LIGO-G2401328

UO LIGO Group

Graduate Students

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Ray Frey
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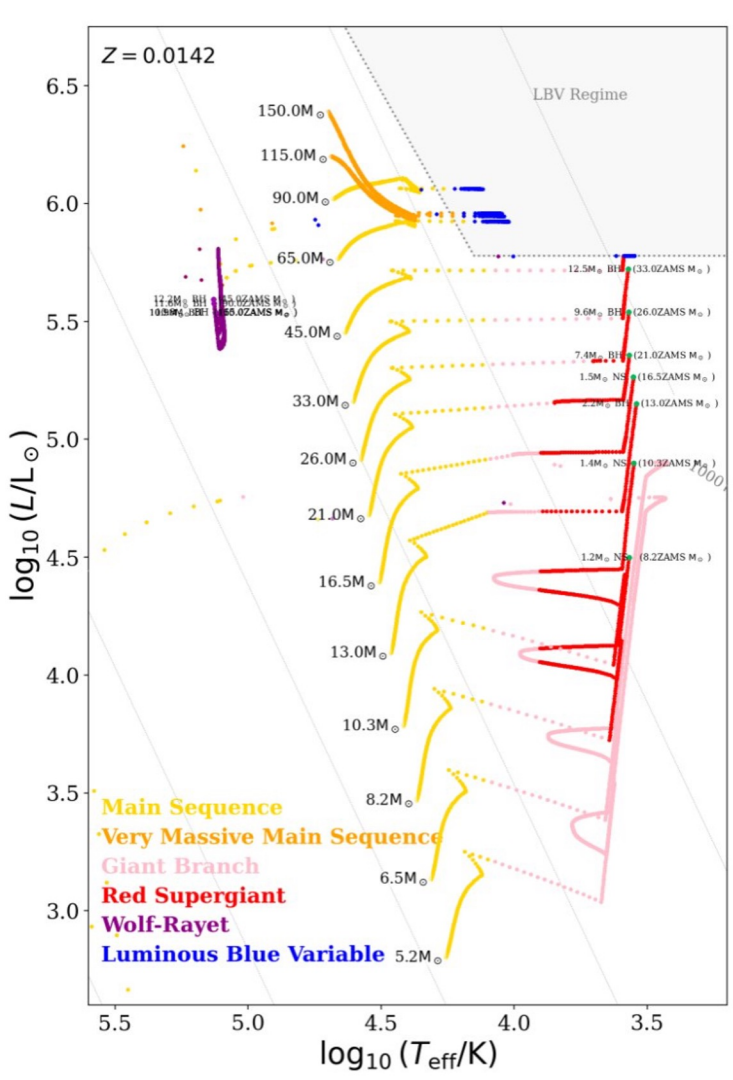
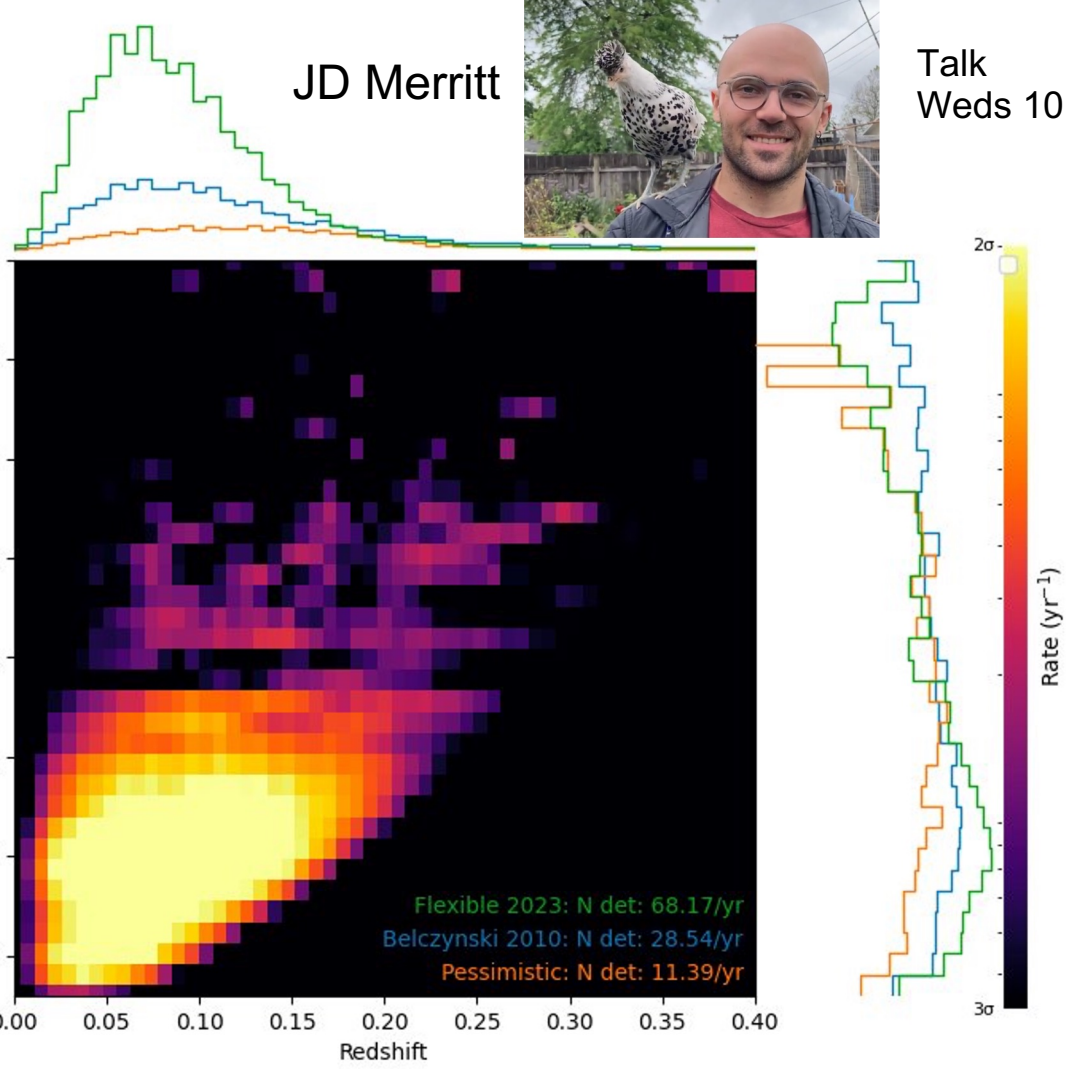
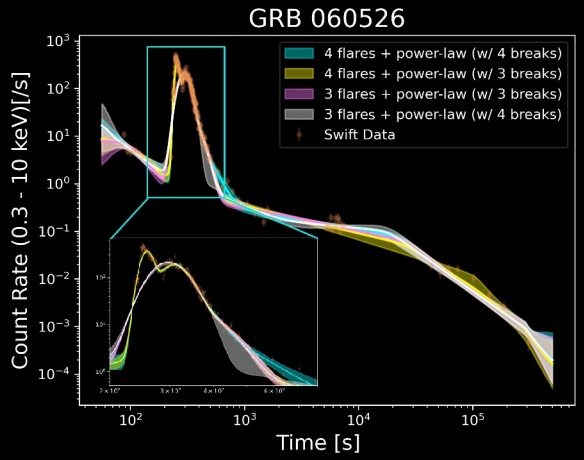
UNIVERSITY OF OREGON

