

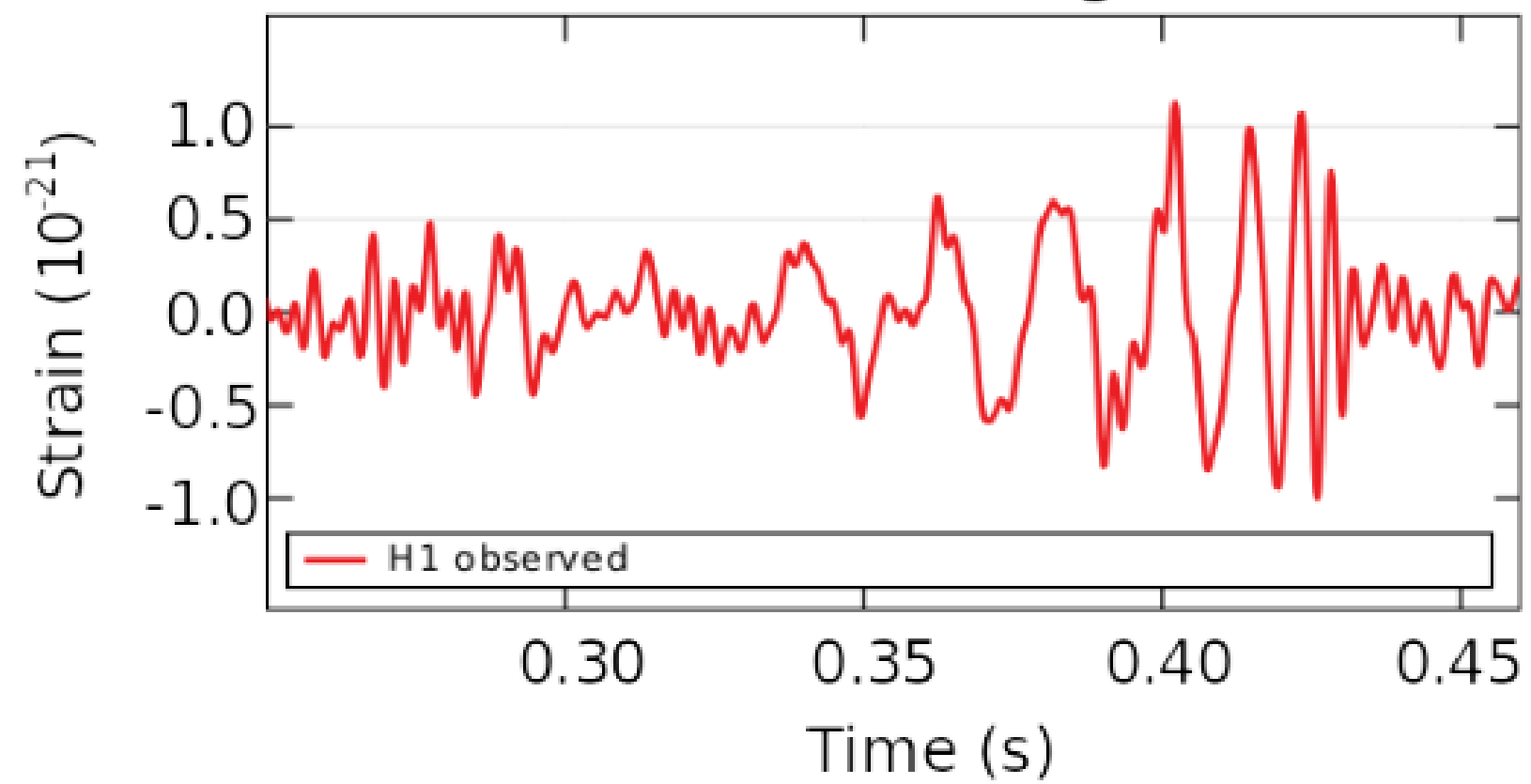


Carl Knox – OzGrav/Swinburne

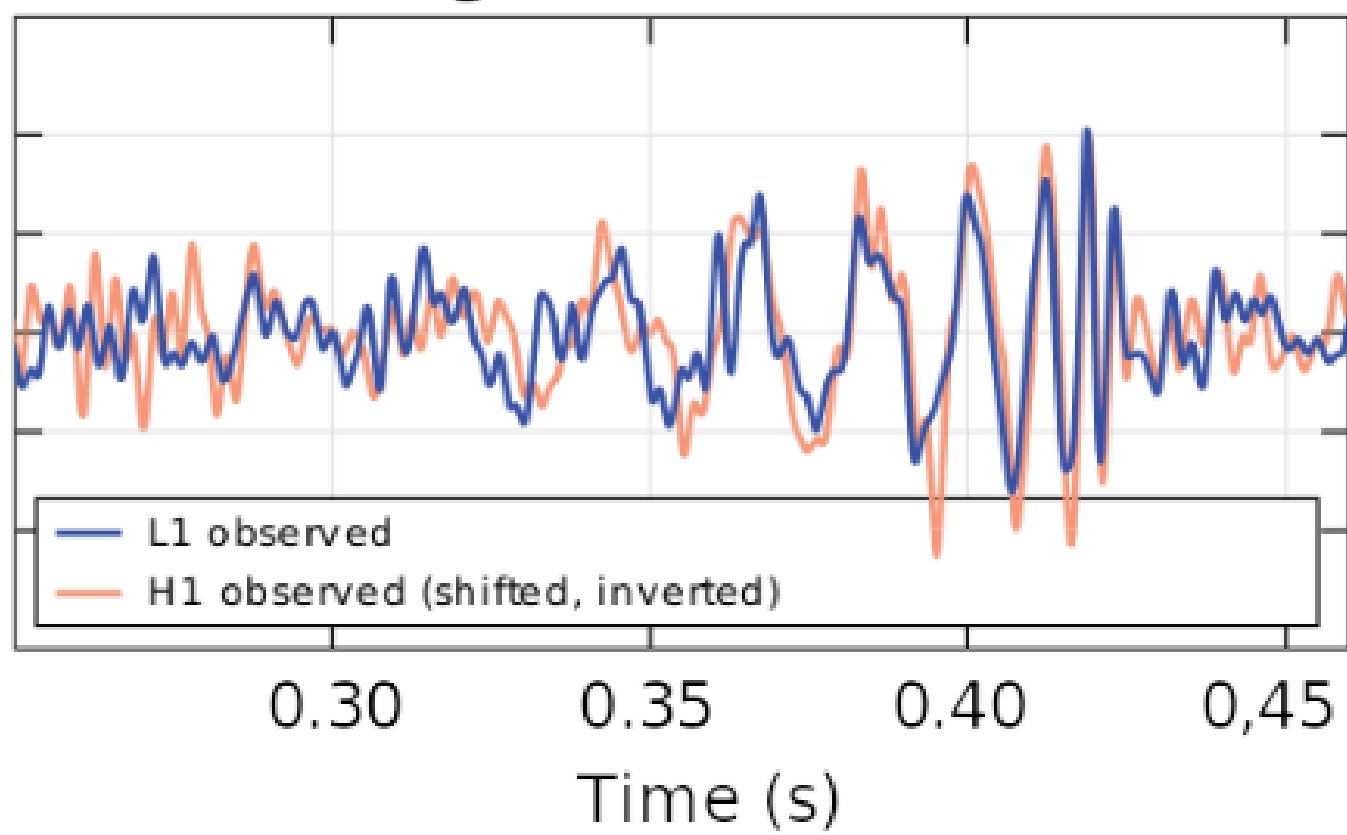
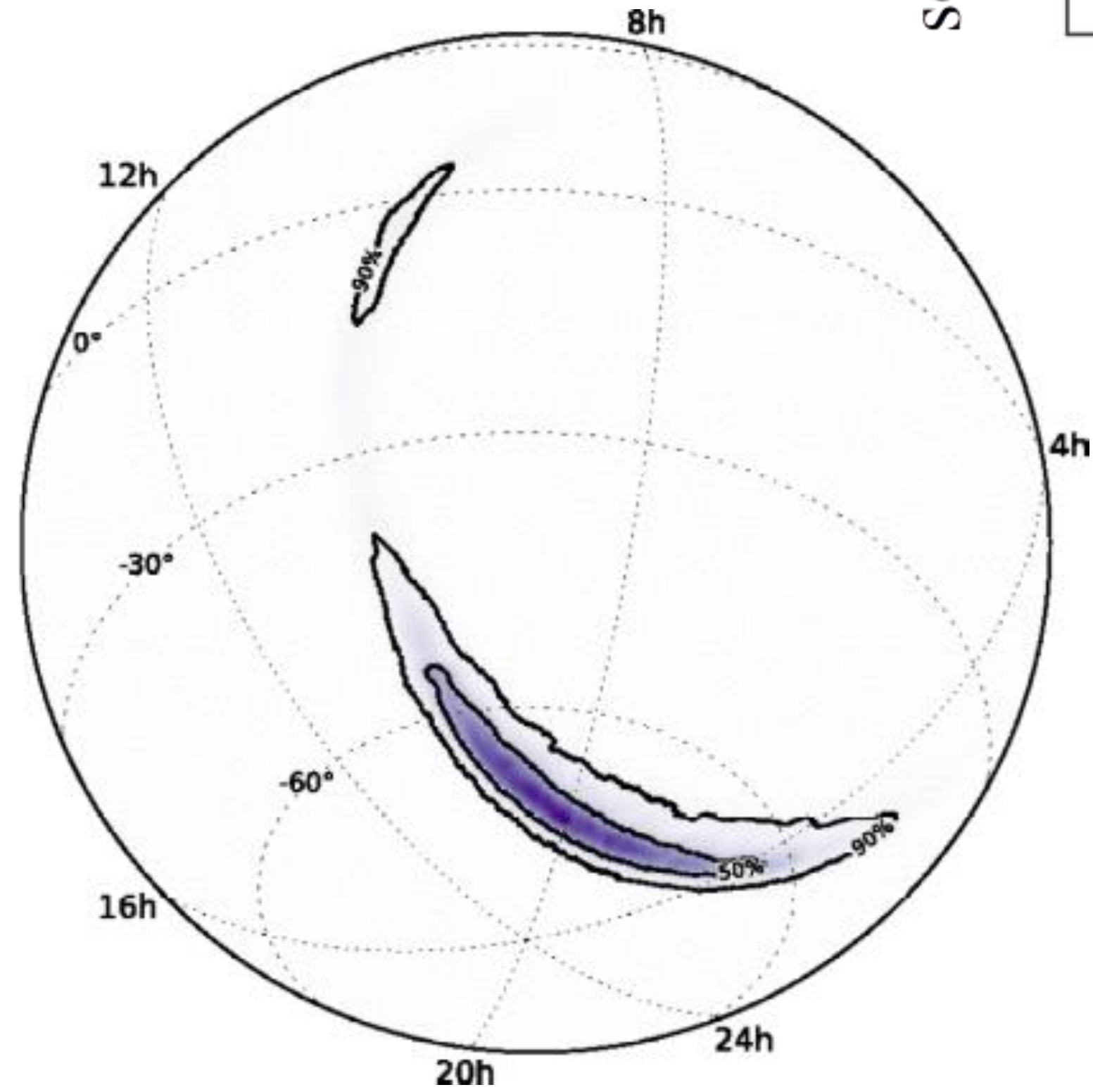
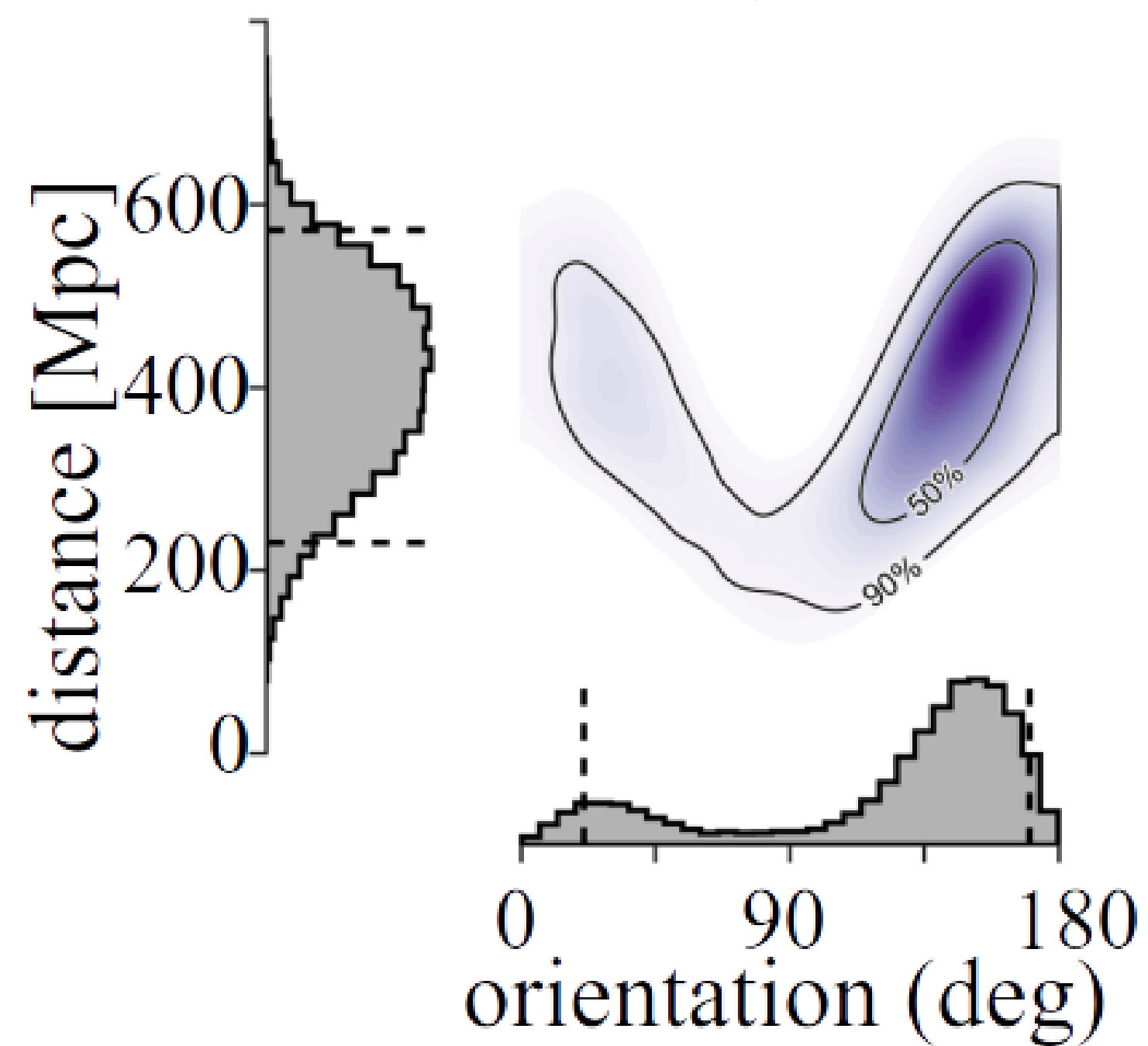
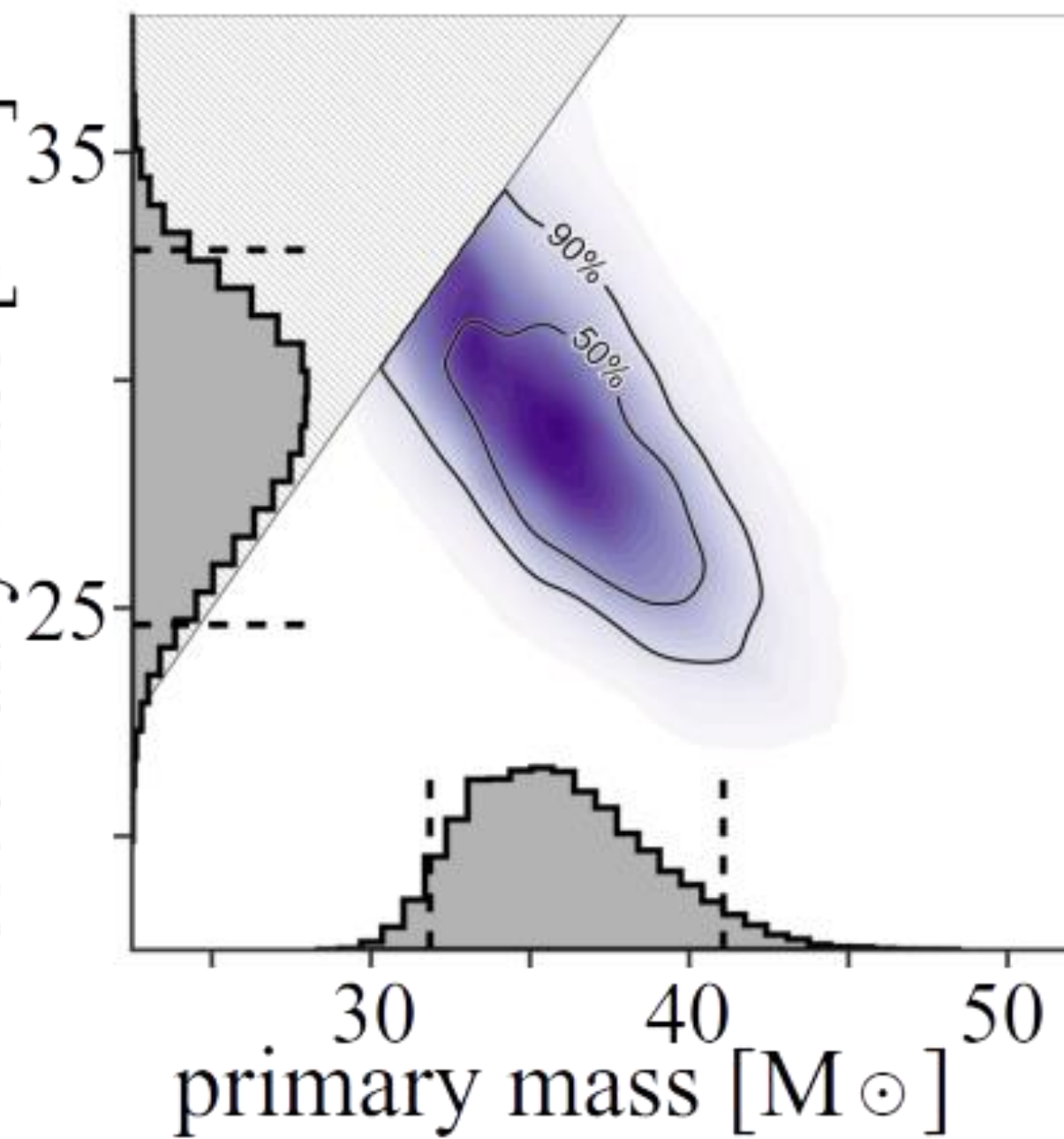
# Science with future gravitational-wave observatories: Astrophysics

