



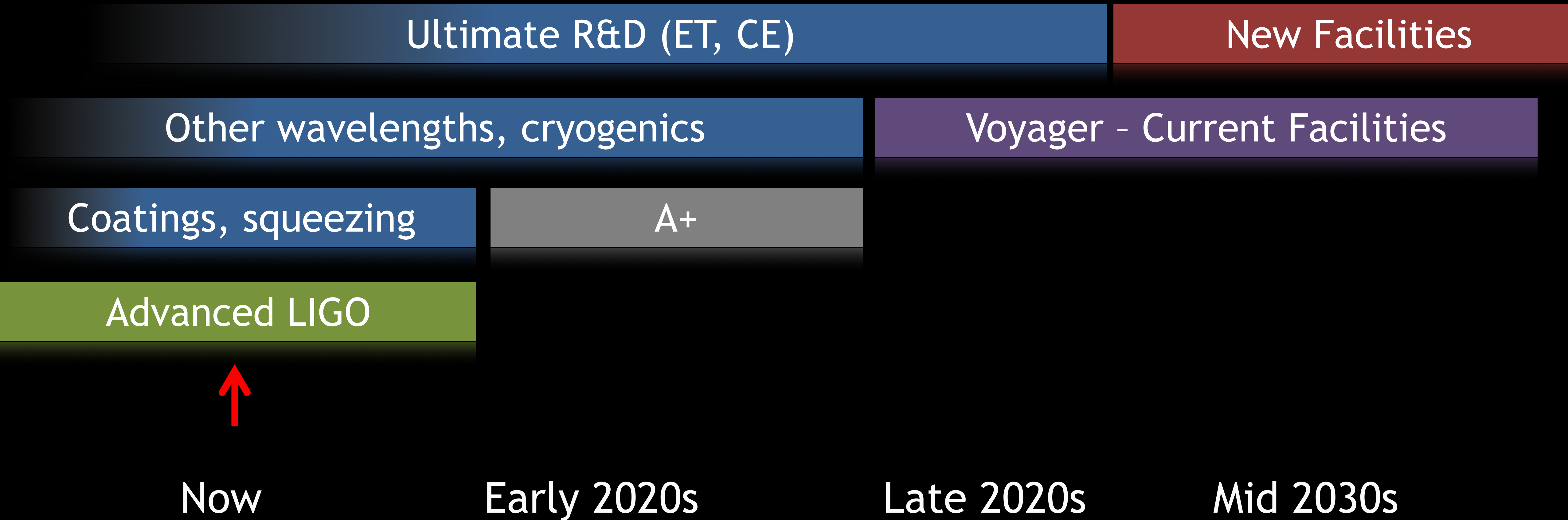
LIGO-Virgo: Status and 5-year plan

Laura Cadonati, Georgia Tech

“Colliding Neutron Stars”
NSF/LIGO/Sonoma State
University/A. Simonnet

LIGO Concept Roadmap

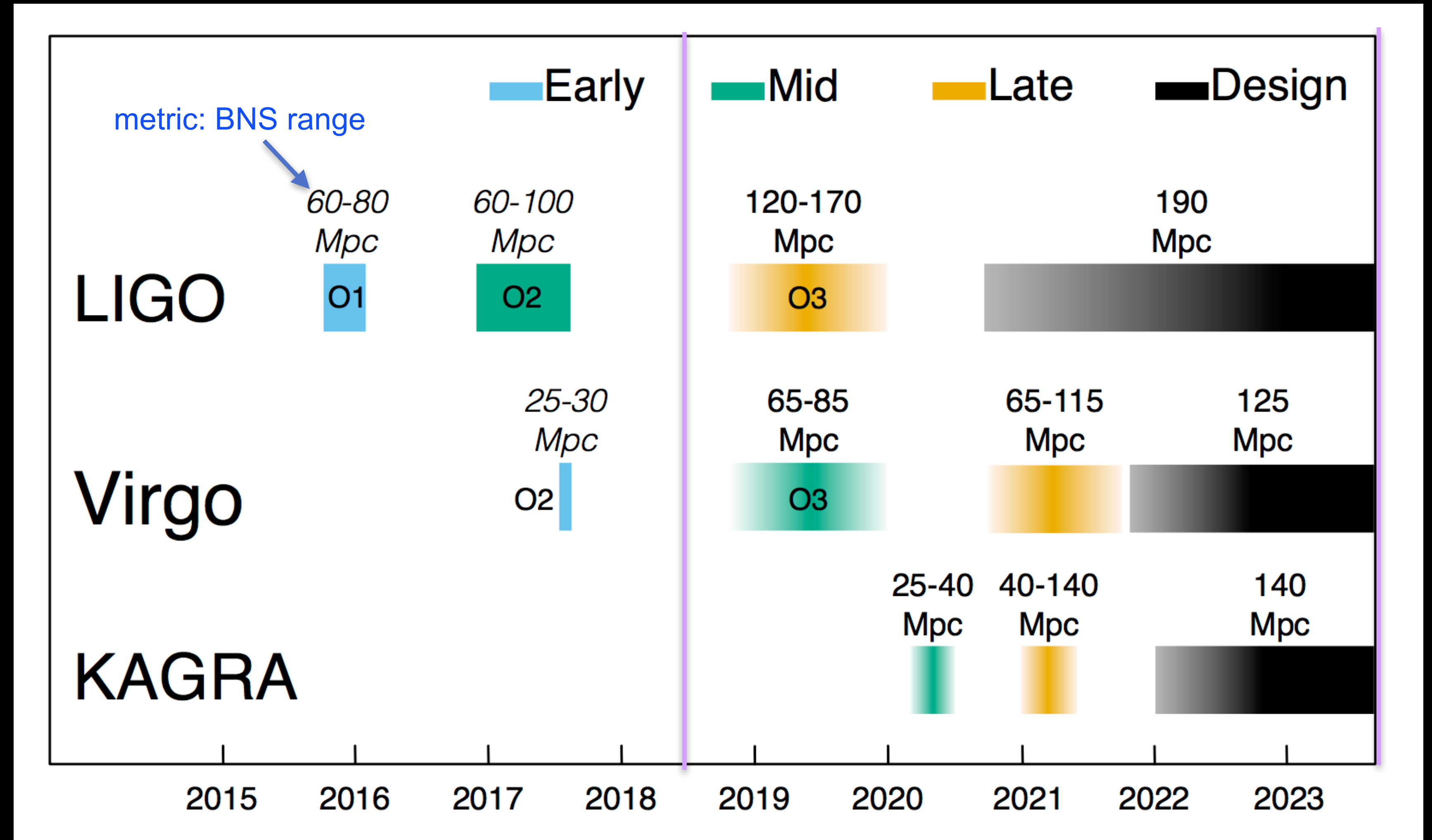
from Evans, session D04



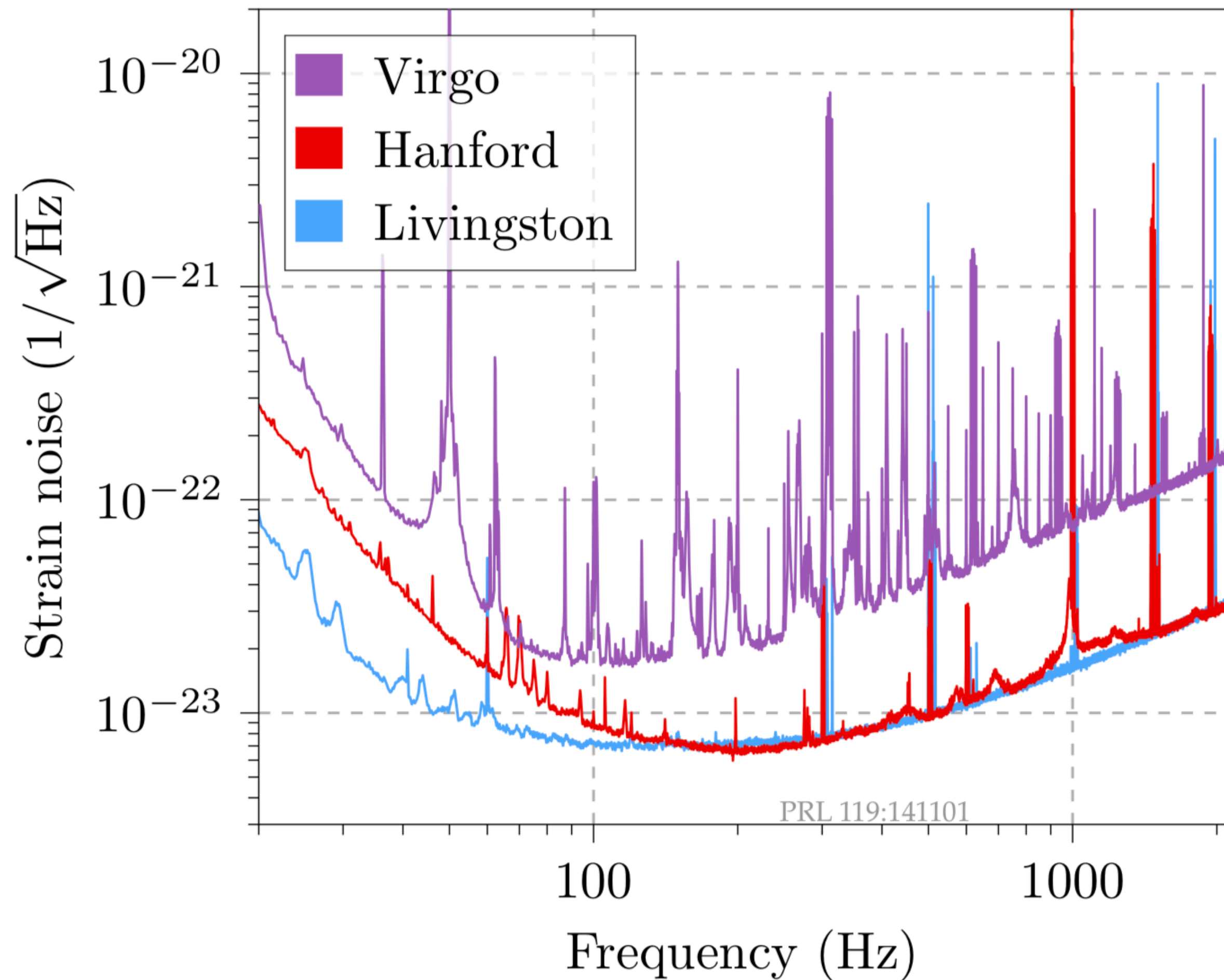
Observing Scenarios

*Prospects for
Observing and
Localizing
Gravitational-Wave
Transients with
Advanced LIGO and
Advanced Virgo and
KAGRA*

[https://dcc.ligo.org/
LIGO-P1200087](https://dcc.ligo.org/LIGO-P1200087)



