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Self Assembly and Elasticity of Nuclear Pasta MATTHEW CAPLAN, CHUCK HOROWITZ, DON BERRY, Indiana Univ - Bloomington, ANDRE DA SILVA SCHNEIDER, California Institute of Technology — While the outer crust of a neutron star is likely a solid ion lattice, the core consists of uniform nuclear matter at or above saturation density. In between, nuclei adopt exotic non-spherical geometries called "nuclear pasta" in order to minimize the nuclear attraction and Coulomb repulsion between protons. These structures have been well studied with both classical and quantum molecular dynamics, and their geometry can be predicted from the density, temperature, and proton fraction. Recent classical molecular dynamics simulations find evidence for a phase transition at $T \approx 0.5$ MeV, where simulations with low proton fractions undergo a solid-liquid phase transition, while simulations with high proton fractions under a glass-rubber phase transition. This is expected to have nontrivial consequences for the elastic properties of the pasta. Additionally, recent observations indicate that the structure of nuclear pasta may be related to structures observed in biophysics, specifically self assembling lipid membranes.

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