Collectivity in neutron-deficient Pb and Po nuclei

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The origin of shape coexistence observed in nuclei around $Z = 82$ close to the proton drip line is a topical challenge in nuclear structure research. In the neutron mid-shell nucleus ^{186}Pb, the first two excited states above the spherical ground state are assigned as 0^+ states. In calculations based on the deformed mean field they appear as oblate and prolate minima [1, 2]. The yrast line above the spherical ground state in ^{186}Pb is formed by a collective band associated with the prolate minimum. Recently, candidates for collective non-yrast bands built on the coexisting oblate minimum have been observed in ^{186}Pb and ^{188}Pb [5, 6] In neutron-deficient Po isotopes similar intruder structures associated with oblate deformed configurations cross the yrast line of nearly spherical states reaching the ground state in ^{192}Po [7].

Calculations predict that the deformation associated with the prolate shape of mid-shell Pb and Po nuclei is larger than that for the oblate one. Experimentally, the degree of deformation is in many cases based on measured moments of inertia, which is in general larger for prolate than oblate bands. However, when level lifetimes are known, the absolute transition probabilities provide a more direct measure of collectivity and allow fundamental questions such as the degree of mixing of shapes as a function of spin to be addressed. To verify the question of deformation and degree of mixing of shapes, absolute transition probabilities are needed.

Results from the first direct measurement of level lifetimes of prolate yrast states up to spin 8^+ in ^{186}Pb and oblate yrast states up to spin 4^+ using the recoil distance Doppler-shift method (RDDS) in conjunction with the recoil-decay tagging technique will be presented. Additionally lifetime information in ^{188}Pb was obtained up to the 8^+ yrast state by using the recoil-gating method. These pioneering experiments demonstrated the viability of the use of tagging techniques in the RDDS measurements. The results provide important information on the deformation of the coexisting configurations in these nuclei and their mixing [8].

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