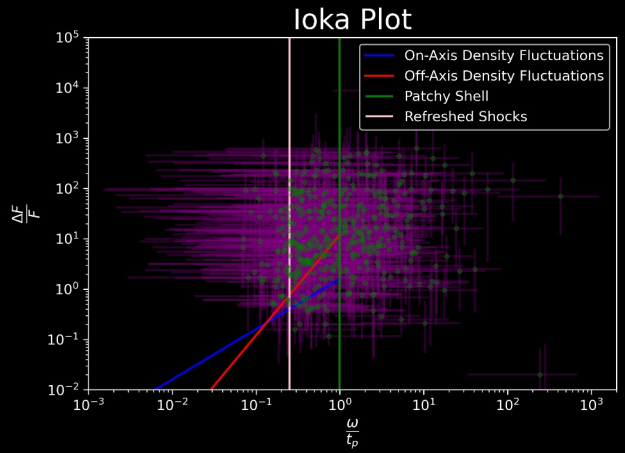
*LSC Fellows, LHO, Summer, Fall 2024


Z = 0.0142
LBV Regime
150.0M⊙
115.0M⊙
90.0M⊙
65.0M⊙
45.0M⊙
33.0M⊙
26.0M⊙
21.0M⊙
16.5M⊙
13.0M⊙
10.3M⊙
8.2M⊙
6.5M⊙
5.2M⊙
Main Sequence
Very Massive Main Sequence
Giant Branch
Red Supergiant
Wolf-Rayet
Luminous Blue Variable
log10 (L/L⊙)
log10 (Teff/K)


JD Merritt
Talk
Weds 10
Chirp mass (M⊙)
Redshift
Flexible 2023: N det: 68.17/yr
Belczynski 2010: N det: 28.54/yr
Pessimistic: N det: 11.39/yr
2σ
3σ
Rate (yr⁻¹)

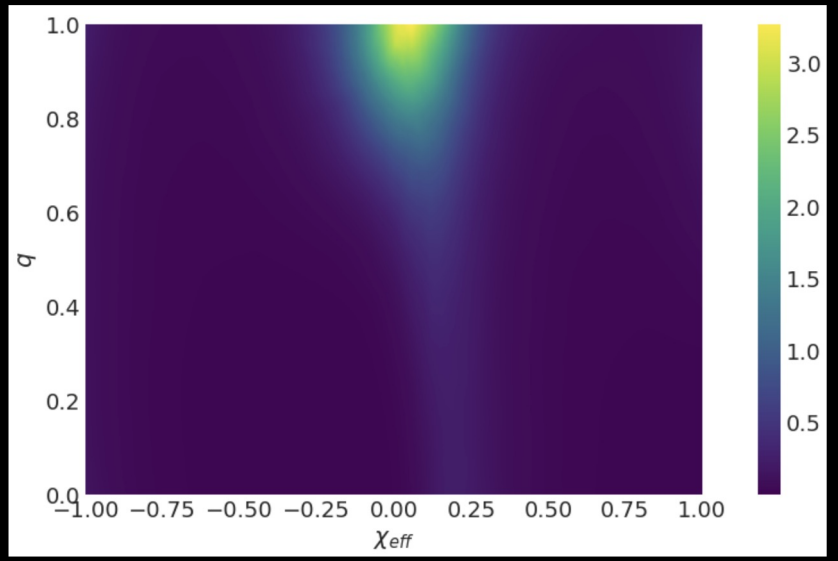
GRB Afterglows





Gino Carrillo

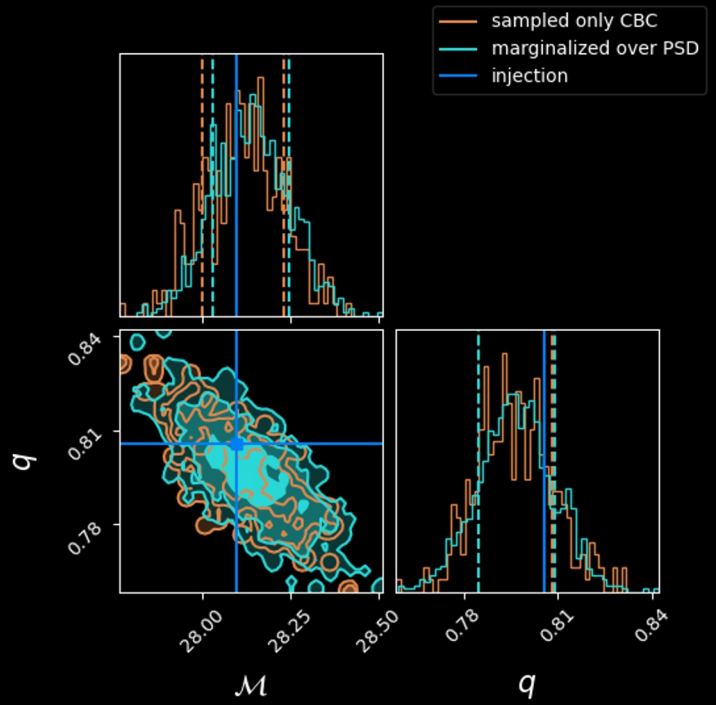
Application of 2D-Bsplines in search of q-chi_eff correlations

