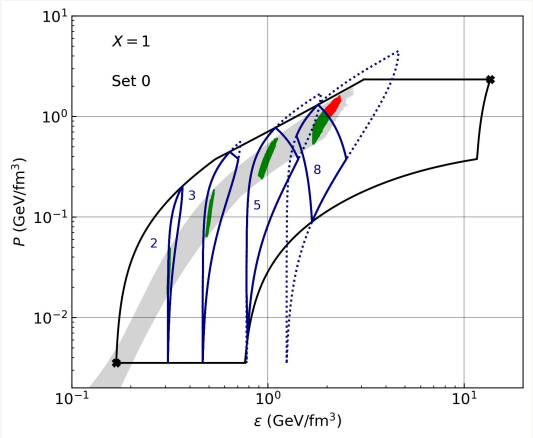
Does pQCD constrain the neutron star equation?

Milena Bastos Albino
Advisors: Constança Providência, Tuhin Malik and Márcio Ferreira

- In [1], the authors restricted the unknown region of the QCD phase diagram using thermodynamic relations and the pQCD and cEFT EoS;
- We applied these constrains to a Relativistic Mean Field (RMF) model [2];
- We concluded that the constrains favor models with hyperons or large contribution of the quadratic vector ω^4 term [2].



[1] DOI: 10.1103/physrevlett.128.202701.
[2] DOI: 10.1103/physrevd.107.103018.

1 2 9 0 UNIVERSIDADE D COIMBRA
FCT Fundação para a Ciência e a Tecnologia

Magnetar formation driven by supernova fallback

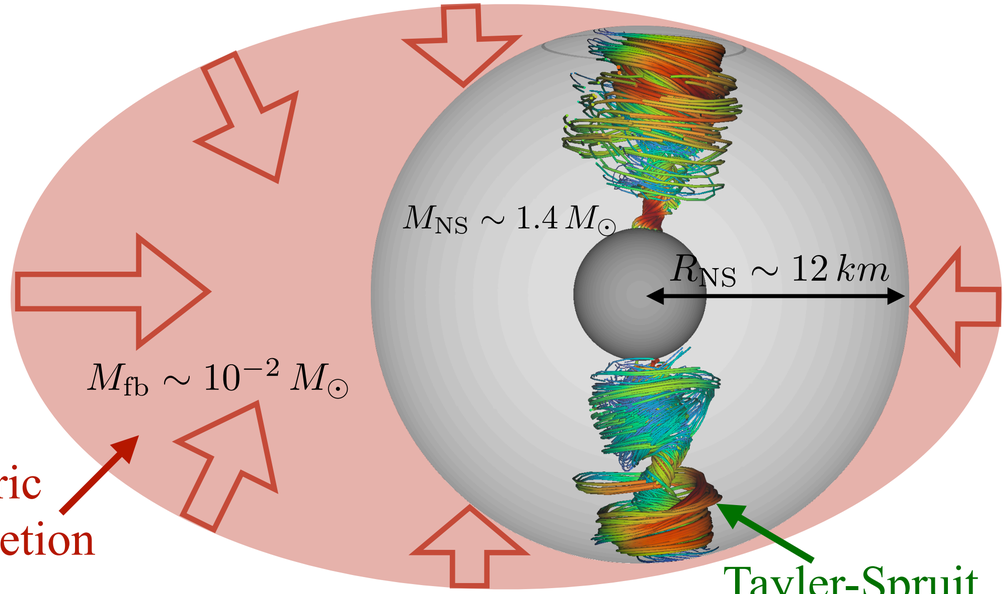
NS magnetic fields:

