Contribution ID: **116**   Type: **Poster**

Exploring neutron stars with three conserved charges in a newly optimized C++ Chiral Mean Field code

Tuesday 5 September 2023 17:30 (2h 10m)

The Chiral Mean Field model (CMF) has been successful in describing the equation of state at large baryon densities, such as those found in neutron stars, neutron star mergers, and heavy-ion collisions. The MUSES collaboration has rewritten the zero-temperature CMF model from Fortran 77 into a parallelized modern C++20 using OpenMP, which has resulted in at least an order of magnitude improvement in runtime. We obtained equations of state across μ_B, μ_S, and μ_Q, and within the metastable regime around the quark deconfinement phase transition. The improved numerical resolution allows for the accurate computation of higher-order derivatives such as susceptibilities. Finally, we computed neutron star observables like quadrupole moment, Love number, moment of inertia, and mass-radius curve.

Category

Theory

Collaboration (if applicable)

MUSES collaboration

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Session Classification: Poster Session

Track Classification: Nuclear astrophysics