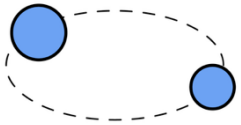
Modeling Gravitational Waves from Binary Neutron Stars

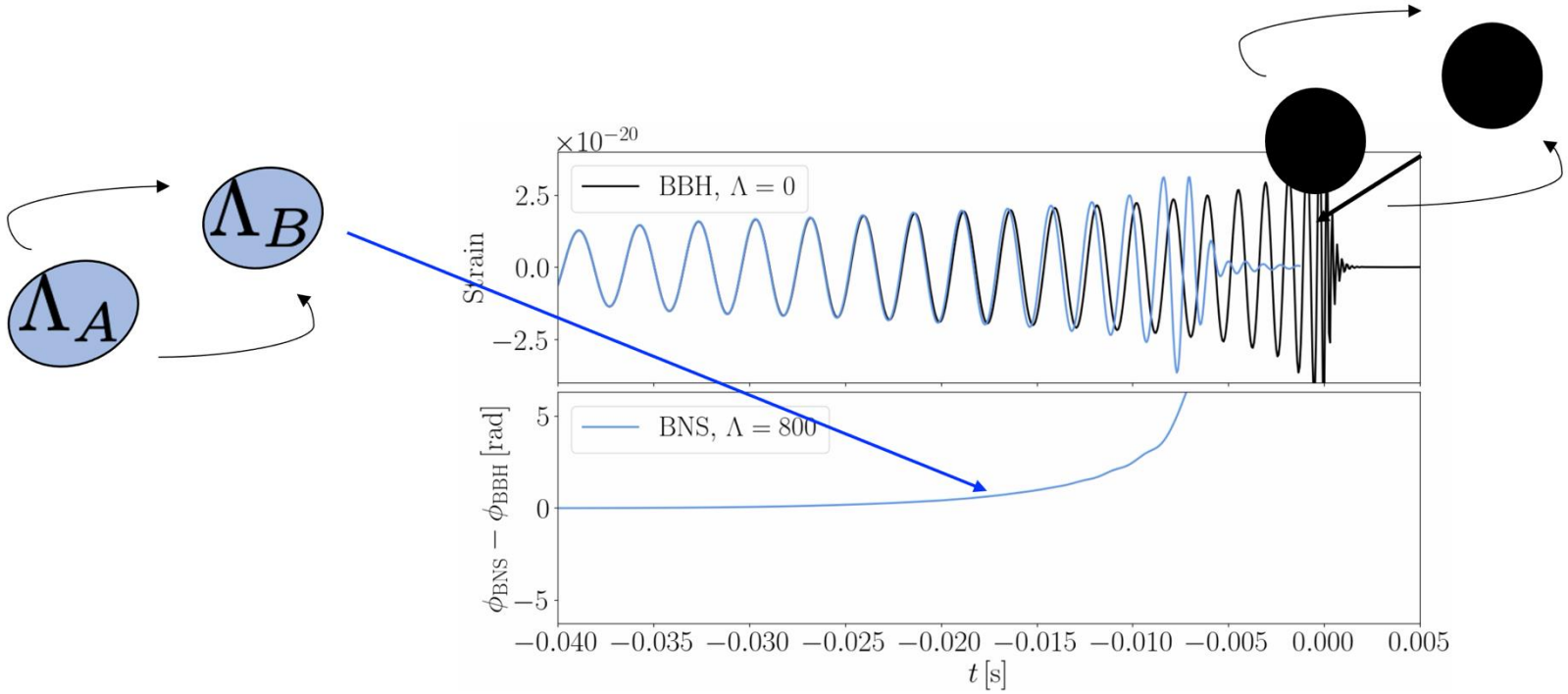
Thematic School GWsNS
Roscoff, France
29 June 2026



Adrian G. Abac, PhD
CNRS/IN2P3, Laboratoire de Physique Corpusculaire, Caen, France

