VNIVERSITAT DE VALÈNCIA

ET activities at the University of Valencia and future plans

Pablo Cerdá-Durán

LIGO VIRGO KAGRA

VIRGO GROUP VALENCIA

EINSTEIN TELESCOPE

RU members

Total: 18

- Core members (10)
  - Pablo Cerdá-Durán, DAA (RU leader)
  - Isabel Cordero-Carrión, DM
  - Daniela Doneva, DAA
  - Miquel Miravet, DAA
  - Martin Obergaulinger, DAA
  - Pantelis Pnigouras, UA
  - Jade Powell, DAA (starting Jan. 2027)
  - Nicolás Sanchis-Gual, DAA
  - Alejandro Torres Forné, DAA
  - Dimitra Tseneklidou, DAA
- Community members (8)
  - Miguel Ángel Aloy, DAA
  - Adrián Del Rio, DFT/IFIC
  - Alessandro Fabri, DFT/IFIC
  - José Antonio Font, DAA
  - Davide Guerra, DAA
  - Maria Antonia Lledó, DFT/IFIC
  - José Navarro Salas, DFT/IFIC
  - Gonzalo Olmo, DFT/IFIC

DAA – Astronomy and Astrophysics Department, Universitat de València
DFT/IFIC – Theoretical Physics Department/IFIC, Universitat de València
DM – Mathematics Department, Universitat de València
UA – Universidad de Alicante

Permanent/tenure track (16)
PhD student / postdoc (2)

ICCUB

Gravitational Waves and Numerical Relativity Group
(6 senior + 2 postdoc + 15 PhD)

Numerical modelling & understanding
- BNS mergers and remnants
- Core Collapse Supernovae & neutron stars
- Exotic compact objects
- GWs beyond GR

Numerical methods
- GRMHD solvers
- Time integrators for stiff ODEs (neutrinos, dissipation, radiation transport …)
- Code optimization (AI, GPUs …)

UV QG
(5 senior + N PhD)

amap
(4 senior + 1 postdoc + 2 PhD)

Mathematics Department @UV
(2 senior + 2 PhD)

Data analysis: detection, data analysis & detector characterization
- Machine learning (CNN, TCN, transformers)
- Sparse dictionary learning
- Bayesian inference

GW template catalogues
- Numerical relativity waveforms
- Surrogates
- Physically motivated phenomenological waveforms

Commissioning (detchar, noise hunting)

Participation in searches (e.g. SNe targeted searches, bursts)

Rapid response team

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LIGO VIRGO KAGRA

EINSTEIN TELESCOPE

Commissioning (detchar, noise hunting)

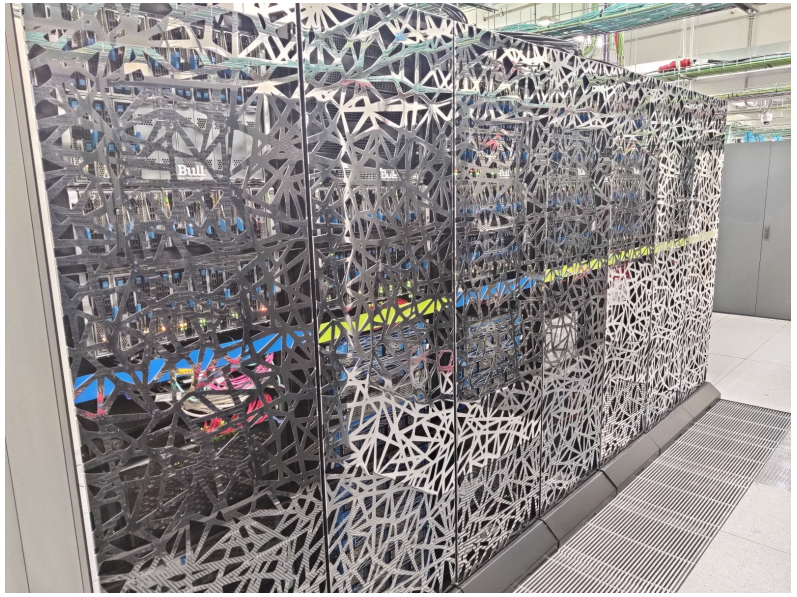
Participation in searches (e.g. SNe targeted searches, bursts)

Rapid response team

LIGO VIRGO KAGRA

Resources @ UV

Computer (CPU) resources at the SIUV



- Tirant (13824 cores, 929 TFlop/s) : 50% RES + 50% UV
- LluisVives-2 (5868 cores, 577 Tflops) : 25% RES + 75% UV
  (a fraction exclusive for astrophysics)

Artemisa

- GPU cluster hosted at IFIC
- 34 nodes with NVIDIA GPUs



Resources @ UV

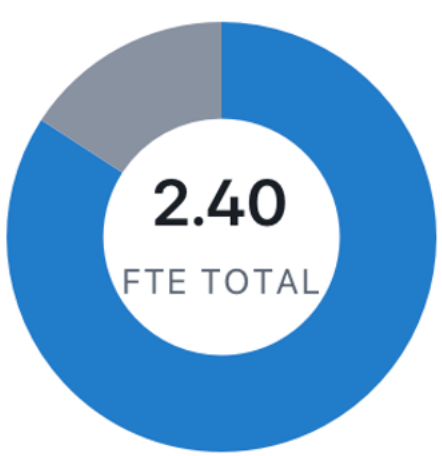


Observatory at Aras de los Olmos

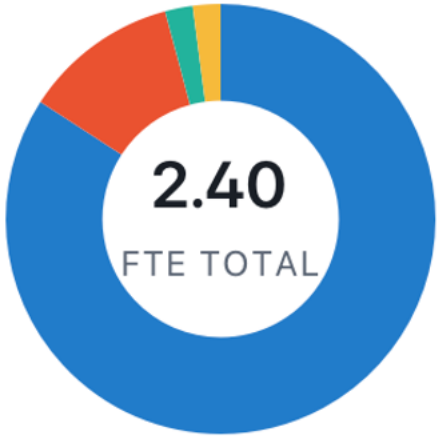
- 50 – 60 cm telescopes
- EM follow up of transients (SNe KNe)

