Direct decays from superdeformed states in ^{192}Pb observed using time-correlated γ-ray spectroscopy

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The observation of superdeformed rotational bands has generated a great deal of interest over the last 15 years, with an intensive experimental campaign resulting in the observation of more than 250 such superdeformed bands in several regions of the nuclear chart [1]. Around 175 superdeformed bands have been observed in nuclei in the $A \approx 150$ and $A \approx 190$ mass regions alone. In spite of the use of high-efficiency arrays such as Eurogam, Euroball and Gammasphere to study nuclei in these two mass regions, very few measurements have been made of the fundamental properties of these states — that is, excitation energy, spin and parity. This lack of information arises from the difficulty in identifying the very weak discrete transitions linking superdeformed states with levels at normal deformations.

Through the application of the techniques of time-correlated γ-ray spectroscopy, the spectrum associated with the decay of superdeformed states in ^{192}Pb has been sufficiently simplified to allow identification of discrete linking transitions [2]. Six transitions have been identified which directly link states in the superdeformed band with isomeric and non-isomeric states in the normal deformed well. With the identification of these transitions, the excitation energy of the (10^+) state of the SD band is determined to be 4.64 MeV. This value (which extrapolates to give a bandhead energy comparable with meanfield and Strutinsky-type calculations) places the superdeformed band only ≈ 2 MeV above the normally-deformed yrast states at the point of decay. The superdeformed minimum is thus escaped in a region in which the density of states in the first minimum is low (compared to that in the more highly-excited superdeformed bands in Hg and Dy isotopes), and which is far below the region where the onset of chaos might enhance the decay-out probability. The decay-out for this band might therefore be expected to be more strongly influenced by the structure of both the normally-deformed states with which it mixes and the available final states.

[1] B. Singh, R. Zywina, and R. B. Firestone, submitted to Nuclear Data Sheets.

[2] A.N. Wilson *et al.*, Phys. Rev. Lett. 90 (2003) 142501.