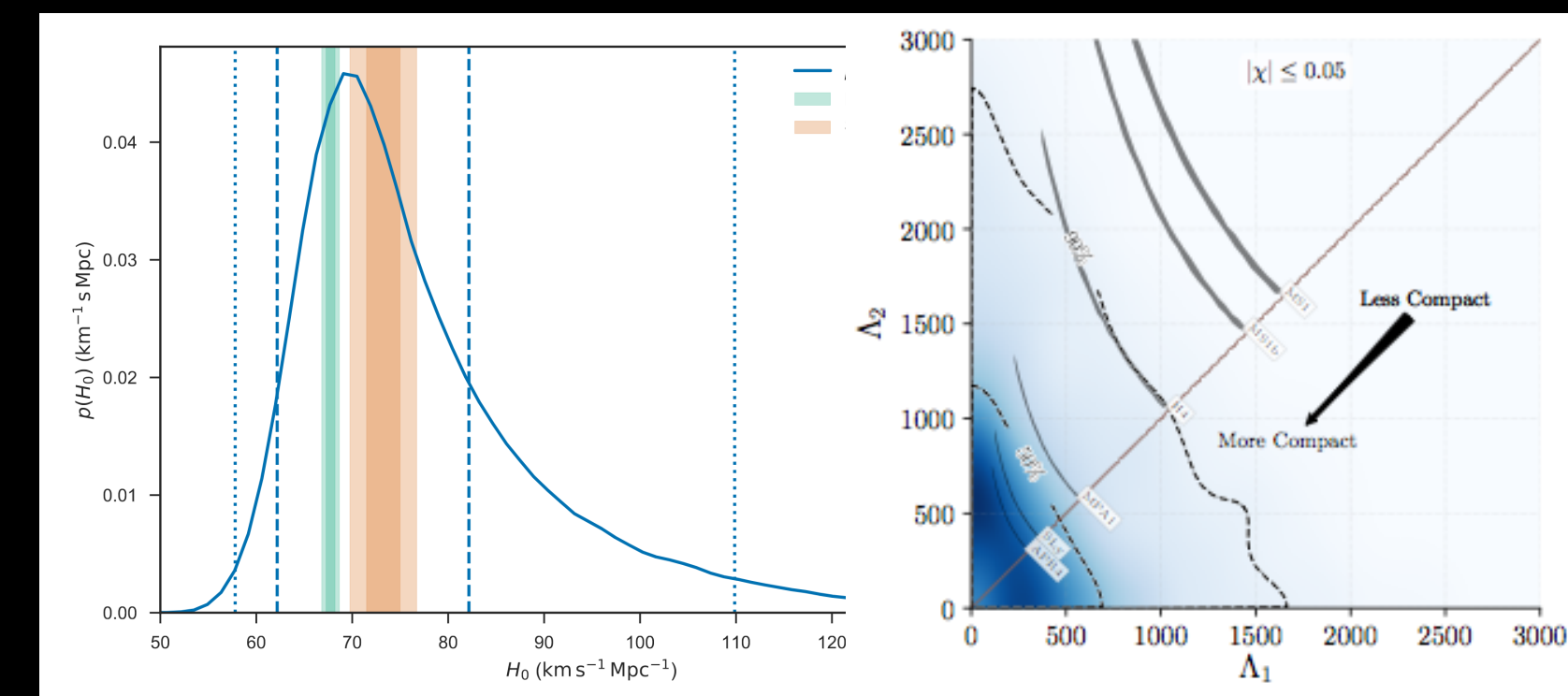
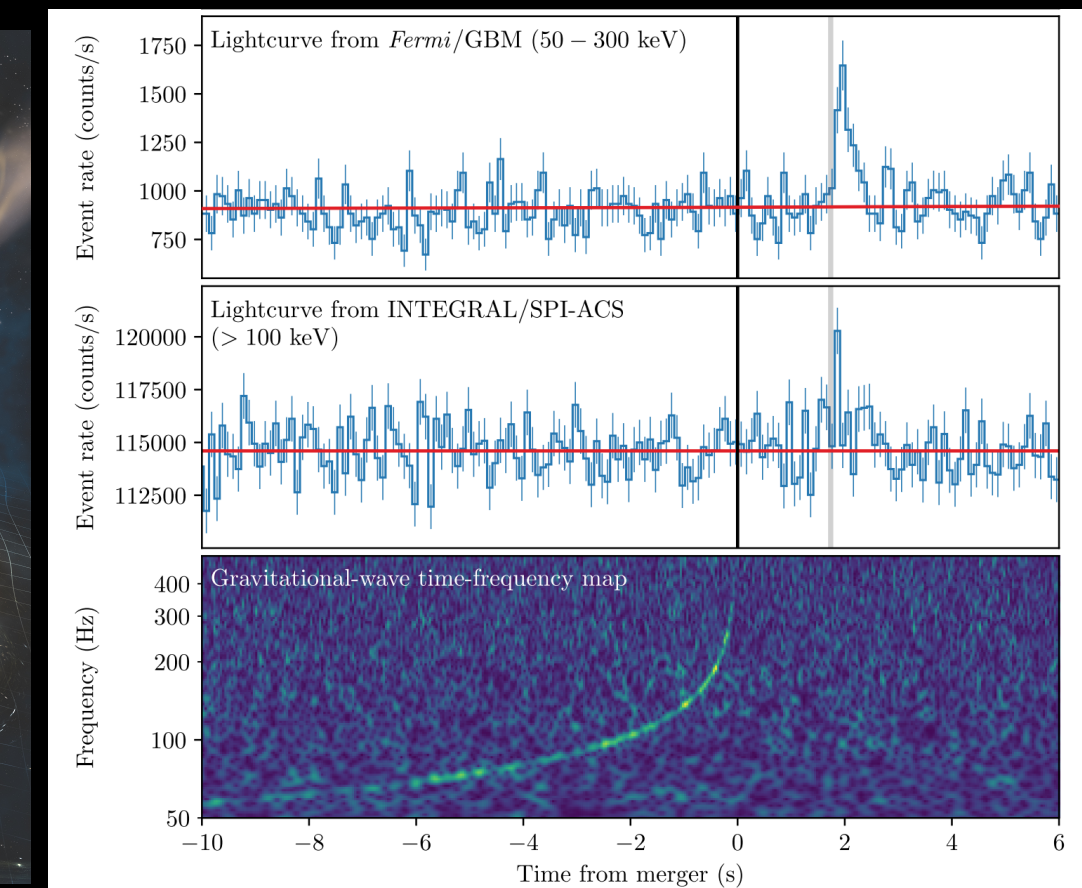
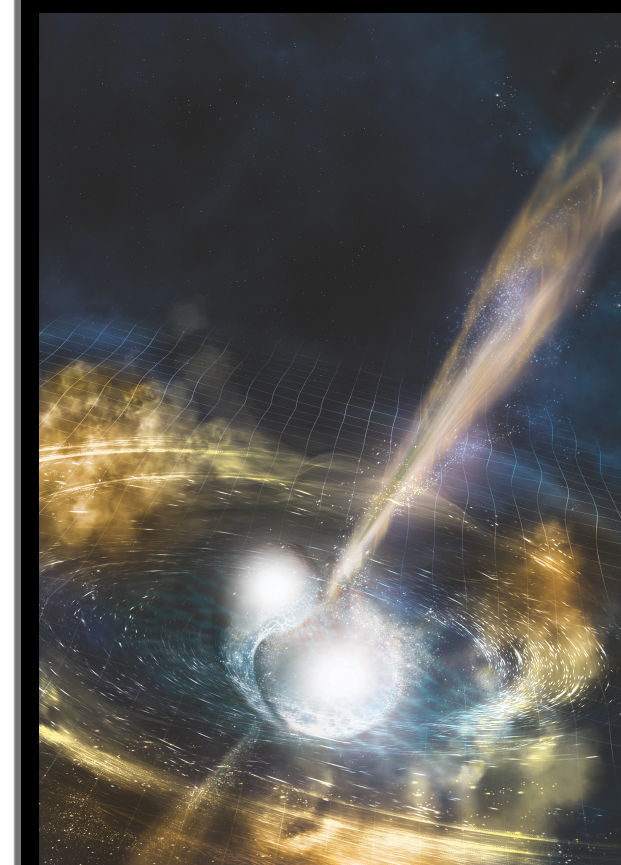
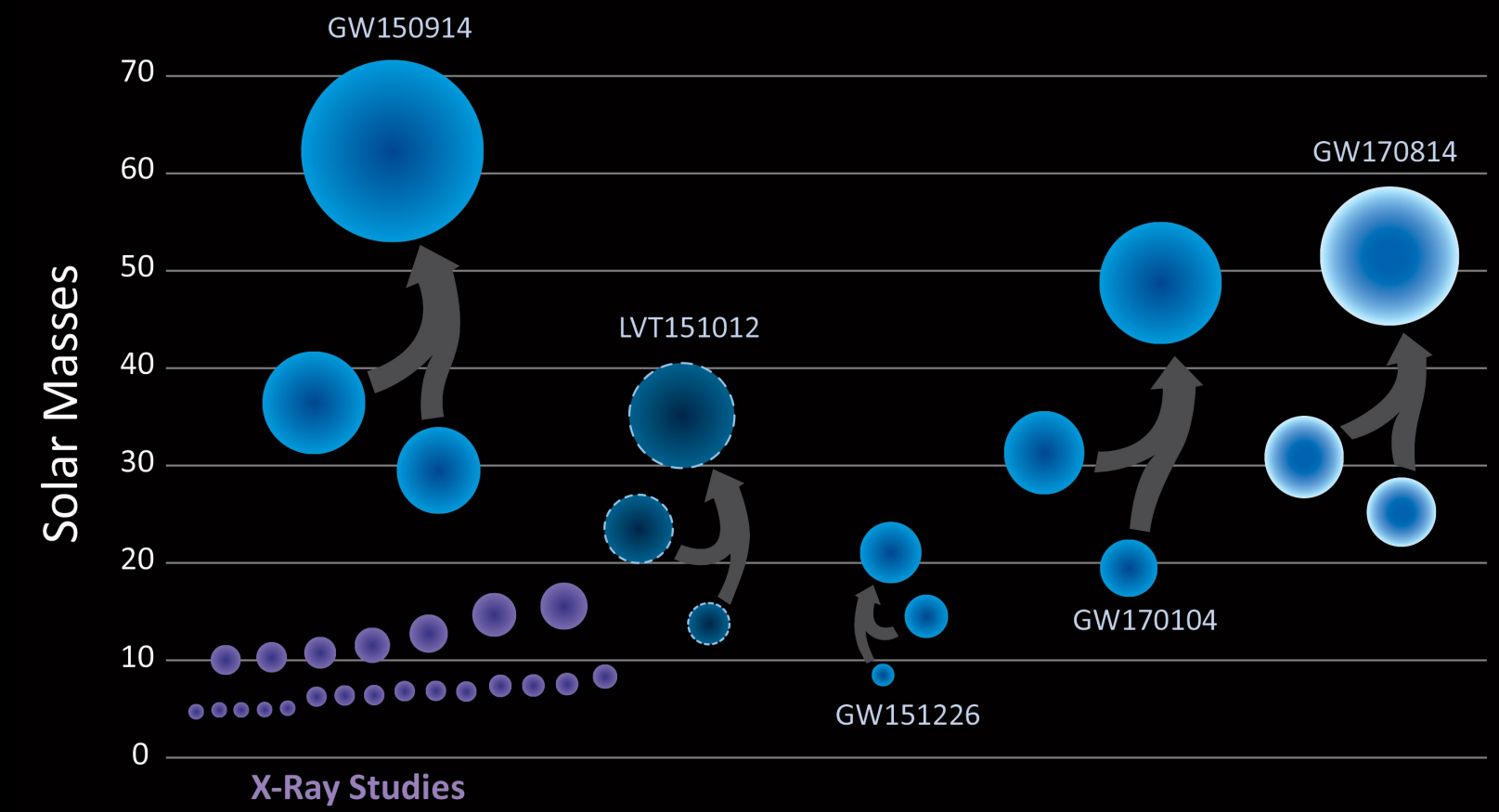
During the time of GW170814