Paul Lasky

Hanford, Washington (H1)

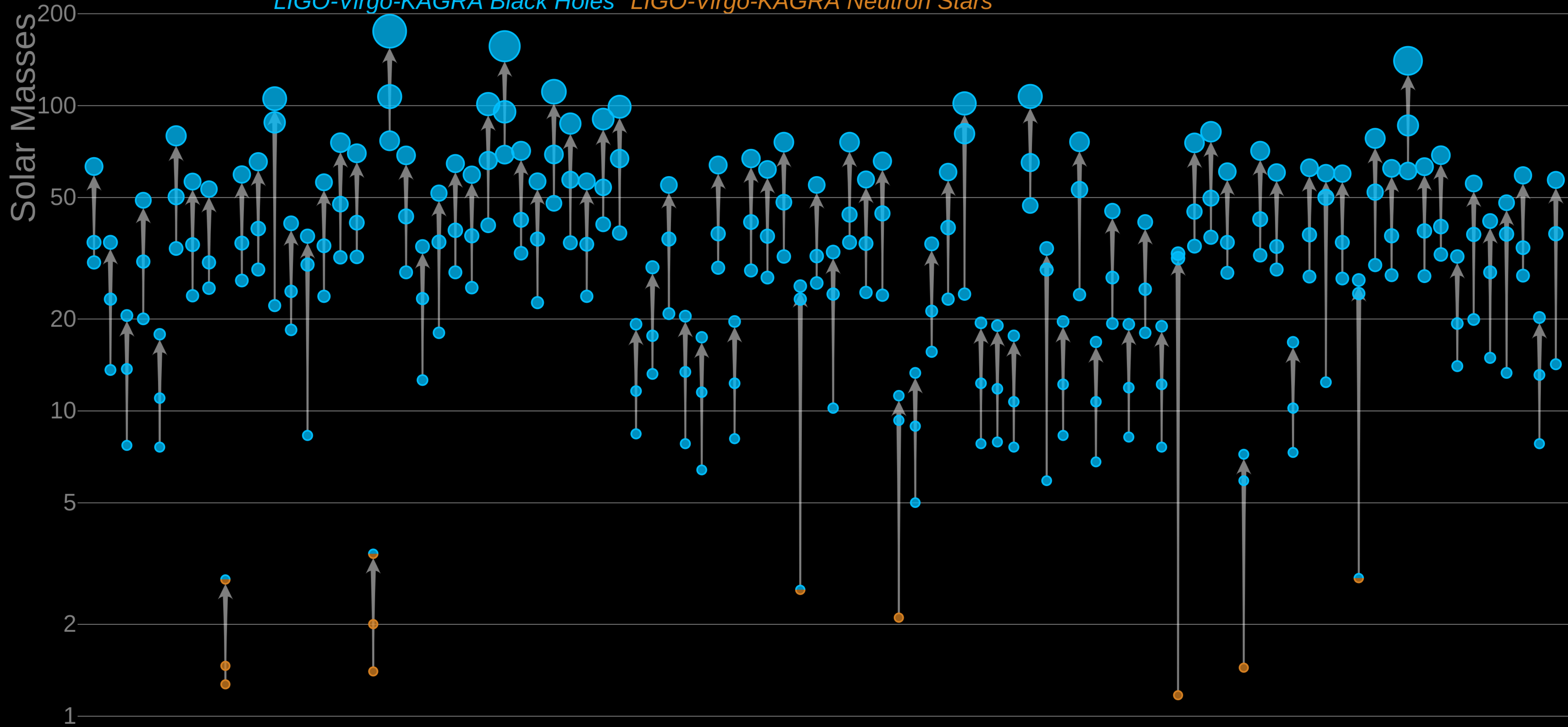


Livingston, Louisiana (L1)

secondary mass [ $M_{\odot}$ ]