Pledges 2026-27

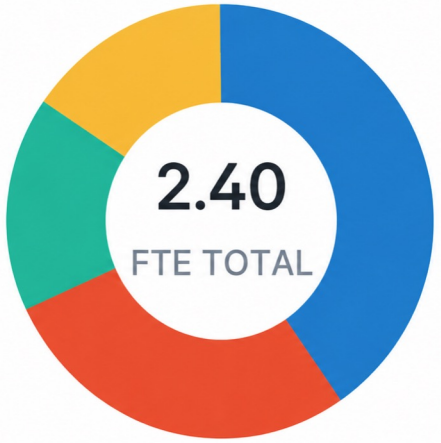
Total: 2.40 FTE



Core program	2.02	84%
Board Activities	0.38	16%



OSB	2.02	84%
SSB	0.28	12%
Governance	0.05	2%
ET-PP	0.05	2%



OSB-Div7	0.95	39.6%
OSB-Div6	0.67	27.9%
OSB-Div1	0.40	16.7%
Board Activities	0.38	15.8%

Core members contributions between 0.2 and 0.4 FTE

Core Program – Stellar collapse & NS

Total div. 7: 0.95 FTE

- **OSB - Div 7 - Stellar Collapse and Isolated Neutron Stars (P-I.1.5)**
  - **Jade Powell - Co-chair of OSB - Div 7**.
  - **Numerical modelling** of supernova gravitational wave emission

    (Core: J. Powell, M. Obergaulinger. Community: M.A. Aloy, J.A. Font).
  - **Detection**: Predicting supernova detection prospects for ET

    (Core: J. Powell, P. Cerdá-Durán. Community: J.A. Font)
  - **Parameter estimation**: Development of methods to infer properties of the progenitor based on the GW emission using e.g. asteroseismology.

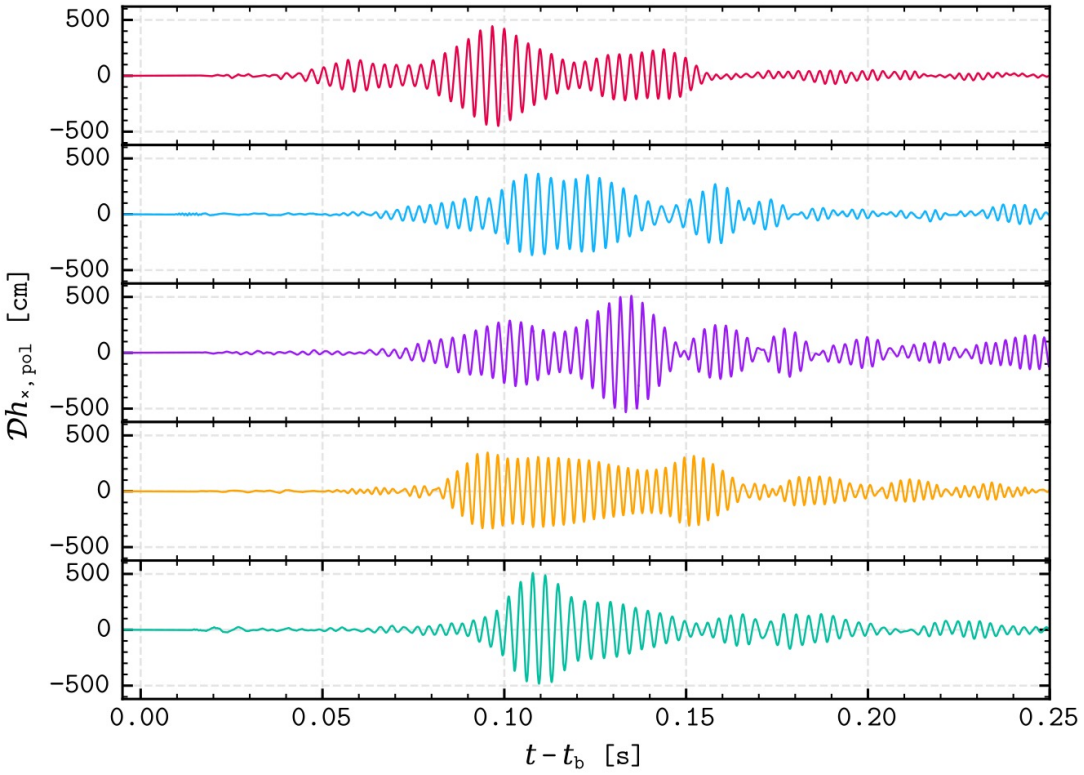
    (Core: P. Cerdá-Durán, A. Torres, D. Tseneklidou.
    Community: J.A. Font)

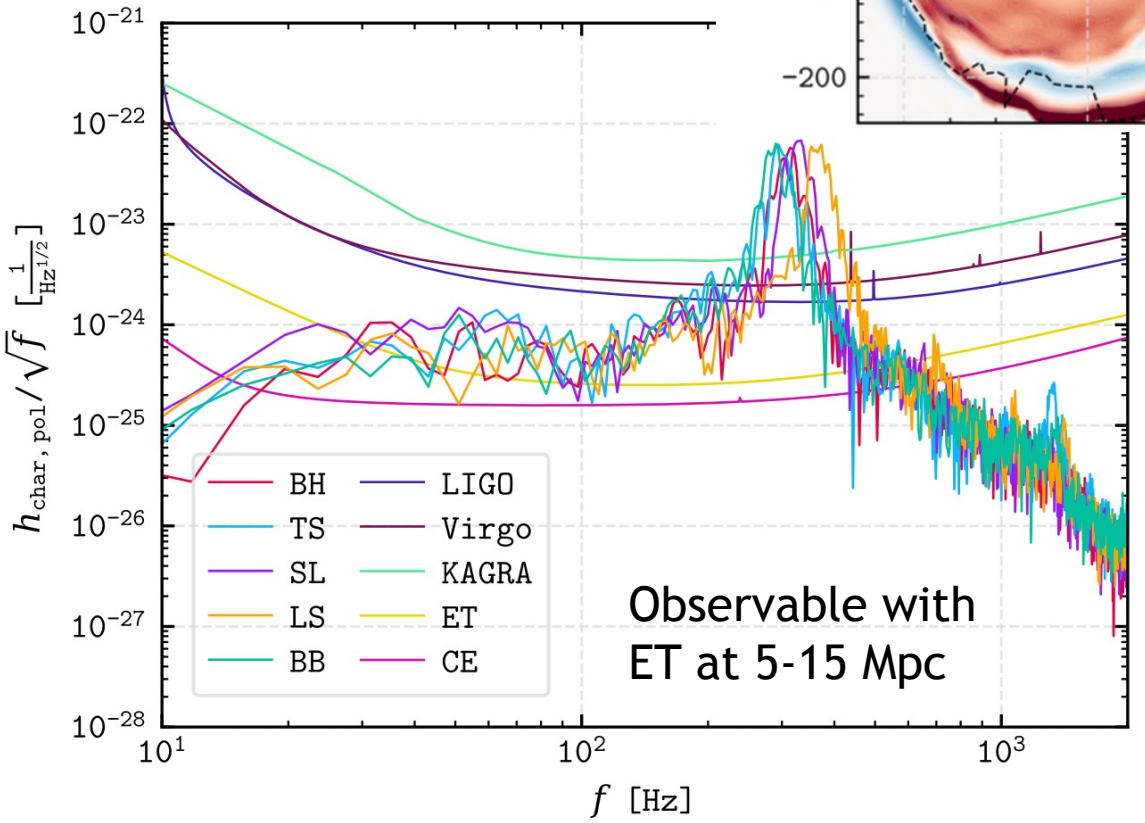
CCSNe - Numerical modelling of fast rotating collapsing cores