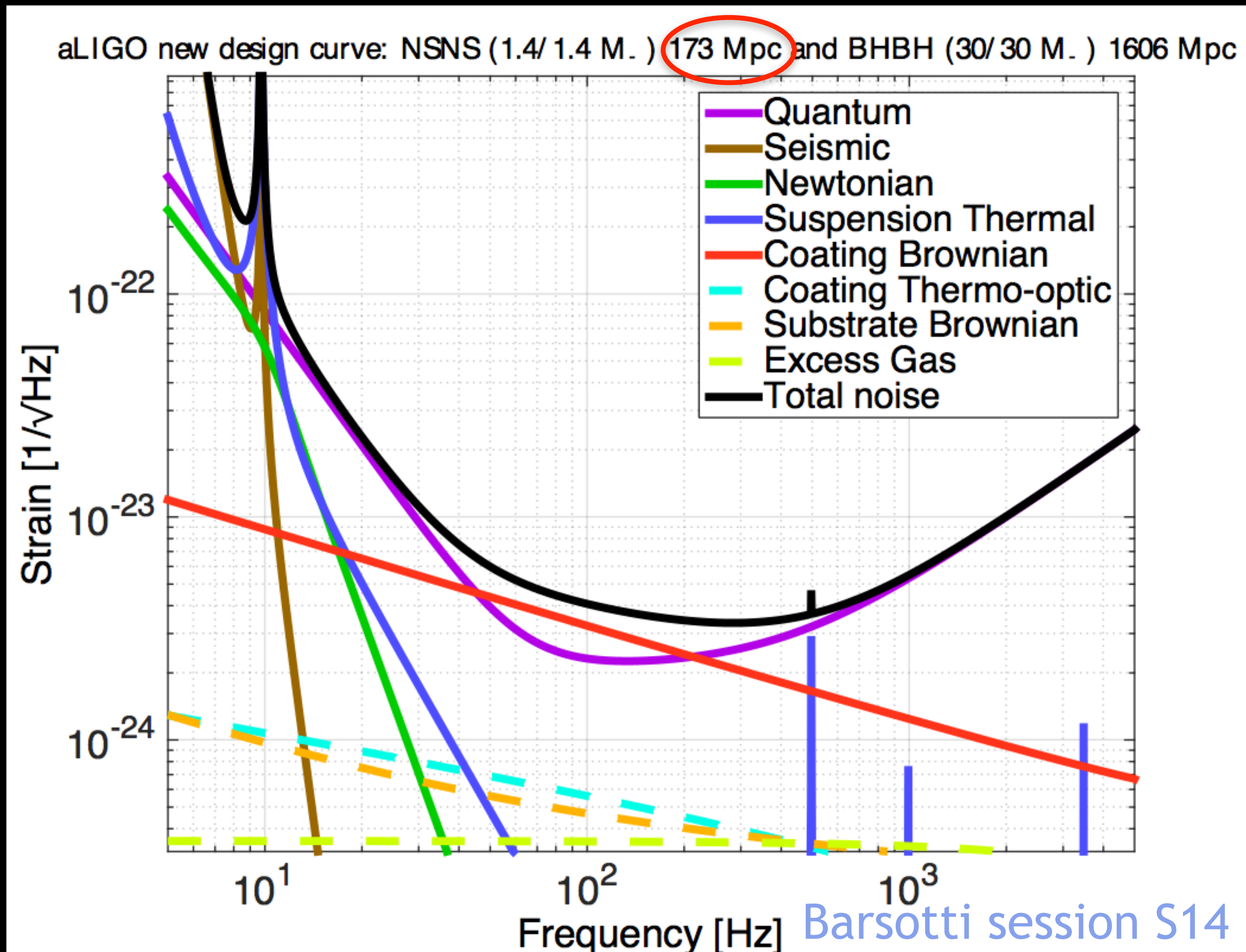
Virgo:
Only online
for ~2 weeks at this
time

