Société Française de Physique

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First-forbidden β-decay study in the pnQRPA approach

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First-forbidden beta decays play an important role in several domains of physics. First, in astrophysics, where nuclear data such as the half-life govern stellar evolution and nucleosynthesis [1]. Second, they are of interest for nuclear reactors physics as first highlighted in 2014 [2]. In first-forbidden β-decays, the form factor of the leptonic spectra are not equal to one as for allowed decays. It has been shown that it could have a non negligeable impact on the shape of the antineutrino energy spectra. Among the models developed since then, which do not all tend to agree [3, 4, 5, 6], some even state that it could solve the reactor antineutrino shape anomaly.
New theoretical calculations of the first-forbidden form factors associated to summation calculations [7] and dedicated experimental measurements would be useful to corroborate or negate already existing predictions.

Charge-exchange excitations corresponding to beta-decay first forbidden transitions in nuclei have been studied in the self-consistent *proton-neutron quasiparticle random-phase approximation* (pnQRPA) using the finite-range Gogny interaction [8]. No parameters beyond those included in the effective nuclear force are included. Axial deformations are taken into account for both the ground state and charge-exchange excitations.
With this formalism, nuclear matrix elements have been computed for operators derived from the multipole expansion of the weak current [9]: spin-dipole, anti-analog dipole and pseudoscalar-axial vector and tensor-polar vector operators. Those operators come to complete the already existing Fermi and Gamow-Teller operators already considered in Ref. [8] in order to have a simultaneous description of the allowed and first-forbidden β-decays.

At this conference, first results of the charge-exchange operators will be presented for both spherical and axially deformed nuclei with a comparison to other theoretical models.

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