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Fast Neutrino Cooling of Nuclear Pasta in Neutron Stars: Molecular Dynamics Simulations ZIDU LIN, University of Tennessee, MATTHEW CAPLAN, Illinois Sate University, CHARLES HOROWITZ, Indiana University Bloomington, CECILIA LUNARDINI, Arizona State University — The direct URCA process of rapid neutrino emission can occur in nonuniform nuclear pasta phases that are expected in the inner crust of neutron stars. Here, the periodic potential for a nucleon in nuclear pasta allows momentum conservation to be satisfied for direct URCA reactions. We improve on earlier work by modeling a rich variety of pasta phases (gnocchi, waffle, lasagna, and anti-spaghetti) with large-scale molecular dynamics simulations. We find that the neutrino luminosity due to direct URCA reactions in nuclear pasta can be 3 to 4 orders of magnitude larger than that from the modified URCA process in the neutron star core. Thus neutrino radiation from pasta could dominate radiation from the core and this could significantly impact the cooling of neutron stars.

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