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Neutron Star Structure, Neutron-rich Matter, and Gravitational Waves[1]

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In addition to opening a new window on the universe, the detection of gravitational waves will have important implications for nuclear physics. In particular, gravitational waves from neutron star mergers contain important information about the structure of neutron stars - which are our best probes of QCD at non-perturbative densities. I will briefly review what we can learn about neutron star structure from gravitational waves and compare that with what we have learned recently from electromagnetic observations. A careful combination of these two types of data will bring us closer to answering one of the fundamental questions about high-density QCD: what are the best degrees of freedom for describing matter above the nuclear saturation density? Also, neutron star mergers are promising sites of r-process nucleosynthesis, and gravitational waves signals may help us understand how much r-process material comes from mergers as opposed to neutrino driven winds. R-process material in mergers originates near the neutrinosphere, a region very sensitive to the nuclear physics input.

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