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Crystallization of the outer crust of non-accreting neutron stars

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The interior of a neutron star is usually assumed to be made of cold catalysed matter. However, the outer layers are unlikely to remain in full thermodynamic equilibrium during the neutron-star formation and cooling, especially after crystallization occurs.
In this contribution, we present a study of the evolution of the nuclear distributions of the hot dense multi-component Coulomb plasma and the equilibrium composition of the outer layers of a non-accreting neutron star down to crystallization.
The variation of the impurity parameter, generally taken as free parameter in cooling simulations and calculated in this work self-consistently using a microscopic nuclear model, will be discussed. Specifically, its non-monotonic behaviour, with values changing by several orders of magnitude reaching about 50, suggests that the crust may be composed of an alternation of pure (highly conductive) and impure (highly resistive) layers, which in turn may have sizeable impact on transport properties and the neutron-star evolution.

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