BNSs as laboratories for fundamental physics

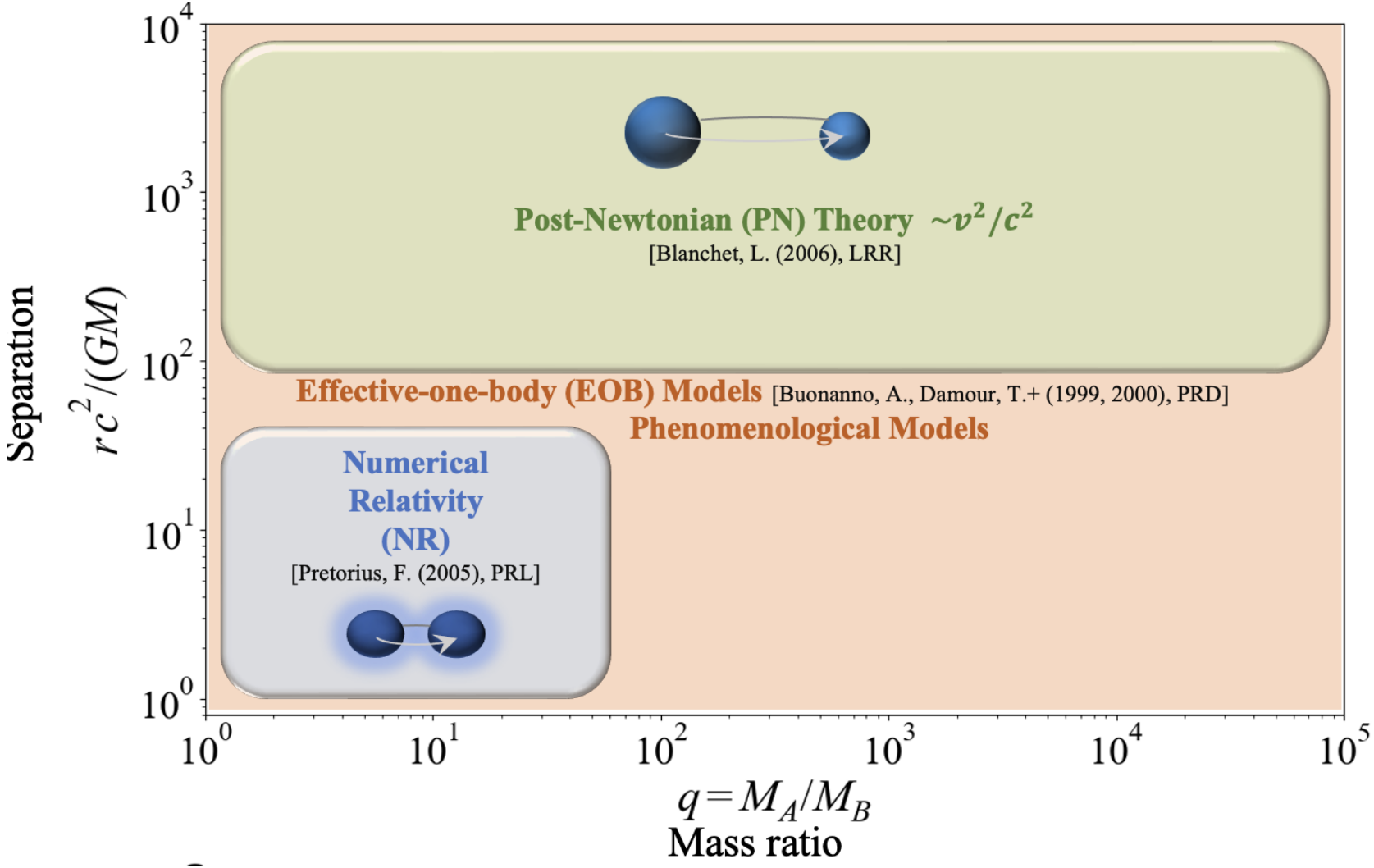
- Each star in a BNS coalescence deforms in the presence of its companion
- Deformation depends on the EOS within the star
- GW signal introduces a dephasing with respect to a BBH system in the late inspiral



Accurate waveform models are key to extracting neutron-star physics from gravitational-wave observations.

How do we model GWs from BNSs?

Waveform models combine different approximation methods across different regimes.



Advancing BNS models

NRTidalv3 model:

Abac, A., Dietrich, T., Buonanno, A., et. al. (2024). *PRD*

- ✓ Larger calibration set
- ✓ q-dependence in fitting parameters
- ✓ Dynamical tides