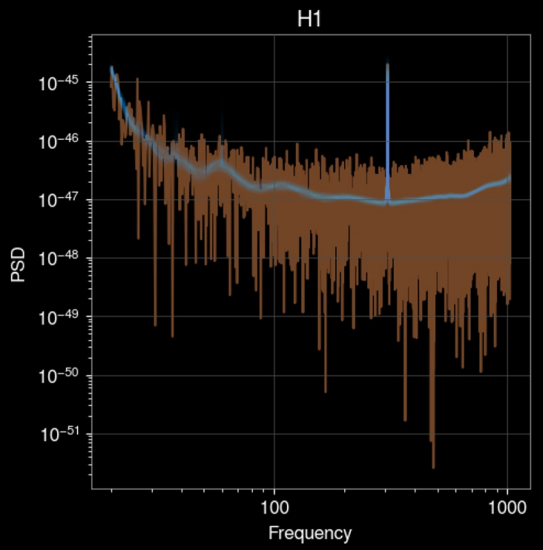


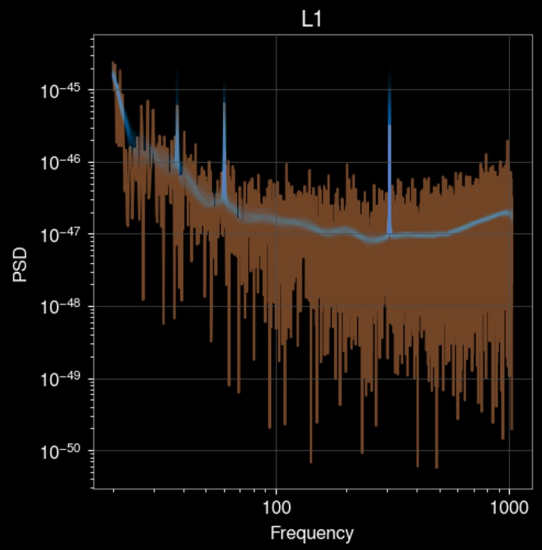
Sangeet Paul

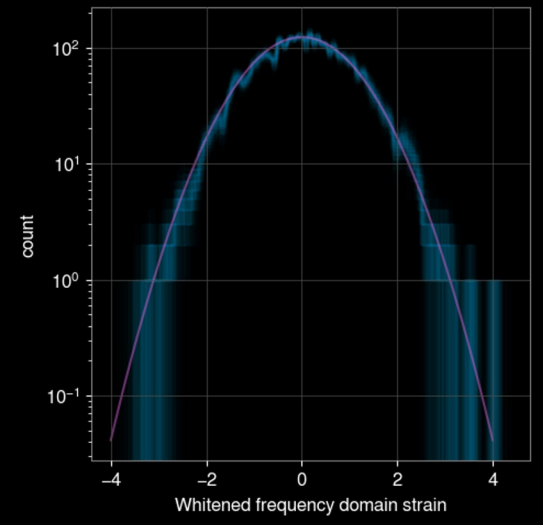
Parametric PSDs

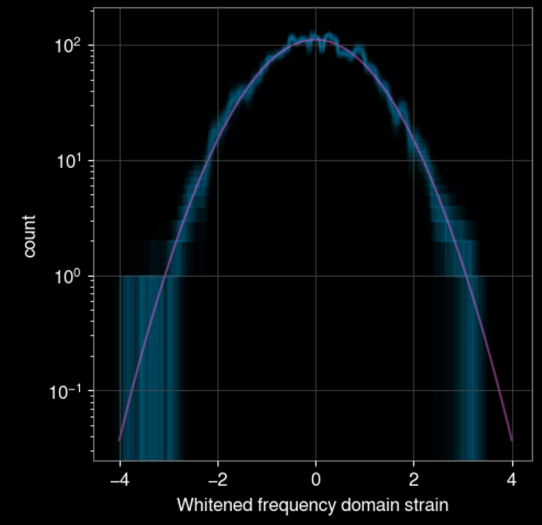
Simultaneous inference of CBC and noise parameters.









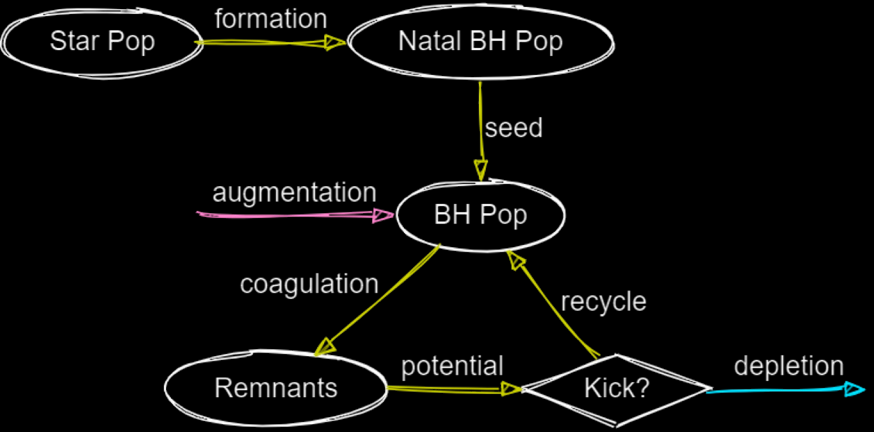


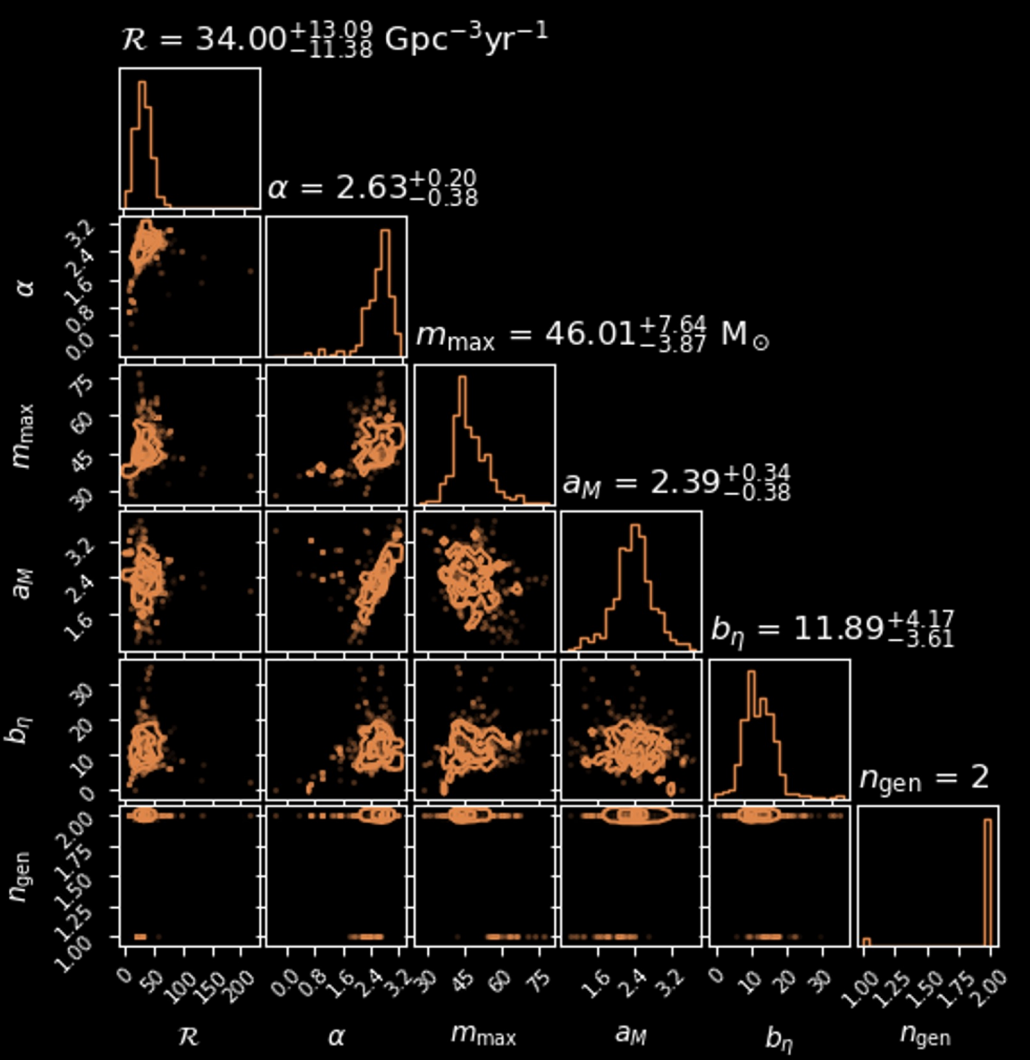
Sangeet Paul

Hierarchical Mergers

Model: BH Coagulation.