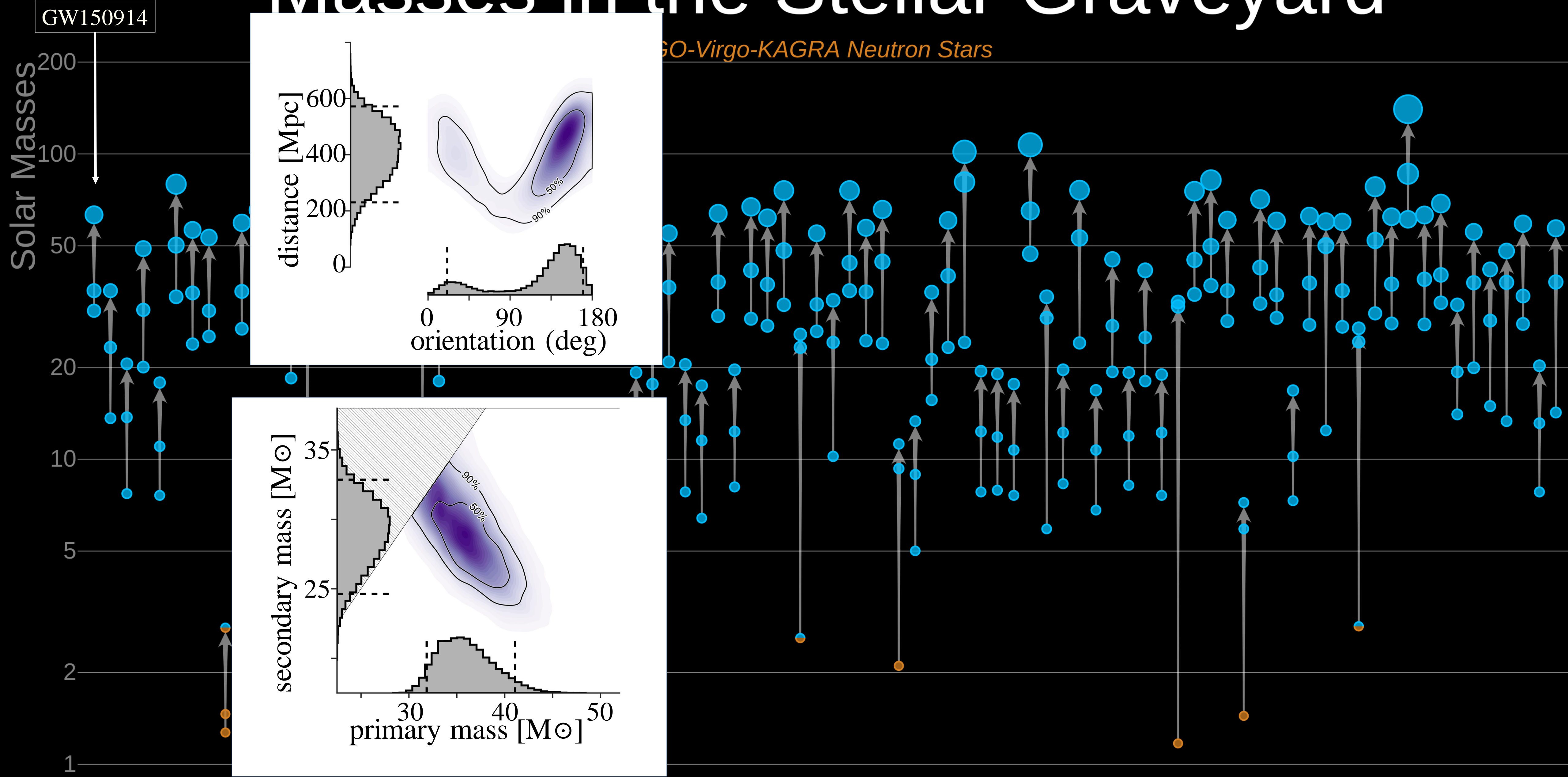
# Masses in the Stellar Graveyard

*LIGO-Virgo-KAGRA Black Holes* *LIGO-Virgo-KAGRA Neutron Stars*



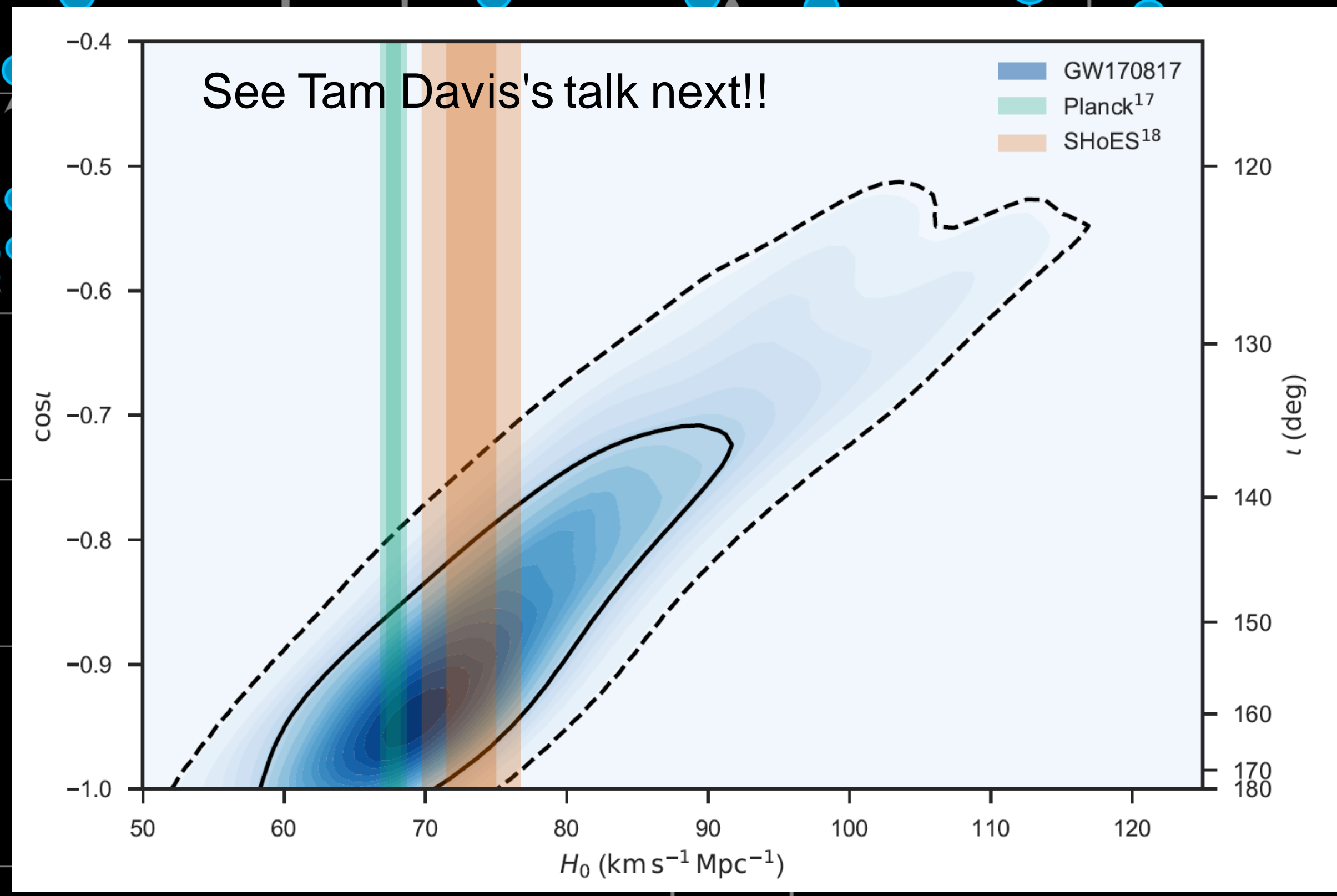
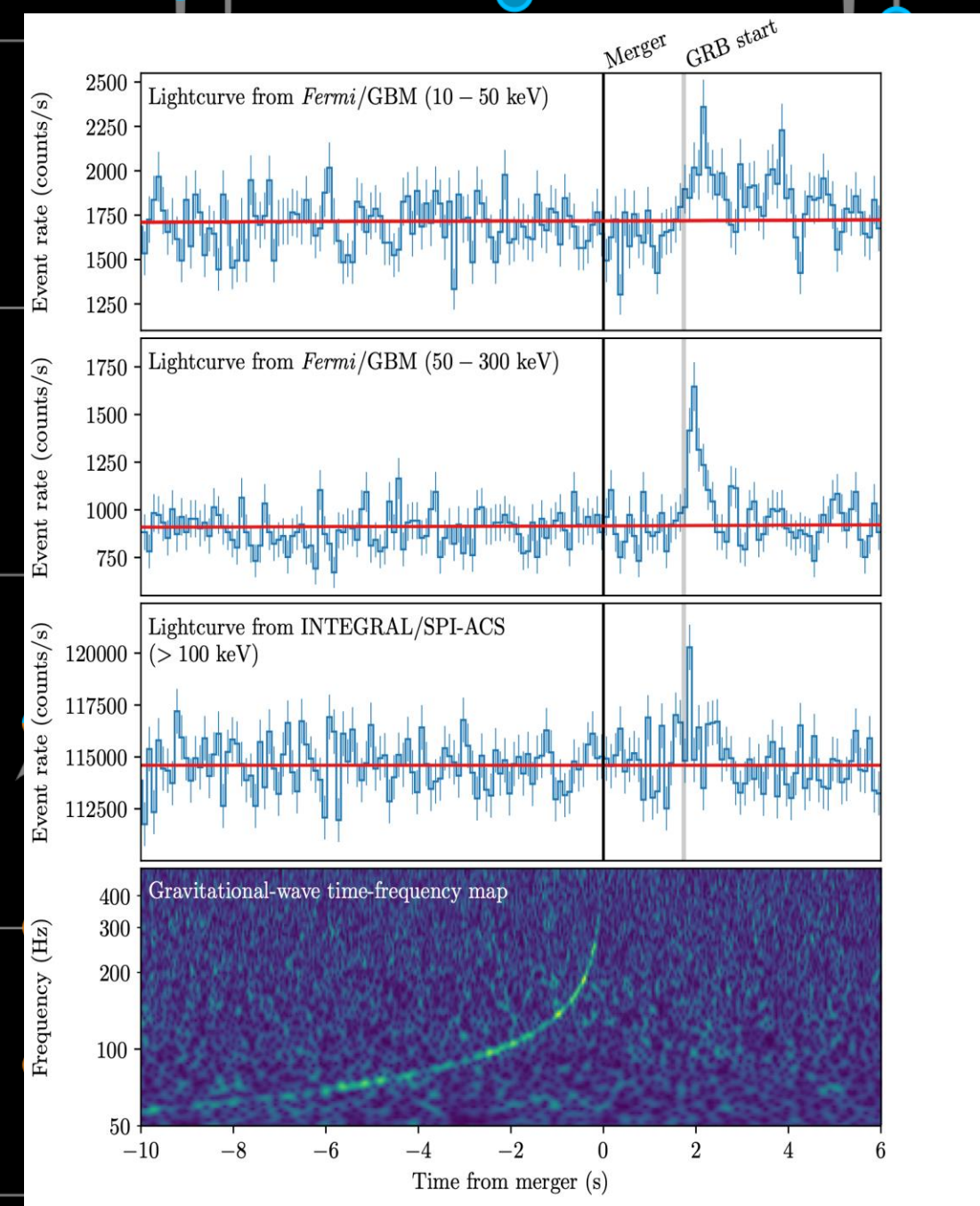
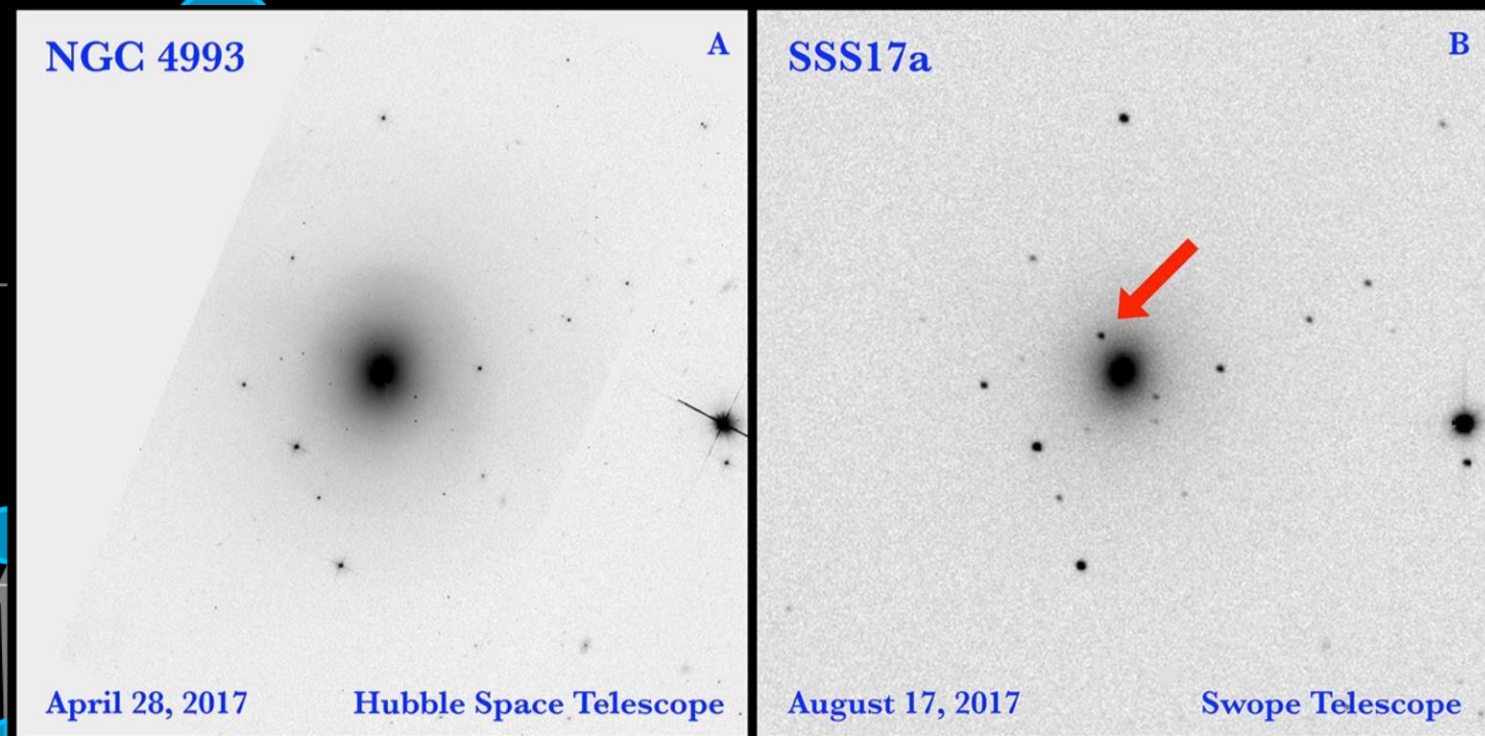
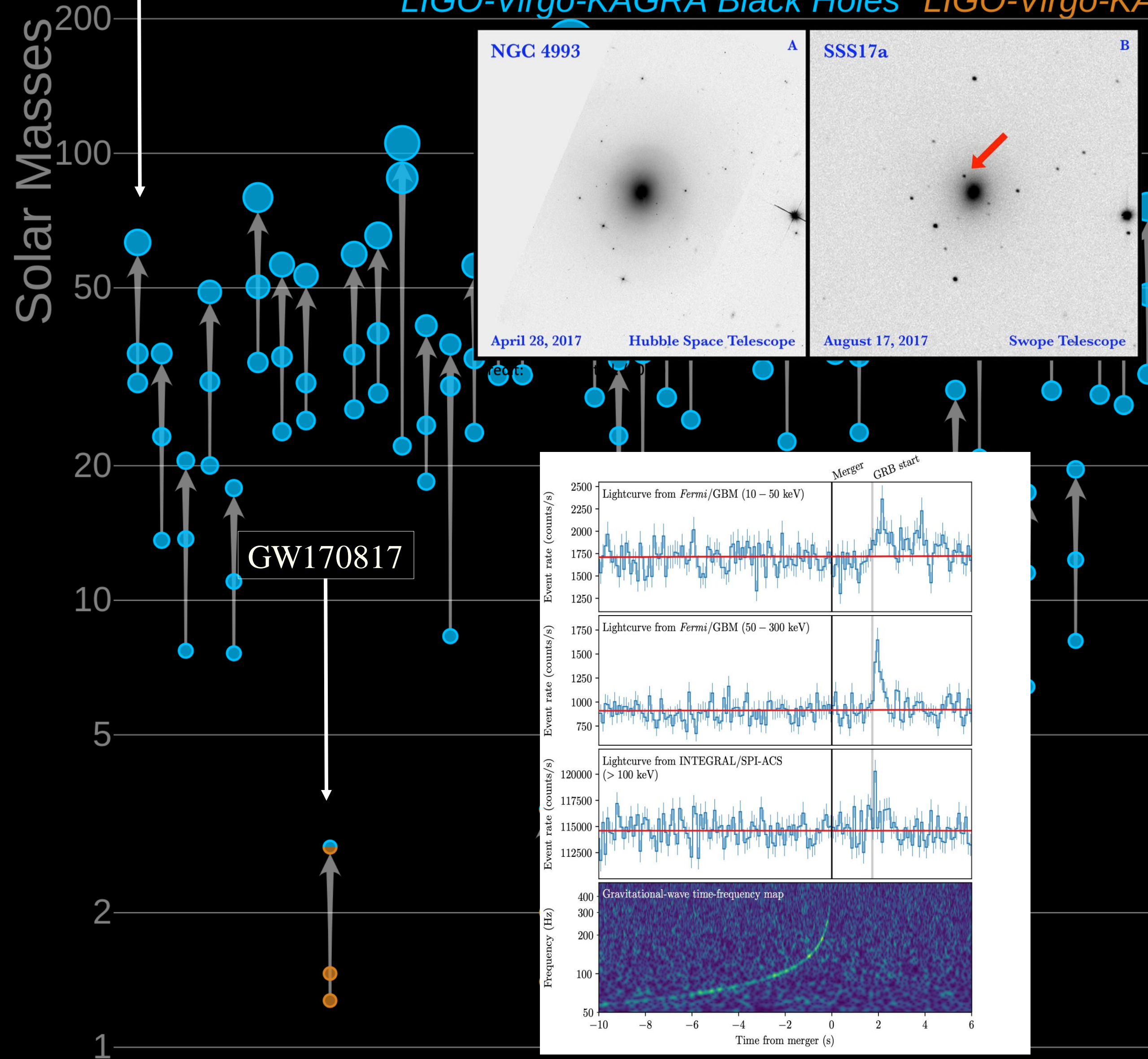
# Masses in the Stellar Graveyard

