In-beam spectroscopy study of \( fp \) shell nuclei: \(^{63}\text{Zn}\) and the proton unbound \(^{55}\text{Cu}\)

SARA PIGLIAPOCO
University of Padova

HOST: MARCO SICILIANO

Friday, February 2, 2024
2:30 p.m. CST

Virtual Meeting
Join Zoom
ID: 160 735 2151 PWD: 009558

Mirror energy differences provides a powerful tool to investigate the evolution of the nuclear structure as a function of angular momenta. In the latest years detailed studies aimed to probe the influence of isospin non-conserving interaction and the effects of halo orbits and their occupation on the displacement of analogue excited states of mirror partners were performed, showing excellent agreement between data and large-scale shell model calculations. Moreover, with the nowadays intensities of radioactive ion beam, the validity of the shell model and, in general, of our knowledge of nuclear structure, can be challenged towards the proton drip line. In this presentation, we will report on some preliminary results from in-beam \( \gamma \)-ray spectroscopy studies of excited states in the \( \text{Tz}=-3/2 \) \(^{55}\text{Cu}\) carried out at the Radioactive Isotope Beam Factory, RIKEN (Japan). The mirror energy differences are interpreted within the shell model framework where Coulomb and isospin breaking terms have been included. In this work we will extend the investigation on the structure of proton-rich nuclei to the middle of the \( fp \) shell and beyond the proton stability. Finally, we will try to address how the competing processes of proton decay and \( \gamma \)-ray de-excitation can impact on cross section estimations.

In the second part of this work, a fusion-evaporation reaction will be reported on for the study of the \( A = 63 \) Zinc isotope. Detailed spectroscopic information is available on the neighboring \( A \sim 60 \) Zinc isotopes. Indeed, the investigation of rotational bands within the \( N-Z \) side of Zinc isotopes has been the focus of extensive research. Due to the limited number of valence particle outside the soft magic \(^{56}\text{Ni}\) core, low-spin states have been effectively explicable through spherical Shell Model calculations. This no longer holds true at higher angular momenta, where collectivity comes into play. These collective phenomena arise on the interplay between the \( 1f_{7/2} \) and the intruder \( 1g_{9/2} \) orbital. As a consequence, promotions of particles from the \( 1f_{7/2} \) to the \( 1g_{9/2} \) lead to the transition from spherical to deformed shapes.

The results obtained from this investigation will extend the level scheme of the nucleus up to 12 MeV. Nonetheless, the additional information gathered, while valuable, may still not be adequate for a more comprehensive exploration of collectivity within this nucleus.