Bayesian inference of natal populations, dynamical environments, merger rates, and merger ancestries.

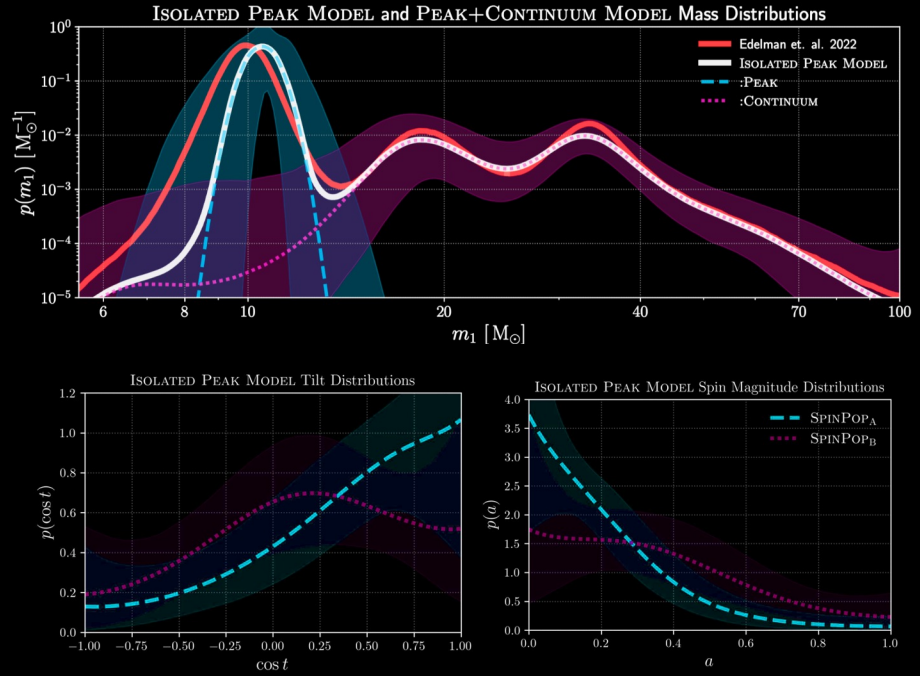




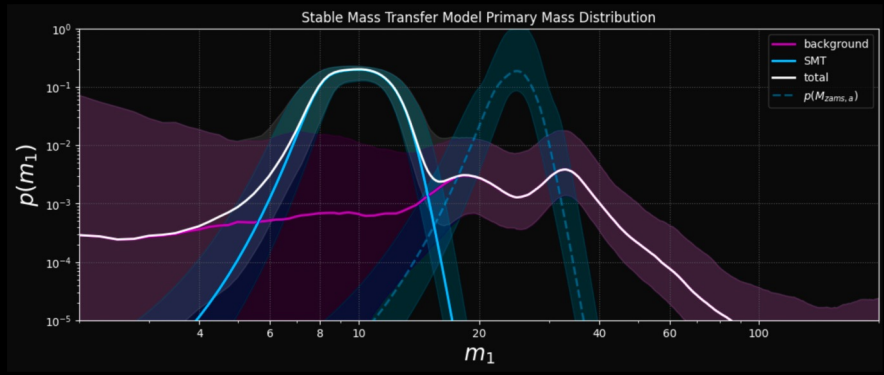
Jaxen Godfrey

BBH Subpopulation Models

Cosmic Cousins: 10 Msun Subpopulation (update)



New Project: Building a Model for Stable Mass Transfer BHs

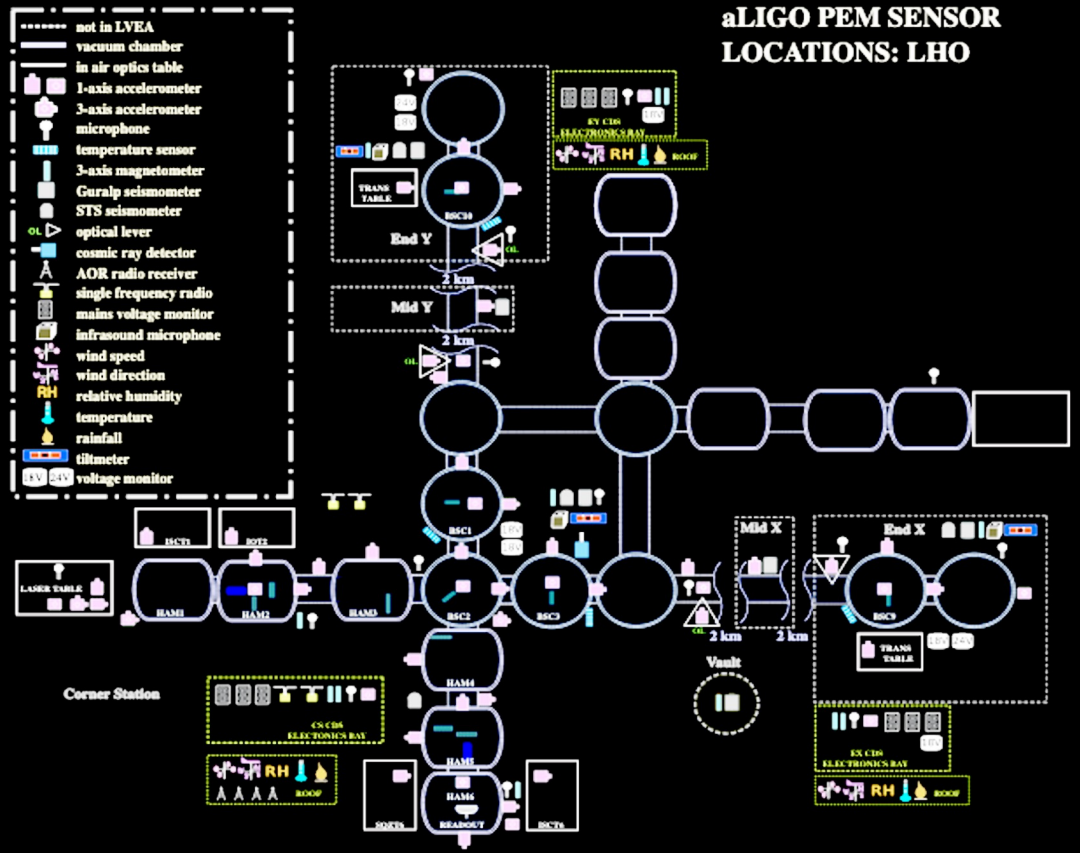


-> Directly model mass distributions of BBH progenitor stars (dashed curve) that undergo stable mass transfer prior to BBH formation

-> prelim results: 10 Msun peak consistent with SMT channel

arXiv:2304.01288

Environmental noise measurement in aLIGO



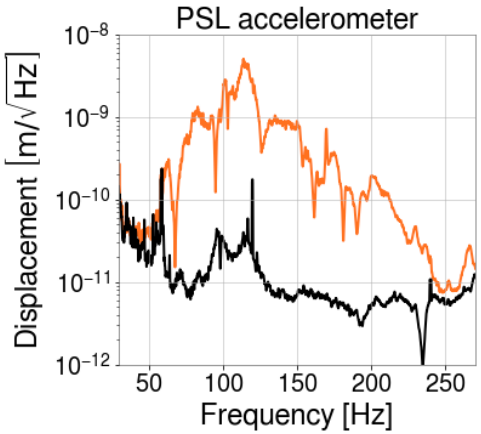
- The non-GW environment – are the candidates GW signals?