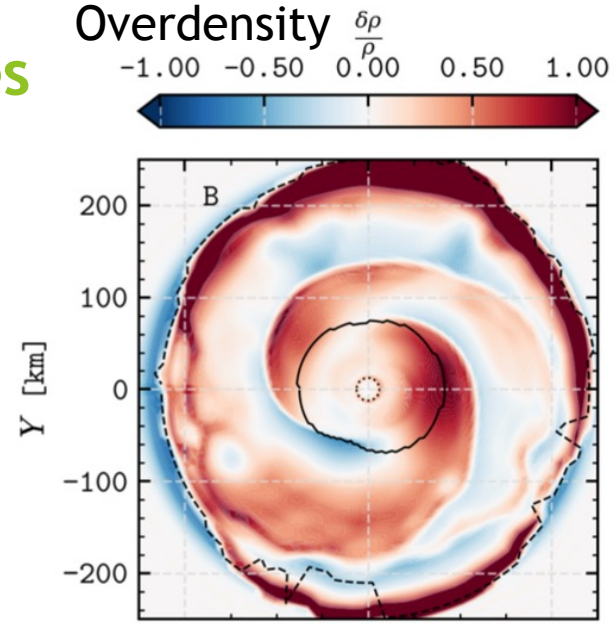
Aenus-ALCAR code

- Special relativistic magneto-hydrodynamics + GR corrections
- Tabulated EOS (LS220, SLy4, BHBΛϕ, BBSk3, TSO)
- M1 multi-energy/flavor neutrino transport

Cusinato et al 2026





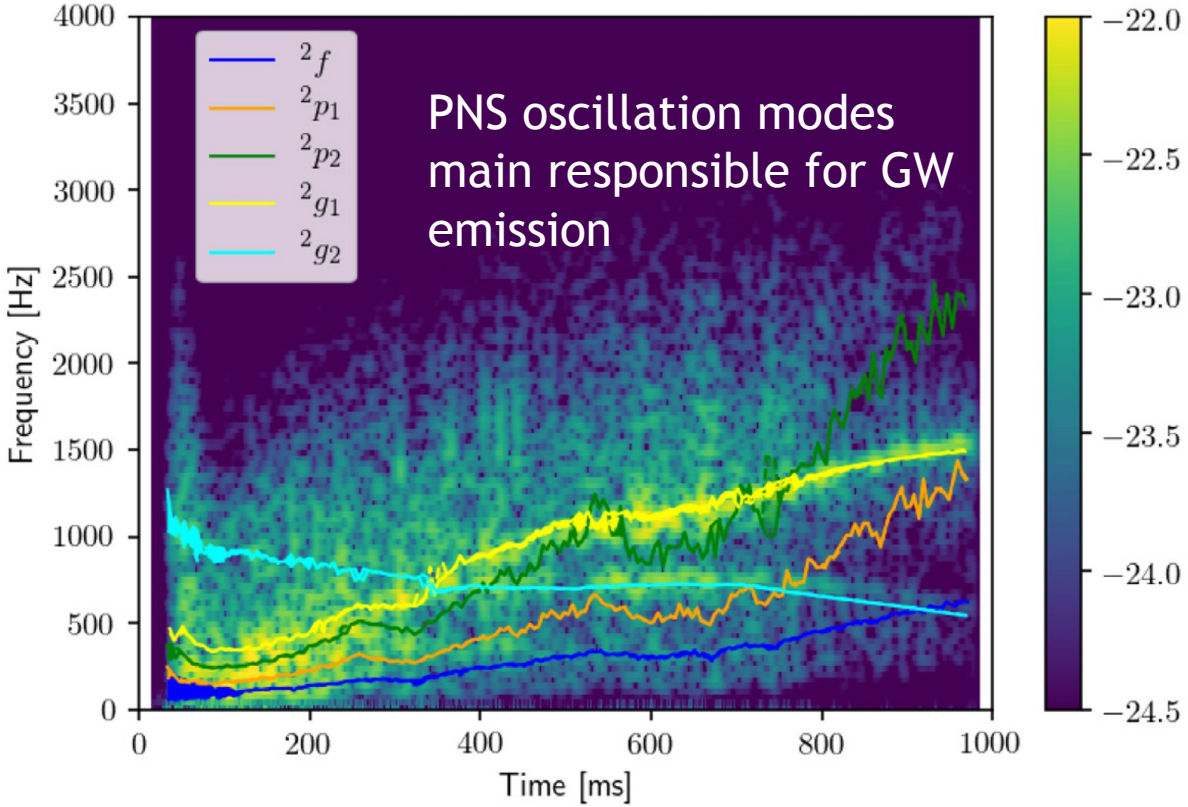


Low-T/W bar mode instabilities enhance the detection prospects for ET. New PE possibilities?

