Results from the recent ^{207,208}Tl experiment using the ISOLDE Decay Station

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A recent experiment was performed using the ISOLDE Decay Station to measure low-lying states in ^{207}Tl populated via the β decay of ^{207}Hg, produced using a molten lead target. The ^{207}Tl nucleus has one proton less than ^{208}Pb, which is a classic shell model core. Above the lowest-lying states, structure is likely based on the coupling of the proton hole to either a broken proton or neutron pair, which would require excitation across a shell closure, or to a collective octupole excitation. The observation of these states will reveal information on the single-particle orbitals near the shell closures at Z = 82 and N = 126, which will be valuable for the improvement of the predictive power of nuclear models.

An additional objective of this experiment was to test the feasibility of producing a ^{208}Hg beam from a molten lead target with the intention of studying states in ^{208}Tl populated via the ^{208}Hg β decay. Such a study is crucial for the understanding of the proton-hole neutron-particle interactions in this region as information is scarce.

The ISOLDE Decay Station consisted of a four HPGe Clover detectors and a MINIBALL cluster for high-resolution γ-ray spectroscopy, in addition to three plastic scintillator detectors for observing radioactive β-decay events. Beams of ^{207}Hg and ^{208}Hg were implanted onto a tape from which subsequent radioactive decays could be observed. Data were recording using

a triggerless data acquisition system in which every signal was recorded with a time stamp, enabling coincident signals to be correlated in software.

Results from both the ^{207}Tl and ^{208}Tl objectives of this experiment will be presented. Gamma-ray transitions associated with ^{207}Tl have been identified using coincidences with known transitions [1] and by comparing their time profile to the known half-life of the mother nucleus. The previous level scheme has been extended and several new transitions, some with energies expected for octupole excitations [2], will be discussed and compared to shell model calculations.

A new level scheme has also been constructed for ^{208}Tl. The assignment of γ-ray transitions to this nucleus has proven to be more complex owing to the half-life of the mother nucleus appearing to be significantly shorter than previously thought [3], which will be discussed. Calculations with which to compare the level scheme have also been performed.

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