1 minute 1 slide

Instructions #1

In light of the very large number of requests, we will have 3 session

- Apr 23 1.00 PM-1.10PM Boston time (10 slots)
- Apr 24 1.00 PM-1.10PM Boston time (10 slots)
- Apr 25 12.45 PM -1.00 PM Boston time (15 slots)

Write **one** slide and *append* it to this slide deck, under the Apr 23, Apr 24 or Apr 25 headers.

You will have one minute to talk.

If a section is already full, use another one. We will **only** cover 10 presentations on April 23, 10 on April 24 and 10 on April 25 so don't add yours if a particular day is already at capacity or else you will not have the opportunity to speak

Instructions #2

Under no circumstances can you add your slide above existing slides on the same day. You must append at the **end** (of a particular day).

Don’t forget to list your name and email in the slide, so that people can contact you if they want to discuss your work with you (we’ll make the slides visible to the participants after the Symposium)

We are really sorry if your favorite day is already full. We hope another day will work. If not, you can still add the slide at the end and it will be viewable offline.

Please check you are not deleting some else’s slide/material. We do not have a backup so be careful, please. If you accidentally delete something, immediately click on “Edit/Undo” to restore it. We rely on your care to avoid problems.

April 23
10 slots

The Unresolved CBC background & CE's sensitivity to Cosmological GWs

arxiv:2310.02517

Sharan Banagiri, Darsan Bellie, Zoheyr Doctor & Vicky Kalogera

Will CBC sources impact CE's sensitivity to cosmological GWs?

An important science target!

Resolvable CBC signals need to be effectively subtracted

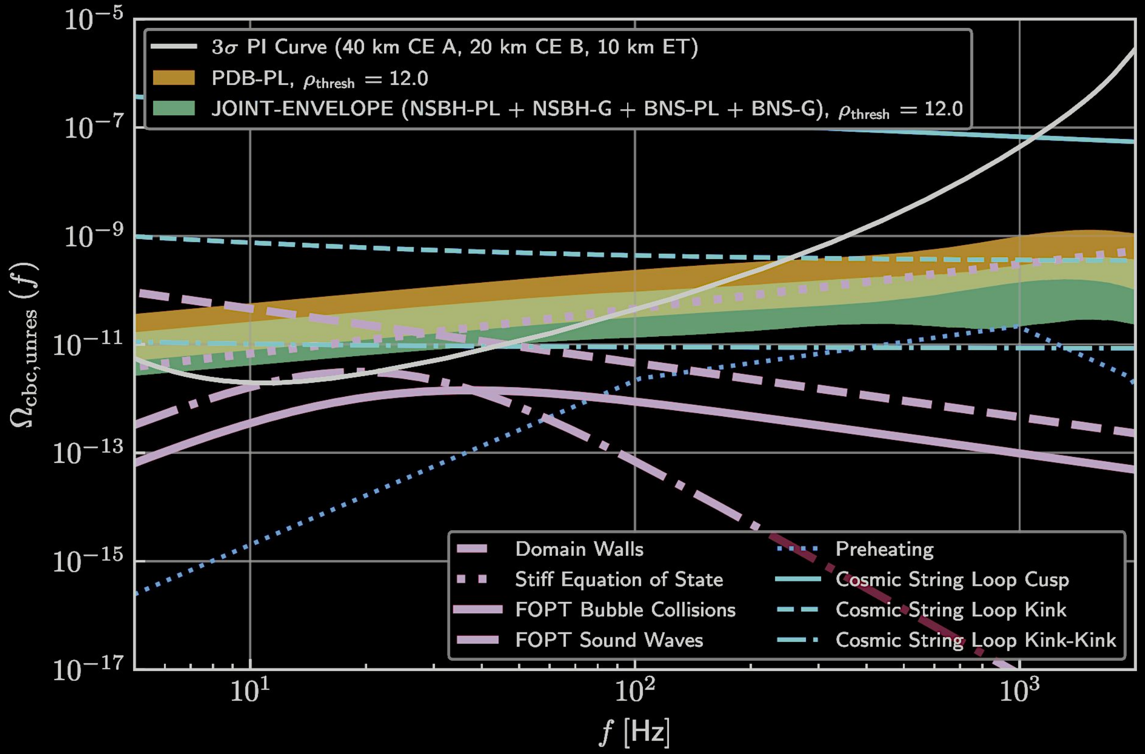
But what about unresolved CBCs?

We estimate the unresolved background in a data-driven manner

Using LVK and galactic NS detections and rates

We find

- The unresolved CBC background will likely be a major impediment for cosmological signals
- The NSBH background is similar in strength to the BNS background



