Studying shape coexistence in ^{174}Yb and ^{178}Hf

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The Q3D data in question is (*p,t*) reaction data on ^{176}Yb and ^{180}Hf targets. Two-neutron transfer reactions are good experimental probes for studying 0+ states as they have a characteristic pattern in the differential cross section which allows for easy identification of these states. Transfer cross sections to the various excited states give insights into the underlying nuclear structures of these states. The two-neutron transfer reactions ^{176}Yb(*p,t*) and ^{180}Hf(*p,t*) were measured at the Q3D spectrometer at the Maier-Leibnitz Laboratory at the Technical University of Munich. The purpose of the data is to confirm previously observed low-lying 0+ states in their respective recoil nuclei, and to identify possible new 0^+ states, and their cross sections.

Several challenges have been encountered while analyzing the data. The calibration target, which was thought to be isotopically pure, was found to be highly contaminated. This made it difficult to clearly identify some of the states in the calibration target to be used in the calibration. The contamination meant that an alternative scheme for the calibration was required, especially at higher energies where the increased level density made identifying states usable for calibration impossible.

Given a target ^{A}X, the triton energies detected at the focal plane correspond to energy states in the recoil product $^{A-2}$X. Based on how the Q3D magnets are tuned, a small slice in momentum is recorded at the focal plane. In this data set, as is usual among experiments like this, the Q3D magnets are tuned such that the first slice includes triton energies that correspond to the ground state (g.s.) of the recoil product. ^{176}Yb(*p,t*) and ^{180}Hf(*p,t*) both had three exposures, each taken at multiple angles. The first two slices of the ^{176}Yb(*p,t*) have been calibrated using known peaks in ^{174}Yb and the first slice of ^{180}Hf(*p,t*) has been fully calibrated using known states in ^{178}Hf and the calibration of the second slice is in progress. Unfortunately, the highest energy slices cannot be calibrated as the increased level density and uncertainty in previously found states in this region would lead to an unreliable calibration. The inability to use the calibration target (a ^{170}Er target found to be contaminated with natural Hf), makes this region unusable.

Currently the calibrated data is being analyzed with some low-energy states, particularly in the g.s. rotational band, requiring FRESCO, to study. Initially TWOFNR, a DWBA code, was used to calculate the expected differential cross section of observed states. Given the strong g.s. transition in (*p,t*)

reactions, we believe some of the first excited state transitions are being influenced by two-step processes involving the g.s. The next steps are to analyse the low-lying states taking into account the rotational excitations and then to analyse the full spectrum of 0^+ states observed.