Hanford:
Unknown excess
low frequency noise

Livingston:
100 Mpc BNS range



aLIGO target sensitivity ~2019

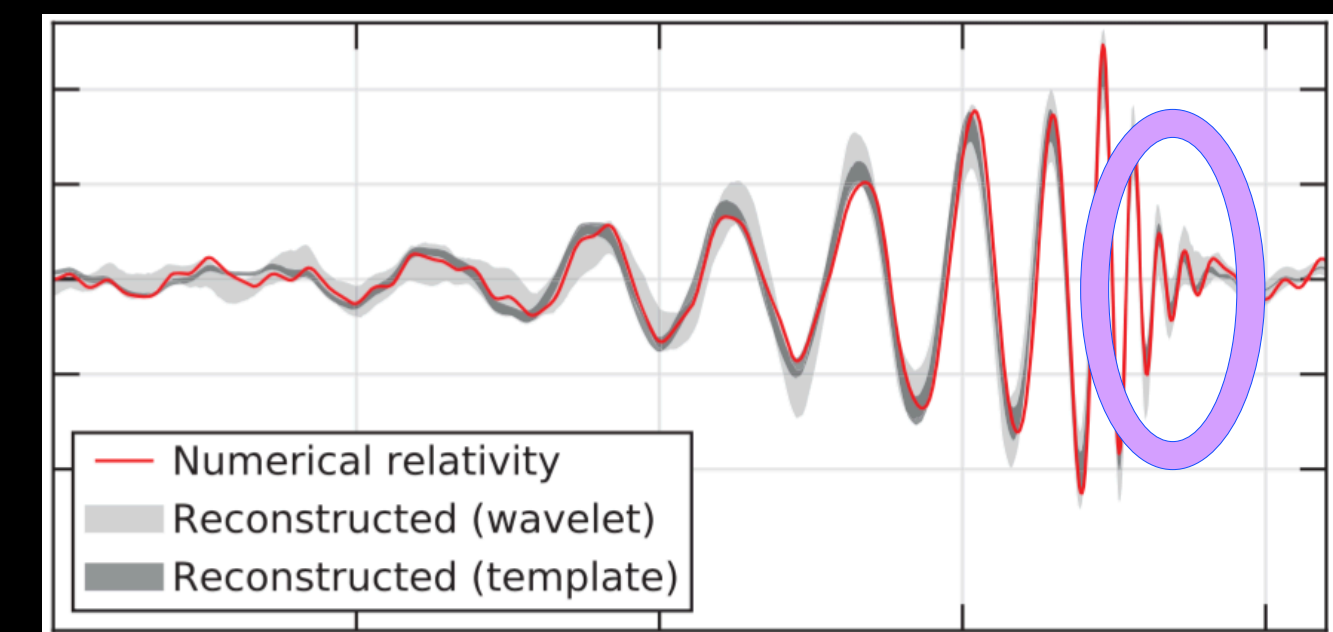


after additional commissioning

BNS reach: $\sim 2\times \text{O2}$

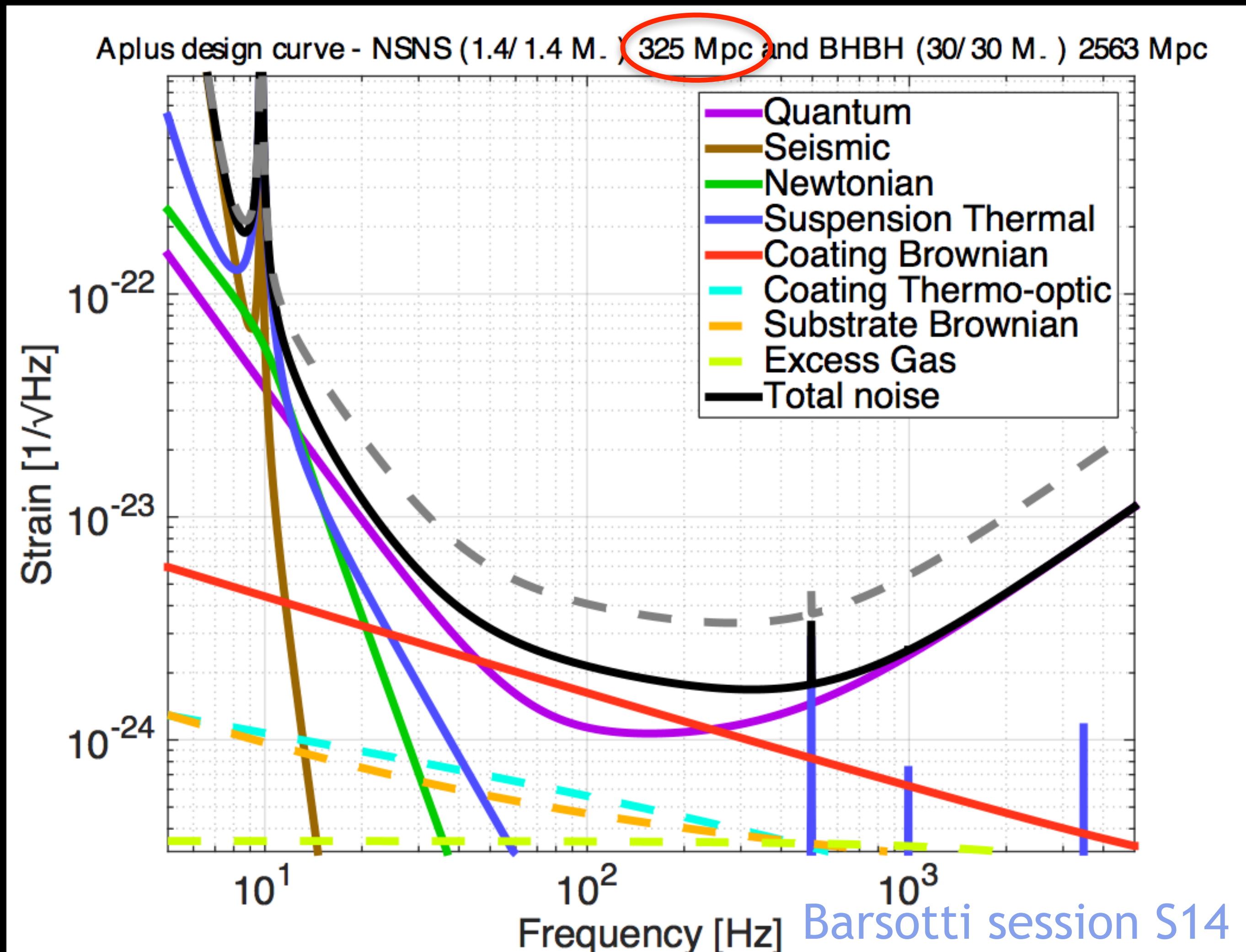
BBH reach: $\sim 4\times \text{O2}$

QNM SNR ~ 20
(for an event like GW150914)