- Pulsars: $10^{11} - 10^{13}$ G
- Magnetars: $10^{14} - 10^{15}$ G

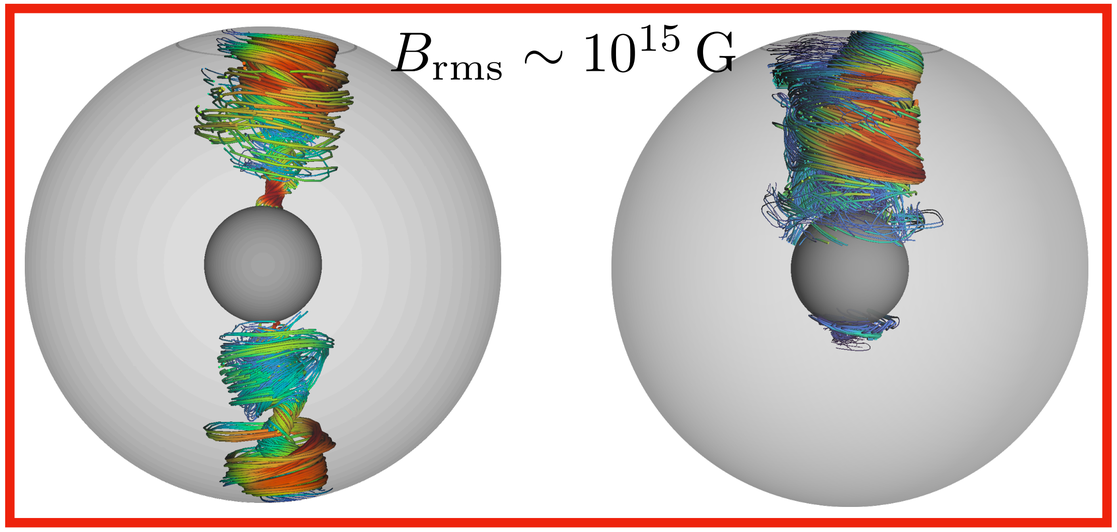
$\Longrightarrow$ **How do magnetars magnetic fields form ?**

$\Longrightarrow$ **A new formation scenario:**

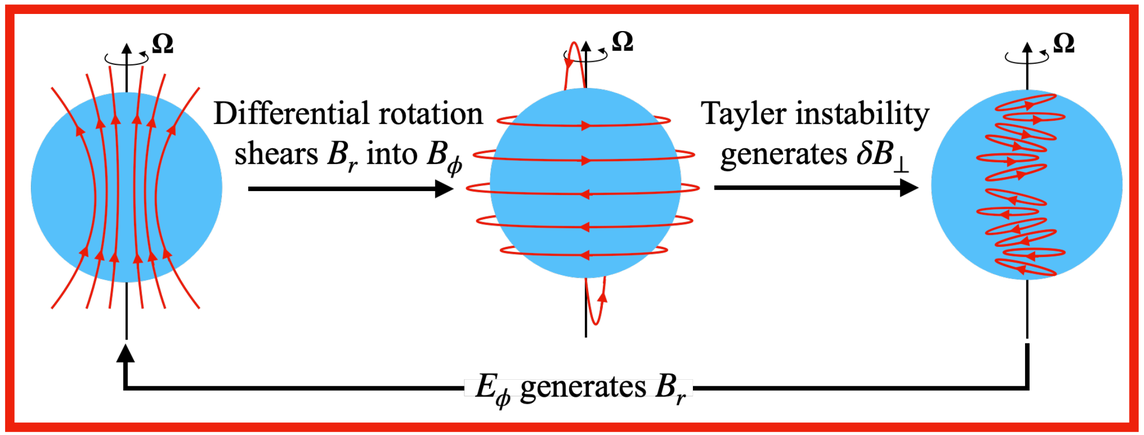
- Analytical approach (one zone)
- Numerical approach (3D)



(Barrère+subm.)



(Barrère+22)



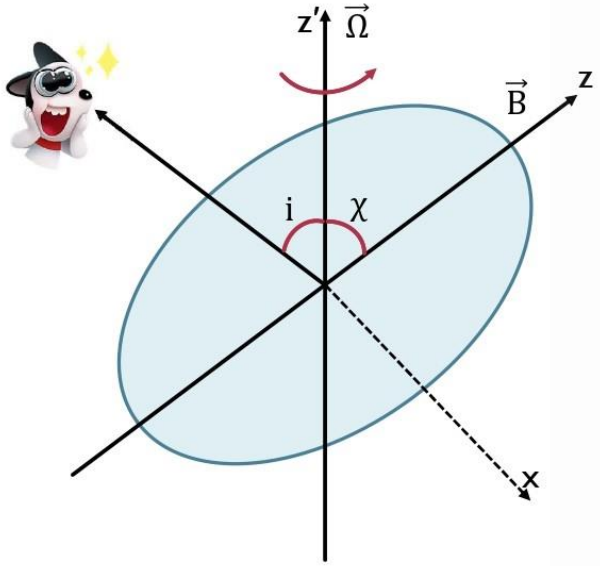
Continuous gravitational waves from isolated rotating magnetized neutron stars

Mayusree Das

With Banibrata Mukhopadhyay

Prime Minister's Research Fellow (**PMRF**)