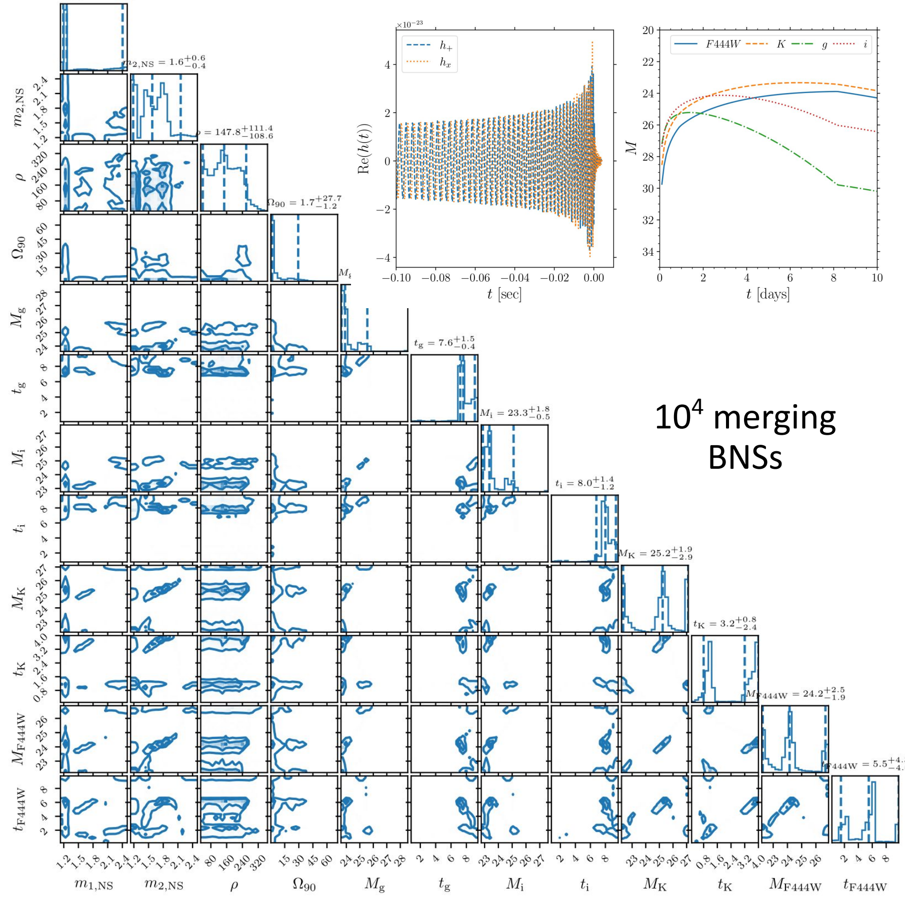
Northwestern | CIERA

April 25
15 slots

A framework for multi-messenger CBCs

Nathan Steinle,
Samar Safi-Harb, Matt Nicholl,
Isabelle Worssam, Ben P. Gompertz
Contact: nsastrophysics@gmail.com
nathan.steinle@umanitoba.ca

University of Manitoba · Queen's University Belfast · University of Birmingham



<u>The pipe</u>:

Binary pop synth -> GW + EM (kilonova)

COMPAS -> gwfast + MOSFiT

- *Modelling systematics, EM target populations, correlations b/w observables*

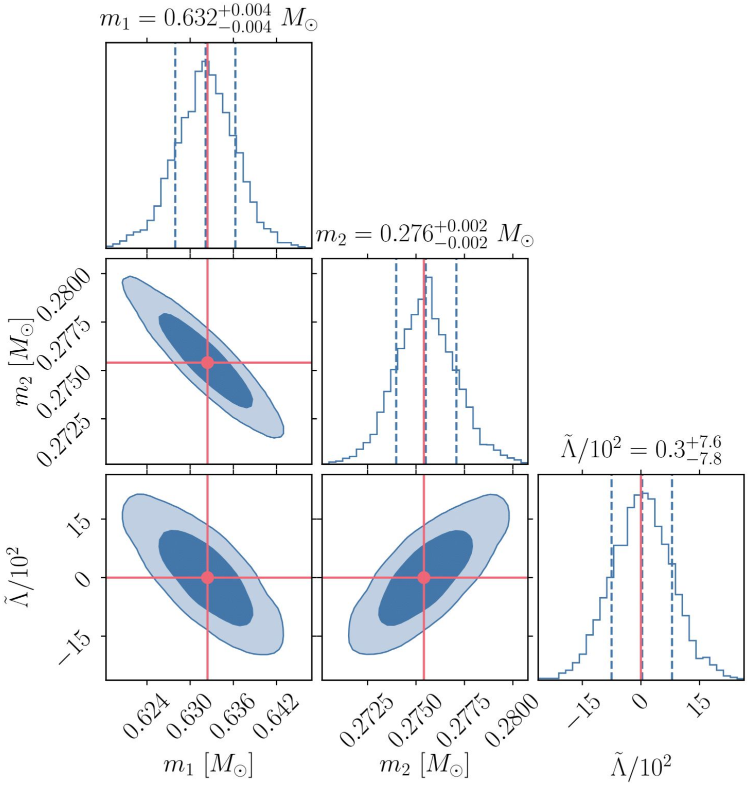
<u>What's next</u>:

GRB afterglow, spin evolution, BHNSs, and cosmology!

PRIMORDIAL BLACK HOLES OR ELSE?
TIDAL TESTS ON SUBSOLAR GRAVITATIONAL-WAVE OBSERVATIONS

Francesco Crescimbeni, on behalf of Gabriele Franciolini, Paolo Pani and Antonio Riotto

- How to distinguish primordial black holes (PBHs) from other subsolar objects?
- The gravitational-wave signal from the latter is affected by strong tidal effects;
- third generation detectors such as Einstein Telescope and Cosmic Explorer could reach a very strong sensitivity to measure the effective tidal;
- rule out various objects with tidal statistics!



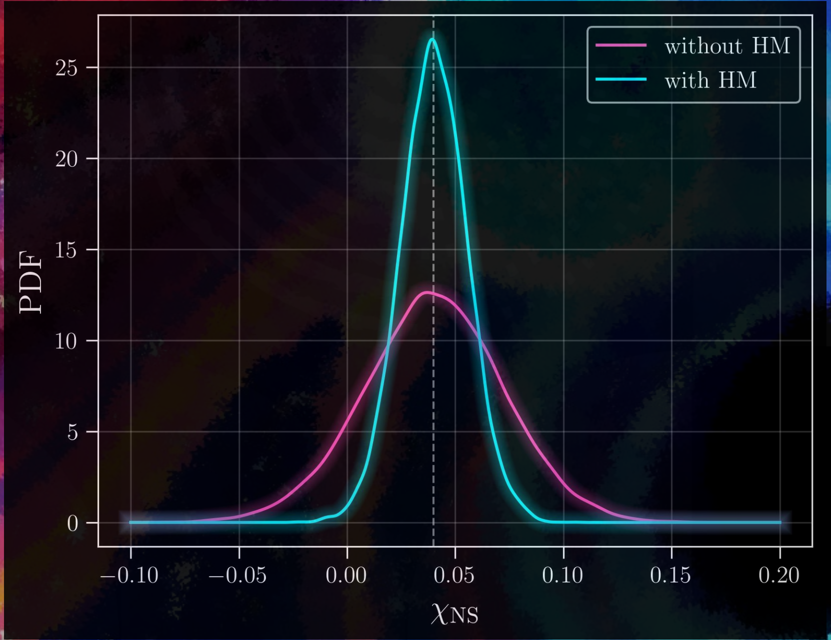
Contact of the speaker: francesco.crescimbeni@uniroma1.it
Contact of the other authors: gabriele.franciolini@cern.ch, paolo.pani@uniroma1.it, antonio.riotto@unige.ch