Advanced LIGO Plus (A+)

Could be operating 2024

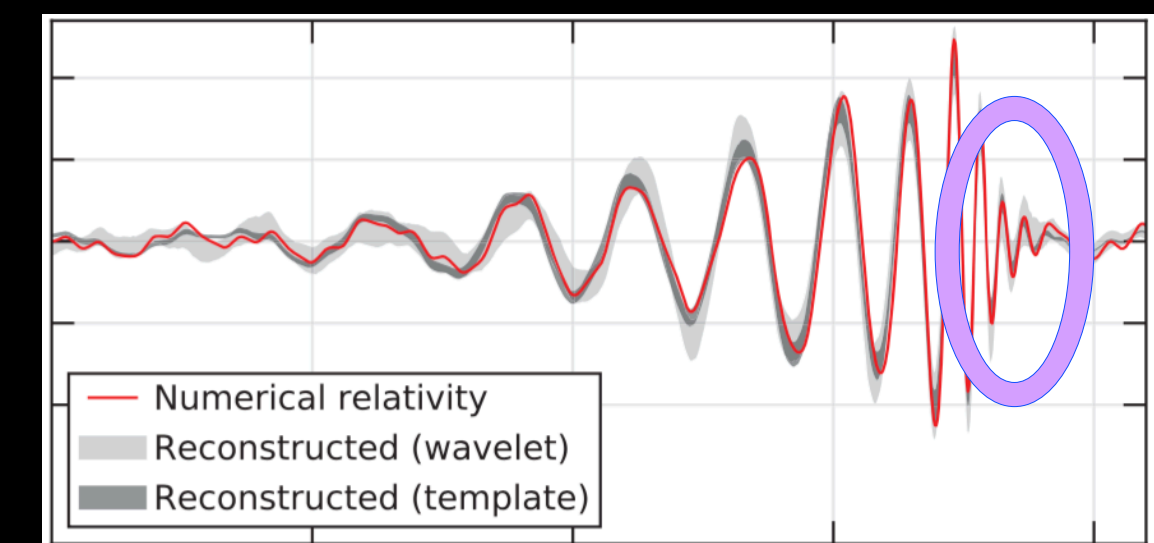


aLIGO with
frequency-dependent squeezing &
lower optical coating thermal noise

BNS reach: $\sim 6\times$ O2

BBH reach: $\sim 10\times$ O2

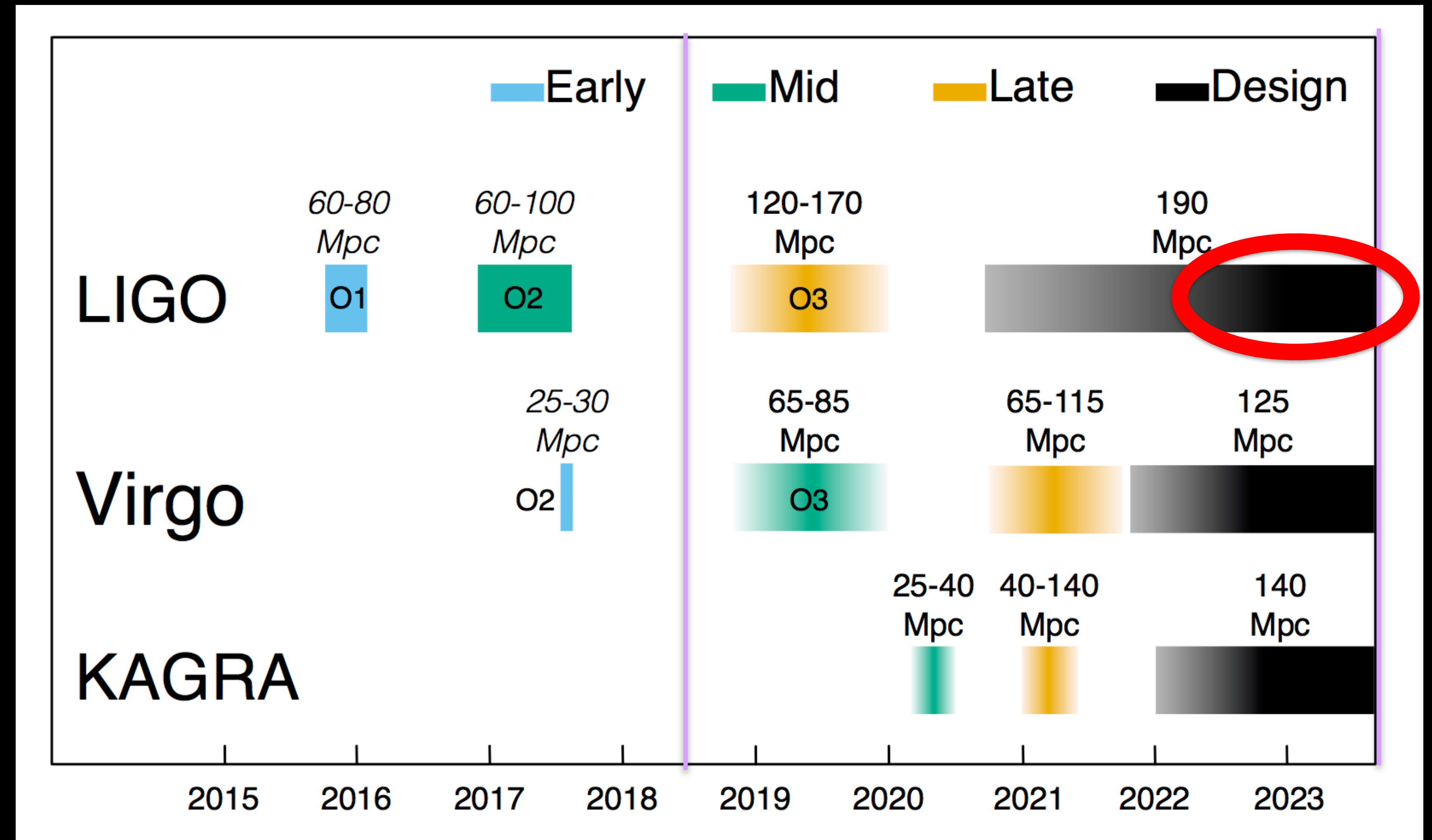
QNM SNR ~ 35
(for an event like GW150914)