Department of Physics, Indian Institute of Science (**IISc**), Bangalore



2D cross-section of an asymmetric NS

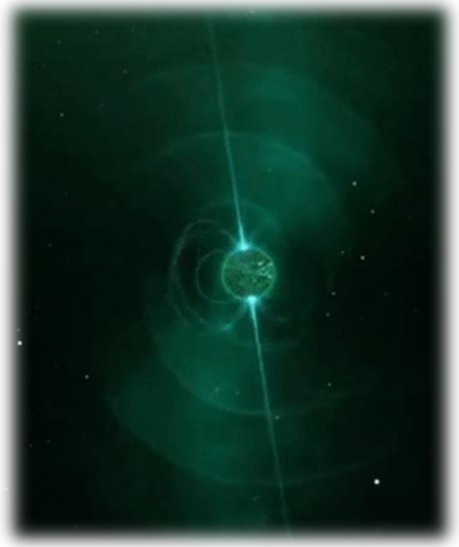
Magnetized, rotating (thus **deformed**) and **misaligned** NS

⬇

Triaxial system with **non-zero time varying** quadrupole moment

Primary focus of my research is to understand possible **direct** detection of **isolated neutron stars (NSs)** via continuous gravitational waves.

- Here we model massive, magnetized, rotating NSs with Einstein's equation solver in GRMHD (XNS code).
- Such NSs with misalignment can emit continuous gravitational waves (CGW). Interestingly, there has been no detection of CGW from NSs in LIGO, VIRGO, aLIGO, and aVIRGO so far.
- We explore the reason by studying (comprehensively) the decays of magnetic field, angular velocity and obliquity angle with time. This suggests that detecting massive NSs is challenging and sets a timescale for detection.
- Future GW missions e.g. Cosmic Explore and Einstein's Telescope should be planned accordingly to detect directly such massive NSs in (1 year of) integration timescale, which, if detected, can provide us an idea about their spin, magnetic field, as well as equation of state.



Credit: Continuous Gravitational Waves group of Max Plank institute for Gravitational Physics

Gravitational wave **continuously** emitted, as long as star is magnetized and spinning

GWsNS School, June 5-9, 2023

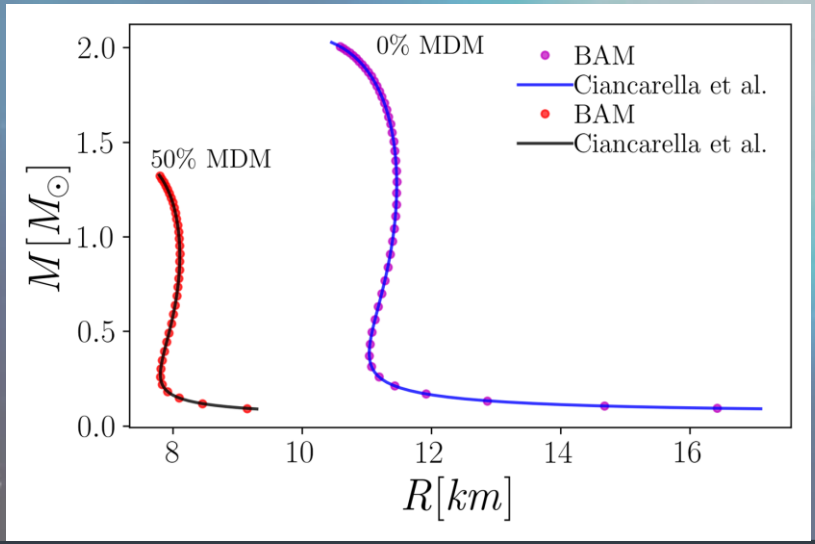
Could neutron star mergers provide direct evidence of dark matter?

