



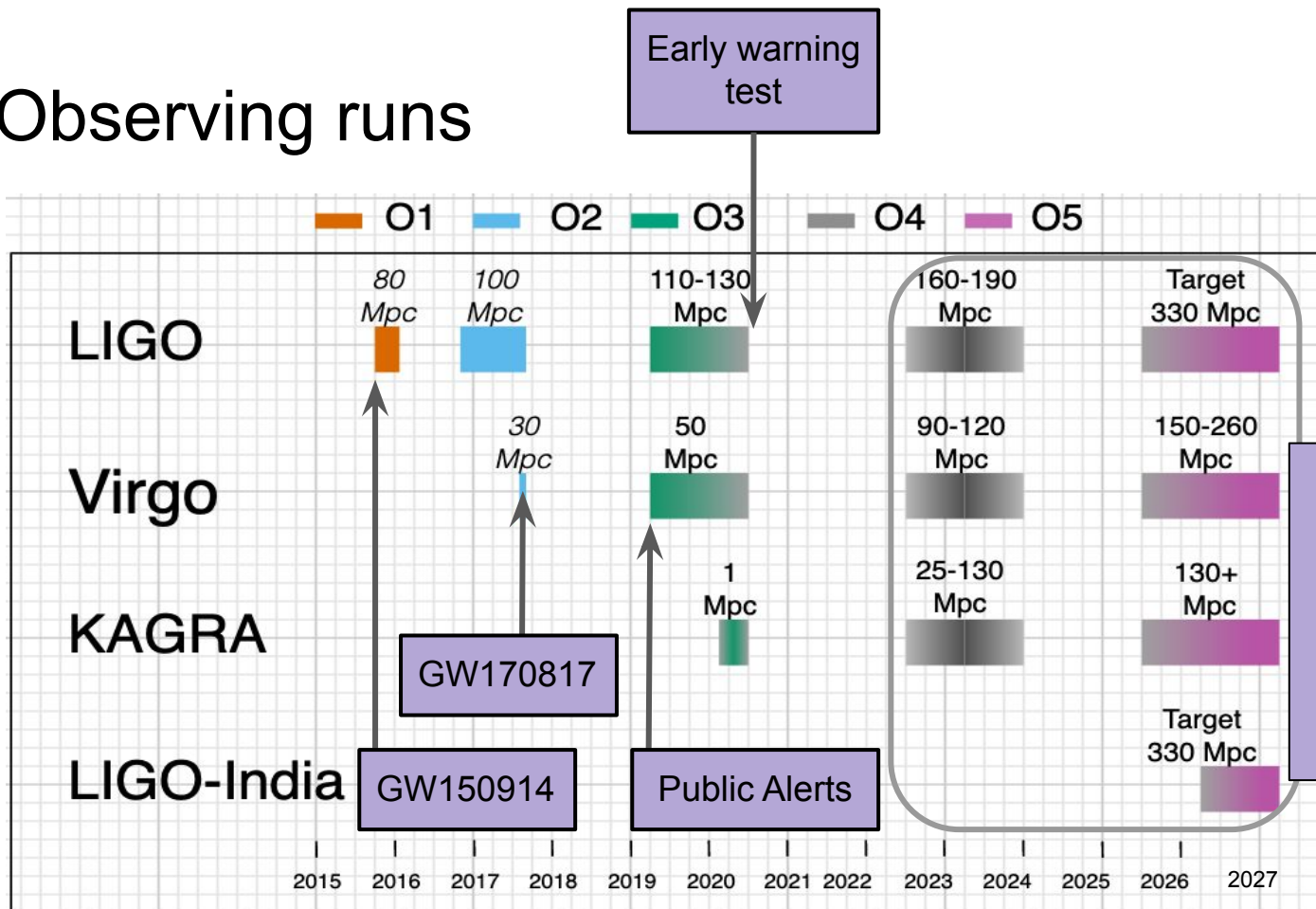
LSC Perspective

Patrick Brady, LSC Spokesperson
University of Wisconsin-Milwaukee

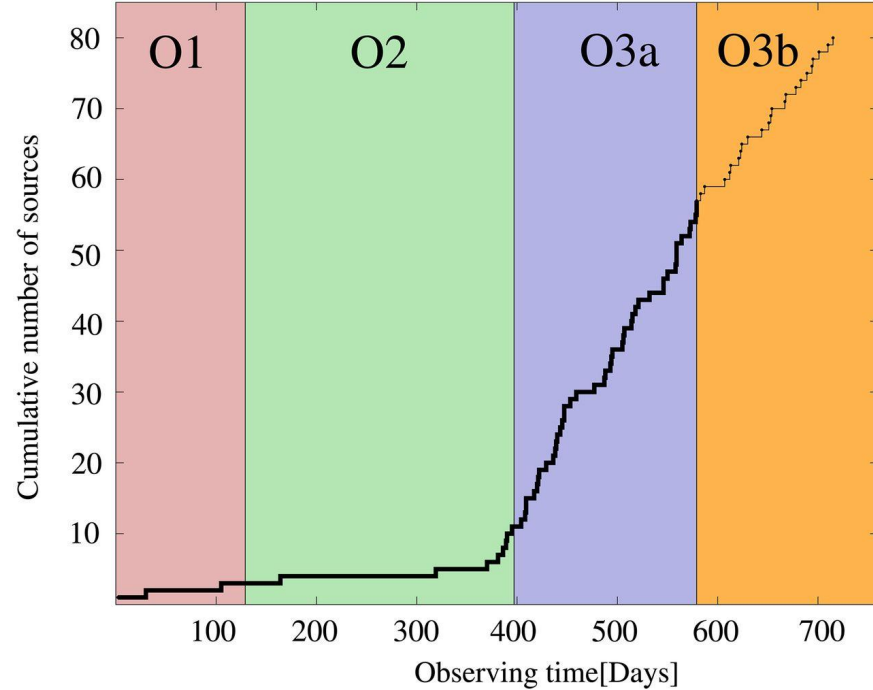
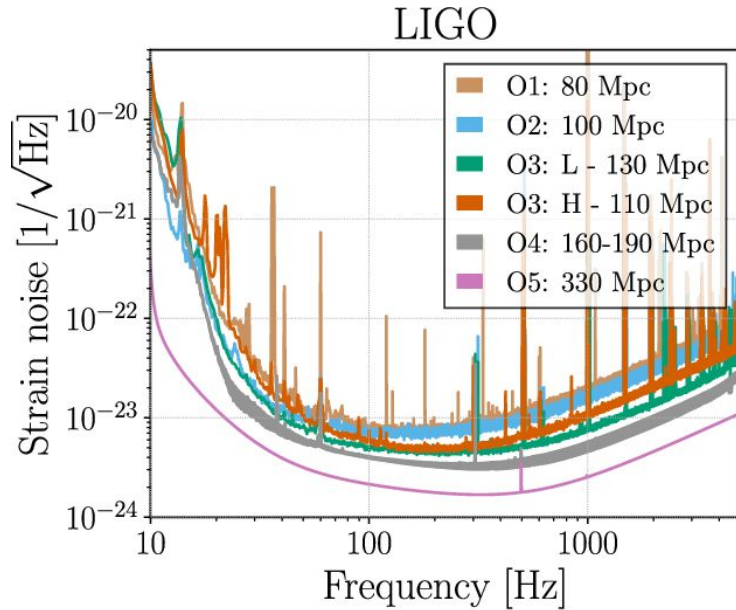
2021 DAWN Workshop, 5-7 October 2021