LIGO-Virgo-KAGRA Neutron Stars



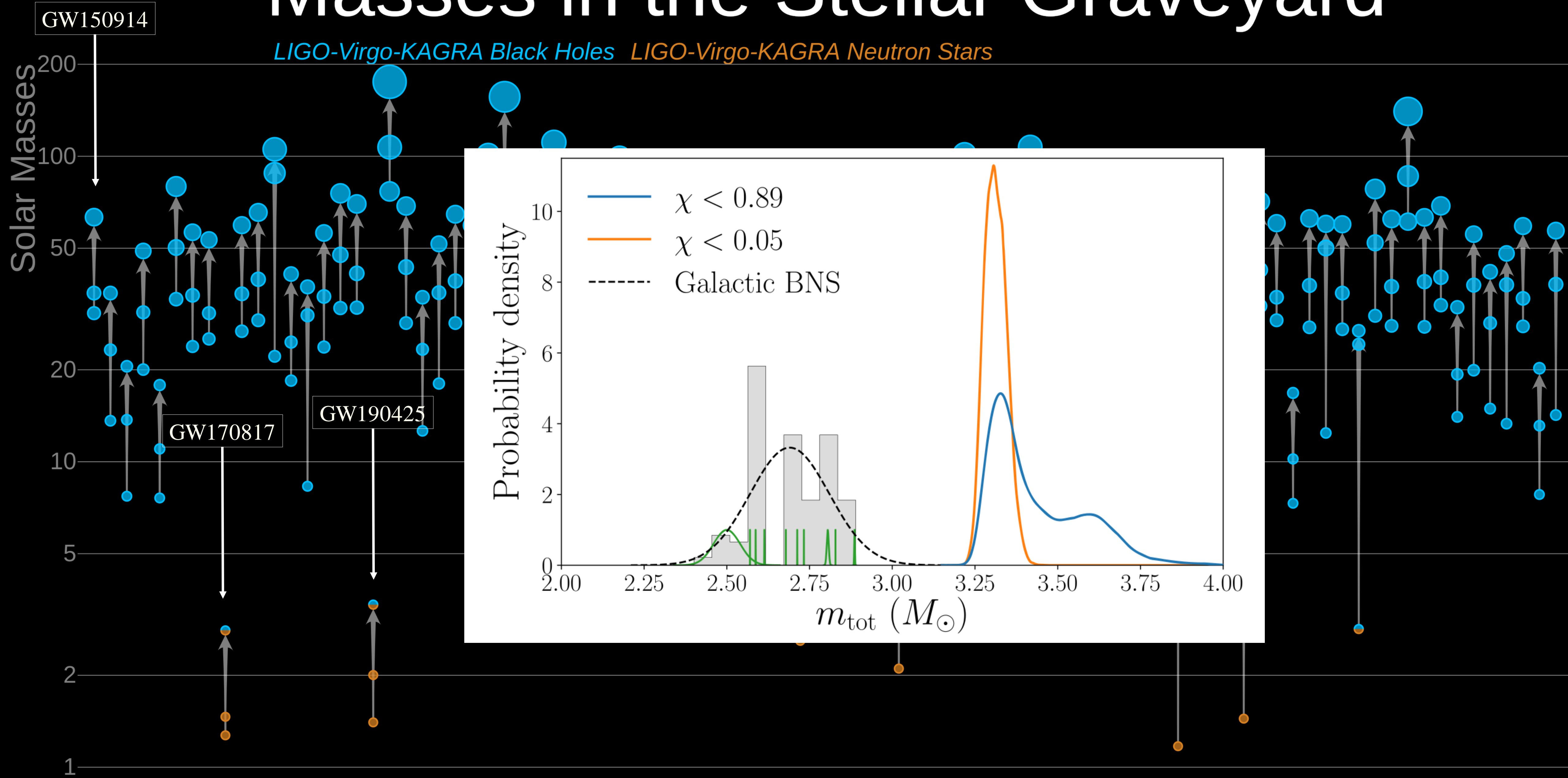
# Masses in the Stellar Graveyard

LIGO-Virgo-KAGRA Black Holes LIGO-Virgo-KAGRA Neutron Stars



# Masses in the Stellar Graveyard

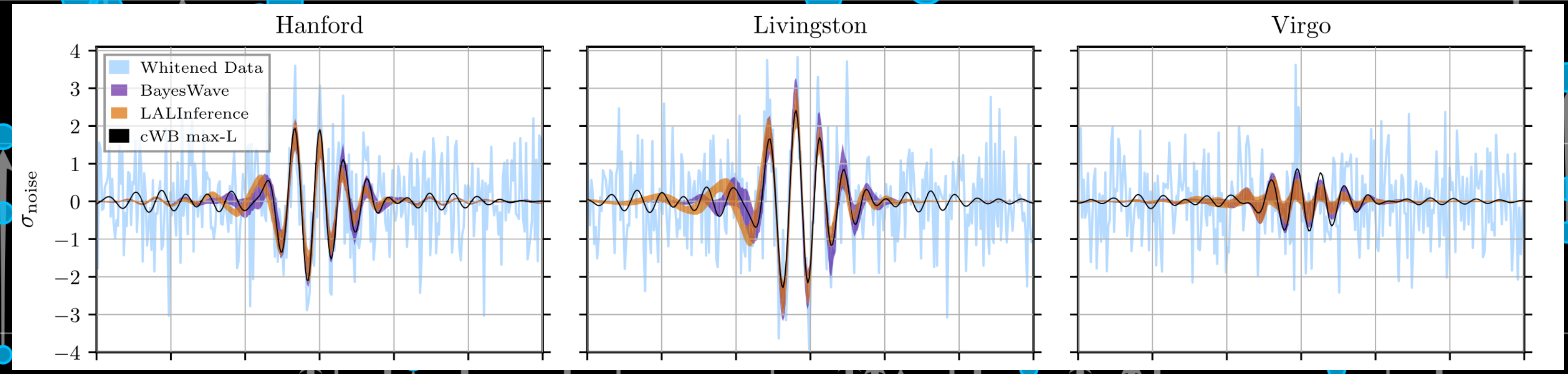
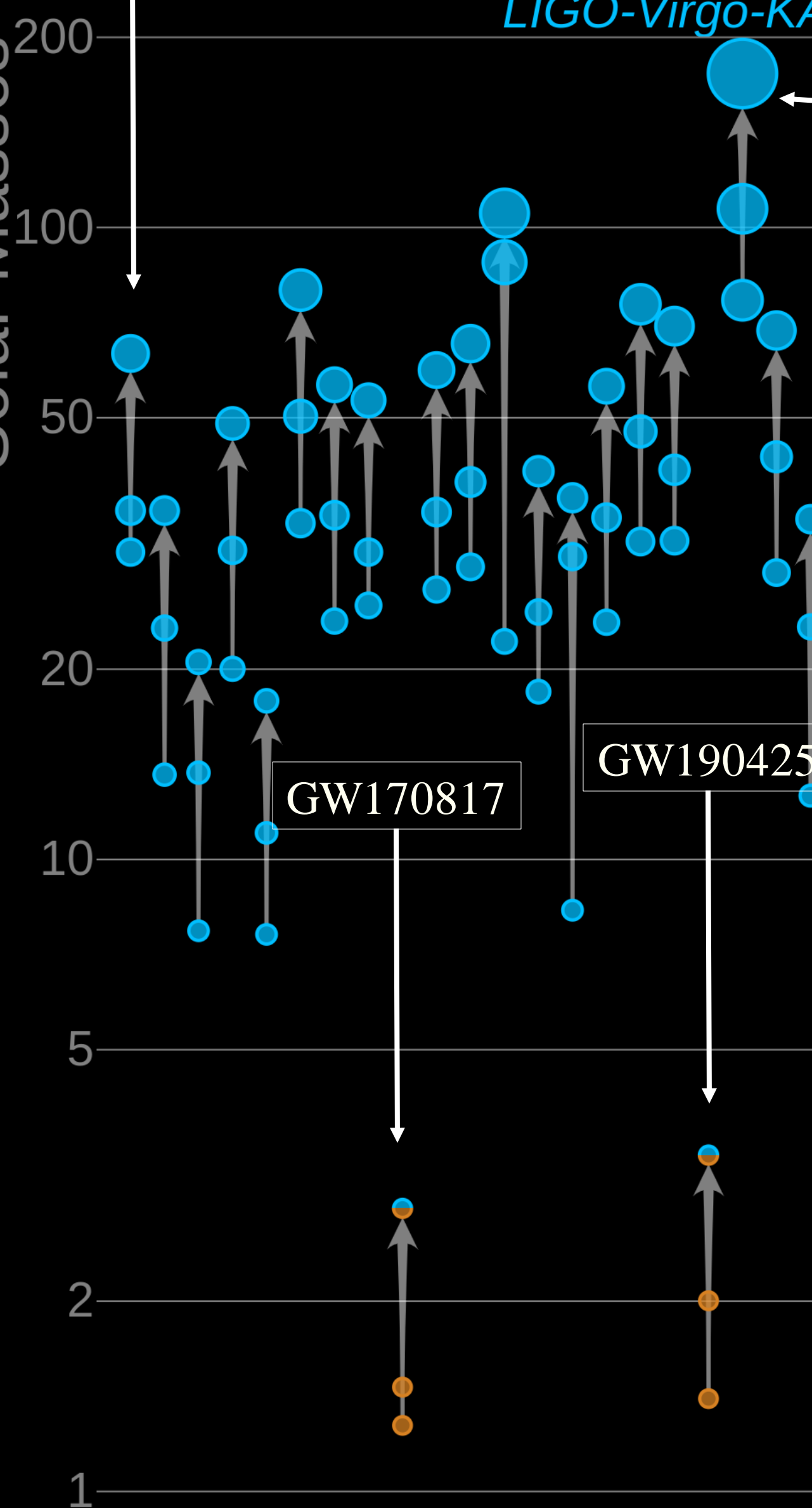
LIGO-Virgo-KAGRA Black Holes LIGO-Virgo-KAGRA Neutron Stars