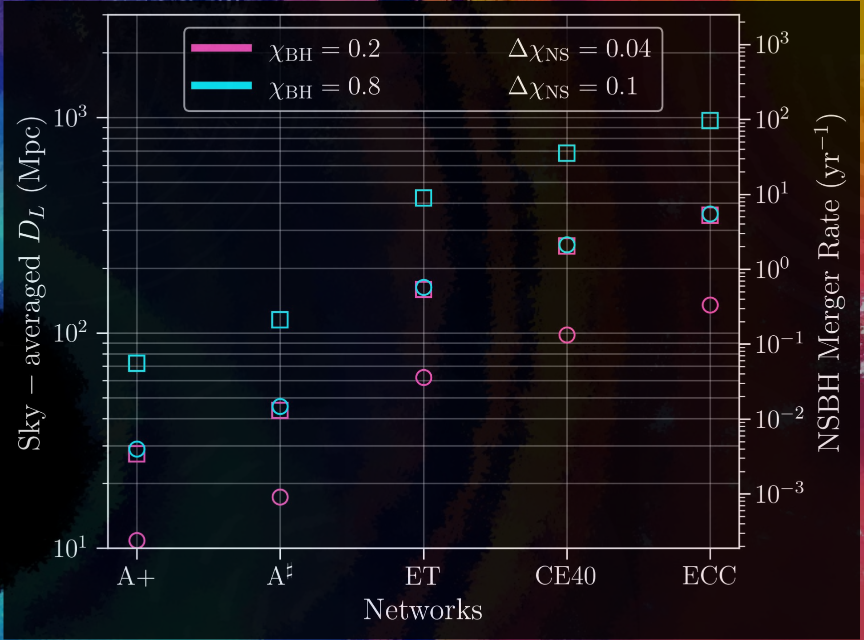
Source ref: F. Crescimbeni, G. Franciolini, P. Pani, and A. Riotto, (2024), arXiv:2402.18656 [astro-ph.HE].

Inferring small neutron star spins with neutron star-black hole mergers

Ish Gupta (ishgupta@psu.edu, Pennsylvania State University)

arXiv: 2402.07075



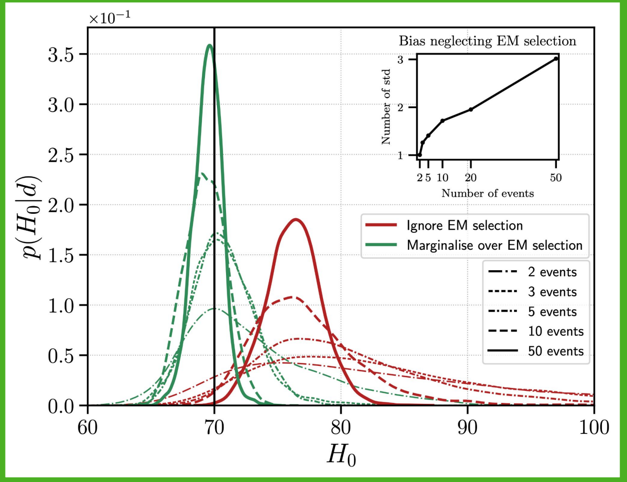


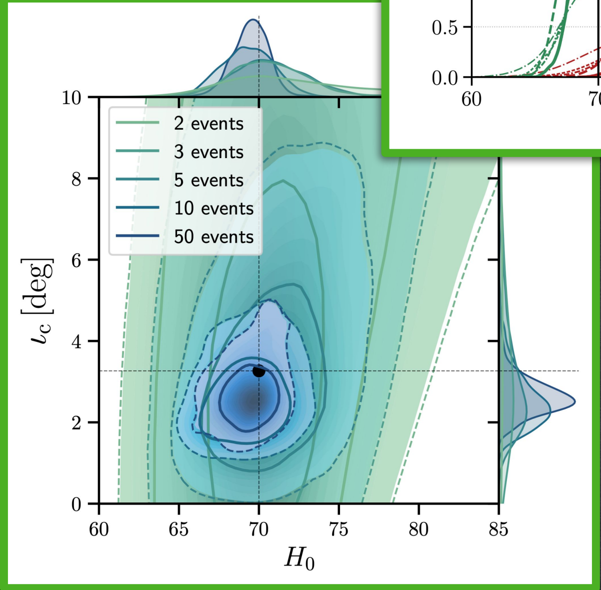
The small dimensionless spins of rapidly rotating neutron stars can be precisely measured with neutron star-black hole mergers!

Accurate standard siren cosmology with joint gravitational–wave and γ–ray burst observations

Francesco Iacovelli, on behalf of M. Mancarella, S. Foffa, N. Muttoni, M. Maggiore

- **Joint GW–GRB** events are promising candidates for **cosmology**
- The possibility of obtaining an accurate measurement of H_0 is severely undermined by **the strong selection effect for the coincident GRB detection** H.-Y. Chen, PRL 125, 201301
- Proper **modelling** of this effect can lead to **unbiased estimations and constraints on the GRB parameters**!

