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Nuclear structure at the proton drip line

Most of the nuclear structure properties of exotic nuclei at the proton drip line can be probed by the observation of proton radioactivity [1,2]. Due to the very small cross sections for their production and quite short half lives, it is the only possibility to gather information about their spectroscopic properties. Therefore, the observation and theoretical interpretation of proton radioactivity plays an important role in present Nuclear Physics studies. It provides a way to define the limits of stability at the proton rich side of the nuclear chart, as it was the case for charges Z between 50 and 83, and in some cases with Z<50 .
The position of the proton drip line influences the path of nucleosynthesis in explosive astrophysical scenarios, but the path depends on the existence of specific resonances in proton drip-line nuclei [3], and on the knowledge of proton separation energies specially, in the region of Z<50. However, it is possible though the interpretation of proton emission data, to impose well defined constraints on these energies, and reduce uncertainties in nuclear astrophysics models.
We have developed the non-adiabatic quasiparticle model [4], a non-relativistic microscopic approach, which includes the excitation spectra of the daughter nucleus and the residual interaction in a consistent way. The model, describes deformed odd-even and odd-odd emitters, with axial and triaxial symmetry,and it has been quite successful to interpret decay data and infer structure properties of proton emitters [5-10].
Within non relativistic microscopic models, the nuclear potential is completely determined from phenomenology, in contrast with the ones derived from covariant density functional theory (CDFT) [11], a fully relativistic quantum field theory, which incorporates a more fundamental input. We have applied CDFT to perform a selfconsistent study of proton radioactivity [12], which was very successful.

From the above discussion, one can conclude that a very solid theory exists that can describe proton radioactivity, interpret the data, and predict features of the structure of nuclei at the extremes of stability. It is the purpose of this talk to discuss recent developments in the study of proton rich nuclei, and their relevance to nuclear astrophysics.

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