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Distant mirror nuclei studied with -1n and -2n knockout reactions

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Isospin symmetry – the neutron-proton exchange symmetry rooted in the concepts of charge symmetry and charge independence of the nuclear force – is one of the key concepts in nuclear physics. It results in beautiful and simple symmetries in the otherwise complex behaviour of nuclei, and examination of how those symmetries are broken can, in turn, shed light on the properties of the interactions concerned. To perform thorough investigations of the physics of isospin requires detailed spectroscopy of proton-rich nuclei – i.e. detailed level schemes and transitions strengths. Knockout reactions from relativistic radioactive beams is proving to be an extremely powerful approach – especially when combined with gamma-ray arrays with tracking capability such as GRETINA at the NSCL facility, results from which are presented here.

Two completely new level schemes of proton-rich, $T_z = -\frac{3}{2}$, nuclei ^{47}Mn and ^{45}Cr, have been produced [1] using one-neutron knockout for ^{47}Mn and two-neutron knockout for ^{45}Cr. In both cases, comprehensive new schemes were established, with confidence given to the final spin/parity assignments using the now well-established "mirrored knockout approach" [2,3] coupled to theoretical predictions of -1n and -2n exclusive cross sections. These results demonstrate the power of using the knockout approach for establishing complex level schemes in exotic nuclei.

Two theoretical models have been employed to analyse the resulting mirror energy differences (MED) – a large-scale fp-shell-model analysis, allowing for excitations from the $d_{3/2}$ level, and a new DFT-based model based on the No Core Configuration Interaction Model [4]. This new DFT approach, first applied in [5], which uses a non-truncated model space, presents an alternative method of MED analysis, which can be applied in well-deformed systems with complex configurations. The latest results and model analysis will be presented.

The analysis of ^{47}Mn, and its mirror nucleus ^{47}Ti (populated by the analogue -1p reaction), has also allowed for measurements of the lifetimes of the two $J^\pi = \frac{7}{2}^-$ analogue first-excited states. This has enabled an unusually high-precision comparison of analogue *B(M1)* transition strengths in a pair of mirror nuclei and the extraction of isoscalar and isovector transition strengths. The dependence of analogue *M1* transition strengths on T_z has been compared with the predictions from isospin formalism, and the latest results will be presented.

[1] S. Uthayakumaar et al., Phys. Rev. C 106, 024327 (2022)
[2] R.Yajzey et al., Phys. Lett. B. 823, 136757 (2021)
[3] S. A. Milne et al., Phys. Rev. C. 93, 024318 (2016).
[4] P. Bączyk and W. Satula, Phys. Rev C. 103, 054320 (2021).
[5] R.Llewellyn, et al., Phys. Lett. B. 811, 135873 (2020).
[6] S. Uthayakumaar et al., to be published (2023)

Attendance Type

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