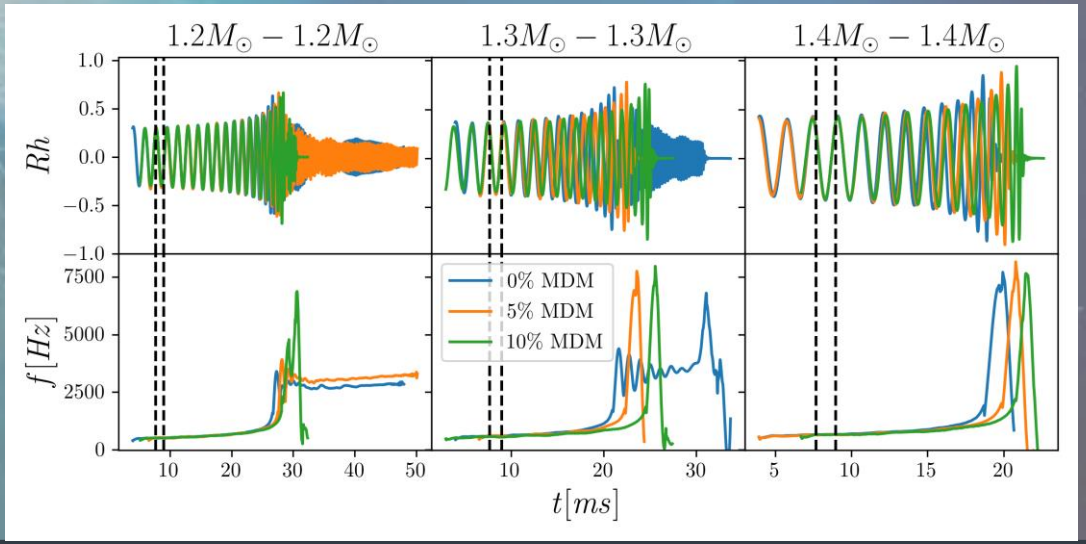
DCC: LIGO-G2300435 mattia.emma.2022@live.rhul.ac.uk

- **Could neutron stars hide a dark matter core?**

  We extend the numerical relativity code BAM to allow for a second perfect fluid to be embedded in the neutron star's core.

- **Could we be able to correctly identify gravitational wave signals emitted by double-fluid neutron star mergers?**





M. Emma, F. Schianchi, F. Pannarale, V. Sagun, and T. Dietrich, Numerical Simulations of Dark Matter Admixed Neutron Star Binaries, Particles 5, 273 (2022), arXiv:2206.10887

Background Image: University of Warwick, Mark Garlick

Can simple models be used for rapid recovery of BNS postmerger GW signals' main features?

Sebastian Gomez Lopez[1 2], Frank Ohme [3 4], Wolfgang Kastaun[3 4], Francesco Pannarale[1 2]

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[2] INFN Sezione di Roma, Piazzale A. Moro 5, I-00185, Roma, Italy
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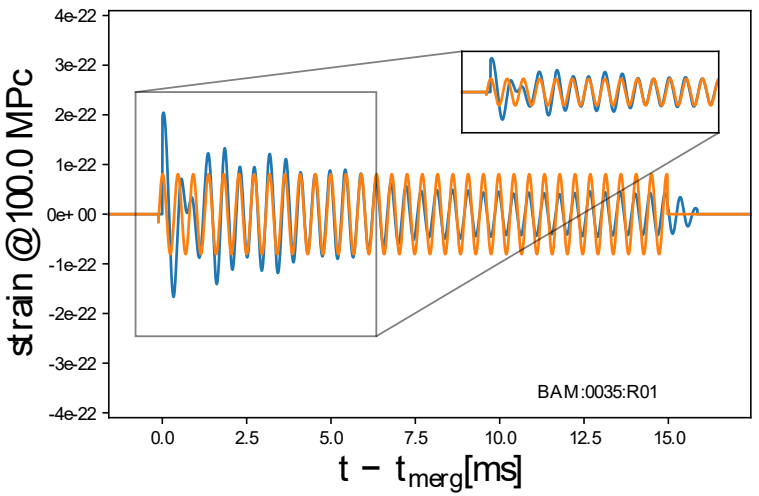
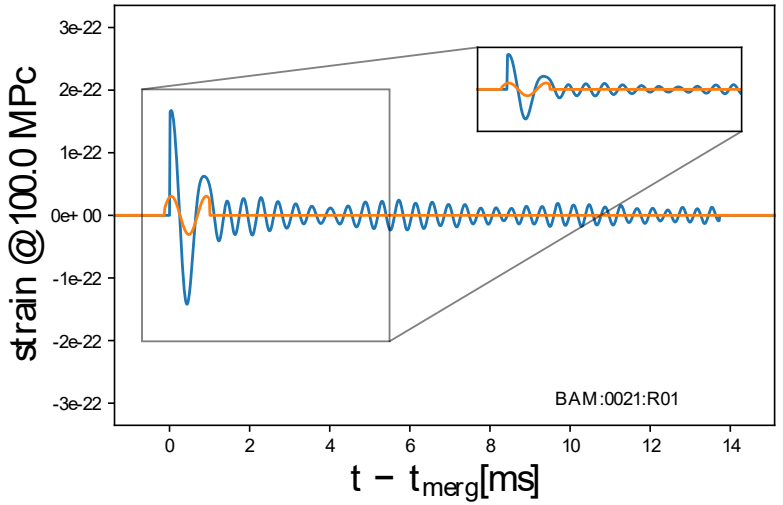
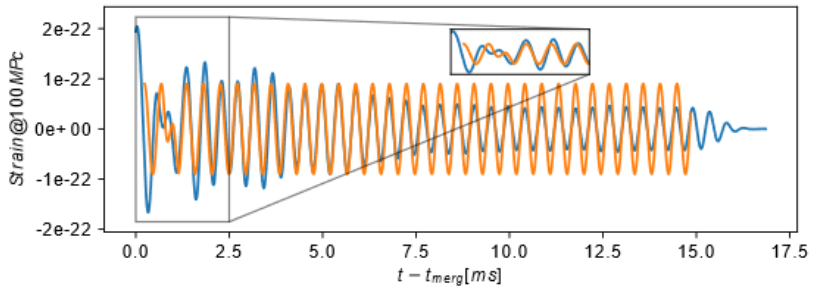
[4] Leibniz Universität Hannover, Appelstraße 2, Hannover 30167, Germany







