Novel isomer spectroscopy and quasiparticle configurations in ^{254}No

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The recently installed GREAT [1] focal plane detector system (with triggerless data acquisition) has been coupled to the gas filled recoil spectrometer RITU at the University of Jyväskylä, Finland, for a study of long-lived isomer decays. The ^{172}Yb(^{48}Ca,4n)^{216}Th reaction at a beam energy of 217 MeV has been used as a 'proof of principle' experiment to verify some new techniques which have been proposed [2] for focal plane isomer spectroscopy. The basic method is a variation on the recoil decay tagging (RDT) technique, by which position-time correlations are performed for recoils, isomer-delayed summed electron conversion transitions and alpha decays at the same position of a multi-pixel, double-sided strip detector. The nucleus ^{216}Th has a long-lived isomeric state [3] with $T_{1/2}$ much greater than 1μs, (which is the approximate transit time of recoils through RITU), followed by an alpha decay of ~25ms ; ideal for the present application. The production cross section is also an order of magnitude larger than that for super heavy elements. The summed electron conversion pulse has been observed in coincidence with γ-rays produced from unconverted transitions in the isomer decay path. The cross section ratio of isomer to prompt decays has been obtained by comparison with RDT events where a summed electron conversion pulse was not present in the position- time correlations. The ^{208}Pb (^{48}Ca,2n)^{254}No reaction has been studied at 219 Mev beam energy, in a similar manner, to obtain, for the first time, the excitation energy and decay path of a long-lived isomer [4] in ^{254}No, which was inferred about 30 years ago. In view of the inherent difficulties, at the present time, associated with the elucidation of single quasiparticle (qp) configurations in odd mass nuclei in this region, the structure of isomeric states may be crucial to our understanding of single particle orbitals in the spherical shell model. An isomer's qp configuration, populating intruder orbitals in the deformed mean field, allows one to deduce their origins from the expected doubly magic, spherical shell model states around A=300. The possible qp configurations of this isomeric state will be discussed.

References

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