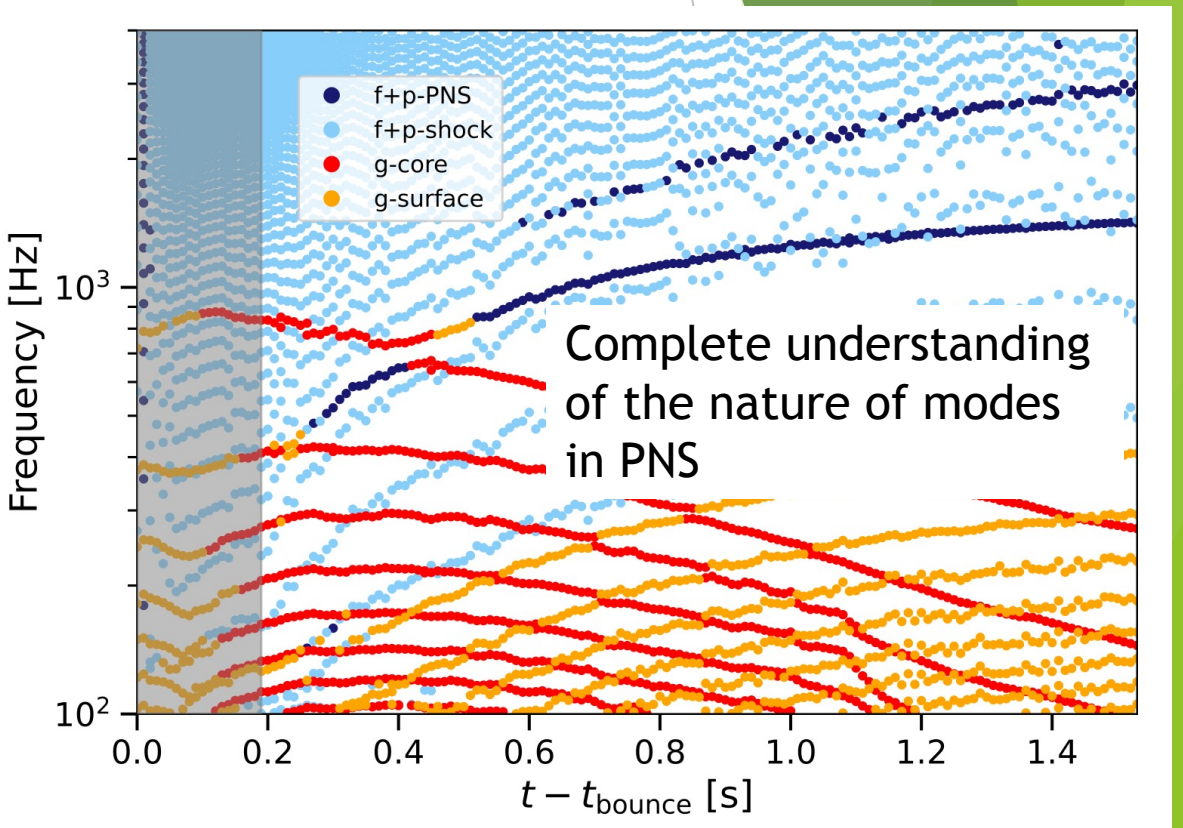
CCSNe – Proto-neutron star asteroseismology

