Microscopic calculations of charge-exchange excitations in stable and unstable nuclei

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The systematics of charge-exchange transitions in which, starting from the ground state of the (N, Z) system, states in the isobaric nuclei $(N \mp 1, Z \pm 1)$ are excited, is not completely known and understood. However, the study of the properties of these states is important since it is expected to shed light on several fundamental questions: for instance, how the isospin symmetry manifests itself in nuclei, or how the isovector effective nucleon-nucleon interaction can be fixed. These issues are crucial nowadays, in view of the ongoing exploration of unstable nuclei with unusual neutron (or proton) excess.

We have developed a fully self-consistent non-relativistic random phase approximation model, in which pairing correlations are taken into account (proton-neutron quasiparticle-RPA), built on a HF-BCS description of the ground state. The effective nucleon-nucleon interaction is described by a Skyrme force in the particle-hole channel and by a zero range density-dependent pairing interaction in the particle-particle channel. Both the isovector and isoscalar components of the residual proton-neutron pairing are included.

We have tested our model by calculating the isobaric analog states (IAS) in the even-even Sn isotopes. The study of the IAS is motivated by its strict relation to the isospin symmetry. In fact, the calculation of isobaric analog states also allows to estimate the isospin mixing in the parent ground state.
In our model the isospin symmetry has been used to fix the isovector part of the residual proton-neutron pairing interaction. This is shown to be important to reproduce the correct concentration of the strength in a single state. In the calculations we have taken into account terms of the nuclear Hamiltonian which break the isospin symmetry, such as, in addition to the Coulomb force, the charge-independence and charge-symmetry breaking nuclear terms (CIB, CSB) and the electromagnetic spin-orbit interaction.
The results reproduce with good agreement the experimental data presently available [1] and allow to make predictions around the unstable regions of the isotopic chain.

We will discuss about other isovector modes, such as the Gamow-Teller resonances (GTR). In this case the isoscalar component of the proton-neutron pairing plays a role in describing the low lying excited states in the β decay window.

[1] K. Pham *et al.*, Phys. Rev. C **51**, 526 (1995).