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Thermal Fluctuations in Nuclear Pasta CAL FORSMAN, MATT CAPLAN, Illinois State University, ANDRE SCHNEIDER , Stockholm University — All stars maintain an equilibrium between the pressure in their cores and gravity compressing them. When massive stars exhaust their fuel nuclear fusion in the core ceases and can no longer support the core against gravitational compression. A core-collapse supernova occurs, and the collapsed core remains as a neutron star. Neutron stars are significantly more compact and thus much denser. At these high densities protons and neutrons rearrange into structures known as 'nuclear pasta' which are theorized to generate gravitational waves on rotating neutron stars. We study thermal fluctuations in nuclear pasta at finite temperatures using molecular dynamics simulations. We render these simulations in 3D using Paraview to study the evolution of nuclear pasta with increasing temperature. We resolve a melting transition above which the structure breaks down. At high temperatures below the melting transition various defects such as holes and filaments spontaneously form and dissolve, and we observe high surface roughness. At low temperatures defects exist but are infrequent and short lived. We characterize the surface of the pasta structures with the Minkowski functionals and find power law deviations in surface curvature which may impact observable properties of neutron stars.

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