# Masses in the Stellar Graveyard

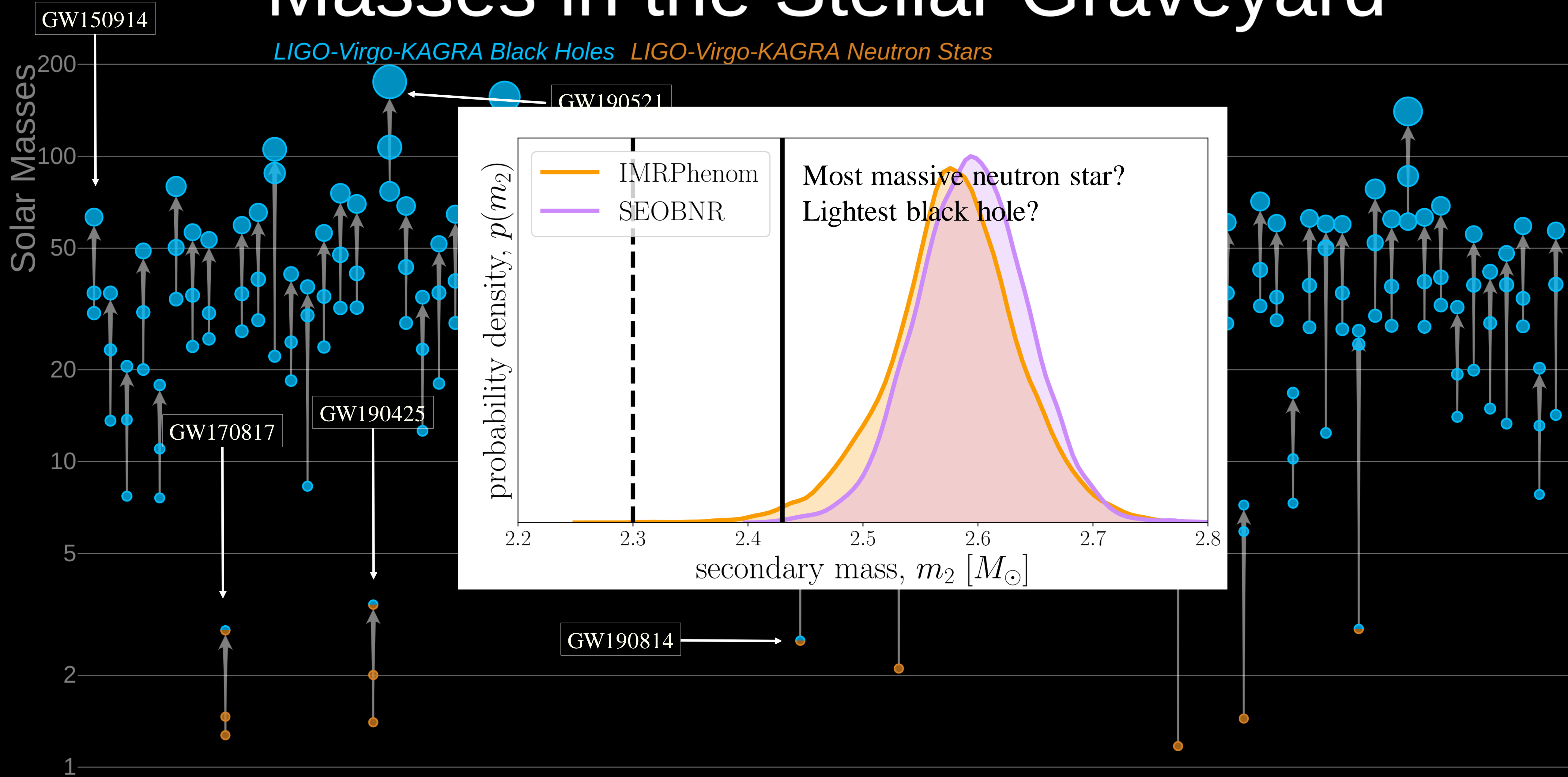
LIGO-Virgo-KAGRA Black Holes LIGO-Virgo-KAGRA Neutron Stars

Solar Masses



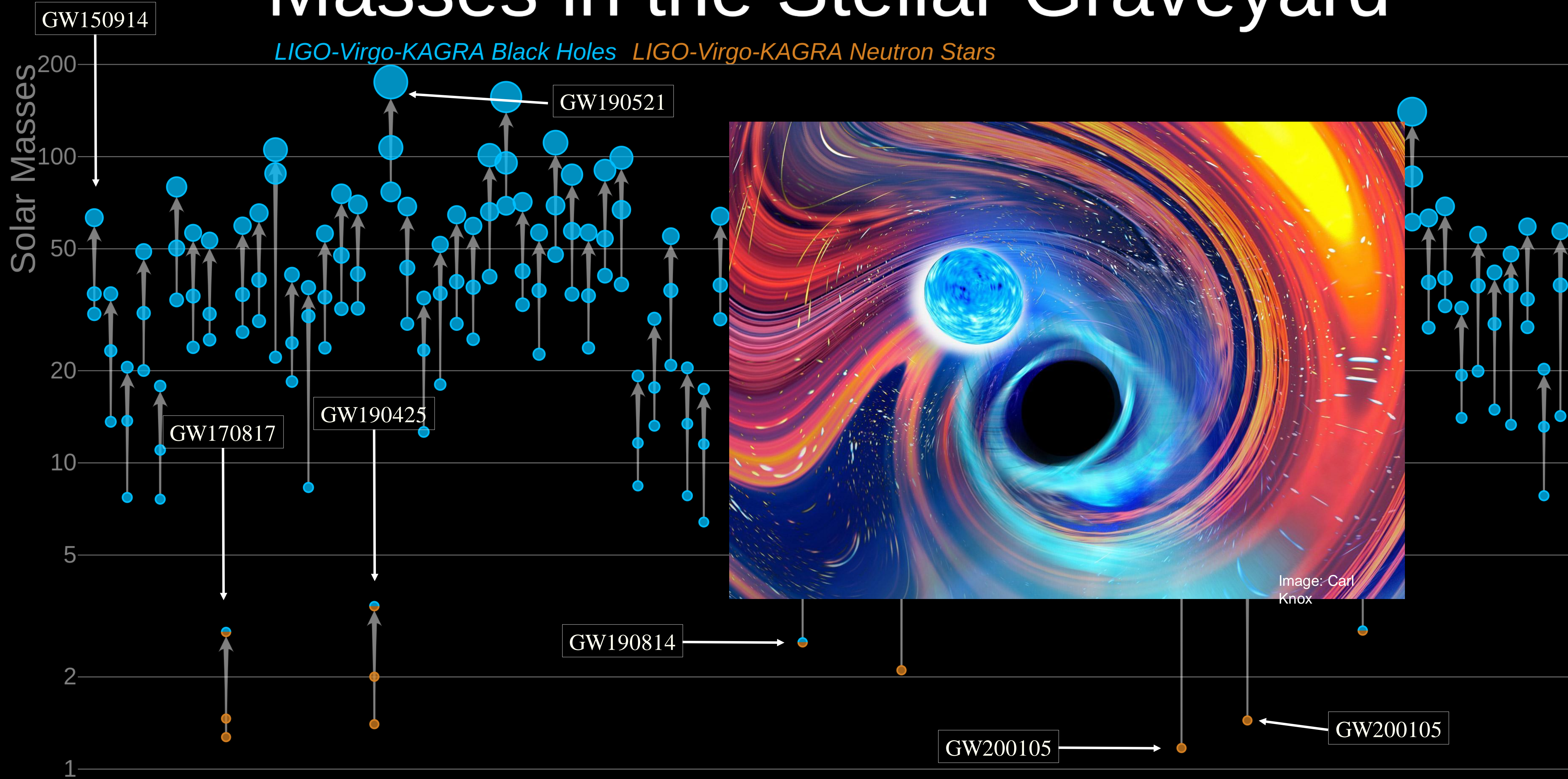
- Most massive system measured to date!
- Eccentric orbit (Romero-Shaw, PL & Thrane 2020)
- How did it form? Dynamical merger / second generation!?

