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The Proto-neutron star crust studied with an Ising approach¹ KARIM HASNAOUI, JORGE PIEKAREWICZ, Florida State University — The thermodynamics of the proto-neutron stars crust is studied in this project. Obtaining information on the star matter thermodynamics will enhance the understanding of physical phenomena involved in the cooling of proto-neutron stars, and the formation of type II supernovae. The main goals of this project is to understand qualitatively, how the different structures of the crust, such as the well known "nuclear pasta" or the liquid and gas phases can be formed as function of the proton fraction X_p , the density ρ , or the temperature T. For this purpose, we have developed a classical model based on a Ising/Lattice-gas approach, where the short range nuclear interaction and the long range Coulomb interaction have been included. We are now able to perform simulation for a very large number of particles, and we will show that the signals of phase transitions between the pasta structures and the gas phase as function of the different conditions previously mentioned, can be clearly identified on the structure form factor S(k), but also on the heat capacity C_v .

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Karim Hasnaoui Florida State University

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