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Pasta Nucleosynthesis: Molecular dynamics simulations of nuclear statistical equilibrium MATTHEW CAPLAN, CHARLES HOROWITZ, ANDRE DA SILVA SCHNEIDER, DONALD BERRY, Indiana Univ - Bloomington — We simulate the decompression of cold dense nuclear matter, near the nuclear saturation density, in order to study the role of nuclear pasta in r-process nucleosynthesis in neutron star mergers. Our simulations are performed using a classical molecular dynamics model with 51 200 and 409 600 nucleons, and are run on GPUs. We expand our simulation region to decompress systems from initial densities of 0.080 fm^{-3} down to 0.00125 fm^{-3}. We study proton fractions of $Y_P = 0.05$, 0.10, 0.20, 0.30, and 0.40 at $T = 0.5$, 0.75, and 1 MeV. We calculate the composition of the resulting systems using a cluster algorithm. This composition is in good agreement with nuclear statistical equilibrium models for temperatures of 0.75 and 1 MeV. However, for proton fractions greater than $Y_P = 0.2$ at a temperature of $T = 0.5$ MeV, the MD simulations produce non-equilibrium results with large rod-like nuclei. Our MD model is valid at higher densities than simple nuclear statistical equilibrium models and may help determine the initial temperatures and proton fractions of matter ejected in mergers.

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