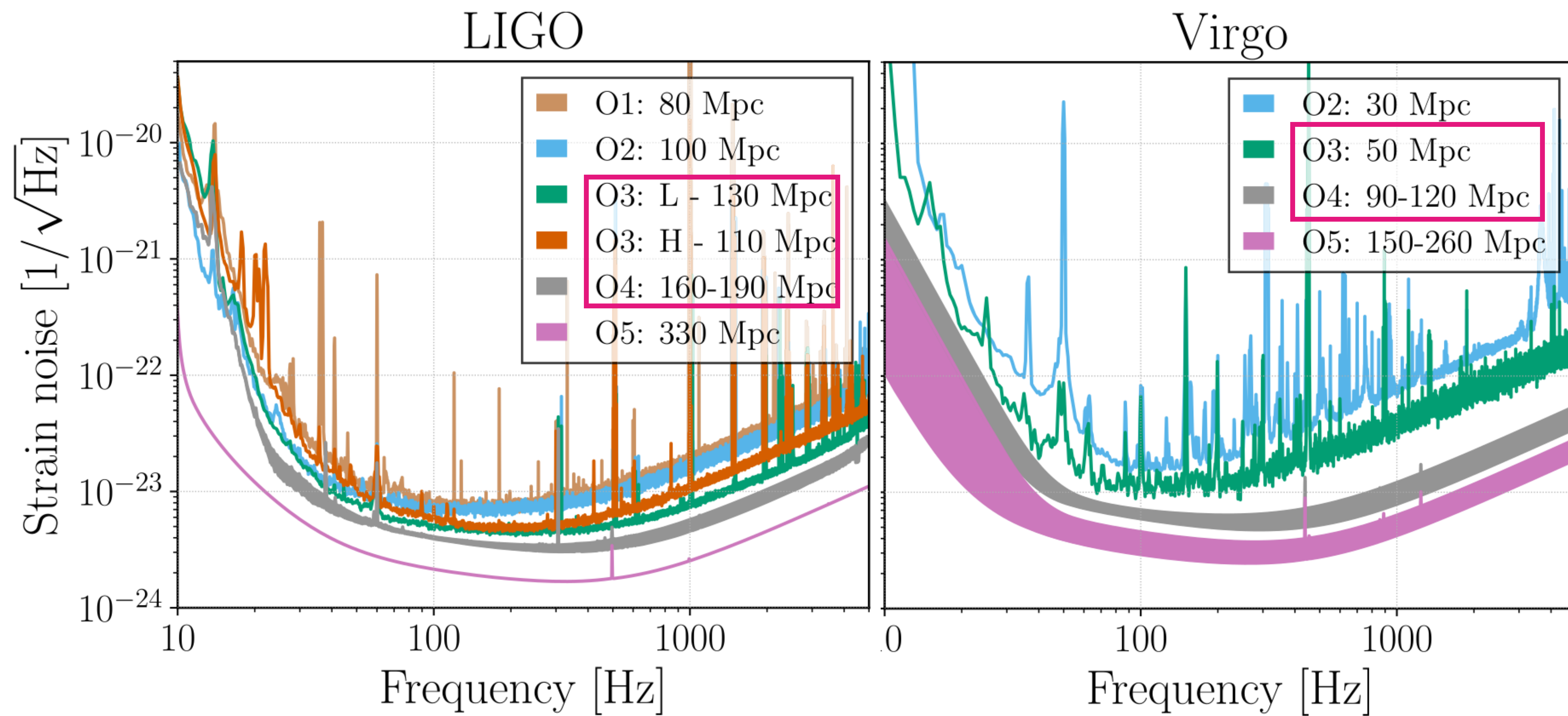
# Masses in the Stellar Graveyard



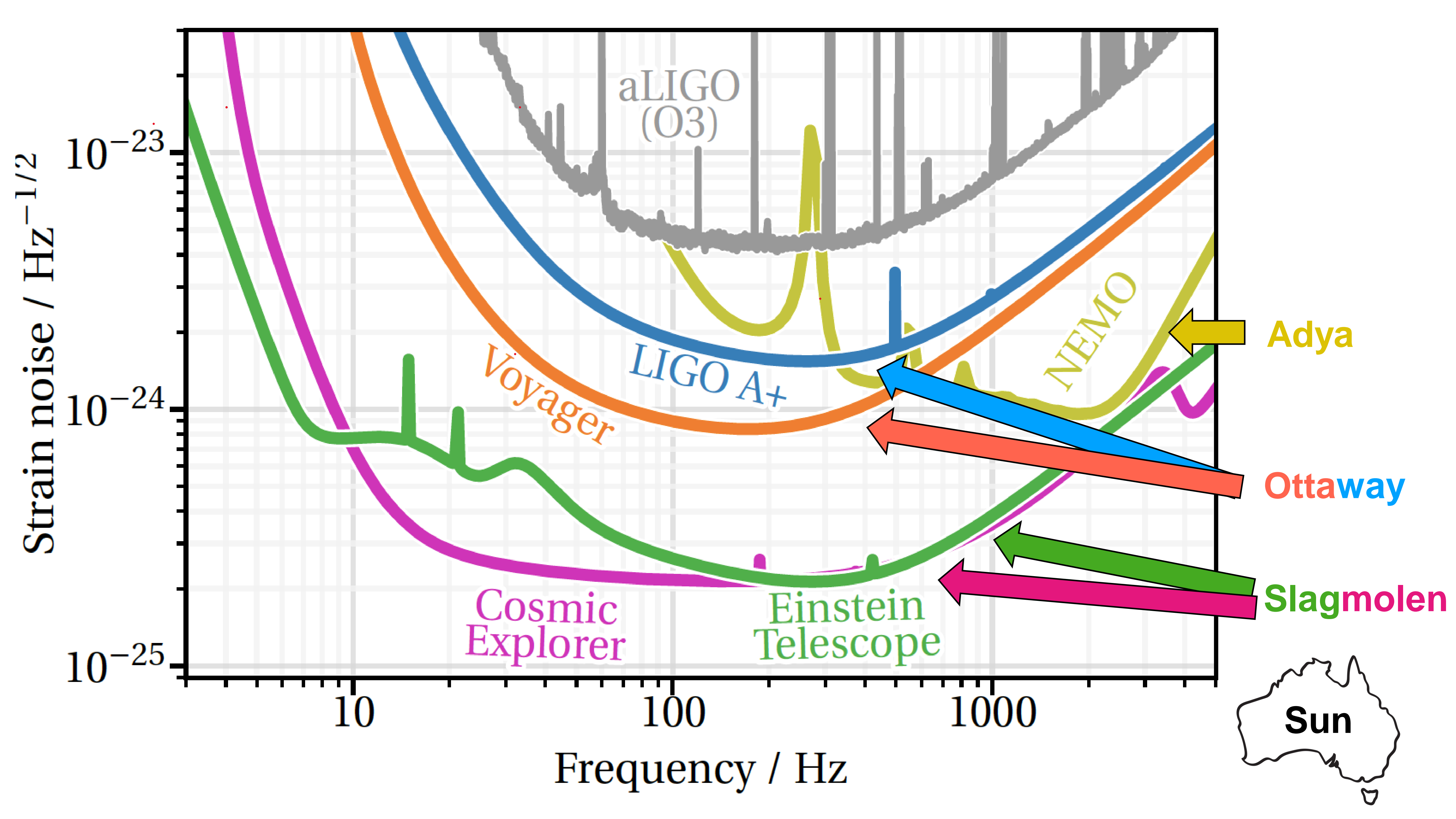


# Masses in the Stellar Graveyard





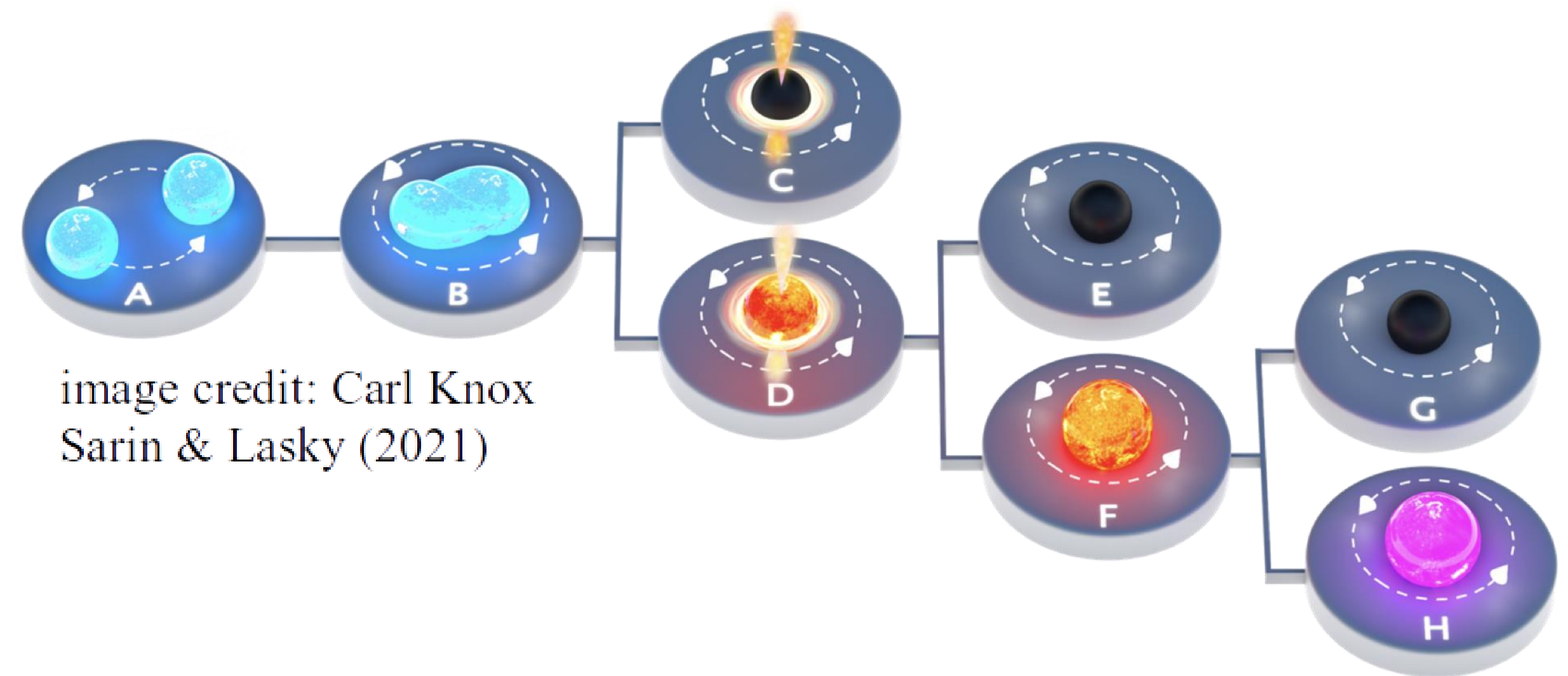
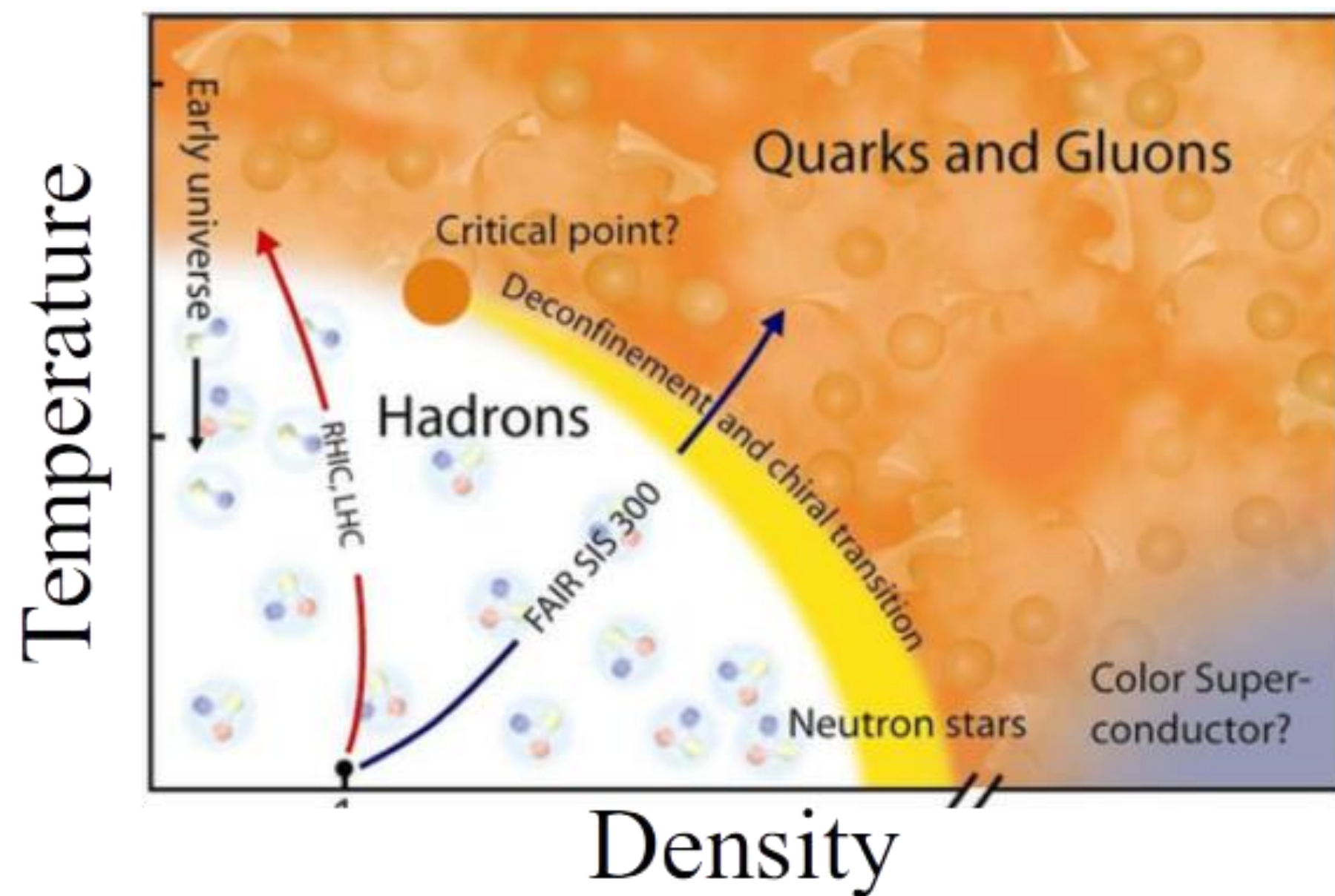
LIGO-Virgo-KAGRA Fourth Observing Run  
~ March 2023



# Physics and Astrophysics

## Neutron star mergers:

- Inspiral: cold equation of state, populations, cosmology (Davis – next!), ...
- Post-merger: hot equation of state, jets, ...
- Multimessenger: gamma-ray burst physics, neutron star astrophysics, ...

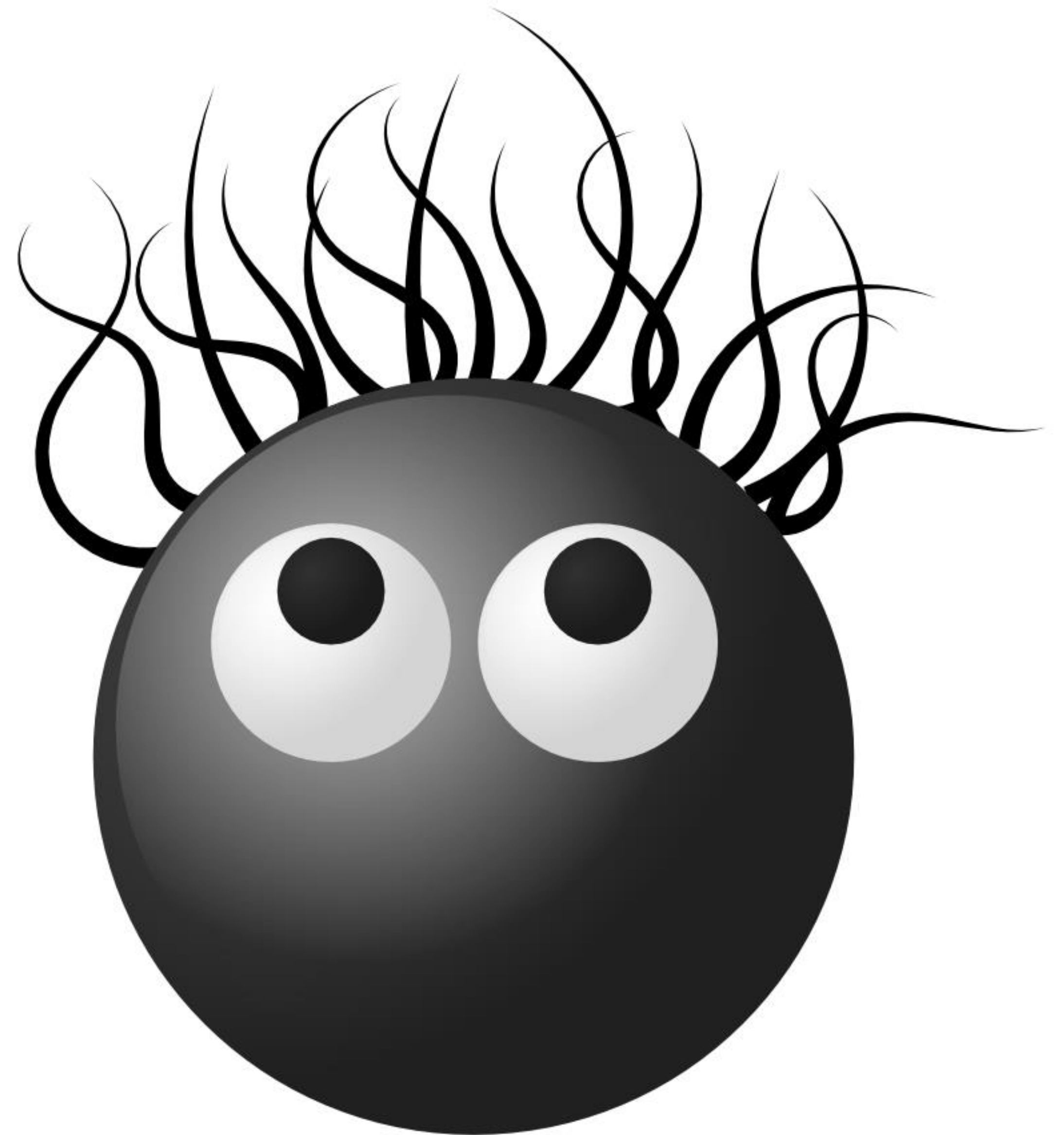


# Physics and Astrophysics

Neutron star mergers

Black hole mergers

- How do black holes form and merge?
- Galactic astrophysics
- Tests of general relativity



