ID de Contribution: **63** Type: **ÉTOILES A NEUTRONS, SUPERNOVÆ ET SYNTHÈSES DES ÉLÉMENTS LOURDS**

What can be learned from a proto-neutron star's mass and radius ?

mardi 30 mars 2021 15:45 (15 minutes)

We make extensive numerical studies of masses and radii of proto-neutron stars during the first second after their birth in core-collapse supernova events. We use a quasi-static approach for the computation of proto-neutron star structure, built on parameterized entropy and electron fraction profiles, that are then evolved with neutrino cooling processes. We vary the equation of state of nuclear matter, the proto-neutron star mass and the parameters of the initial profiles, to take into account our ignorance of the supernova progenitor properties. We show that if masses and radii of a proto-neutron star can be determined in the first second after the birth, e.g. from gravitational wave emission, no information could be obtained on the corresponding cold neutron star and therefore on the cold nuclear equation of state. Similarly, it seems unlikely that any property of the proto-neutron star equation of state (hot and not beta-equilibrated) could be determined either, mostly due to the lack of information on the entropy, or equivalently temperature, distribution in such objects.

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