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Constraints to the Equation of State from Relic Neutrinos

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A neutron star is one of the densest objects in the universe. Therefore, studying and understanding binary neutron star mergers can help us to understand the behaviour of ultra-dense matter also used to describe nuclear matter in extreme conditions. During those stellar events, most of the gravitational potential energy is transferred to neutrinos that escape the neutron-rich ejecta, and some of those particles are possibly detected on Earth. They carry information about the equation of state of ultra-dense matter and their detection in neutrino observatories can be compared to theoretical predictions coming from hydrodynamics simulations. More specifically the use of a given equation of state in simulations predicts a spectrum of neutrinos that is specific to this equation of state. However, binary neutron star mergers are rare. Instead of trying to detect neutrinos coming from a single event we propose to study the contribution from binary neutron star mergers to the diffuse neutrino background. Comparing our predictions of these relic neutrinos with event rates registered at neutrino observatories might allow us to put constraints on the equation of state of hot ultra-dense matter.

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