Extensions

Abac, A., Vidal, F.R., Colleoni, M., et. al. (2025). *PRD*

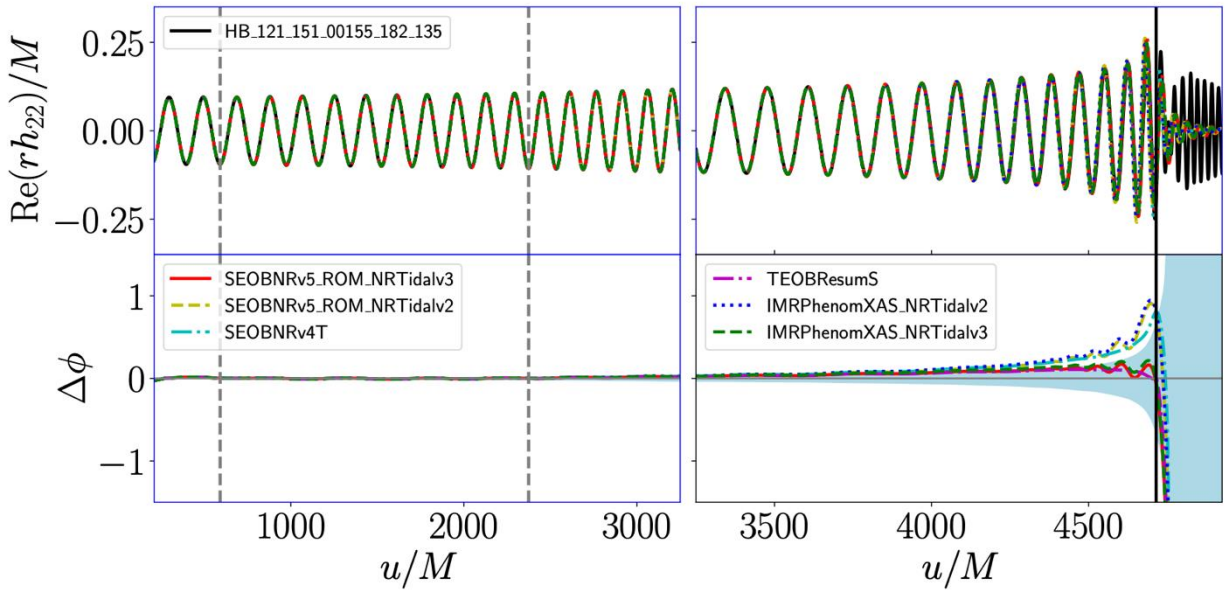
Vidal, F.R., **Abac, A.**, Colleoni, M., et. al. (2026), arXiv: 2606.04810

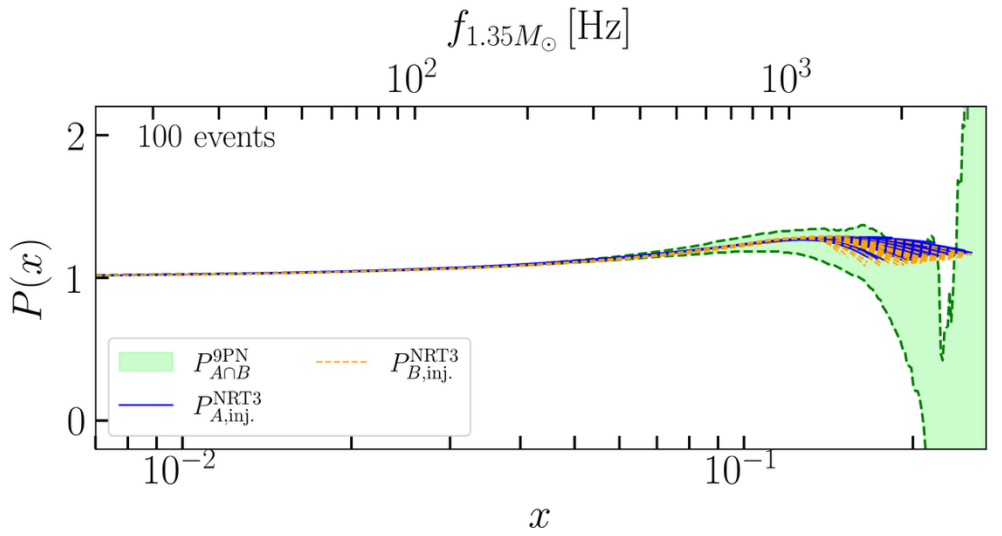
- ✓ Higher-mode content
- ✓ NSBH systems