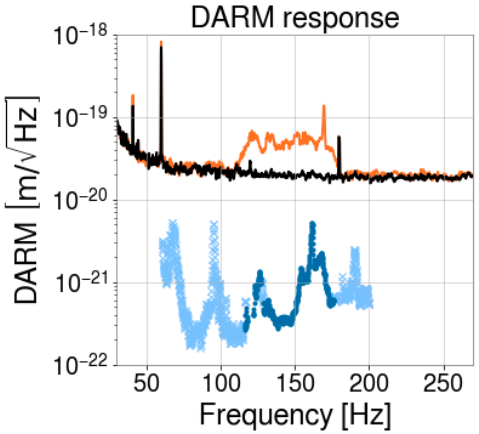
UO responsible for development and maintenance of instrumentation (PEM) required to measure the non-GW environment and its coupling to DARM

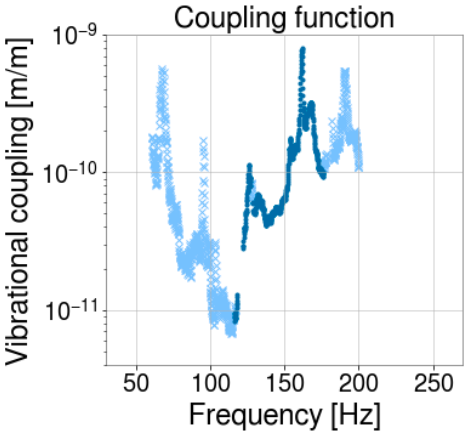
(Schofield, students)

- Commissioning, noise hunting and mitigation (Schofield, et al)

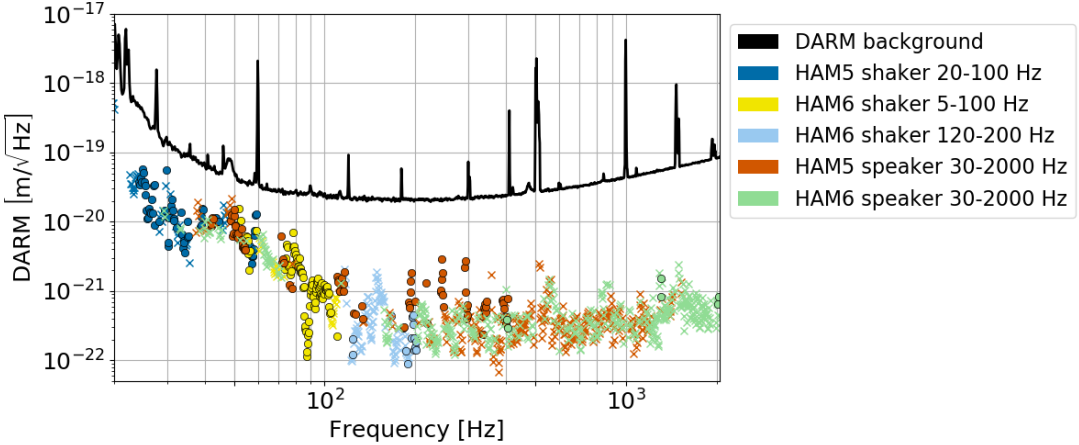
Quantitative measurement of the effect of environmental noise







Schofield, Nguyen, Helmling-Cornell, Frey
Class. Quant. Grav. 38 (2021)

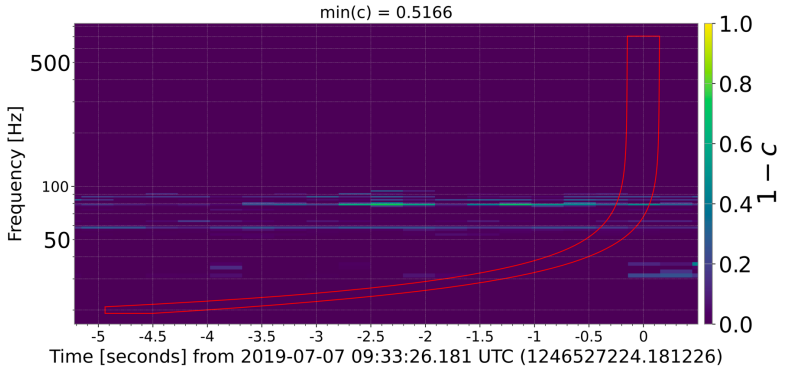


This example (O3) for vibrational coupling, e.g. upconverted ground motion (seismic, wind, etc). Others include:

- Magnetic fields
- Acoustic noise
- RF
- Cosmic rays

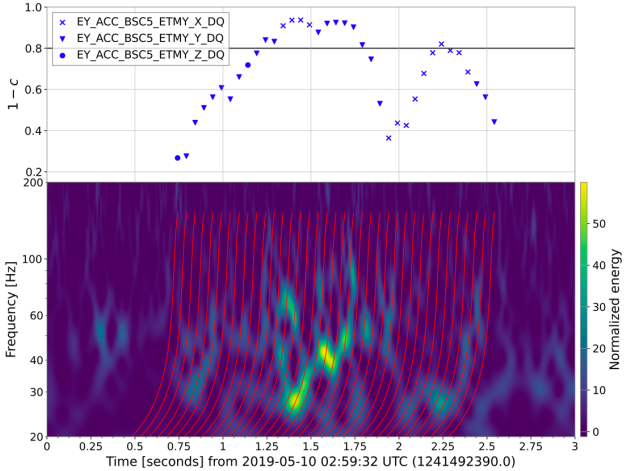
Using the coupling fns to vet GW candidates in low-ish latency – the PEMcheck DQR app

