

The study of proton-emitting nuclei near the magic N=82 neutron shell closure

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Proton radioactivity provides a unique probe of nuclear structure far from stability and for odd-Z elements it is expected to be the decay mode that determines the limit of observability for neutron deficient nuclei. Establishing these boundaries of observability and identifying the nuclear structure at these limits is a long-standing challenge in nuclear physics. The nuclei in the region of the N=82 shell closure are expected to be the most nearly spherical proton emitters and therefore a benchmark for theoretical models of this decay mode [1,2]. These odd-Z nuclei are known to have low-lying isomeric states, which are often substantially longer-lived than the ground states in these nuclei, due to the strong increase of proton-decay half-lives with the orbital angular momentum of the emitted proton. In these cases the isomeric states all have a configuration involving a proton in the $\pi h_{11/2}$ orbital, while in the ground states the protons are in either a $\pi s_{1/2}$ or $\pi d_{3/2}$ orbital. This allows the observation of the isomeric states in proton-emitting nuclei where the ground state is too short-lived to be observed with current experimental techniques, for example ^{159}Re [3]. Additional interest in these nuclei comes from the possibility of microsecond multiparticle isomers that are analogous to those seen in their lighter isotones [4].

The aim of this work was to search for new, and clarify the nature of known proton radioactivities in the region of the N=82 shell closure, and to search for possible isomeric states in these nuclei. The searches were performed at the University of Jyväskylä in Finland. The nuclei of interest were produced by fusion-evaporation reactions induced by a ^{58}Ni beam bombarding isotopically enriched ^{102}Pd and ^{106}Cd targets. The evaporation residues were separated in flight using the Mass Analysing Recoil Apparatus (MARA) [5] and implanted into a double-sided silicon strip detector (DSSD), which was used to measure proton and alpha decays. The DSSD was surrounded by an array of germanium detectors to allow isomer gamma decays to be observed. An overview of the results from the analysis of these data will be presented.

References

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