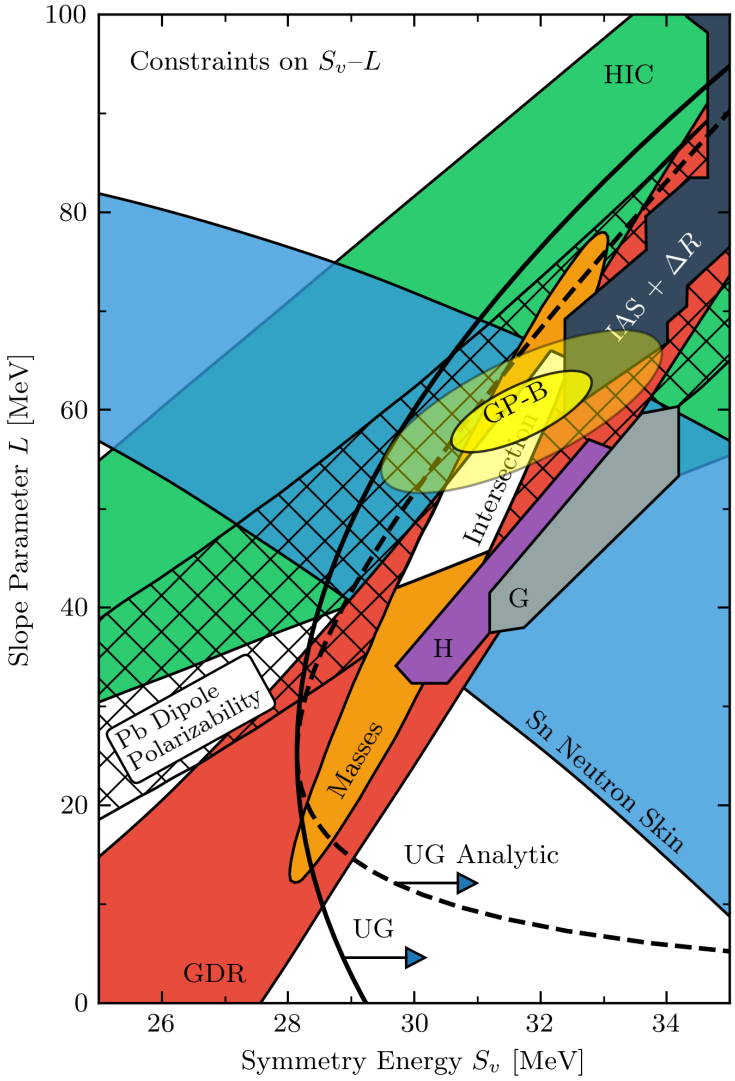
U.S. DEPARTMENT OF ENERGY | Office of Science

How well do we know the matter that is inside of neutron stars?

NUCLEI Nuclear Computational Low-Energy Initiative



Constraints on the symmetry energy and its density dependence from experiment and new theory with UQ (yellow ellipses).

Objectives

- Create a framework for effective field theory truncation errors that includes correlations within and between observables.
- Enable efficient and reliable evaluations of derived quantities (e.g., speed of sound).
- Apply to the dense matter in neutron stars.

Impact

- Produced the first statistically meaningful uncertainty estimates for key quantities of neutron stars. Correlations mean much smaller uncertainty than one might naively expect.
- Prediction for the symmetry energy – slope parameter correlation in excellent agreement with net experimental constraints (see figure).
- Equation-of-state results in good agreement with observations from gravitational waves and NICER.

Accomplishments

C. Drischler et al., Phys. Rev. Lett. 125, 202702 (2020).