We consider several NN potentials with increasing degree of criticality (due to decrease of the ω strength) to reproduce binding energies of few MeV in infinite nuclear matter.

Beyond mean field, the ω strength is increased to reduce the potential depth and make it closer to the phenomenological NN Bonn potential.

The shallow potential classically bounds few-nucleons close to T=0 (see Result 1). However, modifications due to the α mode strongly affects the NN interaction (see Method).

Result 1: Small-size clusters at low T

Molecular dynamics + Langevin Equation

These potentials are implemented into a classical molecular dynamics with thermal noise. Quantum effects are neglected at T=100 MeV, but needed for cold nuclear matter (see [3]).

We consider several NN potentials with increasing degree of criticality (due to decrease of σ mass close to Tc).

We extract physical properties from phase space distribution.

Conclusions

1) NN potential is very sensitive to the QCD critical mode α.
2) Usual potentials for infinite nuclear matter are not able to produce binding around T=100 MeV.
3) NN potential reflecting o-mass suppression close to Tc allows for substantial nuclear clustering.
4) In HICs, finite duration and radial expansion prevent big agglomeration, but small clusters can be formed.
5) Clustering induces NN correlations producing an enhancement of kurtosis close to Tc.

Motivation

We propose new effects in heavy-ion collisions at the Beam Energy Scan (BES) of the Relativistic Heavy-Ion Collider which can signal the presence of a possible QCD critical point at a particular collision energy. We focus on nucleon-nucleon (NN) interaction at energies ~1 TeV mediated by the Walecka-Serot potential.

We stress the importance of correlations between nucleons for binding and eventual clustering (Boltzmann’s Sossia/Israel is not enough to describe this phenomenon).

We extract physical properties from phase space distribution.

Conclusions

1) NN potential is very sensitive to the QCD critical mode α.
2) Usual potentials for infinite nuclear matter are not able to produce binding around T=100 MeV.
3) NN potential reflecting o-mass suppression close to Tc allows for substantial nuclear clustering.
4) In HICs, finite duration and radial expansion prevent big agglomeration, but small clusters can be formed.
5) Clustering induces NN correlations producing an enhancement of kurtosis close to Tc.

References

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