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The neutron star in Cassiopeia A: equation of state, superfluidity, and Joule heating

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The thermomagnetic evolution of the young neutron star in Cassiopea A is studied by considering fast neutrino emission processes. In particular, we consider neutron star models obtained from the equation of state computed in the framework of the Brueckner-Bethe-Goldstone many-body theory and variational methods, and models obtained with the Akmal-Pandharipande-Ravenhall equation of state. It is shown that it is possible to explain a fast cooling regime as the one observed in the neutron star in Cassiopea A if the Joule heating produced by dissipation of the small-scale magnetic field in the crust is taken into account. We thus argue that it is difficult to put severe constraints on the superfluid gap if the Joule heating is considered.

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