Observing runs



Sensitivity & Detections

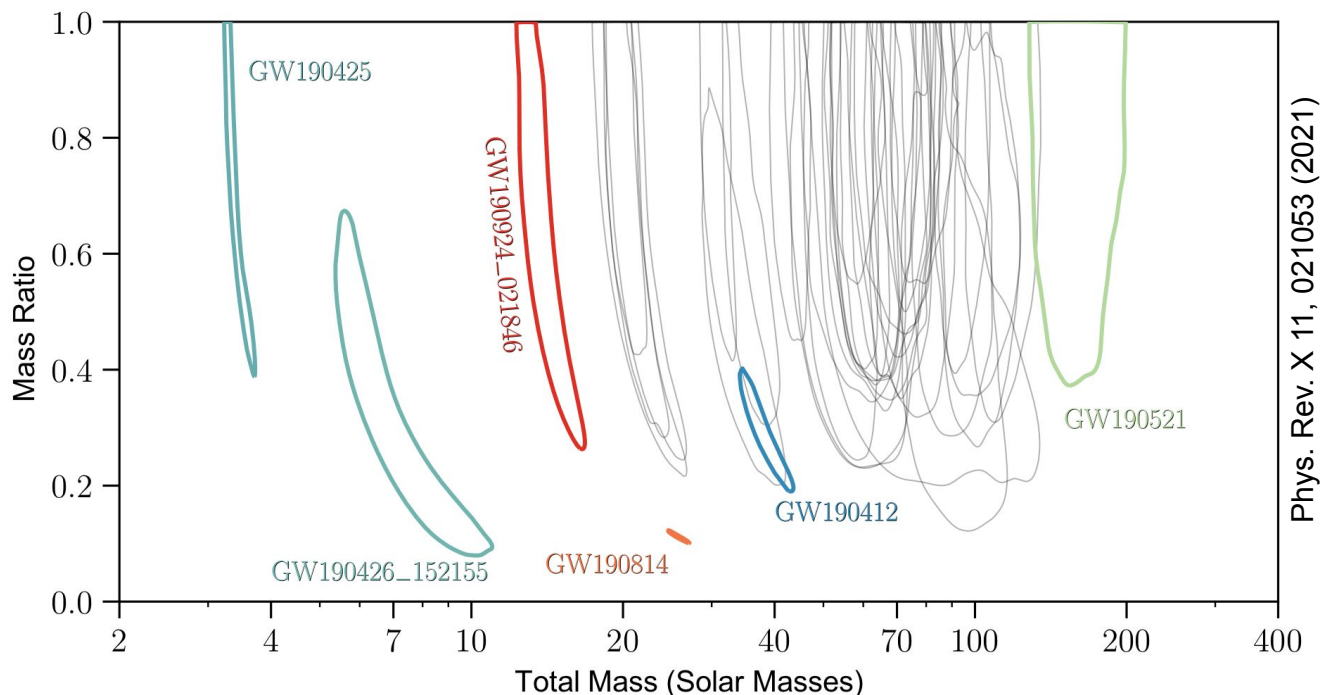


O3 binary detection rate $\sim 1 / (5 \text{ days})$



O3a catalog paper

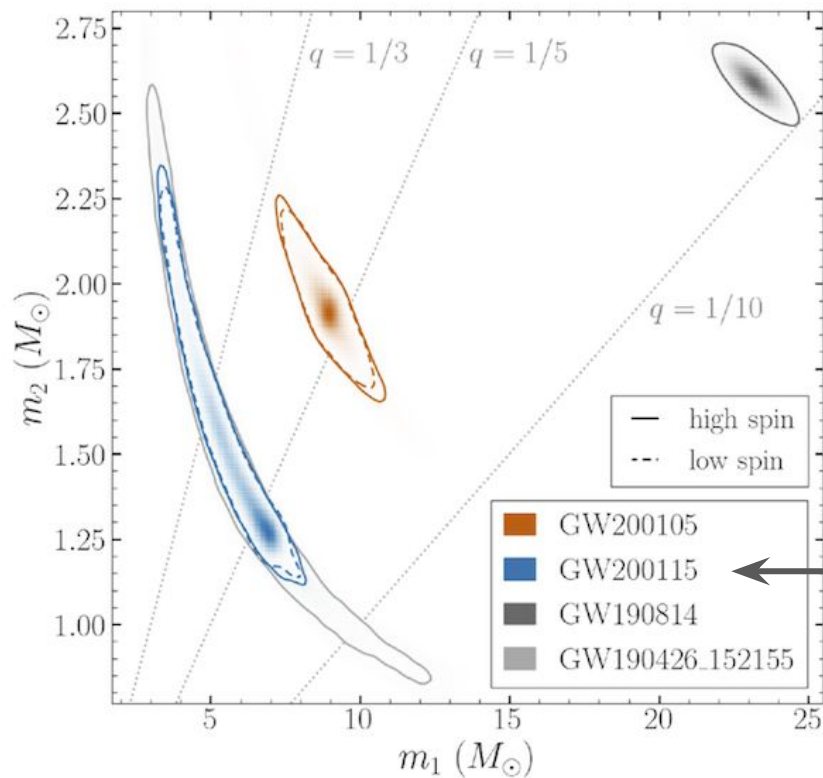
- 50 events:
 - 11 from O1 & O2
 - 39 from O3a
- 4 papers
 - GWTC-2
 - Distributions
 - Testing GR
 - GW-GRB joint
- Released Oct 2020
- GWTC-3
 - O3b catalog
 - Nov 2021



O3a strain data release: 30 April 2021 (6 months data, 19 months after end)
 O3b strain data release: 5 November 2021 (5 months data, 19 months after end)