`GREAT code`: calculation of oscillation modes from linear-perturbation analysis

Torres-Forné et al 2019

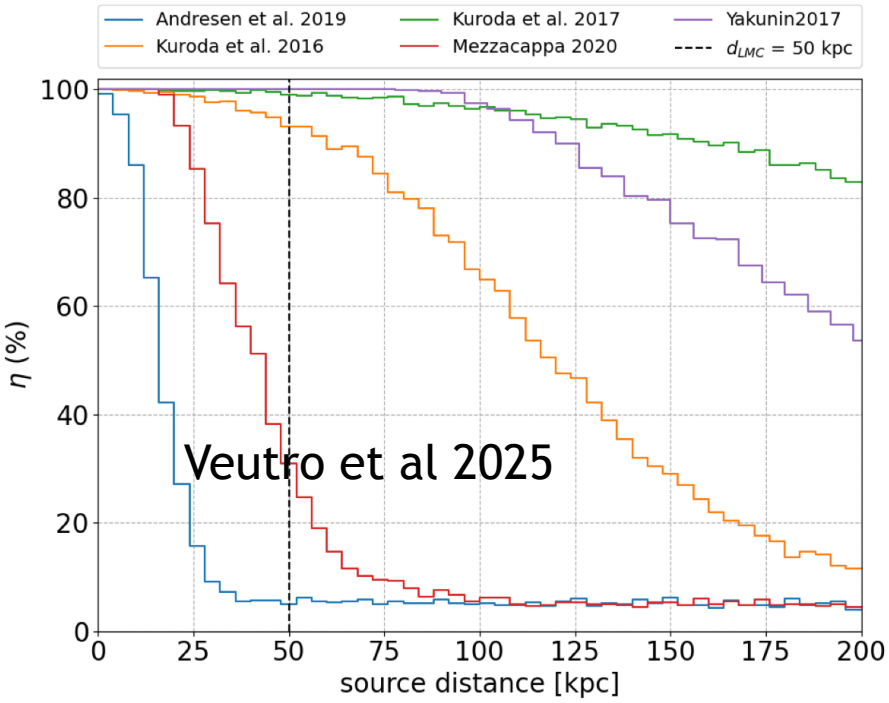


Tseneklidou et al 2026



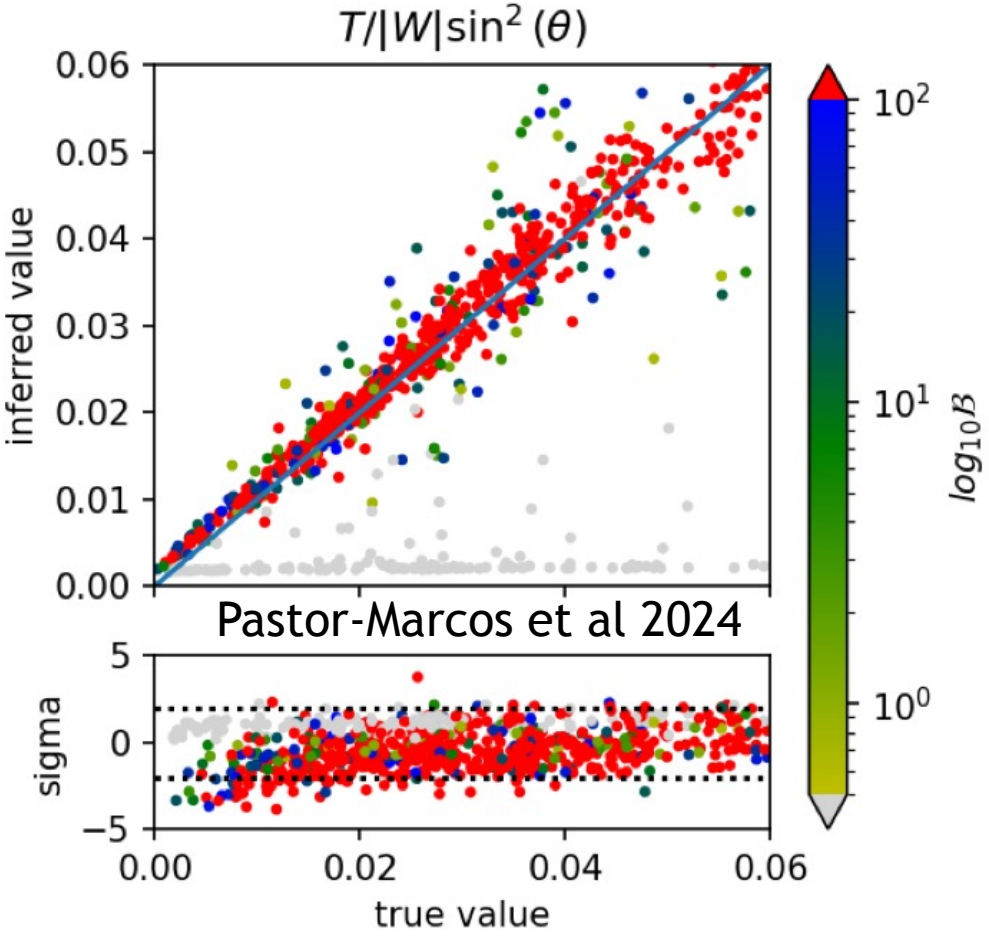
- **Building blocks for PE (see div. 6 activities)**
- **Future: model improvements**
  - **Accretion flows (Tseneklidou et al 2025)**
  - **Rotation → applicability to PNS and post-BNS mergers**

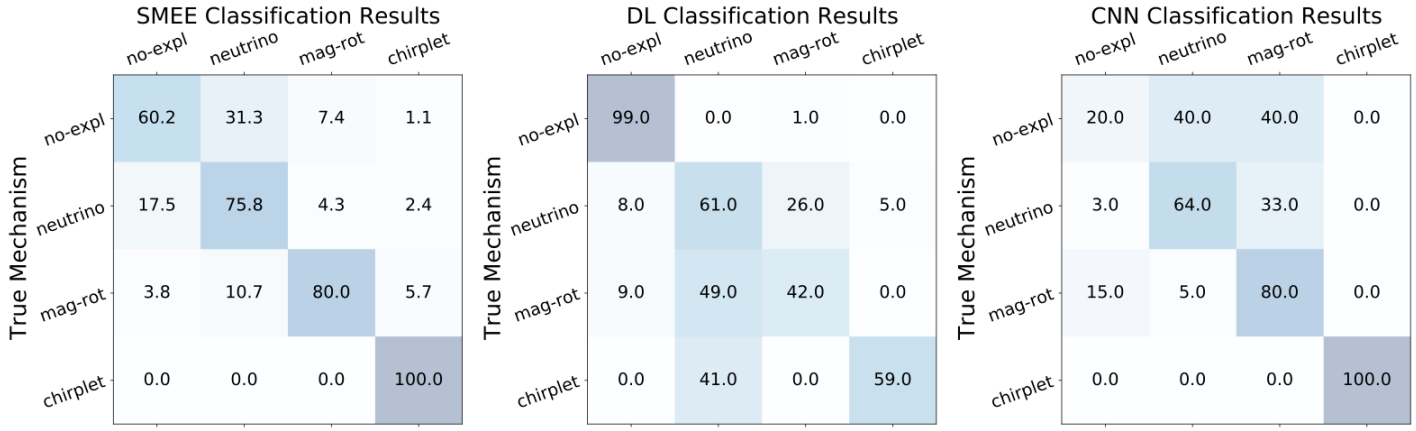
CCSNe - Detection and PE



ET Detection rates with MUSE (Mini Inception-Resnet CNN)

Inference of the rotation rate





Inferring the explosion mechanism with ET (algorithm comparison)

Powell et al 2024

Core Program – Nuclear Physics

Total div. 6: 0.67 FTE

- **OSB - Div 6 - Nuclear and Subatomic Physics (P-I.1.4)**
  - **Parameter inference**: R+D in PE methods for recovering equation of state parameters in the context BNS mergers and CCSNe

    (Core: P. Cerdá-Durán, M. Obergaulinger, D. Tseneklidou, A. Torres-Forné. Community: M.A. Aloy, J.A. Font)
  - **Numerical models** of the impact of nuclear physics on core-collapse supernovae

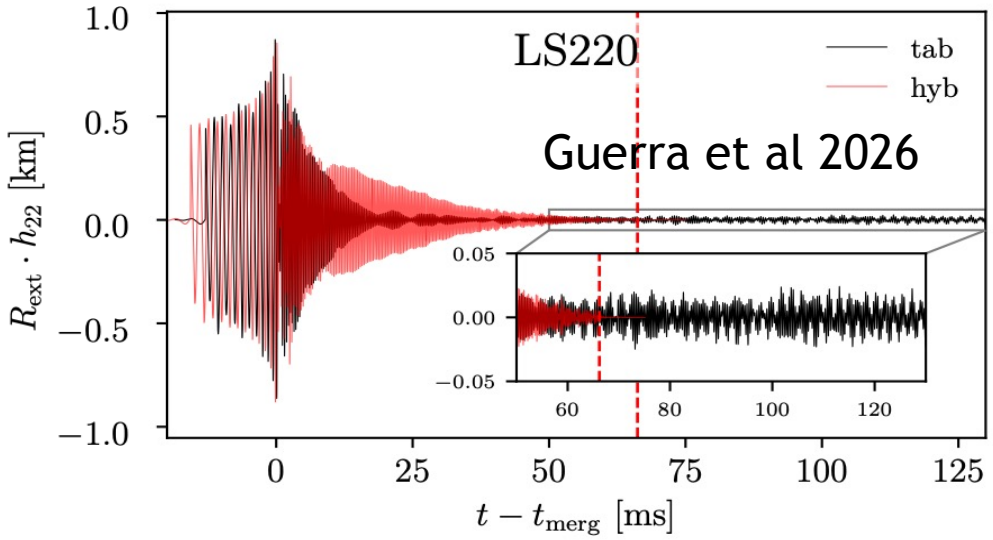
    (P. Cerdá-Durán, M. Obergaulinger, D. Tseneklidou)
  - Modelling of **dynamical tides in BNS mergers** and EOS dependence

    (Core: P. Pnigouras, P. Cerdá-Durán, D. Tseneklidou) → collaboration with ICCUB
  - Numerical modelling of neutron star dynamics in modified theories of gravity and attempting to **disentangle the equation of state uncertainties from strong gravity modifications**.

