The nuclear shell model – older than 60 years

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Abstract

The shell model, introduced more than 60 years ago, has been the standard model for analyzing and calculating nuclear observables. In this model, nucleons move independently in a common central potential well. This has been difficult to reconcile with the rather strong and short ranged interaction between free nucleons. Calculations of energy levels of nuclei have been successfully carried out by determination of the effective interaction from experiment. The latter interaction, determined in simple cases, has some simple features which determine the structure of various nuclei. In parallel, attempts have been made to derive the effective interaction from the one between free nucleons. More ambitious programs aim at starting from the bare interaction and obtain energies and wave functions of nuclear states. In contrast to the complications of such calculations, various measurements indicate that simple shell model wave functions have some reality. The question is whether the simplicity of the shell model will emerge from the complicated many-body theory.