Neutron-star black-hole mergers



Effectively single interferometer detection

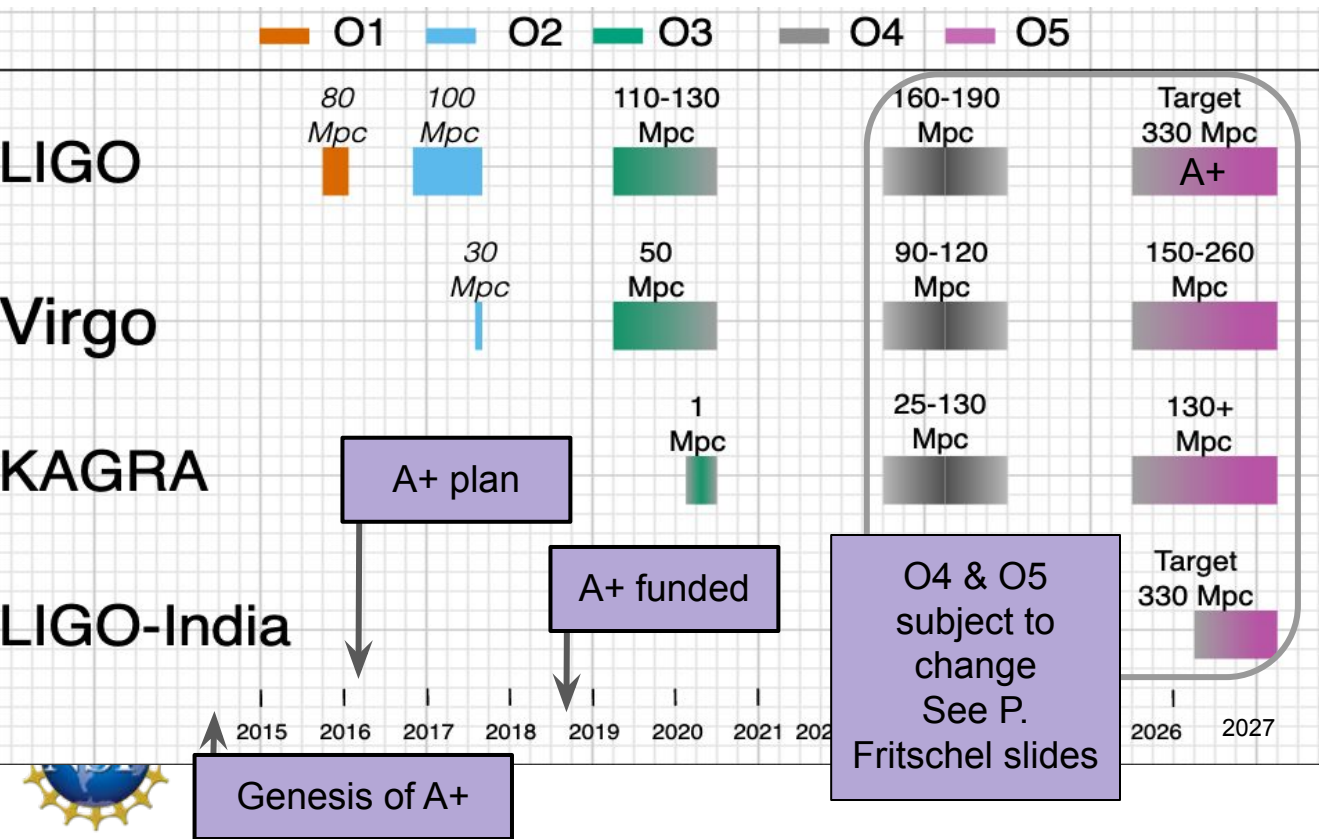


GWOSC - <https://www.gw-openscience.org>

- Event Portal Query Page
 - <https://www.gw-openscience.org/eventapi/html/query/>
- Bulk strain data releases (18 months after each 6 month observation period)
 - <https://www.gw-openscience.org/{O3,O2,O1}>
- GWOSC Office Hours
 - <https://www.eventbrite.com/e/gwosc-office-hours-tickets-147886956869>
- Open Data Workshops
 - 2021 hosted by Max Razzano at INFN, Pisa
