Quadrupole Moment of Superdeformed Bands in ^{151}Tb

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The quadrupole moments of the first two superdeformed (SD) bands (B1 and B2) in the ^{151}Tb nucleus have been measured with the Doppler Shift Attenuation Method (DSAM) using the EUROGAM II γ-ray spectrometer. The first excited band (B2) is identical to the yrast SD band of ^{152}Dy in terms of dynamical moments of inertia and γ-ray energies. It was assigned to a proton excitation from the level π[301]- into the intruder orbital N = 6 leading to the same intruder configuration as for ^{152}Dy SD yrast. The experiment has been performed at the Vivitron accelerator at the Institut de Recherches Subatomiques in Strasbourg. Superdeformed states in ^{151}Tb were populated through the ^{130}Te (^{27}Al, 6n) fusion-evaporation reaction at an incident beam energy of 152 MeV. The target consisted of 1 mg/cm^2 of ^{130}Te on a 15 mg/cm^2 of gold. To prevent sublimation of the target material under beam bombardment, a thin gold layer (60 μg/cm^2) was evaporated on the tellurium. Furthermore, to avoid migration of tellurium material into the gold backing, an aluminium layer (36 μg/cm^2) was evaporated between the target and the backing. Gamma-ray events in coincidence were recorded whenever at least 7 detectors (Compton unsuppressed) were fired. A total of 8 x 10^8 events ($M_\gamma \geq 3$) have been collected for this DSAM lifetime measurement.

The deduced electric quadrupole moments for band BI and B2 are Q_0 = 17.2 ± 0.7 *eb* and Q_0 18.4 ± 0.8 *eb* respectively. The quoted errors include the statistical uncertainties as well as the spread in the initial velocity of the recoiling ions due to neutron evaporation. Using results of the cranked Hartree-Fock calculations with the Skyrme parametrizations SkM^* and SkP [1], the electric quadrupole moments have been calculated using particle-hole excitations with respect to a ^{152}Dy core. The experimental relative values for bands B1 and B2: $\delta Q_0^{exp} = Q_0^{exp}$ (B2) - $Q_0^{exp}(BI)$ = 1.2 ± 0.9 *eb*, free from the stopping power uncertainties, is well-reproduced by Hartree-Fock calculations Q_0^{cal} 1.13 *eb* [1]. At first we have assumed a constant value for Q_0 within the band BI. However a better χ^2 is obtained for band B1 if one allows a variation in Q_0 for the SD states involved in the deexcitation of the band. In this case the two last states of band B1 contributing to the decay-out have reduced experimental Q_0 values of 15 ± 1 *eb* and 12 ± 2 *eb* respectively. The sudden decay-out of SD bands could be explain by the admixture of normal deformed ($|ND>$) and SD ($|SD>$) wave functions [2]. The admixture coefficient of ND wave function in the SD wave function of the last SD state, deduced from the lifetime value for band 1 (B1), is α^2_{ND} = 18 ± 6%.

References:

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2. E. Vigezzi et al., Phys. Lett. **B249** (1990) 163.