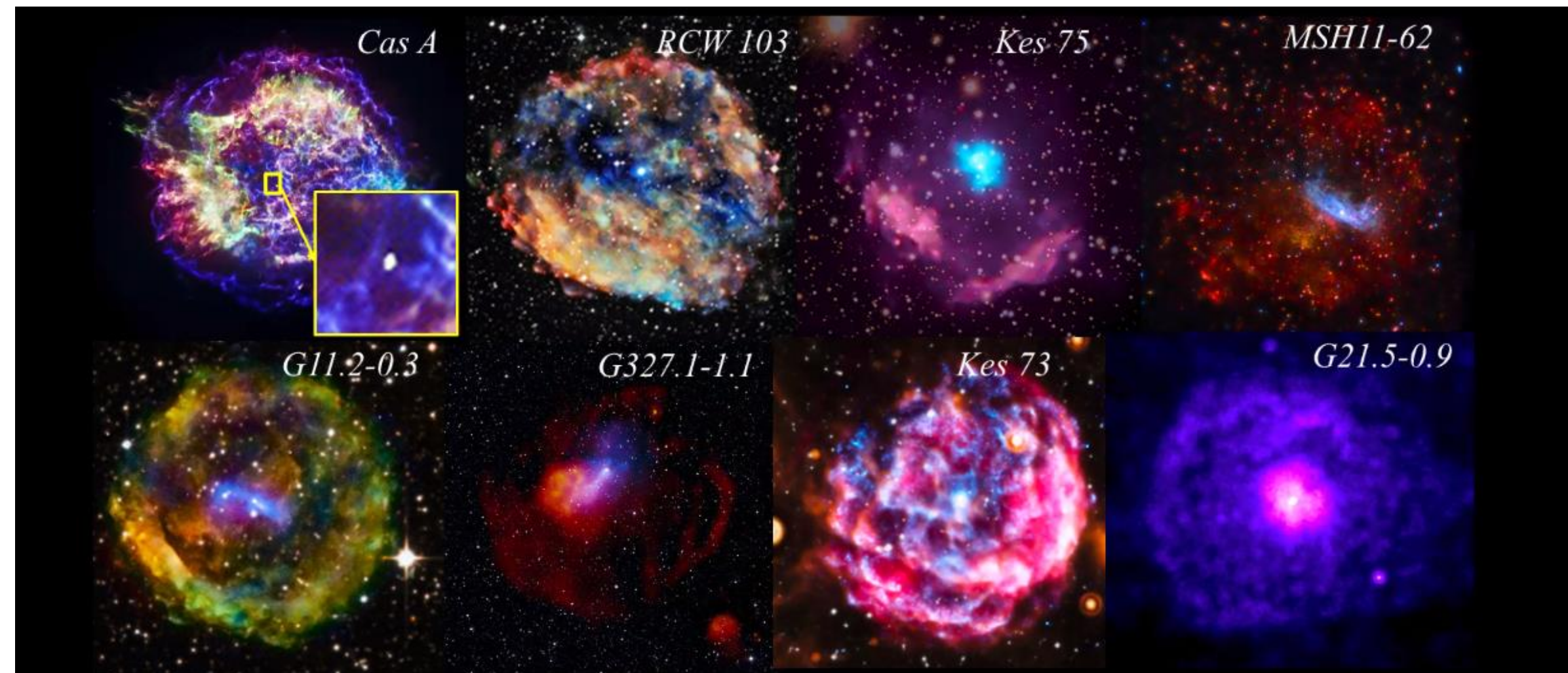
# Physics and Astrophysics

Neutron star mergers

Black hole mergers

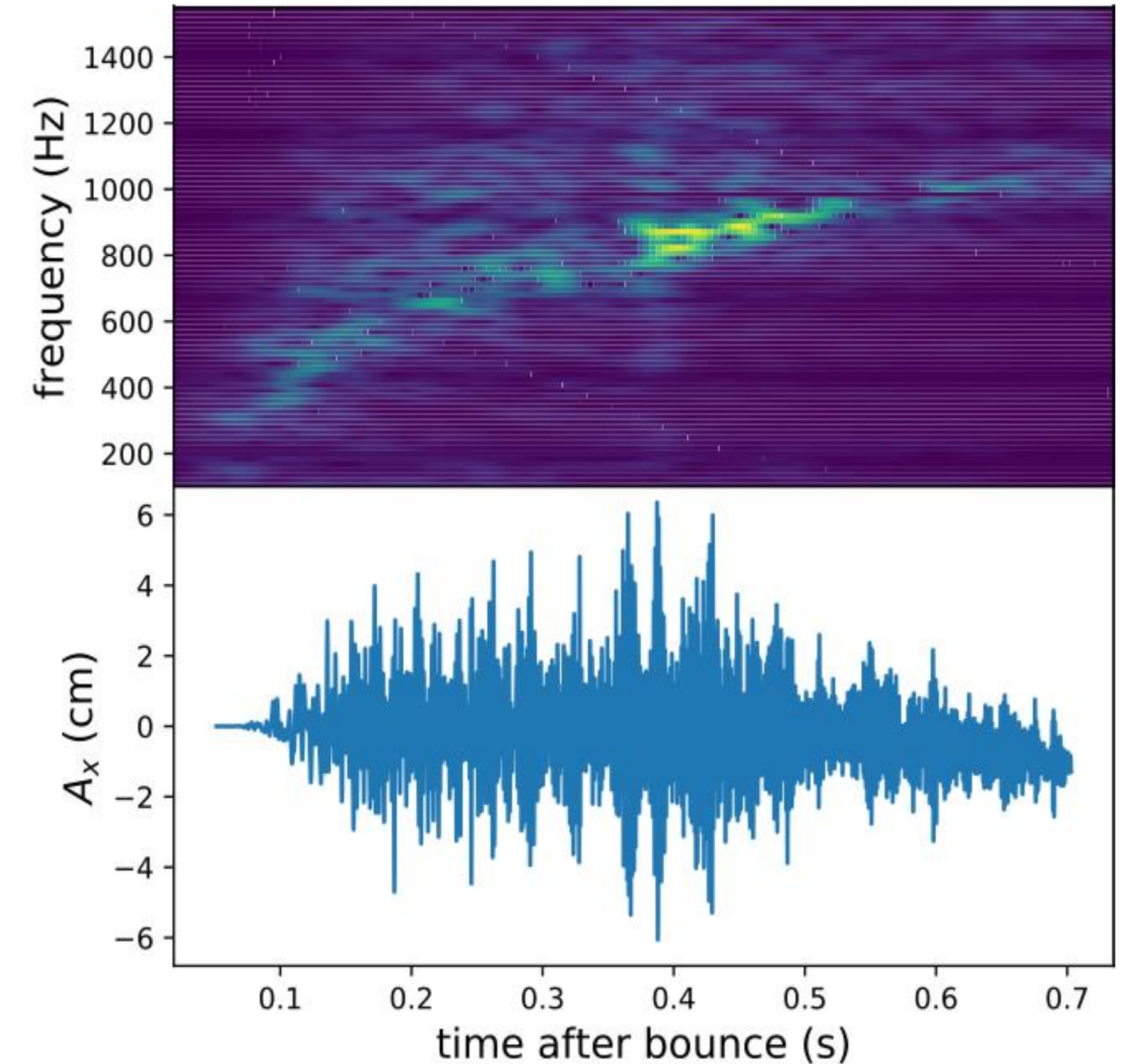
Supernovae

- Core bounce + protoneutron star oscillations
- Supernova explosion mechanism
- Multimessenger (SN remnants, pulsar kicks, ...)



Credit: Katie Auchettl

Powell & Mueller (2019)



# Physics and Astrophysics

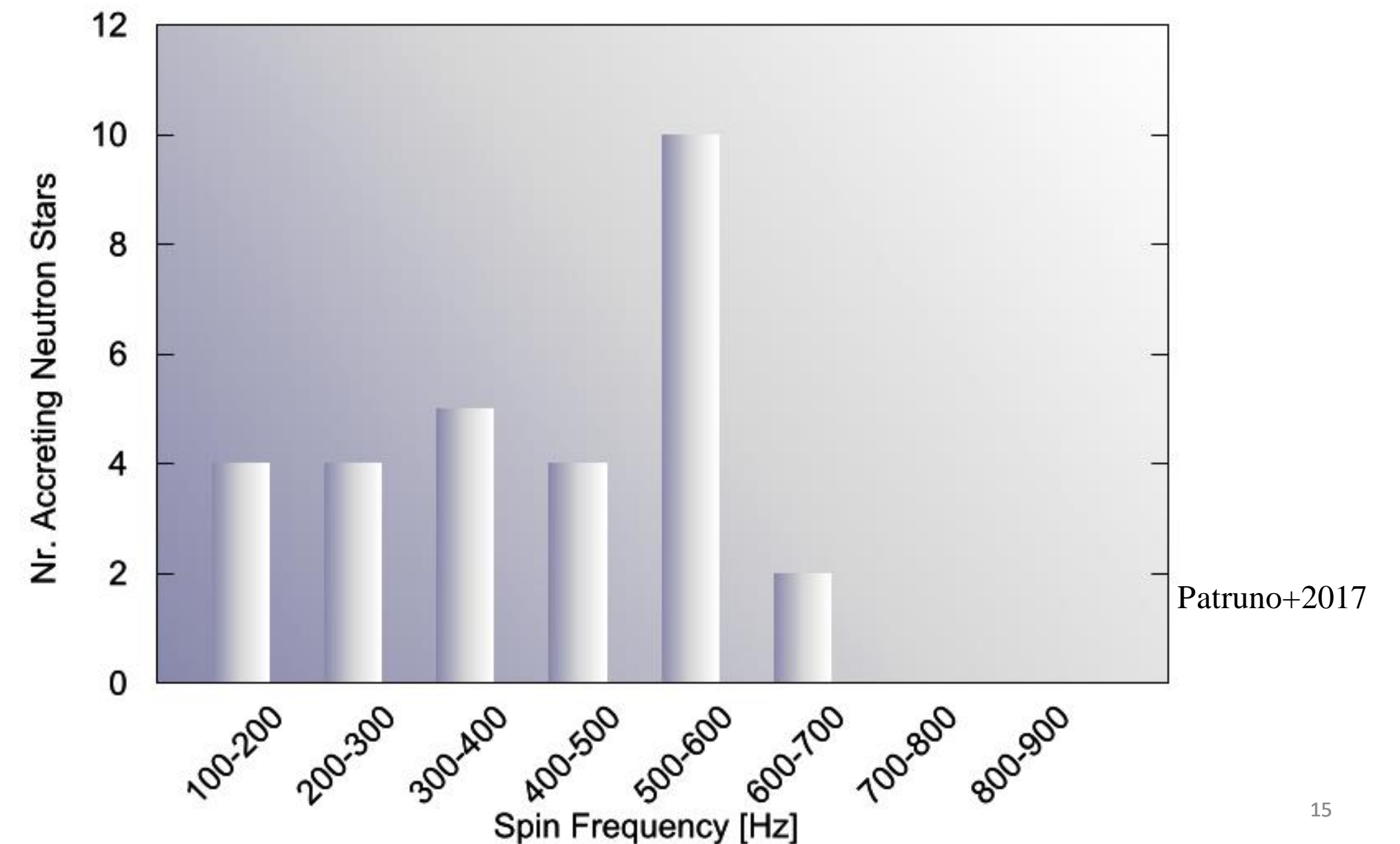
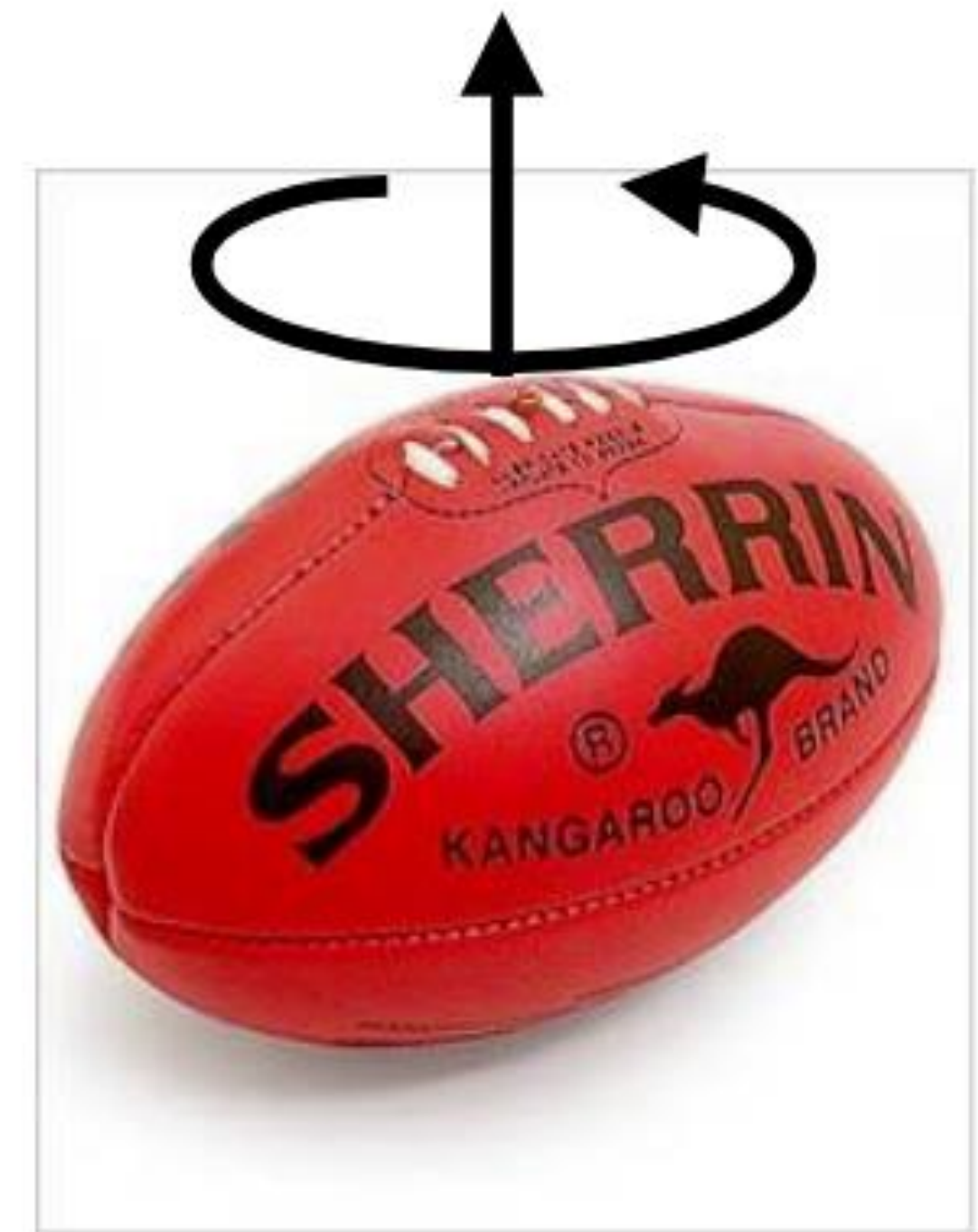
Neutron star mergers