Future

Abac, A., Puecher, A., Dietrich, T. et. al. (2025). *PRL*

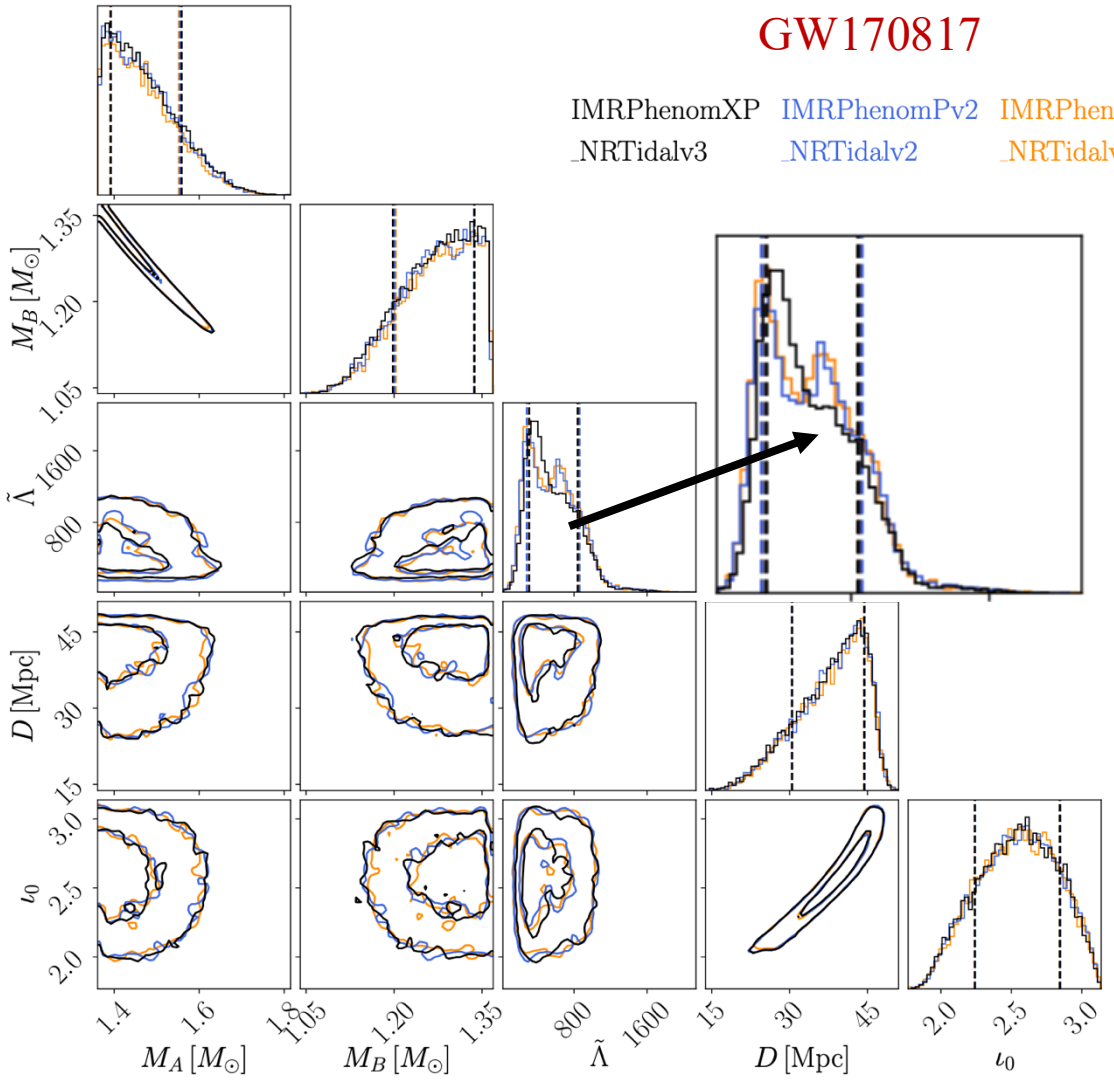
- ✓ Data-driven approach for improving and calibrating mdoels with ET



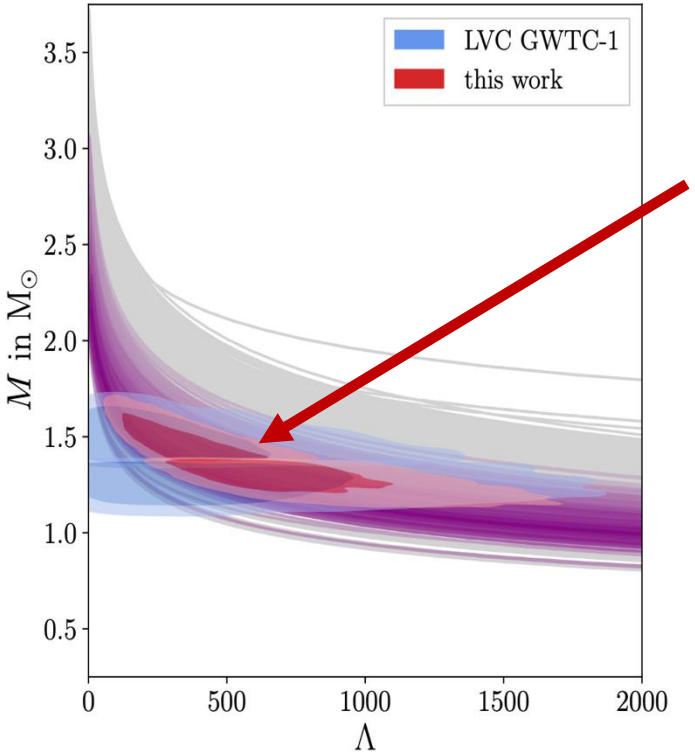


$$\psi_{\mathrm{Tidal}}(x) = A \cdot \Lambda_A \cdot P(x) + B \cdot \Lambda_B \cdot P_B(x)$$

Waveform models → Parameter Estimation → EOS constraints



Koehn, H., et al. (with **Abac, A.**) (2024), *PRX*



Used in conjunction with astrophysical and nuclear physics information