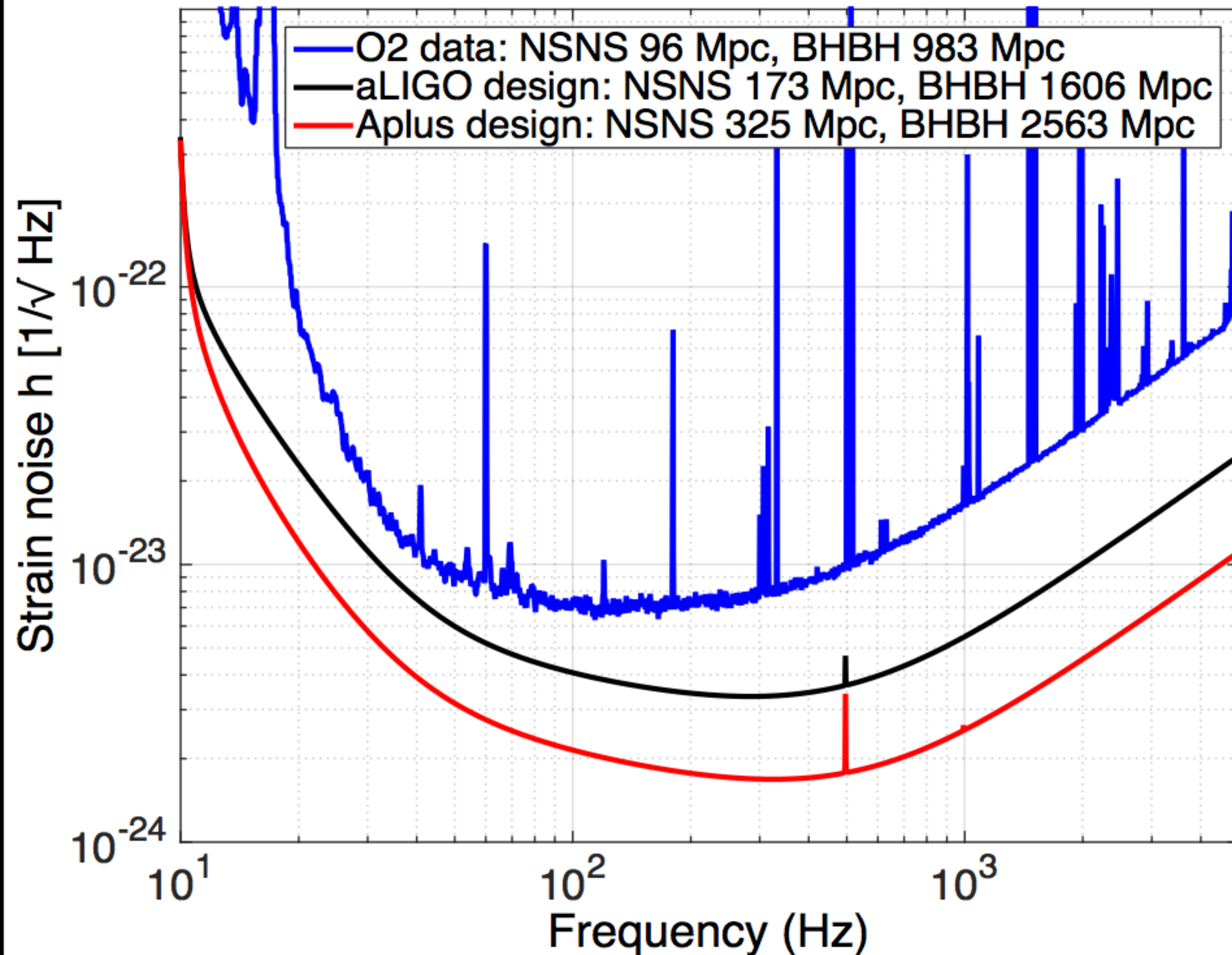
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[https://dcc.ligo.org/
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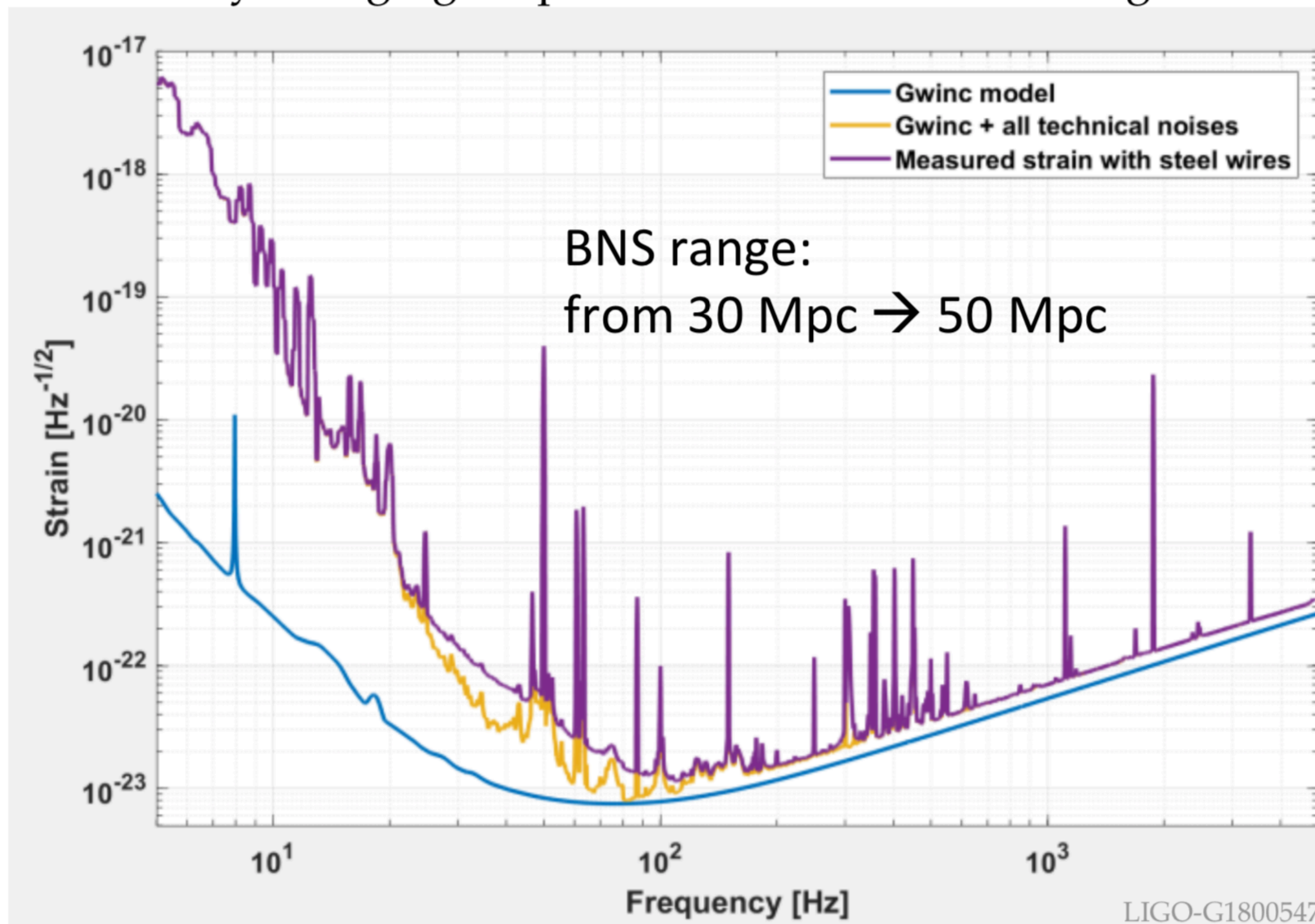


Comoving Ranges: NSNS 1.4/ 1.4 M. and BHBH 30/ 30 M.