INFN Istituto Nazionale di Fisica Nucleare Sezione di Roma

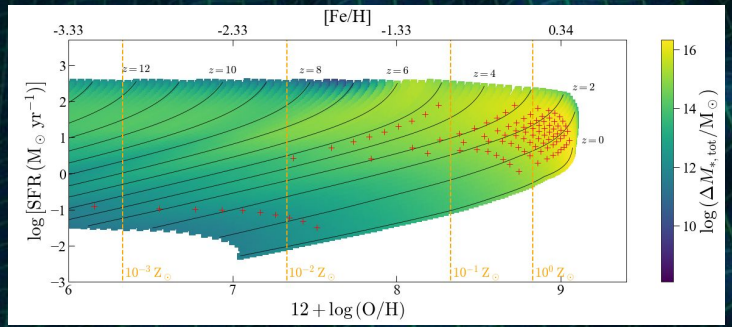
SAPIENZA UNIVERSITÀ DI ROMA

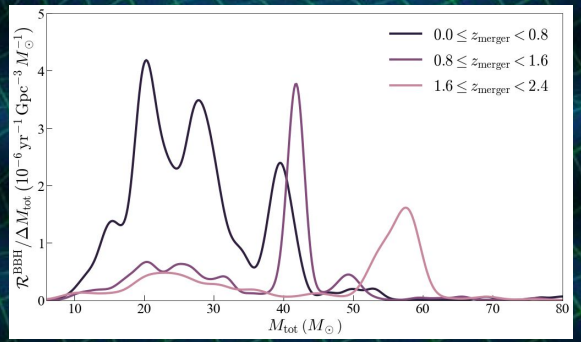
Compact object populations over cosmic time

Lucas M. de Sá
PhD Student, University of São Paulo

Modeling populations of compact objects and their mergers with population synthesis codes, with redshift-dependent initial mass function and orbital parameter distributions.

Aussois, 05/06/2023





Parita Mehta
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Poster: Maximum mass and stability of a differentially rotating neutron star

https://doi.org/10.1017/S1743921322000977

Supervisors: Dr hab. Dorota Rosińska and Dr hab. Radosław Poleski

Research Interests :
Gravitational Wave Physics
Physics of differentially rotating neutrons stars
Gravitational microlensing

WHO AM I?

David Barba González, from Zamora, Spain

Studied my Physics BSc and MSc Physics at UAM.

UAM
Universidad Autónoma de Madrid

I am a PhD Student at the University of Salamanca from 11/2020
My thesis work is about using Molecular Dynamics to extract information (crystal formation, breaking, transport properties, virial EoS, specific heats) from the crusts of Neutron Stars.

VNiVERSiDAD D SALAMANCA

Very, very important: I HAVE A POSTER HERE!

Virial EoS and crystal properties for Neutron Star crusts from microscopic Molecular Dynamics simulations.

Heavy Baryons in Warm Stellar Matter

- Tiago Custódio, 1st PhD student
  $\Rightarrow$ University of Coimbra, Portugal

- **Master's** $\Rightarrow$ Introduce degrees of freedom to the low-density EoS of Warm Stellar matter:
  1. Light clusters
  2. Light hyperclusters
  3. Hyperons
  4. Δ isobars

- **PhD** $\Rightarrow$ Build an EoS, calibrated to HIC, with these degrees of freedom to be used in astrophysical simulations (e.g. NS mergers)

Coimbra, Portugal