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Alpha clustering and condensation in nuclear systems

Alpha clustering in nuclear systems has known an extraordinary growth in activity over the last 15 years or so. I have strongly participated in the theoretical developments of alpha clustering and with my collaborators I have for example proposed that the Hoyle state in 12C can be considered as an alpha particle condensate. This theory explains all known data of the Hoyle state, for instance the inelastic form factor without any adjustable paramter. The so-called THSR (Tohsaki, Horiuchi, Schuck, Roepke) wave function has now been generalized and most of the alpha-gas states of the family of Hoyle states are very well described. Predictions for alpha gas states in 16O are being made.
These alpha gas states are precursors of alpha condensation in low density nuclear matter. The critical temperature is calculated in symmetric and asymmetric matter. At zero temperature it is shown that alpha condensation is a Quantum Phase Transition with the density as control parameter (alpha condensation disappears above a critical (low) density). This is exemplified for nuclear matter but also for finite nuclei. Alpha decay of Actinides is a new subject treated with a THSR type of approach and, e.g., a pocket formation of the alpha on the surface of 208Pb in 212Po can explain the physics at work in alpha decay. The talk is intended to give an overview of alpha clustering in nuclear systems.

Selected session

Nuclear structure

Primary author: Prof. SCHUCK, Peter (Institut de Physique Nucleaire Orsay)

Presenter: Prof. SCHUCK, Peter (Institut de Physique Nucleaire Orsay)