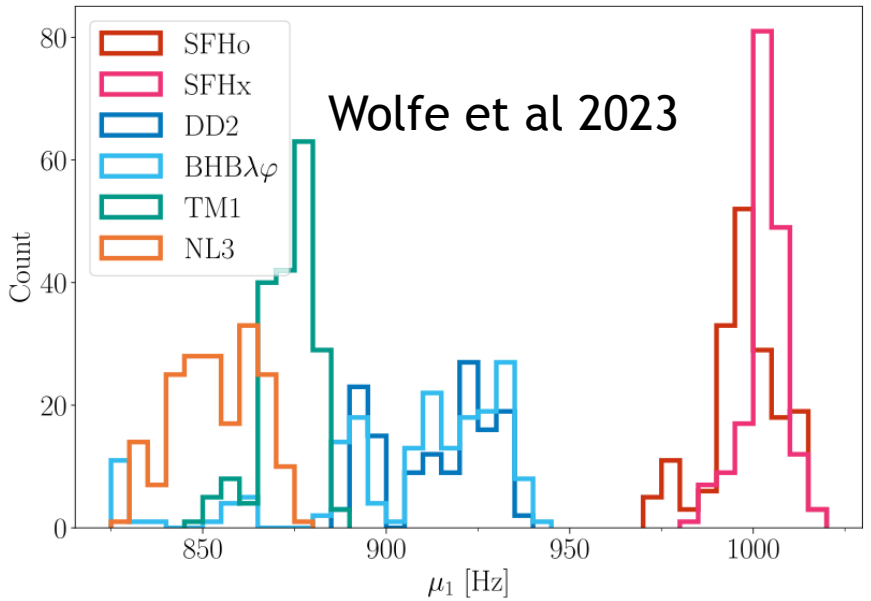
    (Core: D. Doneva)

CCSNe & BNS – Modelling and understanding

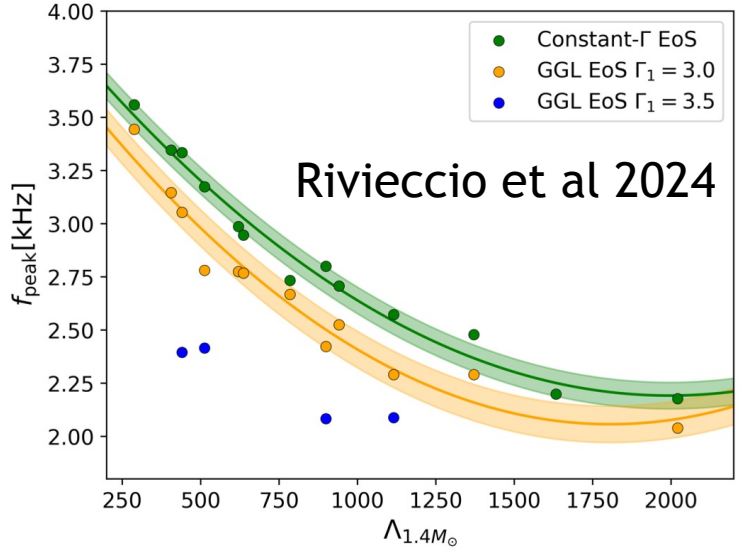
Impact of thermal effects in the EOS for BNS mergers



