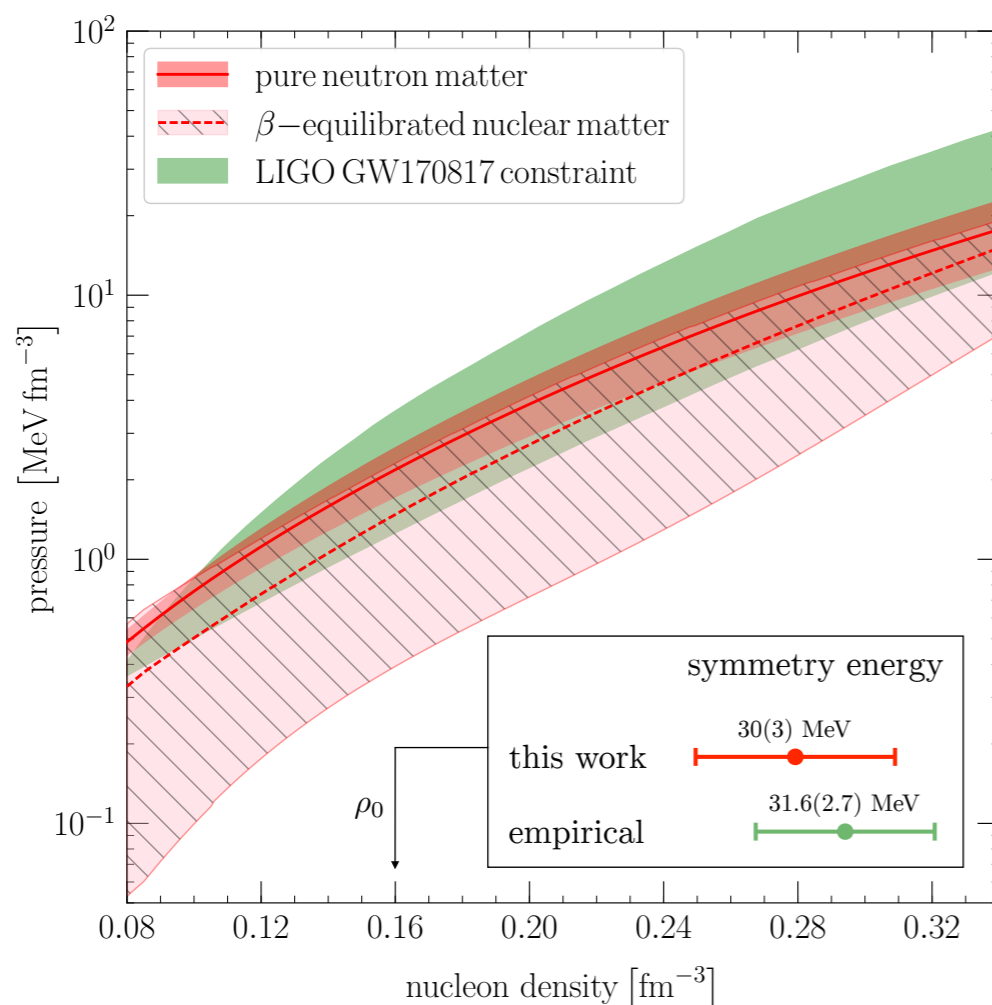


## Objectives

- We use quantum Monte Carlo (QMC) methods to perform exact *ab-initio* calculations of the nuclear equation of state (EOS) and the symmetry energy.
- We employ local chiral interactions up to next-to-next-to-leading (N<sup>2</sup>LO) fit to few-body observables only, and provide a comprehensive uncertainty quantification.



## Impact

- Predicted nuclear matter saturation density ( $\rho_0$ ) and saturation energy are compatible with empirical values within the quoted statistical and systematic uncertainties.
- The symmetry energy as a function of the density is consistent with current constraints at  $\rho_0/3$ ,  $\rho_0$ , and  $2\rho_0$ .
- The expectation values of the symmetry energy and its slope ( $L$ ) at saturation density are compatible with empirical values. Prediction for  $L$  at  $2\rho_0$  is also provided.
- The pressure as a function of the density is given for neutron matter and beta-equilibrated matter. Results are in good agreement with constraints extracted from gravitational waves of the neutron-star merger GW170817 by the LIGO-Virgo collaboration.
- In QMC calculations of nuclear matter, the dominant source of uncertainty is theoretical: truncation of the chiral expansion, regulator and cutoff artifacts.
- Chiral Hamiltonians, fit to few-body observables only, can simultaneously describe the ground-state physics of light and medium-mass nuclei and nuclear-matter properties.

## Accomplishments

Publication: D. Lonardoni, I. Tews, S. Gandolfi, and J. Carlson, [Phys. Rev. Research 2, 022033\(R\) \(2020\)](https://doi.org/10.1103/PhysRevResearch.2.022033)

Nuclear matter EOS and symmetry energy predictions (red). Experimental/observational constraints in green.