Black hole mergers

Supernovae

Pulsars

- How elliptical are millisecond pulsars?  $\sim \langle \epsilon \rangle \sim$
- Neutron star equation of state
- Pulsar astrophysics



# Physics and Astrophysics

Neutron star mergers

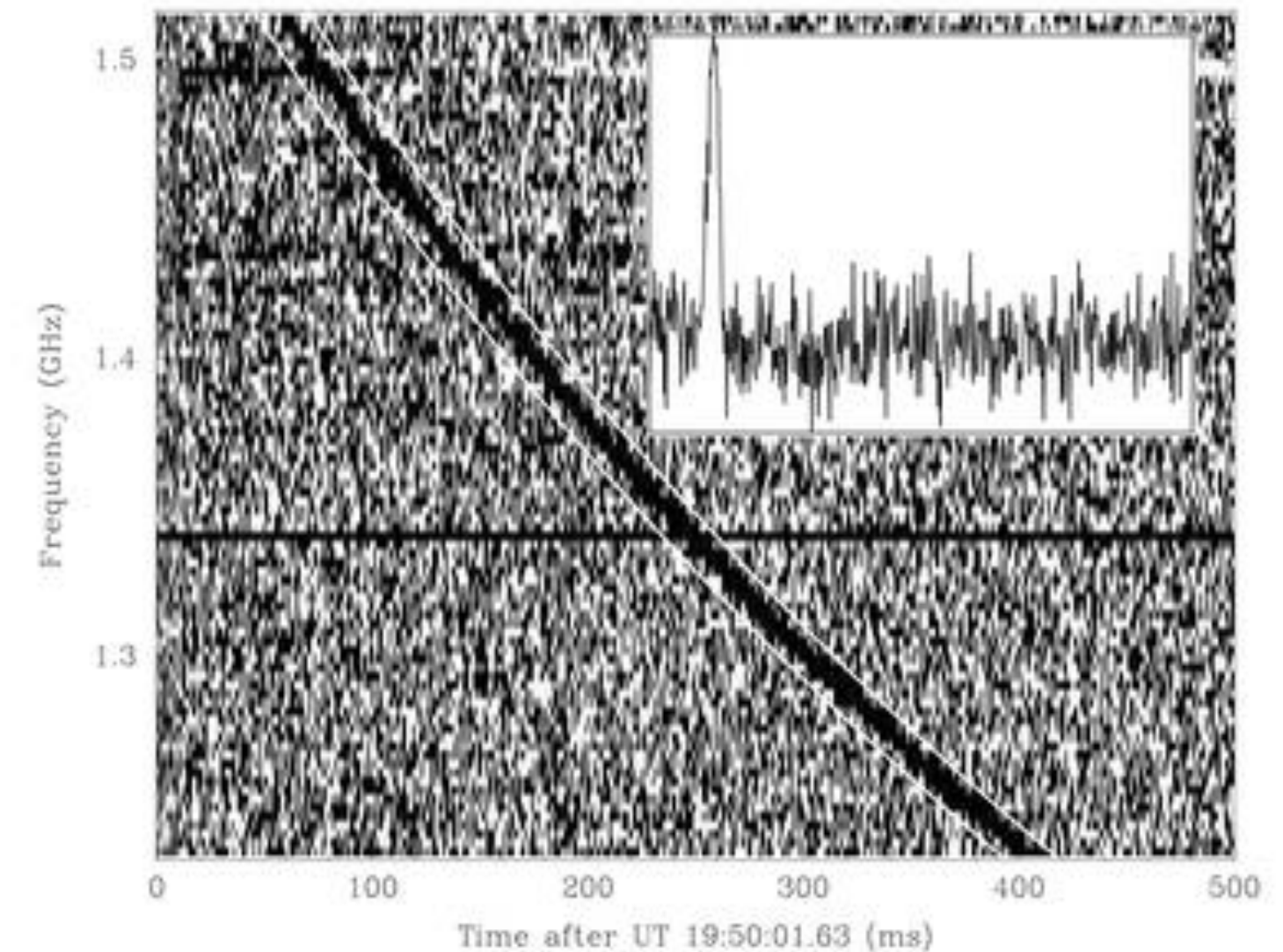
Black hole mergers

Supernovae

Pulsars

Other burst sources

- Magnetar flares (kHz, unknown amplitude)
- Fast radio burst progenitors
- Neutron star glitch's
- .....





# Physics and Astrophysics

Neutron star mergers

Black hole mergers

Supernovae

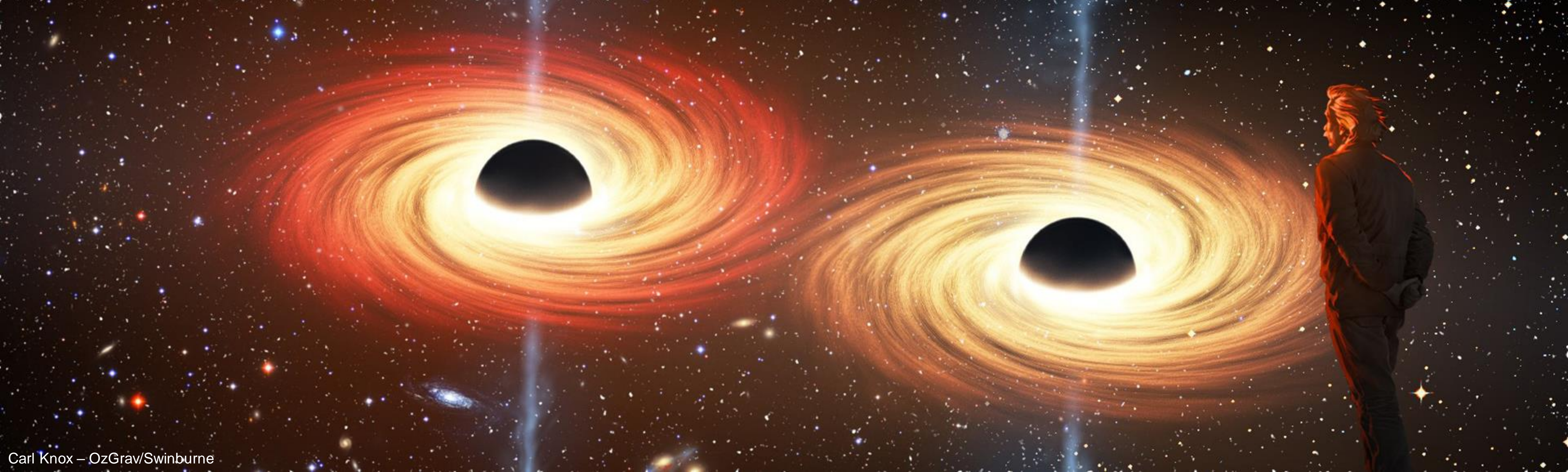
Pulsars

Burst sources

Exotica

- **<cliché alert>Opening a new window on the Universe</cliche alert>**
- Cosmic strings, black hole spectroscopy, superradiant instabilities, echos,  
....



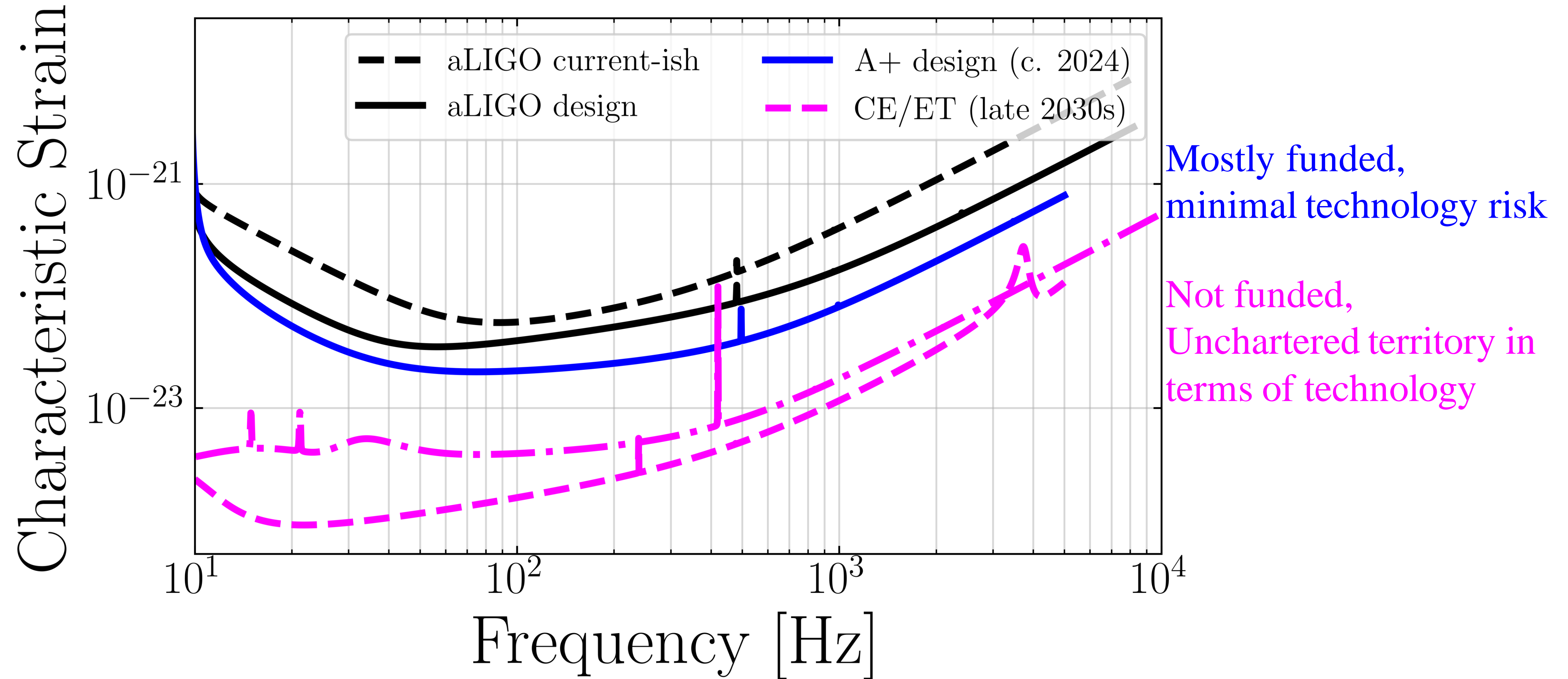


Carl Knox – OzGrav/Swinburne

# Science with future gravitational-wave observatories: Astrophysics

Paul Lasky

# What's next in gravitational-wave astronomy?



# What's next in gravitational-wave astronomy?

