Study of unique first-forbidden beta-decays in the ^{78}Ni region.

The allowed Gamow-Teller transitions are the most common nuclear weak-processes which play a key role in astrophysical processes, like supernovea explosions and nuclear synthesis. However, in neutron rich nuclei, where valence protons and neutrons occupy orbitals of different parities, the first-forbidden transitions become of importance and can not be omitted in the evaluation of beta-decay half-lives, crucial ingredients of e.g. r-process nucleosynthesis simulations.

In the present Master training we will focus on particular type of first-forbidden transitions, i.e. unique first-forbidden ones (change of spin between parent/daughter nucleus by 2 units). After getting familiar with the elements of the beta-decay theory and the large-scale shell model approach, which will be our tool for computing the nuclear states, the candidate will perform numerical applications in the region of ^{78}Ni nucleus. ^{78}Ni is a hot topic in nuclear structure : this possibly dubly magic nucleus is a key for the nuclear structure models and the comprehension of shell evolution far from stability. However, only its half-life is so far known experimentally. A wealth of experimental data of nuclei around it, including those from beta-decays, has been accumulated. A proper theoretical interpretation of those could help to discover the shell structure of ^{78}Ni and the mechanisms governing the shell evolution in neutron-rich nuclei.

The student is expected to learn the beta-decay theory and get familiar with the Strasbourg shell model codes (knowledge of fortran required). The master thesis can be followed by a PhD thesis, enlarging the present subject to the studies of non-unique forbidden transitions as well as other nuclear observables of importance for stellar evolution models and nucleosynthesis.

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