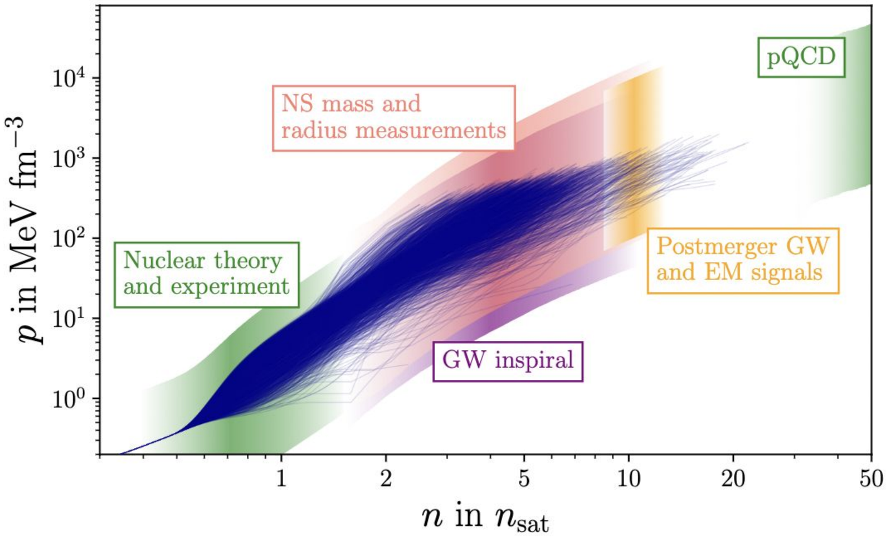




Simulation for O5…
…next 3G!

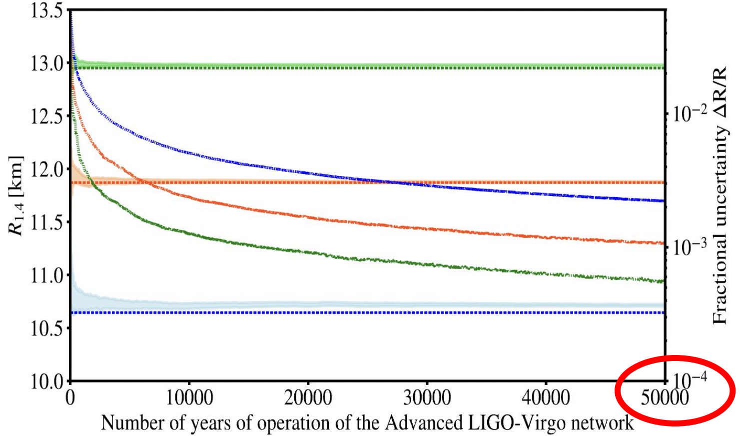
Contact: Francesco.Iacovelli@unige.ch

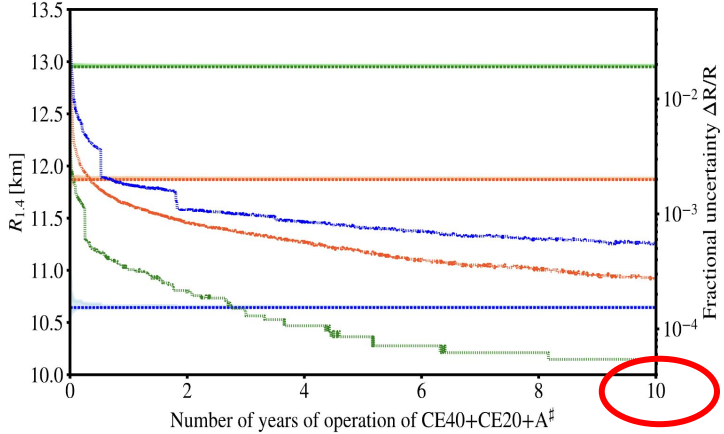
The Neutron Star Radius with second and third generation Gravitational Wave Detectors



Koehn et al. [incl. **RS**], 2402.04172

Bandopadhyay et al. [incl. **RS**], 2402.05056





Cosmic explorer can measure $R_{1.4}$ to within 10m in ~5 years whereas our present detectors can never achieve such a sensitivity.

Contact: Rahul Somasundaram; rsomasun@syr.edu

Microscopic Properties and Gravitational Wave Emission

D. Barba-González, C. Albertus & M.A. Pérez-García

Fundamental Physics Department, University of Salamanca, Spain

Contact the speaker at:
david.barbag@usal.es

What can we do?

MD simulations of the outer crust of a NS:

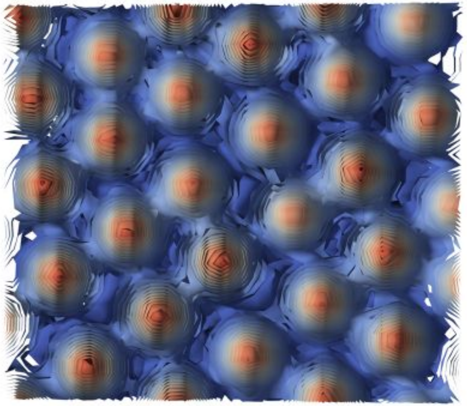
- Ionic degrees of freedom with finite, Gaussian size.
- Long-range effective interaction with screened Coulomb form.

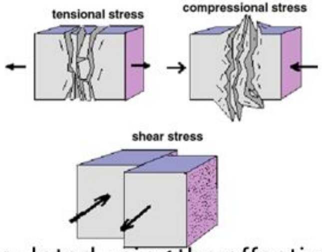
$$\rho(r) = \left(\frac{a}{\pi}\right)^{3/2} e^{-ar^2}, \phi(r) = \frac{Z}{r} e^{-r/\lambda}$$

Main outcomes are the positions and velocities of the individual ions.

But also the stress tensor:

$$\sigma_{\alpha\beta} = \begin{pmatrix} \sigma_{11} & \sigma_{12} & \sigma_{13} \\ \sigma_{21} & \sigma_{22} & \sigma_{23} \\ \sigma_{31} & \sigma_{32} & \sigma_{33} \end{pmatrix}$$



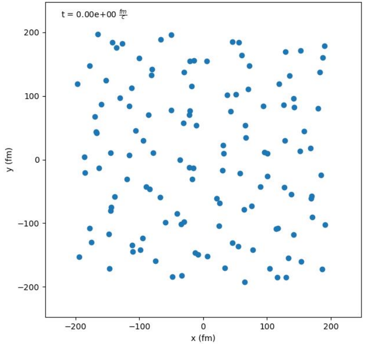


Calculated using the effective electromagnetic forces between ions.