 - Now an online course, w/ 800 students enrolled: <https://gw-odw.thinkific.com>
- Vibrant community using these data
 - See for example *3-OGC: Catalog of gravitational waves from compact-binary mergers* by Nitz et al [arXiv:2105.09151]



Looking ahead: O4, O5



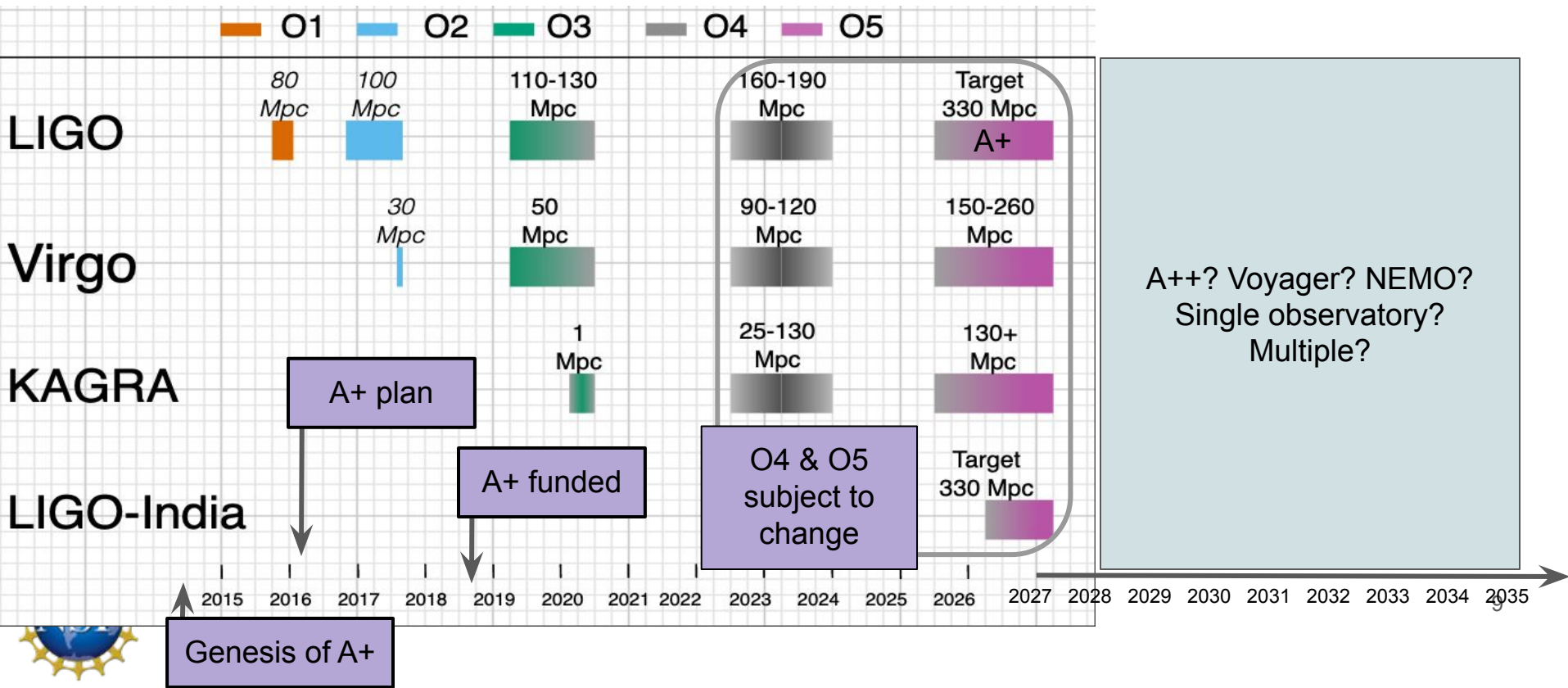
- Binary detection rates
 - O3 ~ 1 / 5 days
 - O4 ~ 1 / 2 days
 - O5 ~ 3 / day
- Improved public alerts
 - Localization
 - Classification
 - Latency
- Other science
 - Improved SNR
- Discovery space
 - **New sources?**

