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Laser spectroscopy of neutron-rich K isotopes

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Collinear laser spectroscopy provides a powerful high-resolution method for the investigation of the nuclear structure of the exotic nuclei. In combination with bunched ion beams a very high sensitivity can be reached. The hyperfine spectra of 48-51K (Z = 19) isotopes were observed at ISOLDE (CERN) for the first time. For this purpose, the CW laser was set to the 4s 2S1/2 ⟶ 4p 2P1/2 transition (769.9 nm) providing power of ˜1 mW into the beam line. In order to study 51K with a production rate of only ˜4000 ions/s, the optical detection system was improved, yielding a considerable reduction in background.
The ground-state nuclear spins of 49K (N = 30) and 51K (N = 32) were measured to be I = 1/2 and I = 3/2 respectively [1]. This points to the re-inversion to the normal order of the π2s1/2 and π1d3/2 orbits when filling the ν2p3/2, after their inversion for a completely filled ν1f7/2 (N = 28). In this way, the role of the monopole interaction in the evolution of the single-particle orbits is revealed. In addition, measured magnetic moments were compared to shell-model calculations performed for two different effective interaction, namely SDPF-NR and SDPF-U. From this comparison, the composition of the ground-state wave function was obtained indicating a strong mixing between and for 48,49K [2].
Additionally, the difference in the mean square charge radii were deduced from the observed isotope shift. There was no indication found for N = 32 being a sub-shell closure [3].

[1] J. Papuga et al., Physical Review Letters 110, 172503 (2013)
[2] J. Papuga et al., Physical Review C, in preparation
[3] K. Kreim et al., Physics Letters B, submitted

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