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Persistence of nuclear shell closures far from stability: in-beam γ spectroscopy of 79Cu after proton knockout

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The shell model remains one of the main building blocks of nuclear structure. Its robustness is well proven for nuclei close to stability, where it successfully explains the occurence of magic numbers. However, these magic numbers are not universal throughout the nuclear chart and their evolution away from stability, observed experimentally over the last decades, has generated much interest. To probe the possible erosion of the Z=28 shell gap in 78Ni, in-beam γ-ray spectroscopy of 79Cu was performed at the Radioactive Isotope Beam Factory of Riken in Japan. The incoming isotopes were identified in the Bigrips spectrometer. The knockout reaction from the selected 80Zn beam at 270 MeV/n took place in the Minos liquid-hydrogen target, surrounded by a TPC for proton tracking. The outgoing nuclei were identified in the Zerodegree spectrometer. The Dali2 scintillator array was installed around Minos for gamma-ray detection. We built the first level scheme of 79Cu up to 4.6 MeV of excitation energy, at the limit of gamma-ray spectroscopy. The results were compared to Monte-Carlo shell-model calculations and show that the 79Cu nucleus can be described in terms of a valence proton outside a 78Ni core, providing indirect evidence of the magic character of the latter. Cross sections were extracted and compared to recent DWIA calculations, from which we find more fragmentation of the single-particle strengths than expected.
New data was also obtained on the 83Ga and 85Ga isotopes beyond N=50, which is presently under analysis and includes a fresh level scheme for 83Ga.

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