Barba-González, Albertus & Pérez-García, PRC 106, 065806 (2022)
Barba-González, Albertus & Pérez-García, MNRAS 528, 2 (2024)

What do we produce?

- Phase transitions in the crust: solid-liquid and liquid-gas.



- Transport coefficients such as shear and bulk viscosity, and thermal conductivity.

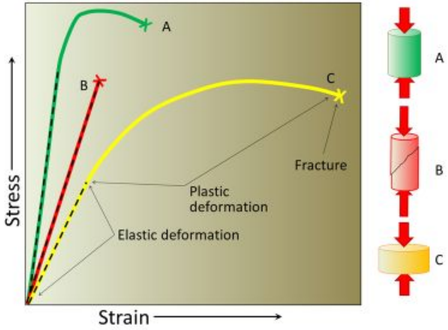
$$\eta \sim \langle \sigma_{xy}(t)\sigma_{xy}(0)\rangle$$
$$\xi \sim \Sigma_{\alpha\beta}\langle \sigma_{\alpha\alpha}(t)\sigma_{\beta\beta}(0)\rangle$$

- Resistance of the material to deformations, i.e. breaking stress (shear or bulk) over which the material does not support deformations.
- Elastic constants.

$$\Pi_{\alpha\beta} = C_{\alpha\beta\mu\nu}\epsilon_{\mu\nu}$$

Ability of the crust to support deformations crucial to:

1) Sustainability of pulsar glitches.
2) Bumps (mountains) that are a source of ellipticity, and in turn of GWs.



Including eccentricity, precession and higher harmonics in GW templates for search pipelines

(Jay) Digvijay Wadekar

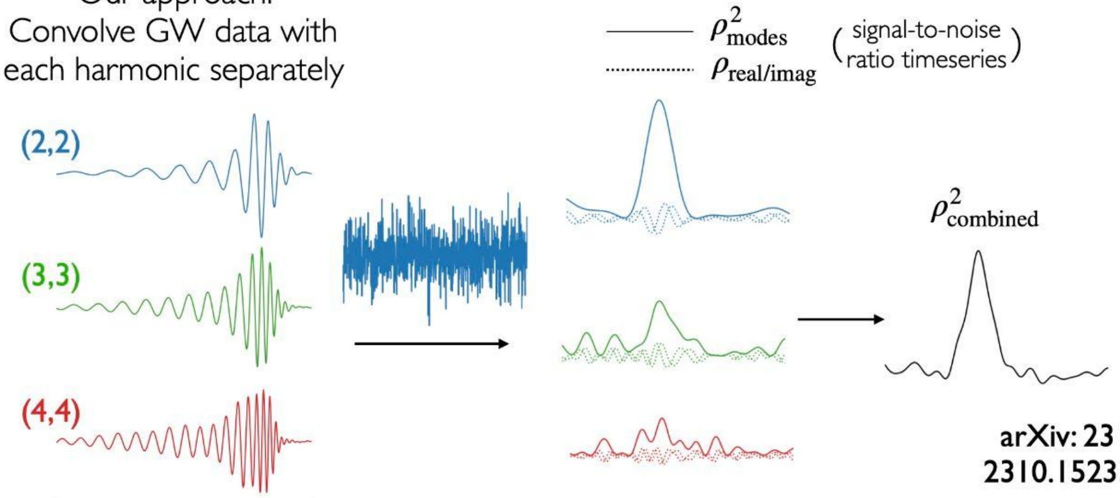
IAS

jayw@ias.edu

- Nearly all of the search pipelines currently *do not include these effects* in the templates
  (which can lead to missing important mergers in the data)

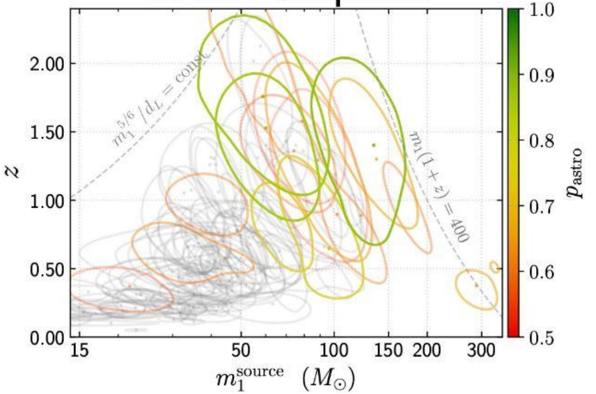
- We recently formulated a way to generically include additional effects
  (without leading to an explosion in the number of templates and without reducing the sensitivity of the search)

Our approach:
Convolve GW data with each harmonic separately



arXiv: 2312.06631 , 2310.15233 & in prep

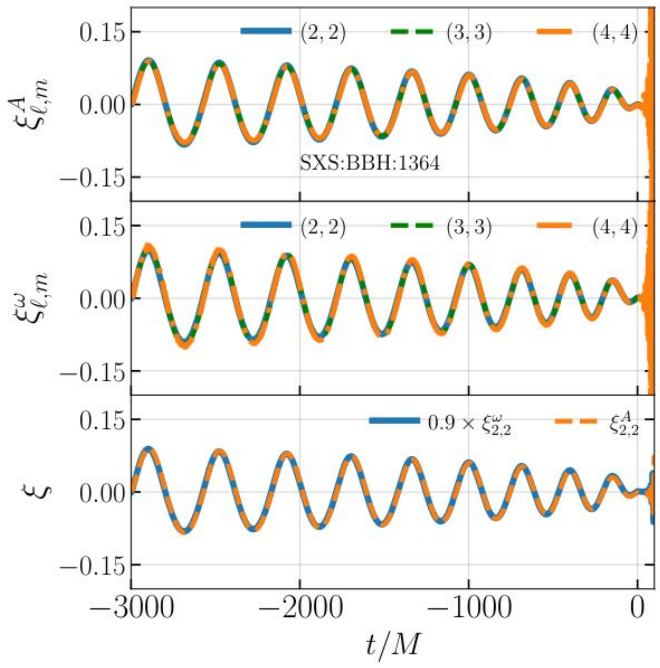
Colored: new candidate events in O3 data including higher harmonics in GW templates



