The Equation of State and Thermodynamic Properties of Nuclear Matter at Low Densities

H. R. Jaqaman
UNESCO Chair in Mathematics and Theoretical Physics, Birzeit University, Birzeit,Palestine
hjaqaman@birzeit.edu

Abstract:

In 1960 Overhauser [1] suggested that the ground state of nuclear matter may not be described by plane wave orbitals corresponding to a uniform density fluid phase but rather by orbitals that produce a periodically varying density. Such Overhauser orbitals were shown [2] to give an energy lower than that obtained from plane waves, but only at
low densities. Such periodic densities correspond to α particle-like clusters arranged on a lattice and thus correspond to a solid phase. These results were subsequently extended to finite temperature [3] and a triple point of nuclear matter was found at a temperature of about 1.1 MeV. Recent experimental analyses of moderate-temperature nuclear gases produced in heavy ion reactions reveal a large degree of α particle clustering at low densities [4]. The thermodynamic properties and equation of state of low density nuclear matter, including cluster formation, will be examined.

[1] A. W. Overhauser, Phys. Rev. Lett. 4, 415 (1960).
[2] L. Doenert, M. de Llano and A. Plastino, Nucl. Phys. A291, 45 (1977).
[3] H. R. Jaqaman, Phys. Rev. C 38, 1418 (1988).
[4] S. Kowalski et al, Phys. Rev. C 75, 014601 (2007).