International Gravitational-Wave Observatory Network (IGWN)



- Success is tightly bound with network operations!
 - Detection rates, localization, other parameters, polarisation ...
 - Astrowatch - coverage for exceptional events (Galactic supernova)
- A nascent organizational framework for LIGO-Virgo-KAGRA to collaborate, to jointly plan and execute observational runs, and to share common services.

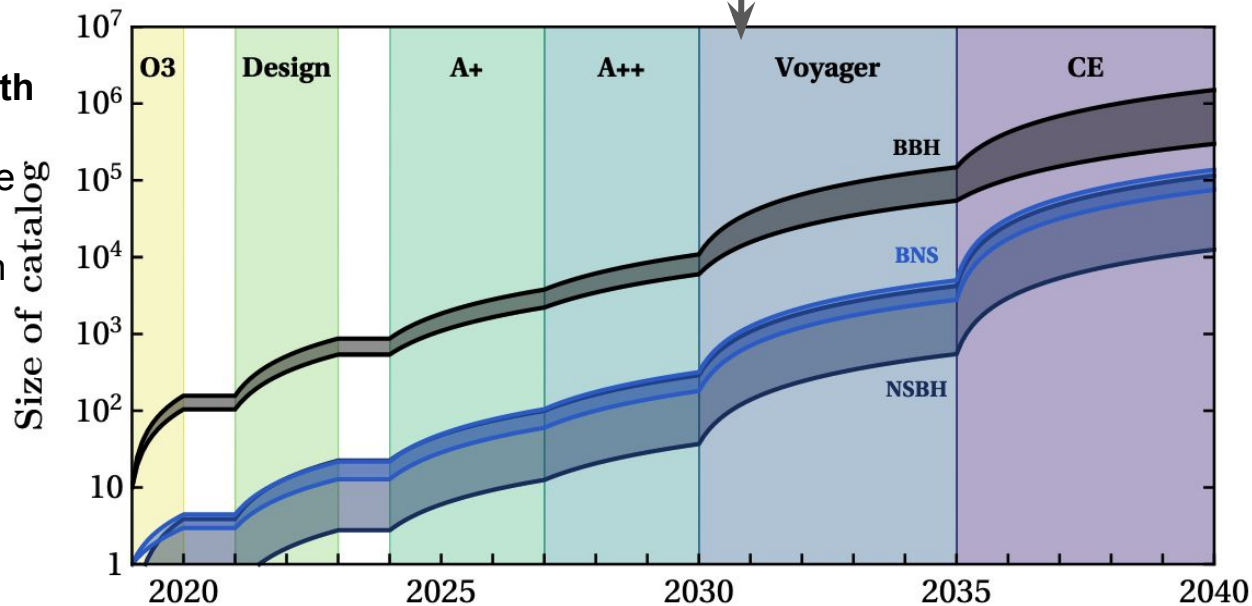
Looking ahead: post-O5 preparations



LSC (and Virgo) post-O5 Study

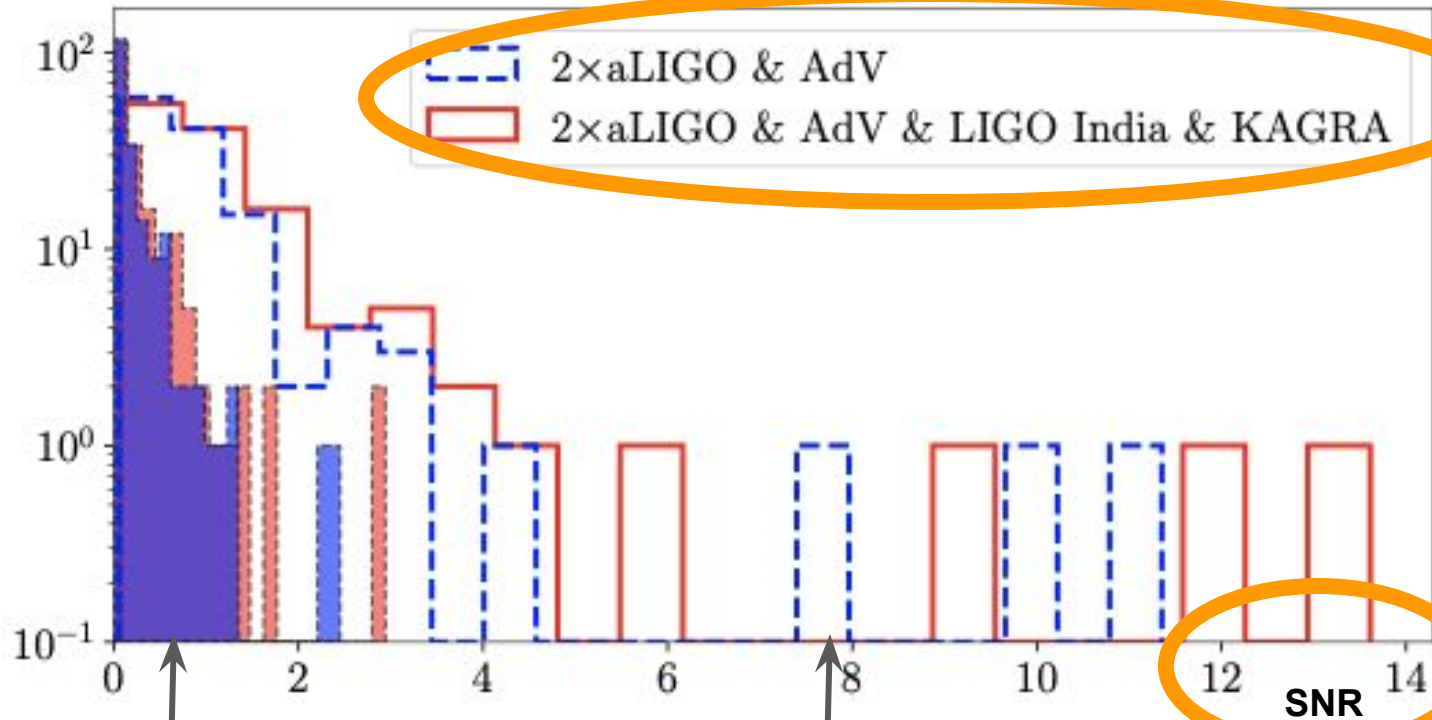
- **Develop plans that dovetail with Cosmic Explorer & ET**

- Upgrades that demonstrate technologies
- Instrumental risk mitigation
- Continued observational coverage for multi-messenger astrophysics
- Discovery space
 - **New sources?**



Baibhav et al, Phys. Rev. D 100, 064060 (2019)