Quasi-universal modulation in eccentric waveforms

Tousif Islam
Kavli Postdoctoral Scholar, Kavli Institute of Theoretical Physics (KITP)
Visiting Scientist, California Institute of Technology

arXiv:2403.15506



Frequency modulation

$$\xi^\omega_{\ell m}(t;q,e_{\rm ref}) = k^\omega_{\ell m}\frac{\omega_{\ell m}(t;q,e_{\rm ref}) - \omega_{\ell m}(t;q,e_{\rm ref}=0)}{\omega_{\ell m}(t;q,e_{\rm ref}=0)}$$

Amplitude modulation

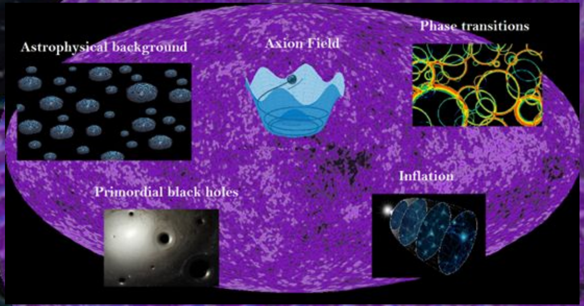
$$\xi^A_{\ell m}(t;q,e_{\rm ref}) = k^A_{\ell m}\frac{2}{\ell}\frac{A_{\ell m}(t;q,e_{\rm ref}) - A_{\ell m}(t;q,e_{\rm ref}=0)}{A_{\ell m}(t;q,e_{\rm ref}=0)}$$

Eccentricity modulations are all the same no matter which mode or which quantity (amplitude or frequency) you look at!

GW background anisotropies with 3rd generation detectors

Giorgio Mentasti, *Imperial College London*
g.mentasti21@imperial.ac.uk

We study an anisotropic GW background



$$\langle h^*(f,\hat{n})h(f,\hat{n})\rangle \propto H(f,\hat{n})$$

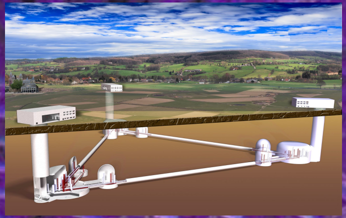
Which can produce a signal on a ground-based interferometer

$$m(t) \equiv \frac{\Delta T}{T} \propto s(t) + n(t)$$

We correlate the signals from each instrument

$$\langle C_{OO'}\rangle \propto \langle m_O(t)m_{O'}(t)\rangle$$

+

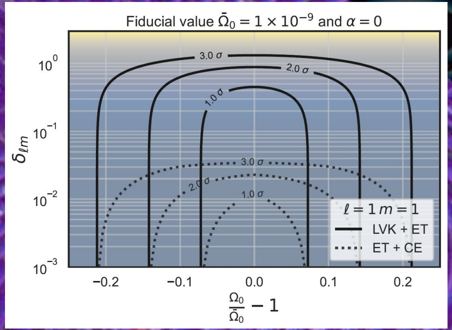


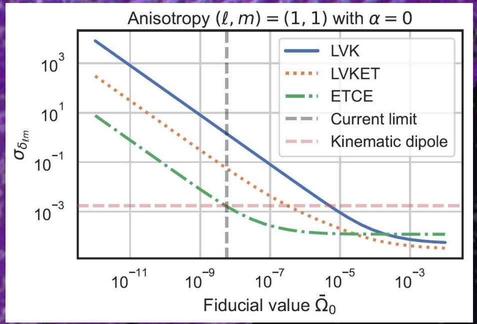
Cosmic Explorer

Einstein Telescope

And perform the **map making**

$$\Omega(f,\hat{n}) = \Omega_G\psi(f)\sum_{\ell m}\delta_{\ell m}Y_{\ell m}(\hat{n})$$

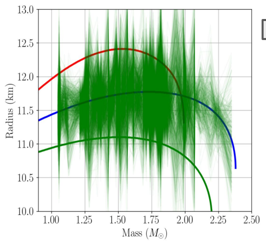




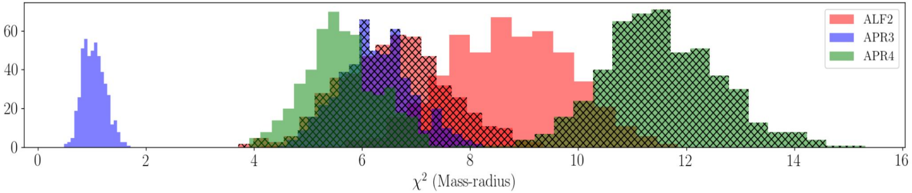
1) Mentasti+ 2304.06640
2) Mentasti+ 2301.08074
3) Mentasti, Peloso 2010.00486