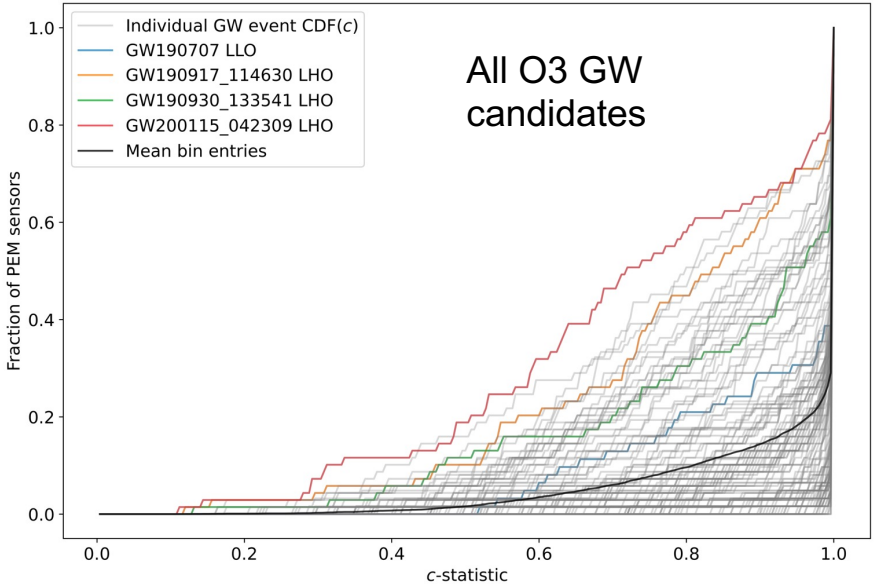
Adrian Helmling-Cornell, Schofield, Nguyen, Frey
to appear in CQG



A statistic (c-statistic) is calculated to indicate the possibility of environmental contamination. c < 0.2 considered suspicious

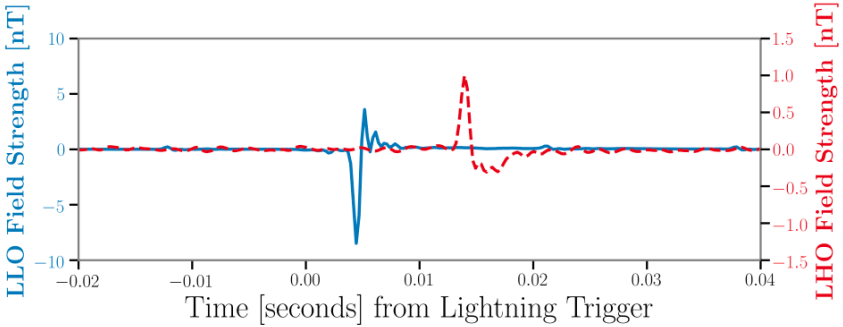
Sanity check: Thunderclap

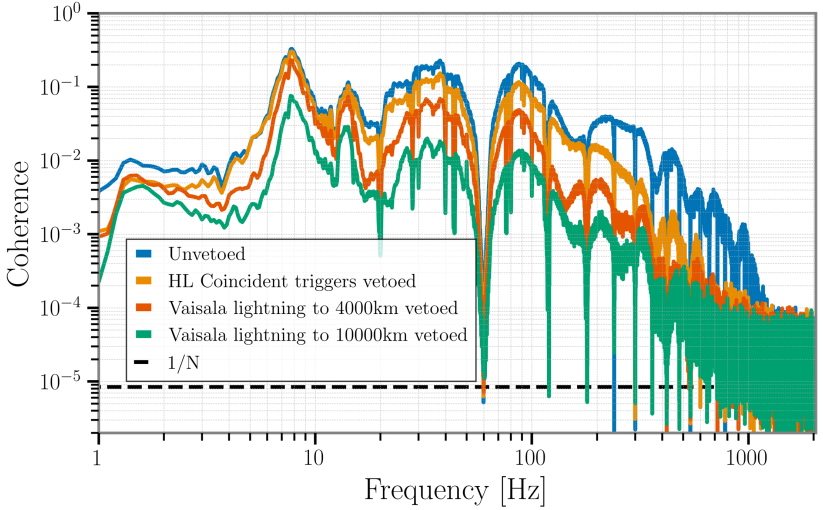


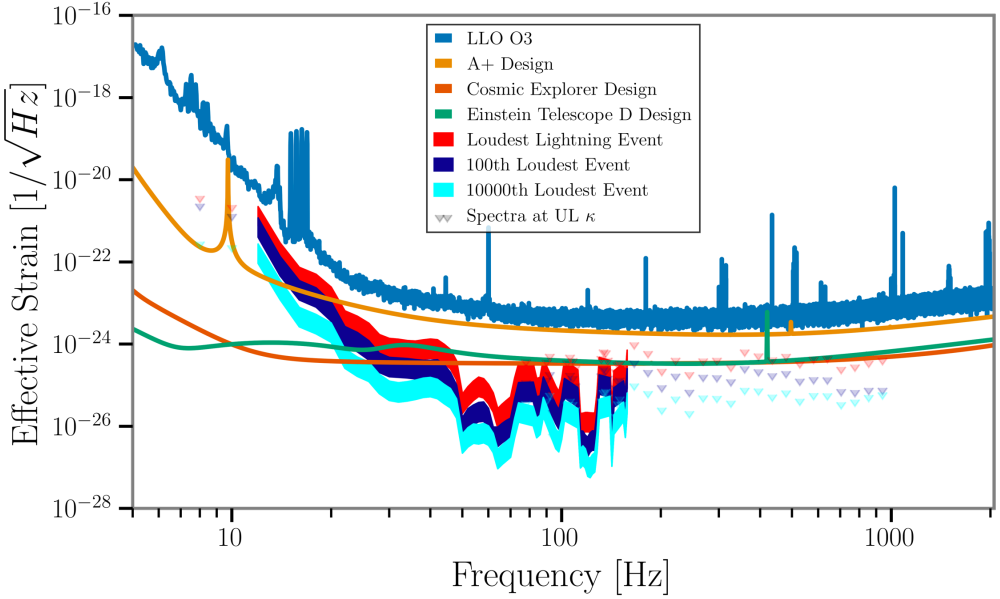


Lightning-induced coherent magnetic noise

Matthew Ball, Schofield, Frey
PRD 107, 022004 (2023)



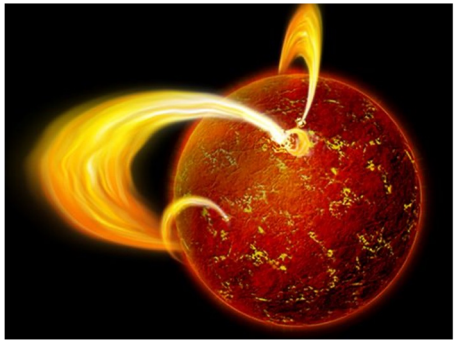




If the coupling of magnetic fields to DARM is unchanged, a BNS signal in Cosmic Explorer will include ~100 lightning strokes