Virgo

Effect of only changing suspensions from metal wire to glass fibers

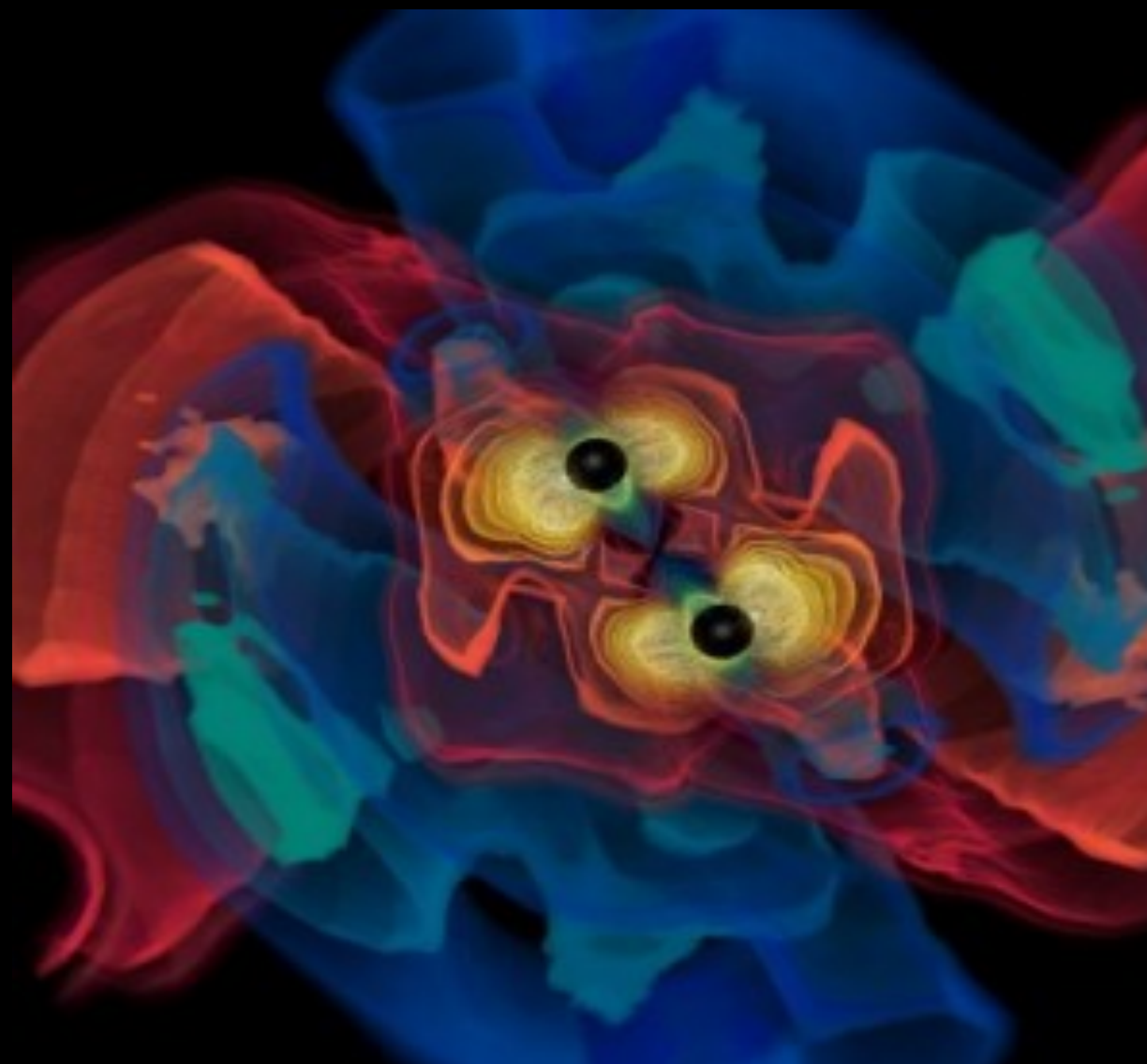


LIGO-G1800547

Virgo
O3 expected

Science Targets

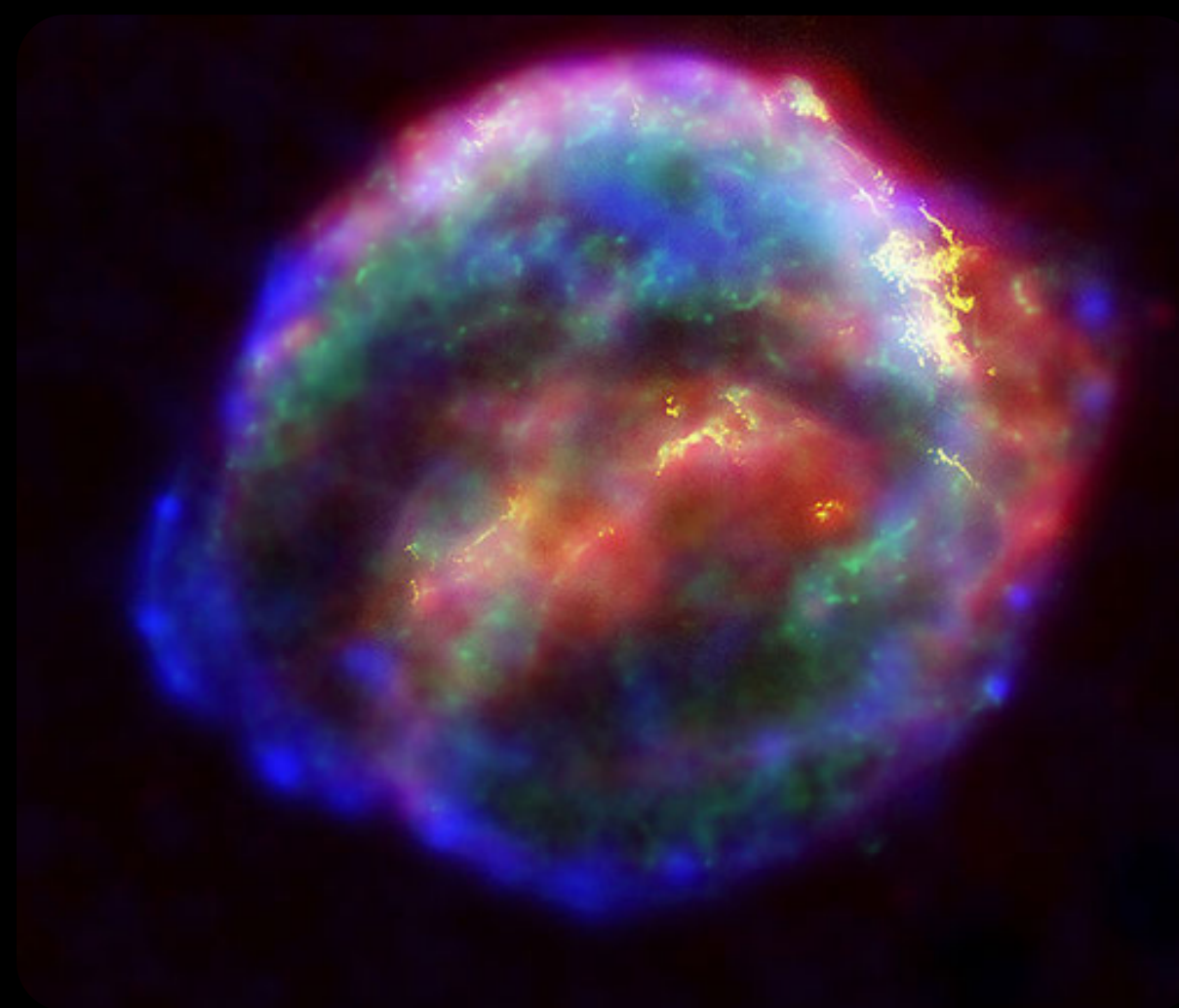
- Compact Binary Coalescences: populations, mass, spin, rates
- neutron star EoS - connection with nuclear physics
- standard sirens, cosmology
- Tests of GR
- Ringdowns



