Shape coexistence in the neutron-deficient isotope ^{187}Tl

A.B.F. Lee[a], G.J. Lane[a], G.D. Dracoulis[a], A.O. Macchiavelli[b], P. Fallon[b] and R.M. Clark[b]
[a] *Department of Nuclear Physics, The Australian National University, ACT 0200, Australia.*
[b] *Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley, California 94720.*

Neutron-deficient nuclei near the Z=82 closed shell exhibit the phenomenon of shape coexistence where the nucleus can take on oblate, prolate, and even spherical shapes at around the same excitation energy. The single-proton excitations in ^{187}Tl (with Z=81) can be used as a probe into the microscopic mechanisms behind this phenomenon. Previous studies of ^{187}Tl deduced the presence of coexisting prolate and oblate shapes from characteristic level structures [1, 2], and these shapes were also assigned from direct quadrupole moment measurements [3]. Long-lived states with microsecond lifetimes were also observed in ^{187}Tl [4], but their microscopic origin was uncertain.

A new study of ^{187}Tl was initiated at the Lawrence Berkeley National Laboratory, using a heavy-ion fusion-evaporation reaction involving 154 MeV ^{32}S beams incident on a 1.2 mg/cm^2 ^{159}Tb target, backed with 4.5 mg/cm^2 of ^{197}Au. The beams were provided by the 88-inch cyclotron, and were pulsed at 60 ns intervals. The emitted gamma-rays were detected by the Gammasphere array [5], and the structure of ^{187}Tl was subsequently studied through the application of the techniques of gamma-ray spectroscopy.

Extensions to existing structures were observed, including confirmation of the $h_{11/2}$ band which is interpreted to have a prolate deformation larger than previously predicted [2], the first observation of the unfavoured signature of the $h_{9/2}$ prolate band, and identification of new structures above the microsecond isomers. Evidence for the existence of enhanced prolate deformations associated with the $i_{13/2}$ structure will also be presented.

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