Astrophysical inference from NS f-modes

Matthew Ball, Frey, Merfeld
arXiv:2310.15315

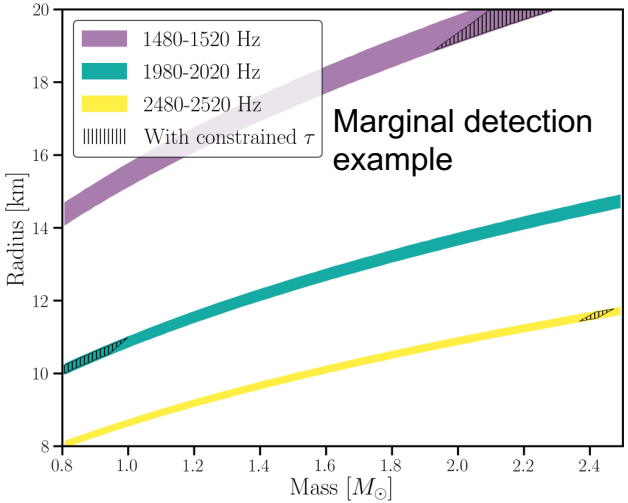


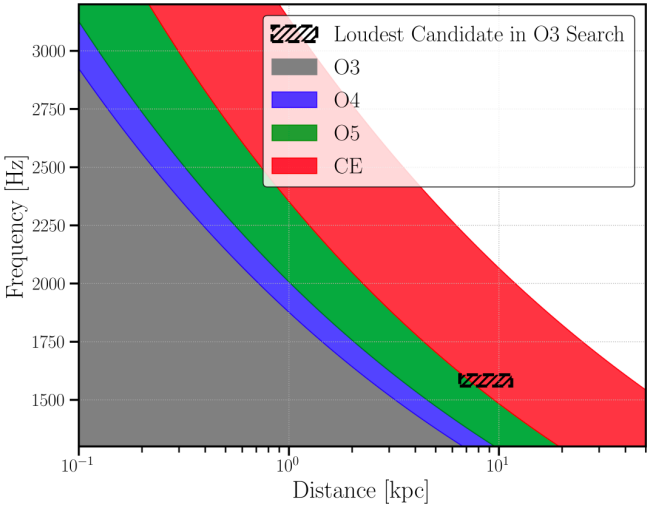
- X-ray flares from magnetars accompany a major perturbation, such as crust cracking or B-field rearrangement
- These probably ring up mechanical modes: f-modes → GWs
- Can use a detection or non-detection to infer NS properties
- Use Bilby PE code to infer parameters

f-modes as damped sinusoids (Andersson & Kokkotas

$$\nu_{GW}(kHz) \approx 0.78 + 1.635\left(\frac{\overline{M}}{\overline{R}^3}\right)^{1/2}$$

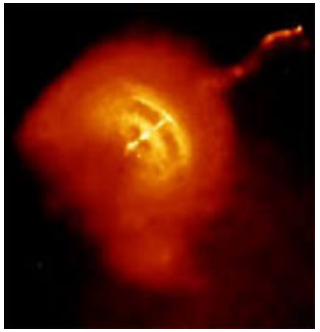
$$\frac{1}{\tau_{GW}(s)} \approx \frac{\overline{M}^3}{\overline{R}^4}\left[22.85 - 14.65\left(\frac{\overline{M}}{\overline{R}}\right)\right]$$





Distance/frequency space where 10% of candidates could be detected with SNR>3 for current/future detectors

Vela Glitch of April 29, 2024



Matthew Ball, Frey, et al

Radio observations:

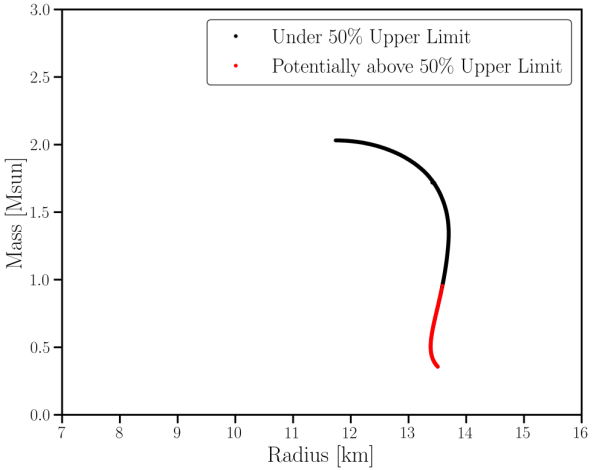
- Rotational frequency changed: $\frac{\Delta f}{f} \sim 2.4\times10^{-6}$
- Time of glitch known to ~ +/- 4 s

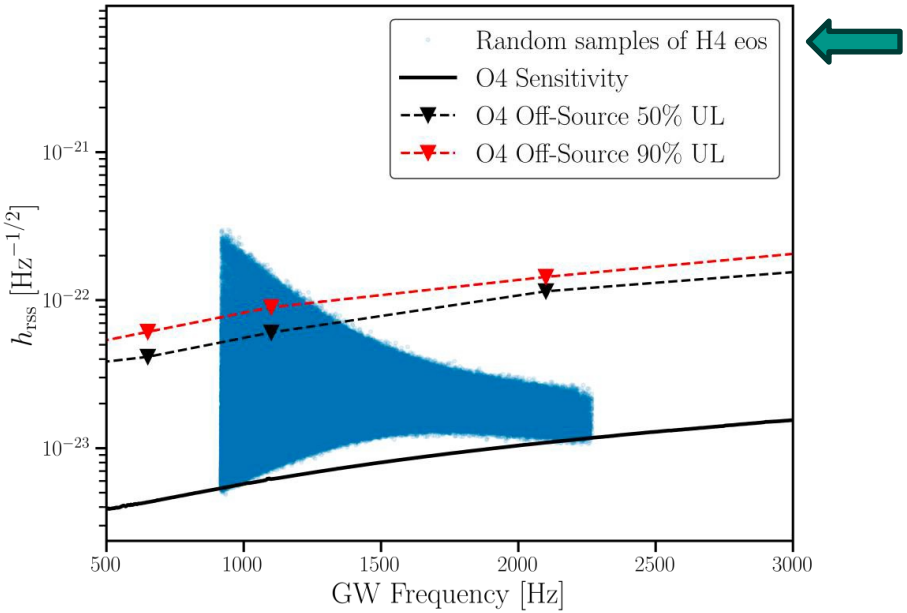
An impulse which can ring up f-modes ?

➔ analysis ~ magnetar flare

Vela distance: 267 pc

Assume all glitch energy goes into f-modes:

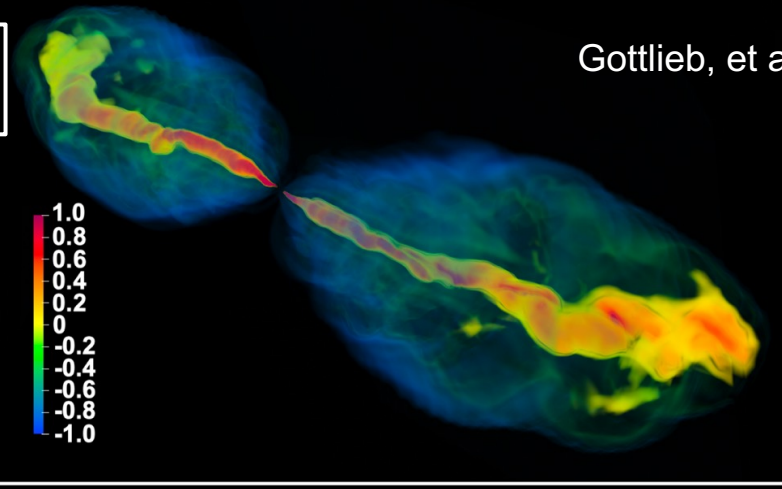




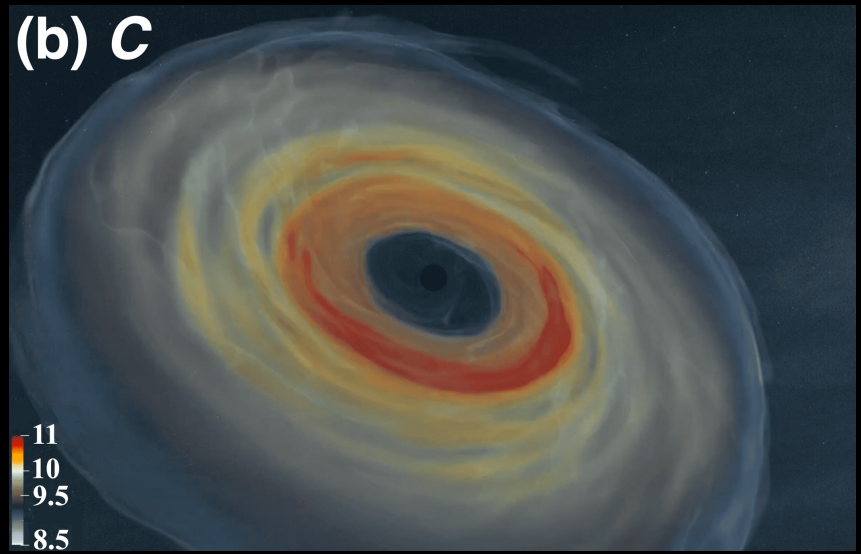
GWs from collapsars

Ben Mannix,
Genevieve Connolly

- Collapsars: The collapse of massive, highly rotating evolved stars
- Progenitors of (most) long GRBs (gamma-ray light curves longer than ~2s)
- LGRB placement follows star formation
  - Most distant z~8
  - Nearest 40 Mpc (pre-LIGO)
  - Redshifts largely unmeasured (few %)
- Collapsar accretion disks long considered to be potential GW sources – non-homogeneities
  - van Puttten, Piro & Pfahl
- Recent full hydrodynamic simulations optimistic
- GWs from wobbling jets (top)
- GWs from generic accretion disk formation (bottom)
- The GW emission extends well outside the GRB
  - Searches triggered by GRB detection
  - Searches triggered by Type Ib,c SN



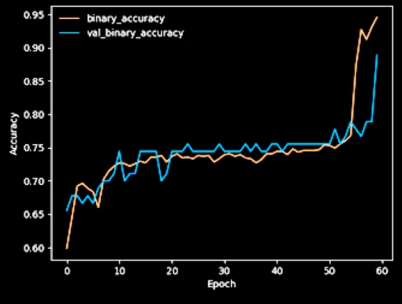
Gottlieb, et al

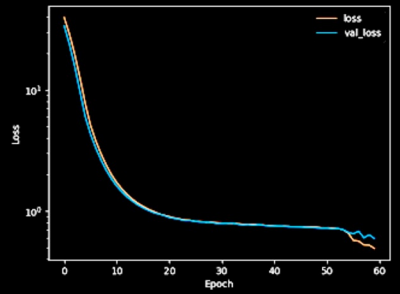


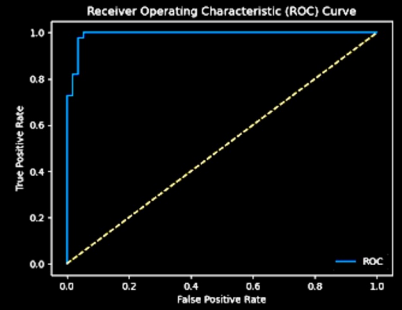
Adrian Helmling-Cornell

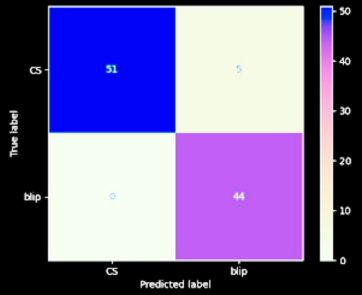
Blip Glitches and Cosmic Strings

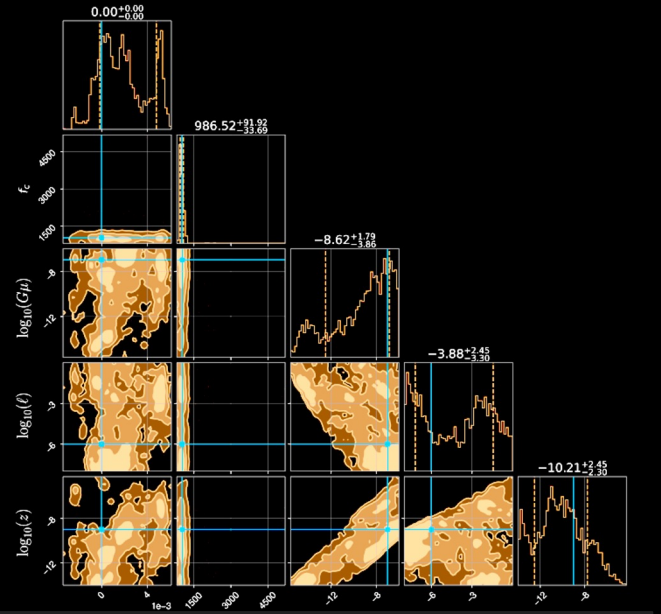
Machine learning methods for distinguishing GWs from cosmic strings from glitches in the detector, parameter estimation with injected GW CS signals, O4 burst search (Helmling-Cornell)





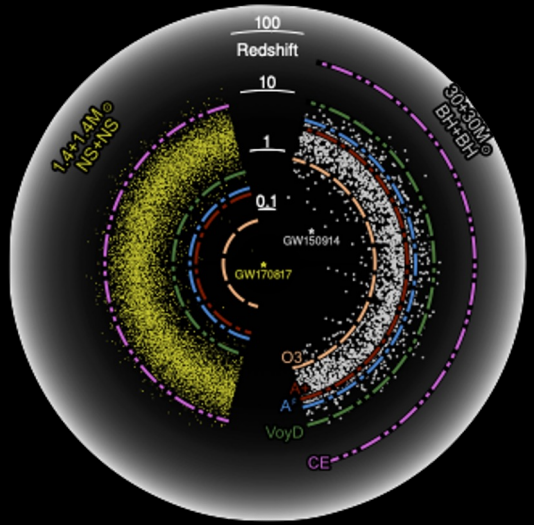






Post-O5

What should we do with current facilities after O5?



LASER INTERFEROMETER GRAVITATIONAL WAVE OBSERVATORY
- LIGO -
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LIGO SCIENTIFIC COLLABORATION

Technical Note	LIGO-T2200287–v2	2022/11/09

Report from the LSC Post-O5 Study Group

Post-O5 Study Group

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