Credit: AEI, CCT, LSU

Coalescing Binary Systems

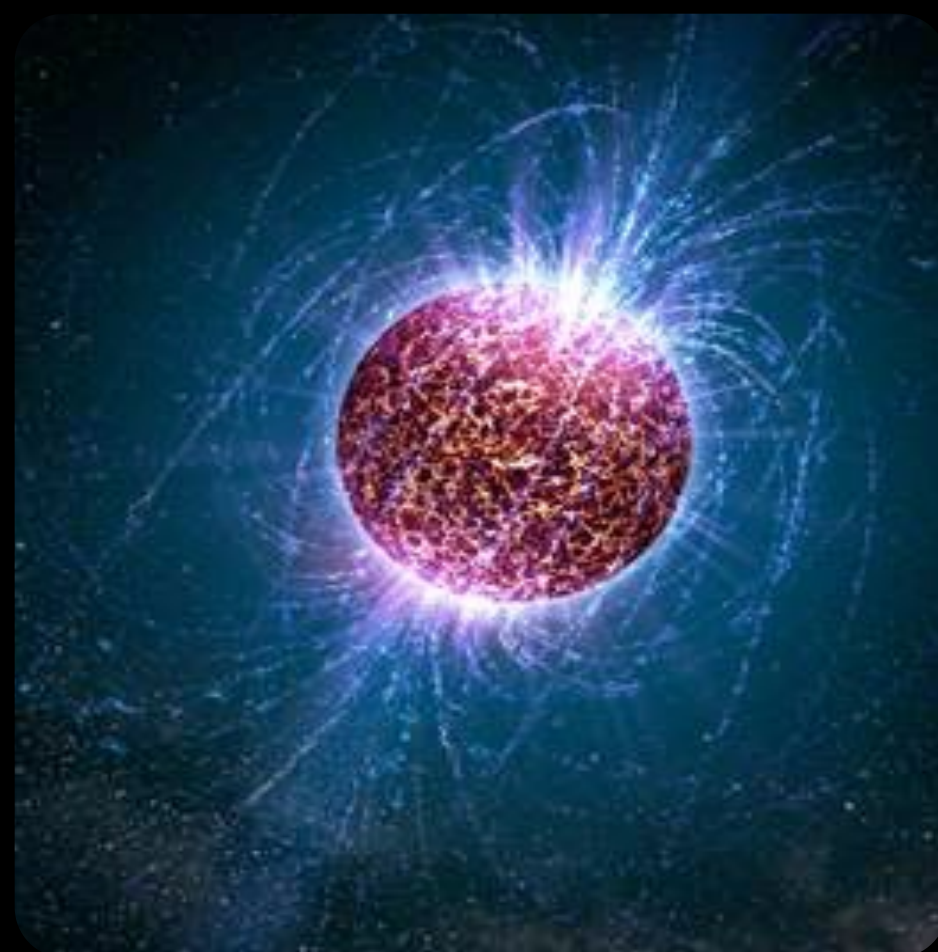
Neutron Stars,
Black Holes



Credit: Chandra X-ray Observatory

'Bursts'

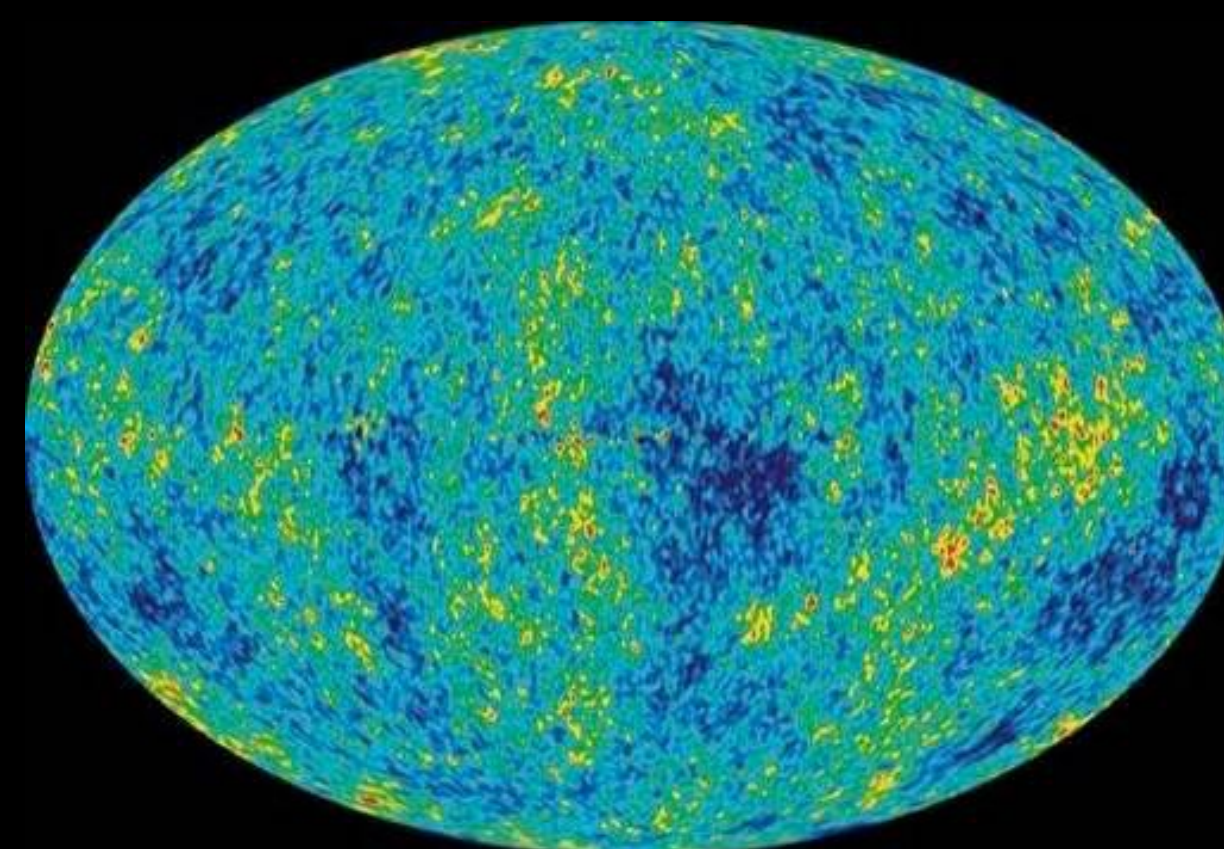
asymmetric core collapse
supernovae
cosmic strings
???



Casey Reed, Penn State

Continuous Sources

Spinning neutron stars
crustal deformations, accretion



NASA/WMAP Science Team

Cosmic GW background

stochastic, incoherent
background

LSC-Virgo Astrophysics Search Working Group				
	Burst	CBC	CW	SGWB
Highest priority	All-sky search for generic GW transients, both in low latency for multi-messenger follow-up and offline	Detecting the coalescence of neutron star and black hole binaries and measuring their parameters	All-sky search for isolated neutron stars, both as a <i>quick-look</i> on owned resources and as a deep/broad search on Einstein@Home	Searches for an isotropic stochastic GW background
	Parameter estimation for the astrophysical interpretation of detected burst events	Characterizing the astrophysical distribution of compact binaries	Targeted search for high value, known pulsars	Directional searches for stochastic GW backgrounds
	Search for GW bursts triggered by outstanding GRB alerts	Responding to exceptional CBC detections	Directed searches for the most promising isolated stars (Cas A, Vela Jr etc.)	Search for very long transients (~ 10 hr – days)
	Searches triggered by outstanding astrophysical events (a galactic supernova, neutron star transients, an exceptional high energy neutrino alert)	Multi-messenger astronomy with compact binaries	Directed searches for X-ray binaries Sco X-1 and XTE J1751–305	Data folding for efficient SGWB searches
	Search for cosmic string kinks and cusps	Searching for CBC-GRB coincidences		Searches for non-Gaussian GW backgrounds
		Testing General Relativity with compact binaries		Data quality and detector characterization studies
High priority	Searches triggered by high energy neutrinos, extragalactic supernovae, and GRB observations	All sky search for spinning binary neutron star systems (deep and low latency)	Targeted search for other known pulsars	Long transient follow-up of CBC and burst candidates
	Burst search for intermediate mass ratio and eccentric black hole binary systems	Matched filter search for intermediate mass black hole binary systems	Directed searches for other isolated compact stars and X-ray binaries	
	All-sky search for long bursts of > 10 s duration			
Additional priority	GRB-triggered search for long-duration bursts and plateaus	Exploring effects of detector noise on parameter estimation	All-sky search for isolated compact stars (alternative approaches)	
	Hypermassive neutron star follow-up	Searching for sub-solar mass CBC signals	All-sky search for CW signals from binary systems	
	Burst searches triggered by radio transients and by SGR/SGR-QPO	Developing searches for CBC signals with generic spins	Spotlight deep sky-patch search	
	Burst tests of alternative gravity theories **		Search for continuous-wave transients	
			Search for supernova post-birth signals **	

*The LSC-Virgo White Paper
on Gravitational Wave Data
Analysis and Astrophysics
(2017-2018 edition)*

<https://dcc.ligo.org/T1700214>