BEOMS: Bayesian EOS Model Selection Pipeline

Rahul Kashyap, Ish Gupta, Bangalore Sathyaprakash, Penn State, rkk5314@psu.edu

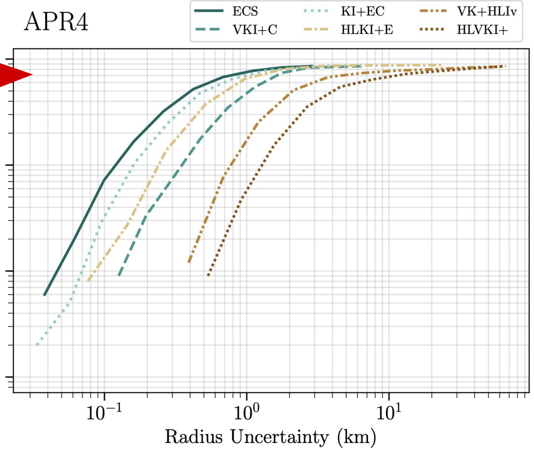


$$\chi^2_{k,M} = \frac{1}{N}\sum_{n=1}^{N}\frac{(r_n^k - r_n^M)^2}{\sigma_n^2}$$



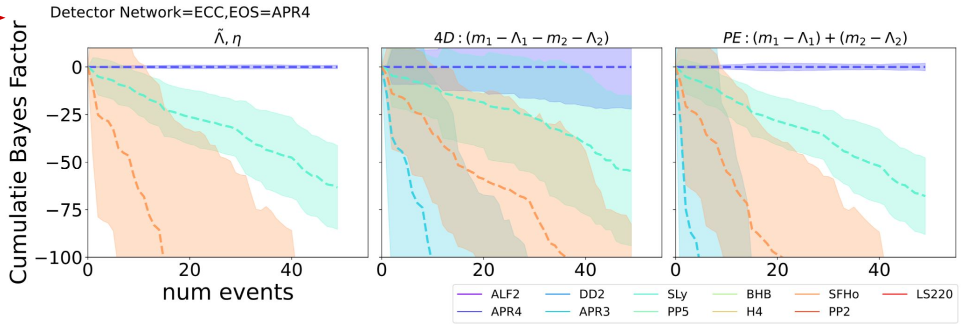
RK et. al. 2022, Phys. Rev. D 106, 123001: Frequentist Method with radius measurement and model selection forecast for XG detectors.

Huxford, RK et. al. 2024 (2307.05376, accepted PRD): Forecast of sub-percent level measurement of NS radii and combining radius errors from multiple events to inform nuclear physics constraints



Bayesian Framework (BEOMS) (RK. et. al. 2024 *in prep*)

- Cumulative evidence: allows the correct model to be identified despite little evidence in events individually
- A notion of distinguishability allowing to distinguish nuances features of EOS models



COSMIC EXPLORER

CHARTING THE COSMOS

GRAVITATIONAL WAVE CLUES FROM COSMOLOGY & INFORMATICS INITIATIVES

Contact me for collaborations:
mattia.scompa@gmail.com

[1] **Damping of cosmological tensor modes in Horndeski theories after GW170817** [https://arxiv.org/abs/1903.01502]

[2] **Cosmic structures and gravitational waves in ghost-free scalar-tensor theories of gravity** [https://arxiv.org/abs/1712.04002]

- Signatures of Modified Gravity (MG) theories on cosmological GWs (ex. Damping og GWs Signal due to free-streaming neutrinos)
- Tests for GR VS Dark Energy models and new physics

$$(y+1)\chi''(y)+\frac{\delta_1(4+5y)}{2y}\chi'(y)+\delta_2\mathcal{Q}_k^2\,\chi(y) = -24\frac{\delta_3 f_{0,\nu}}{y^2}\int_0^y \mathcal{K}[U(Y)-u(y)]\,\chi'(Y)\,dY,$$

[3] **Cadabra and Python algorithms in General Relativity and Cosmology II: Gravitational Waves** [https://arxiv.org/abs/2210.00007]

[4] **Cadabra and Python algorithms in General Relativity and Cosmology I: Generalities** [https://arxiv.org/abs/2210.00005]

- Cadabra is a Python-integrated CAS for GR and GWs computations:
  - Up-to-date algorithms that grow with Python framework development
  - Integration with standard libraries (R, sympy, …)
- Open source technology
  - (Cheap) courses/education on GWs physics to large audiences (students, researchers,…) -> direct expertide on computation algorythms

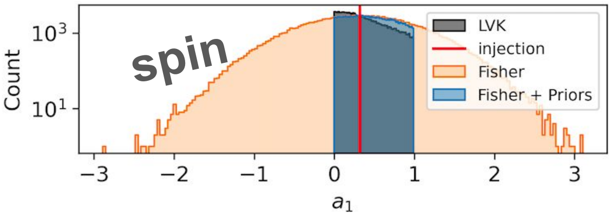
Ref: SCOMPARIN MATTIA

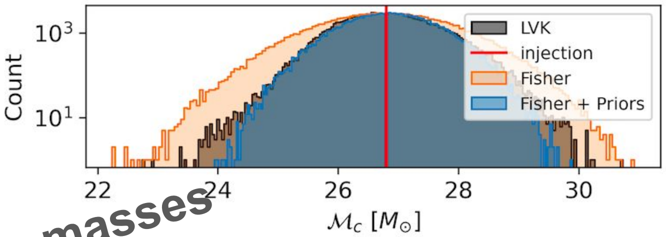
Contact: mattia.scompa@gmail.com

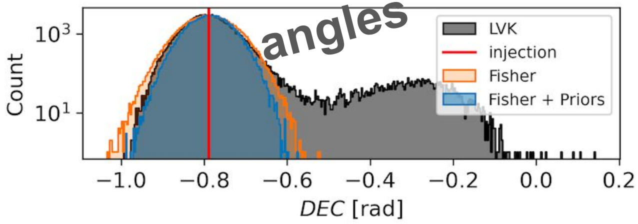
Enhancing Fisher Matrix Results with Physically Motivated Priors

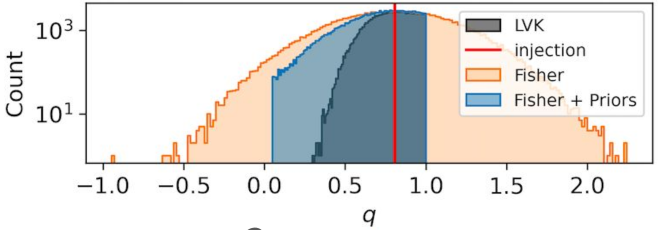
GWFISH
[GitHub link]