GW from pulsars



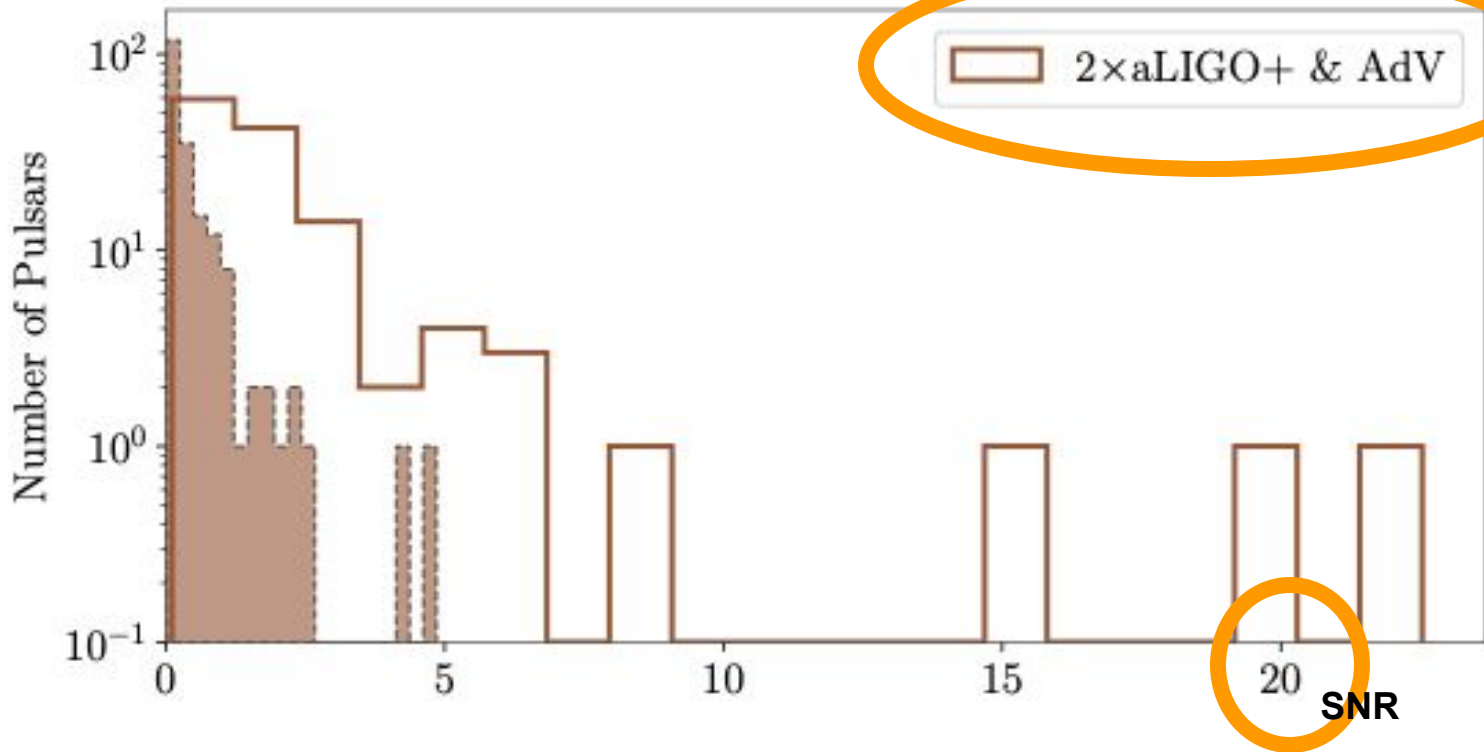
Solid: ellipticity $1e-9$

Empty: gravitar

Pitkin et al, Ap. J. Lett 863, 2, L40 (2018)

