Cyclotron Colloquium on Friday, August 17th, 2016, at 3:45 pm in Room 228

Refreshments will be served at 3:30 pm

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Abstract:

Pre-equilibrium emission and its possible relation to alpha-clustering in nuclei

Cluster structure effects in nuclei have been investigated looking to the preequilibrium particles emitted in the $_{16}$O+$_{65}$Cu and $_{19}$F+$_{62}$Ni reactions at the same beam velocity of 16 AMeV which lead to the same 81Rb* compound nucleus. Despite the slight difference in excitation energies, the same fast emission should be expected from the two systems; unless major effects induced by the projectile's cluster structure, which should influence the preequilibrium α-particle production during the non-equilibrium stage, are present. The experimental data have been collected with the GARFIELD+RCo apparatus at Laboratori Nazionali di Legnaro. In this talk I will report on the preliminary spectra of light-charged particles, obtained in coincidence with evaporation residues, and their comparison with the results obtained from model calculations.

Competition between fermions and bosons in nuclear matter at low densities and finite temperatures

Experimentally dilute nuclear matter can be produced in heavy-ions reactions. Below the nuclear saturation density, the strong interaction leads to the occurrence of correlated states of nucleons (clusters). A recurring theme has always been the determination of the thermodynamic properties of nuclear matter, which play an important role in studies of various astrophysical phenomena. When considering a wide range of temperatures, densities and/or proton fractions, a thermodynamic quantity such as the free energy of fragments is needed. Its characterization as a

function of temperature and density provides important information about the nuclear equation of state.

I will report on experimentally derived free energy for fermions and bosons obtained by using the Landau free-energy approach. We confirm previously obtained results for fermions and show that the free energy for alpha particles is negative and very close to the free energy for ideal Bose gases Deuterons behave more similarly to fermions (positive free energy) rather than bosons. This is due to their low binding energy, which makes them very 'fragile', i.e., easily formed and destroyed. We show that the **α**-particle fraction is dominant at all temperatures and densities explored in this work. This is consistent with their negative free energy, which favors clusterization of nuclear matter into **α**-particles at subsaturation densities and finite temperatures. The role of finite open systems and Coulomb repulsion is addressed