In-beam studies of proton emitters using the Recoil-Decay Tagging †

D. Seweryniak[a,b], P.J. Woods[c], J. Ressler[b], C.N. Davids[a], A. Heinz[a], A. Sonzogni[a], J. Uusitalo[a], W. B. Walters[b], J. Caggiano[a], M.P. Carpenter[a], J.A. Cizewski[d], T. Davinson[c], K.Y. Ding[d], N. Fotiades[d], U. Garg[e], R.V.F. Janssens[a], T.-L. Khoo[a], F. Kondev[a], T. Lauritsen[a], C.J. Lister[a], P. Reiter[a], J. Shergur[b], I. Wiedenhoever[a]

[a] Argonne National Laboratory, Argonne, Illinois, USA
[b] University of Maryland, College Park, Maryland, USA
[c] University of Edinburgh, Edinburgh, United Kingdom
[d] Rutgers University, New Brunswick, New Jersey, USA
[e] University of Notre Dame, Notre Dame, Indiana, USA

The last five years have witnessed a rapid increase in the volume of data on proton decaying nuclei. The path was led by decay studies with recoil mass separators equipped with double-sided Si strip detectors. The properties of many proton decaying states were deduced which triggered renewed theoretical interest in the process of the proton decay.

The decay experiments were closely followed by in-beam γ-ray studies which extended our knowledge about high-spin states of proton emitters. The unparalleled selectivity of the Recoil-Decay Tagging method combined with the high efficiency of large arrays of Ge detectors allowed, despite small cross sections and overwhelming background from strong reaction channels, the observation of excited states in several proton emitters.

Recently, in-beam studies of the deformed proton emitters ^{141}Ho and ^{131}Eu have been performed with the GAMMASPHERE array of Ge detectors and the Fragment Mass Analyzer at ATLAS. Evidence was found for rotational bands in ^{141}Ho and ^{131}Eu. It should be noted that the cross section for populating ^{131}Eu is about 50 nb and it represents the weakest channel ever studied in an in-beam experiment.

During the talk the experimental techniques used to study excited states in proton emitters will be introduced and the state-of-the-art RDT detection systems will be briefly presented. Recent in-beam results on the deformed proton emitters ^{141}Ho and ^{131}Eu will be discussed in detail. In particular, the deformations and the single-particle configurations proposed for the proton emitting states from the earlier proton-decay studies[1,2] will be confronted with the assignments deduced based on the in-beam data. In addition, the response of ^{141}Ho and ^{131}Eu to the stress of rotation will be analyzed.

† supported by the U.S. Department of Energy, Nuclear Physics Division, under contracts No. W-31-109-ENG-38 and No. DE-FG02-94-ER40834.

1) C.N. Davids et al., Phys. Rev. Lett., 80 (1998) 1849.
2) A. Sonzogni et al., Phys. Rev. Lett. (in press).