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Single-particle states in fp-shell nuclei through $^{50}\text{Ca}(d, p)^{51}\text{Ca}$ transfer reaction.

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Neutron-rich Ca isotopes towards neutron number $N = 34$ are pivotal for exploring the evolution of the fp-shell orbitals [1]. Beyond the $N = 28$ shell gap at ^{48}Ca , new magic numbers at $N = 32$ and 34 were established through spectroscopy of low-lying states [2] and mass measurements [3]. Most recently, the spatial extension of the $1f_{7/2}$ and $2p_{3/2}$ neutron orbitals was determined via a one-neutron knockout reaction from ^{52}Ca [4], while the single-particle $2p_{1/2}$, $1f_{5/2}$ and $1g_{9/2}$ orbitals defining the shell gaps at $N = 32, 34$ remain to be established experimentally. The $^{50}\text{Ca}(d, p)^{51}\text{Ca}$ transfer reaction presents itself as well suited-method to access spectroscopic factors in the fp-shell, where the angular distribution of the reaction products allow for deduction of the angular momentum transfer.

The SHARAQ12 experiment was performed at the RIKEN Nishina Center in December of 2022 and May of 2024, aiming to study the single-particle structure of ^{51}Ca via the (d, p) reaction using a ^{50}Ca secondary beam. The secondary beam was produced at the BigRIPS separator and then degraded to approximately 15 MeV/nucleon at the OEDO [5] beamline. Beam-tracking has been performed with the recently developed Strip-Readout PPAC detectors [6], recoiling protons coming from the interaction of the beam with the secondary target of CD_2 ($260 \mu\text{g}/\text{cm}^2$ in 2022, $644 \mu\text{g}/\text{cm}^2$ in 2024) have been identified with the detector setup TINA2 [7], while the heavy recoils have been identified at the QQD SHARAQ spectrometer. In this contribution, I will present the experiment, current status of the analysis, and the implications on the structure of neutron-rich Ca isotopes.

References

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Abstract

Primary author(s) : FERRERA GONZÁLEZ, Carlos (IEM-CSIC)

Presenter(s) : FERRERA GONZÁLEZ, Carlos (IEM-CSIC)

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