



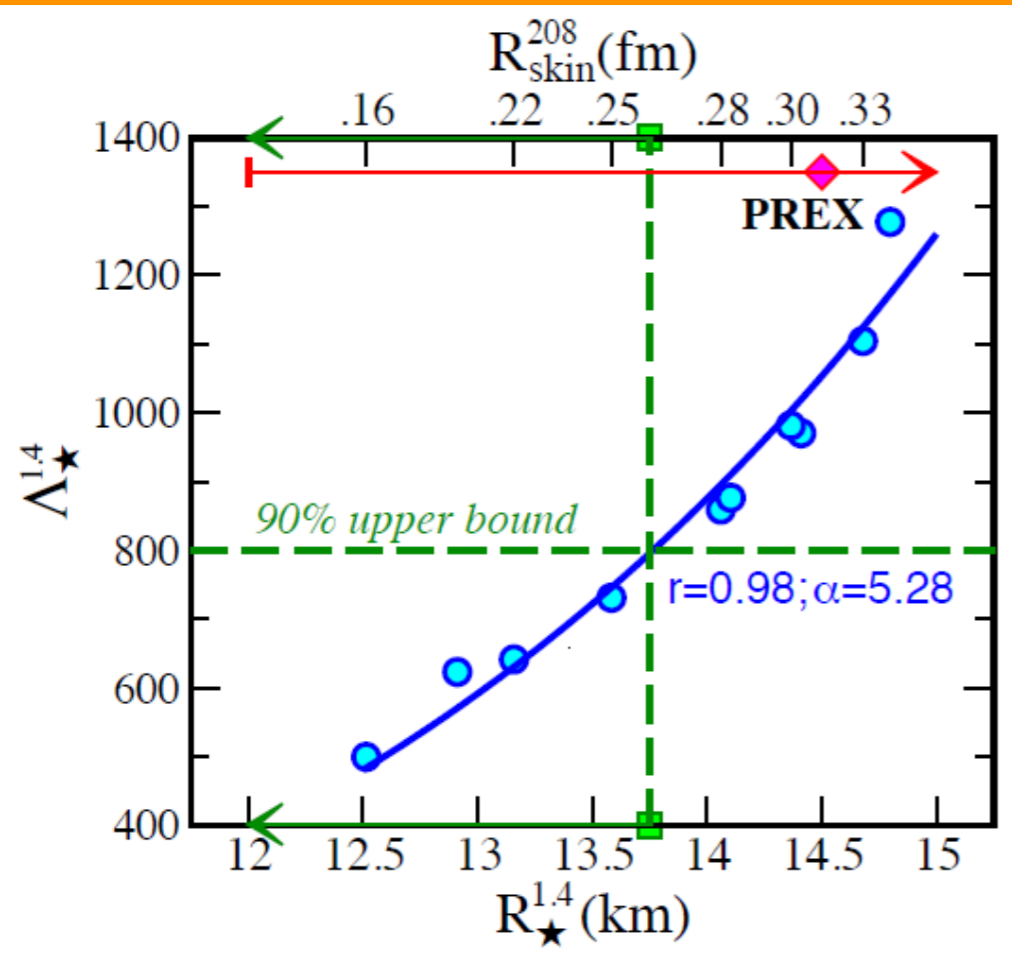
# Connecting Neutron Skins to Gravitational Waves

## Objectives

- Use a set of realistic equation-of-state (EOS) models to confront their predictions against tidal deformabilities extracted from the gravitational-wave (GW) data of binary neutron star merger GW170817.
- Given the sensitivity of GW data to the EOS, find constraints on the neutron star radius.
- Explore density dependence of the nuclear symmetry energy and analyze the impact of this measurement on the neutron skin thickness of  $^{208}\text{Pb}$ .

## Impact

- Based on the GW data we deduced an upper limit on the neutron star radius of a 1.4 solar-mass neutron star:  $R \lesssim 13.76$  km.
- We inferred a corresponding upper limit on the neutron skin thickness of  $^{208}\text{Pb}$ :  $R_{\text{skin}} \lesssim 0.25$  fm.
- Relying on experimental lower bound of  $R_{\text{skin}}(^{208}\text{Pb})$  as measured by the PREX Collaboration, we were able to provide the lower limit on the tidal deformability  $\gtrsim 490$ .
- If the upcoming experiment measures a thicker skin, this may be evidence of a softening of the symmetry energy at high densities, or indicative of a phase transition in the interior of neutron stars.



Model predictions for tidal deformability as a function of the neutron star radius and the neutron skin thickness of  $^{208}\text{Pb}$ .

## Accomplishments

- Publication: F. J Fattoyev, J. Piekarewicz, and C. J. Horowitz, [Phys. Rev. Lett. 120, 172702 \(2018\)](#).
- Highlighted as [Editors' Suggestion](#).
- Featured in Physics (phys.aps.org) as Synopsis: [Gravitational Waves Shed Light on Dense Nuclear Matter](#).
- Featured by [Inside Science](#), [Physics World](#), [Sky & Telescope](#), and several international news outlets.