Dependence of core g-mode on EOS in CCSNe

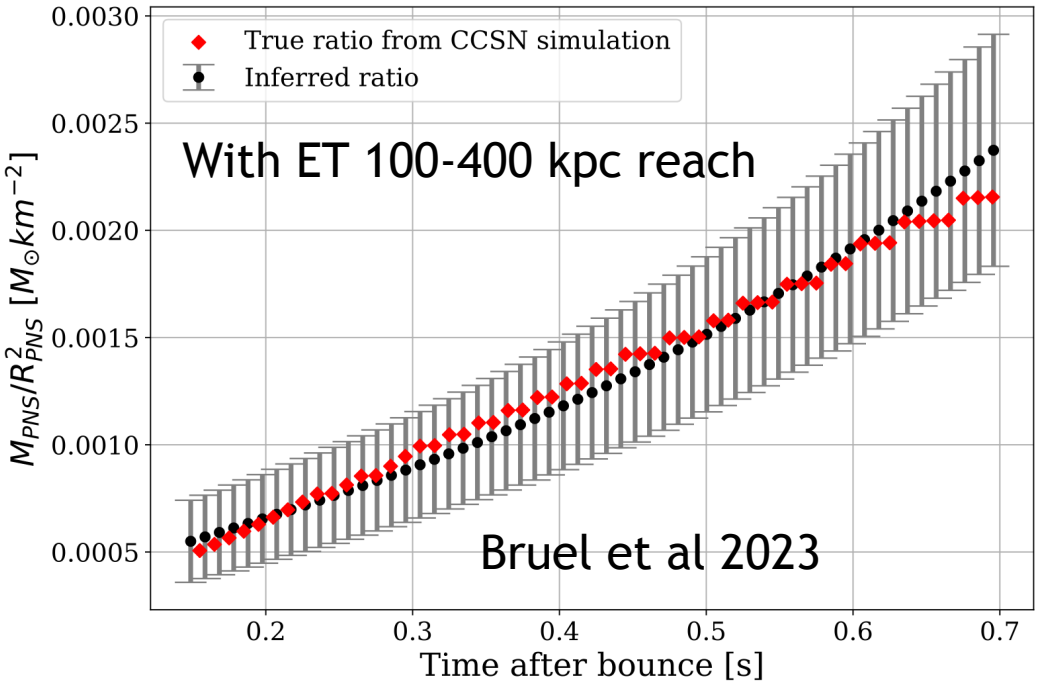


Impact of non-convex dynamics and phase transitions in BNS mergers

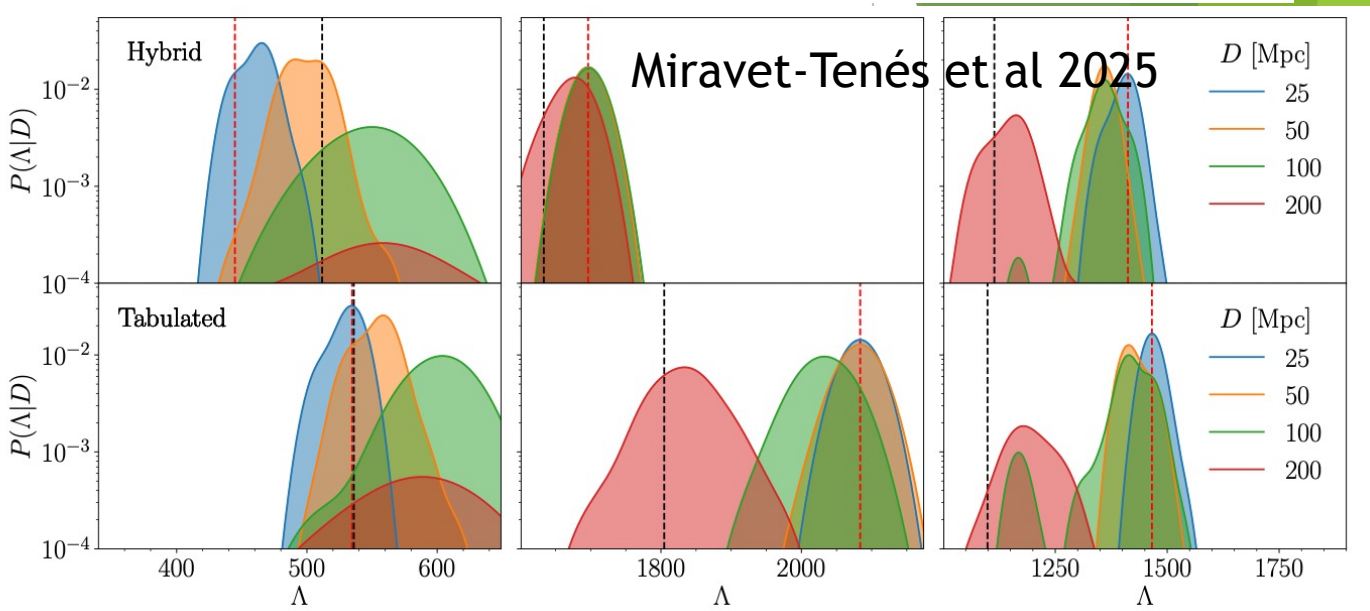


CCSNe & BNS - Inference

Inference of PNS mass and radius in CCSNe

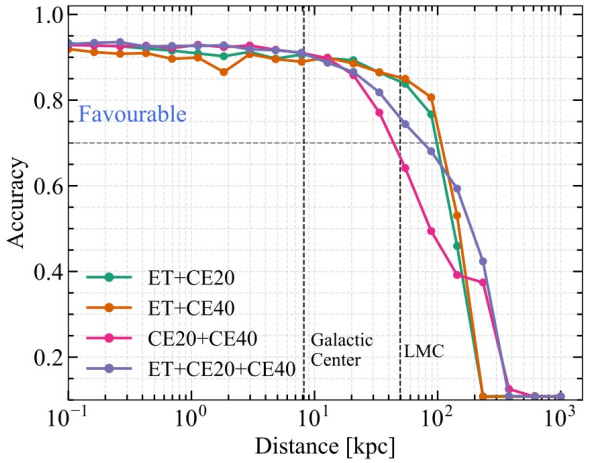


Impact of thermal effects in the measurement of the tidal deformability from the post-merger f2 peak



EoS inference in CCSNe using ML

Akhmetali et al 2026



Core Program - Fundamental Physics

Total div. 1: 0.4 FTE

- **OSB - Div 1 – Fundamental Physics (P-I.1.1)**
  - Developing numerical relativity **waveforms for binary black hole mergers in theories beyond GR**.

    (Core: D. Doneva. Community: J.A. Font)
  - Development of gravitational **waveforms from bosonic star mergers** (scalar and Proca). Evolving and producing a catalogue of constraint-satisfying initial data for bosonic star mergers (quasi-circular).

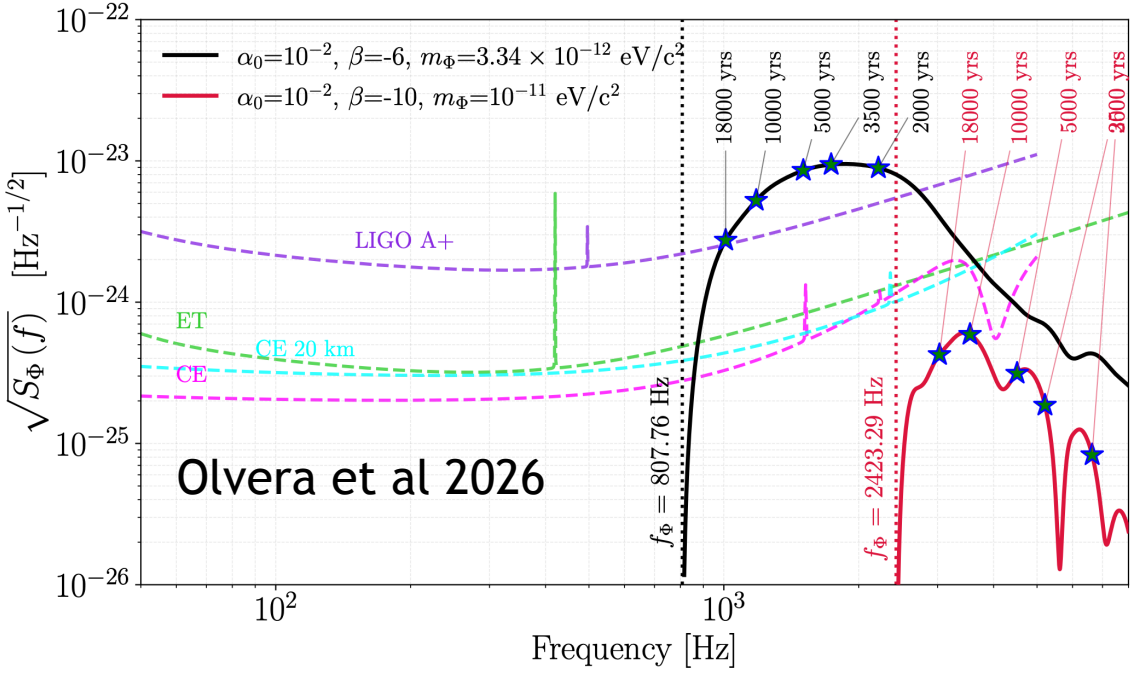
    (Core: N. Sanchis. Community: J.A. Font)
  - **BH spectroscopy and echoes**: Quasinormal modes, ringdown and echo signatures of black holes and exotic compact objects.

