH GW150914-like PhenomD
Run Time x 1 Nvidia A100 GPU 40 GB	~50mins	~35mins
Network SNR	~50	~260



Summary

- Dealing with likelihood-based methods.
- Likelihood-free methods also out there, in general machine-learning based.
- Possible to construct waveforms in a way to use most of resources.