ID de Contribution: **74** Type: **ÉTOILES A NEUTRONS, SUPERNOVÆ ET SYNTHÈSES DES ÉLÉMENTS LOURDS**

Influence of the crust on neutron star macrophysical quantities and universal relations

mardi 30 mars 2021 16:45 (15 minutes)

Measurements of neutron star macrophysical properties thanks to multi-messenger observations offer the possibility to constrain the properties of nuclear matter. Indeed cold and dense matter as found inside neutron stars, in particular in their core, is not accessible to terrestrial laboratories.

We investigate the consequences of using equations of state that employ models for the core and the crust that are not calculated consistently on the neutron star macrophysical properties, on some of the so-called universal relations and on the constraints obtained from gravitational wave observations. Various treatments found in the literature are used to connect together non-consistent core and crust equations of state. We assess the discrepancies in the neutron star macrophysical properties obtained when consistent models for the whole star and non-consistent ones are employed.

The use of crust models non consistent with the core introduces an error on the macrophysical parameters which can be as large as the estimated accuracy of current and next generation telescopes. The precision of some of the universal relations reported in the literature is found to be overestimated. We confirm that the equation of the crust has limited influence on the macrophysical properties.

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Classification de Session: Contributed talks: Neutron stars, supernovae and heavy elements