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Equation of state representation for neutron star oscillations

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The choice of an equation of state is crucial in stellar structure. The most common choice is polytropes as they are good approximations for zero-temperature Fermi gas of electrons or nuclear matter. However, when going to more in-depth description of neutron stars, nuclear equations of state are needed to describe the interactions between baryons at very high densities. Those equations of state are often not analytical and thus come as tables, as given for example in CompOSE. Therefore, using them comes with interpolation schemes for the physical quantities are not limited to tabulated values. This, added to the fact that numerical precision of tables may not be as high as one wants due to the phenomenological nature of the nuclear equations of state, brings numerical noise in the simulation codes. One way to address this issue is to create analytical fits of the tables which not only allows for any desired numerical accuracy but also possibly reduces computation time as all thermodynamical quantities of interest can be computed analytically instead of having to interpolate through tables containing thousands to millions of grid points, which can be computationally expensive. I will describe the idea of pseudo-polytrope which generalizes polytropic equations of state, and present the current version of a code aimed at simulating the post-merger hypermassive neutron star.

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