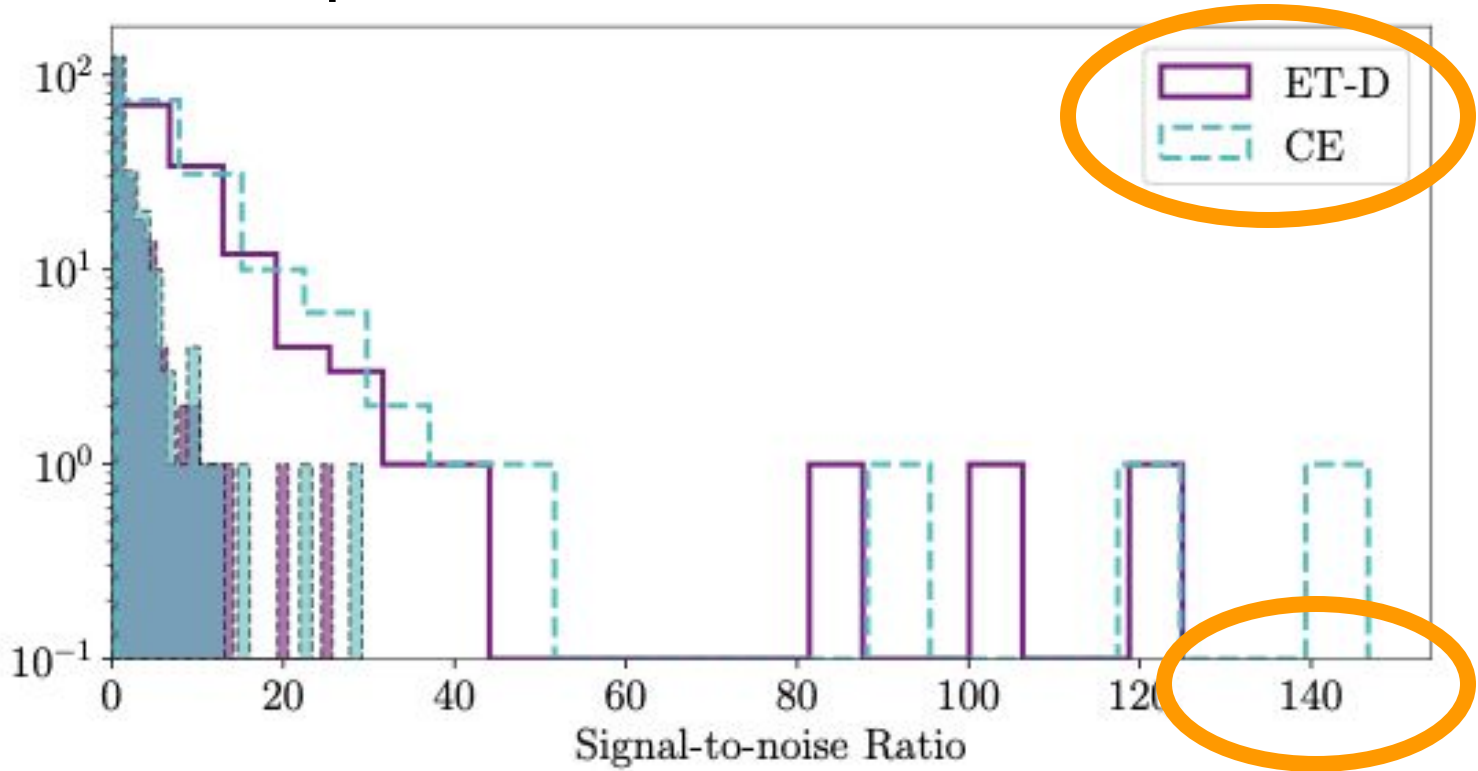


GW from pulsars



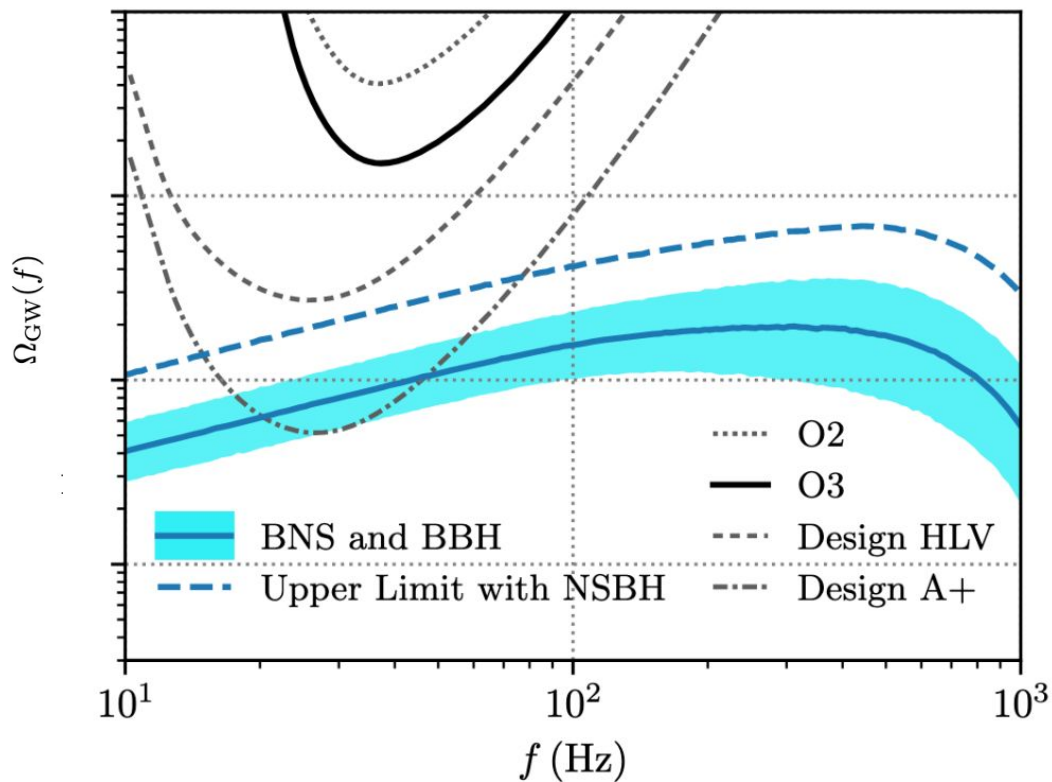
Pitkin et al, Ap. J. Lett 863, 2, L40 (2018)

GW from pulsars



Pitkin et al, Ap. J. Lett 863, 2, L40 (2018)

Isotropic GW Background



LVC, Phys. Rev. D 104, 022004 (2021)

- **Develop plans that dovetail with Cosmic Explorer & ET**
 - Upgrades that demonstrate technologies & mitigate risk
 - Continued observational coverage for multi-messenger astrophysics
 - Expand discovery space
 - **New sources?**

Science		No CE	CE with 2G					CE with ET					CE, ET, CE South				
Theme	Goals	2G	20	40	20+20	20+40	40+40	20	40	20+20	20+40	40+40	20	40	20+20	20+40	40+40
Black holes and neutron stars throughout cosmic time	Black holes from the first stars	Grey	Grey	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
	Seed black holes	Grey	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
	Formation and evolution of compact objects	Grey	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Dynamics of dense matter	Neutron star structure and composition	Grey	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
	New phases in quantum chromodynamics	Grey	Green	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
	Chemical evolution of the universe	Grey	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
	Gamma-ray burst jet engine	Grey	Yellow	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Extreme gravity and fundamental physics	Grey	Grey	Yellow	Yellow	Green	Green	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Discovery potential	Grey	Grey	Yellow	Yellow	Green	Green	Yellow	Green	Green	Green	Green	Green	Green	Green	Green	Green	Green
Technical risk		Red	Yellow	Yellow	Yellow	Yellow	Red	Yellow	Yellow	Yellow	Yellow	Red	Yellow	Yellow	Yellow	Yellow	Yellow

Table 1.1, Cosmic Explorer Horizon Study, CE-P2100003-v7, October 2021

