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Constructing neutron star equations of state by connecting a parity doublet nuclear model and Nambu—Jona-Lasinio type model: observational constraints on the nucleon chiral invariant mass

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The mass of a nucleon consists of chiral variant and invariant components. Since their medium properties are different, the composition can be examined through matter in extreme conditions. For this purpose neutron stars are one of the ideal laboratories. Using a parity double model for nuclear matter, we study the mass composition of nucleons through construction of neutron star equations of state, where we assume crossover from nuclear to the color-flavor-locked quark matter. Confronting the neutron star masses and radii in our model with the observational data of LIGO-Virgo and of NICER, we found that the chiral invariant mass is more than 80% of the mass of nucleon. We discuss how the chiral condensate changes from nuclear to quark matter.

Presenter: MINAMIKAWA, Takuya (Nagoya Univ.)