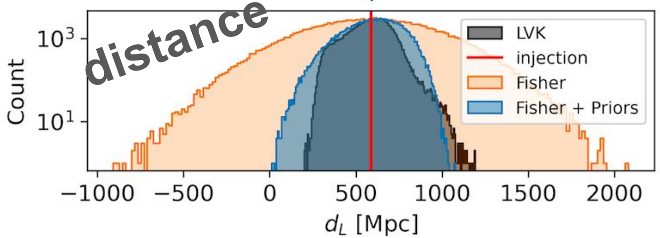
GW170814











SNR vs multi-modality vs degeneracies

Validity of Fisher approximation

Role of priors

Ulyana Dupletsa

ulyana.dupletsa@gssi.it

GRAN SASSO SCIENCE INSTITUTE
SCHOOL OF ADVANCED STUDIES
Scuola Universitaria Superiore

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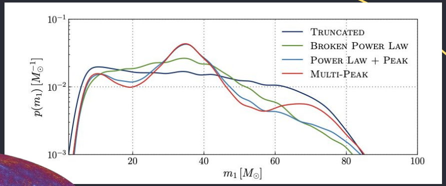
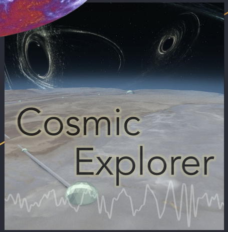
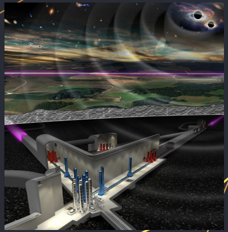
LIGO VIRGO KAGRA

A data challenge for the XG GW detectors

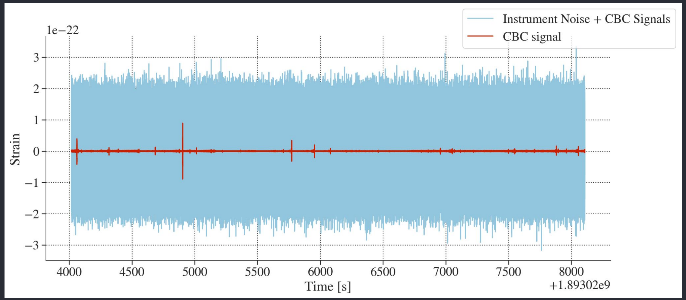
Koustav Chandra | kbc5795@psu.edu | Pennsylvania State University







gwforge



Address:

- Computational Challenges
- Astro/physical Challenges

XG-MDC Workshop @ PSU |
10-11 June

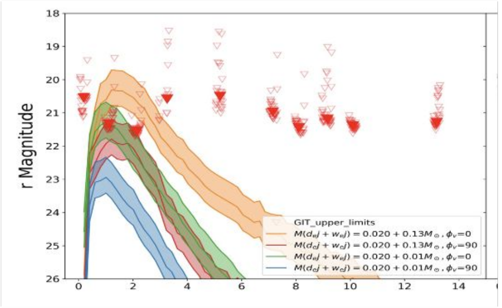
For offline viewing

Harsh Kumar | PostDoc @CFA | Harvard

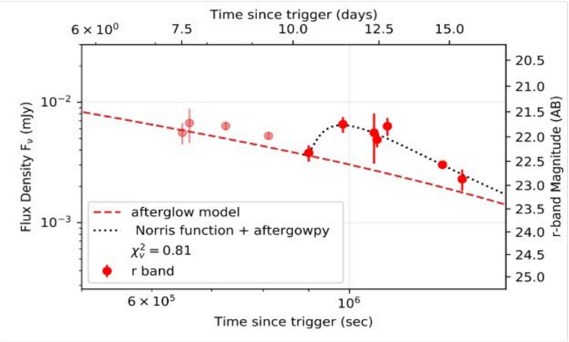
harsh.kumar@cfa.harvard.edu

Past Work

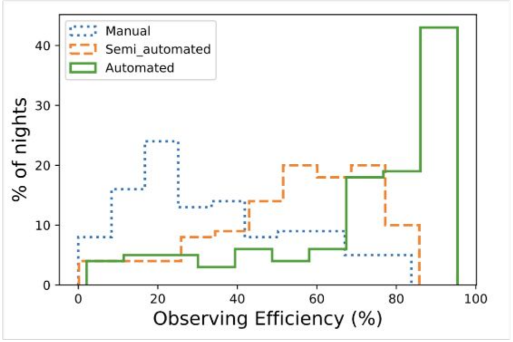
Kilonova Searches	GRB Afterglows
FBOTs	Telescope Automation



Ref: Kumar et al (2022b)



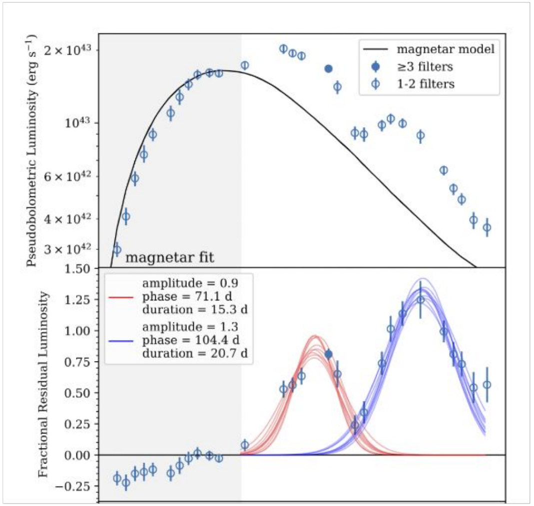
Ref: Kumar et al (2022a)



Ref: Kumar et al (2022c)

Current Work

Working on SLSLN. Trying to understand the reason of bumps in a small subset of SLSN-I population.



Ref: Hosseinzadeh et al., (2022)