    (Community: G. Olmo)
  - **Gravitational-wave propagation and quantum signatures**. Modified gravity effects (birefringence, damping, forbidden frequency bands) and quantum-state signatures of primordial gravitational waves.

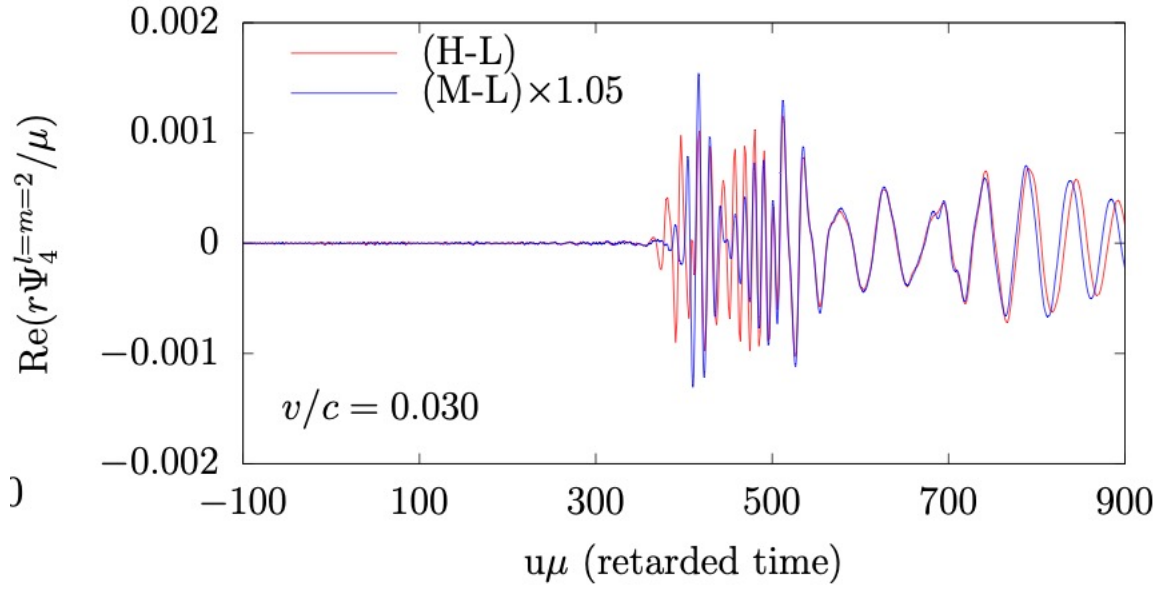
    (Community: G. Olmo, J. Navarro)

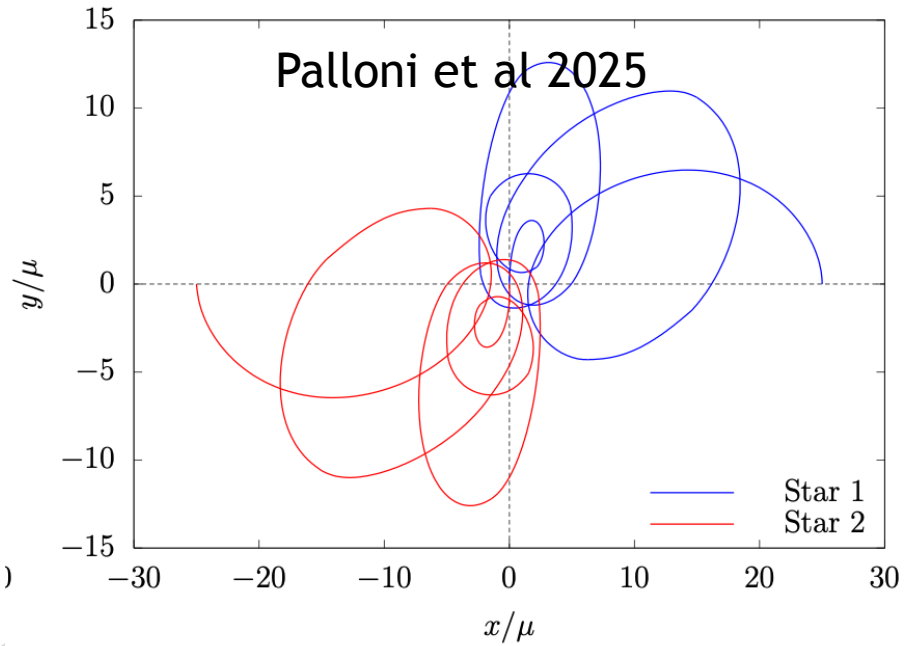
Fundamental physics

Descalarization bursts from Galactic supramassive neutron stars



Eccentric mergers of binary Proca stars





Board Activities

Total BA: 0.38 FTE

- **Pablo Cerdá Durán**
  - **VLC RU leader**
  - **Collaboration Board member**
- **Isabel Cordero-Carrión**
  - **Coordinator of W10.4 of the ET-PP WP10** (Education, Outreach and Citizen Engagement) and contributor to several tasks of the WP10
  - **Member of the Communications and Education Committee** (CEC) and contributor to comms and education activities
- **Miquel Miravet**
  - **Member of the Early Career Support Committee** (ECS)

Thank you!

VNIVERSITAT DE VALÈNCIA

GENERALITAT VALENCIANA
Conselleria d'Innovació, Universitats, Ciència i Societat Digital
TOTS A UNA veu

Fons Europeu de Desenvolupament Regional
Una manera de fer Europa
UNIÓ EUROPEA

MINISTERIO DE CIENCIA, INNOVACIÓN Y UNIVERSIDADES
AGENCIA ESTATAL DE INVESTIGACIÓN