

**Stony Brook University
The Graduate School**

Doctoral Defense Announcement

Abstract

Structure Assignments to Excited States of Heavy Nuclei from Lifetime Information

By

Alin V. Costin

Understanding the evolution of collective nuclear structures represents a major goal for the research on the nuclear many-body quantum system. The confined β -soft (CBS) rotor model interpolates between the spherical-to-deformed critical point approximation X(5) and the rigid rotor limit. It uses infinite square-well potentials in the quadrupole deformation parameter β with boundaries allowed to vary. The model's single free parameter r_β defines the width of the square-well potential. Its limiting values, zero and one, coincide with the physical cases of X(5) and the rigid rotor, respectively. With this choice of potentials, the CBS describes the evolution of collectivity from X(5) to rigid rotor. A key prediction of the CBS is the increase in average deformation of nuclei with angular momentum. This phenomenon is referred to as centrifugal stretching. Centrifugal stretching causes an increase in transitional quadrupole moments Q_t as a function of spin which is clearly observed in nuclei close to the region described by X(5). Due to the limit of precision for lifetime measurements, observation of the predicted small centrifugal stretching of strongly deformed nuclei close to the rigid rotor limit is still not possible because the effect to be measured is predicted by the CBS to be of the same size as the experimental uncertainties. However, in order to push the observations of centrifugal stretching toward the region of strongly deformed nuclei it is interesting to extend precise lifetime information to nuclei with larger stiffness than those near the spherical-to-deformed critical point. New, more precise lifetime measurements using two different methods, the recoil distance Doppler-shift method and the delayed coincidence timing method were performed on nuclear states in the ground state bands of the isotopes $^{168,170}\text{Hf}$. The results are consistent with the concept of centrifugal stretching of well deformed nuclei.

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