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Title: **Collective Rotational Motion in the $N = Z$ Nucleus ^{36}Ar**

Author(s): C. E. Svensson,[1,2]
Affiliation(s): [1]*Nuclear Science Division, Lawrence Berkeley National Laboratory, Berkeley CA 94720, USA,*
[2]*Department of Physics, University of Guelph, Guelph, Ontario N1G 2W1, Canada*

High-spin states in the $N = Z$ nucleus ^{36}Ar have been studied via the ^{28}Si(^{16}O,2α)^{36}Ar and ^{24}Mg(^{20}Ne,2α)^{36}Ar reactions in two experiments conducted at Argonne National Laboratory with the Gammasphere array and the Microball charged-particle detector. These experiments resulted in the identification of a "super"-deformed ($\beta_2 \approx 0.46$) rotational band in ^{36}Ar. At low spin the band is firmly linked to previously known states, while at high spin it is observed to its termination at $I^\pi = 16^+$. Spins, parities, excitation energies, and in-band, as well as decay-out, transition matrix elements have been established throughout the band, providing essentially complete spectroscopic information.

This highly-deformed band in ^{36}Ar arguably represents the best known example of well-developed collective rotational motion in a light nucleus. In analogy with rotational motion in heavier nuclei, two major shells are active for both protons and neutrons, yet, in ^{36}Ar, the valence space dimension remains small enough to be meaningfully approached from the shell model perspective. This band thus provides an ideal case in which to study the microscopic origins of collective rotation through a comparison of the experimental data with both deformed mean-field models of the nuclear intrinsic state and the laboratory-frame description of rotational motion achieved in large-scale spherical shell-model calculations.

We have initiated this program of studies by performing both configuration-dependent cranked Nilsson-Strutinsky (CNS) and $(s_{1/2}d_{3/2})$-pf shell-model (SM) calculations for ^{36}Ar. These calculations have provided a consistent description of the band based on a highly-deformed configuration in which four pf-shell orbitals are occupied. While an excellent description of the energetic properties of the band has been achieved, detailed comparisons with the $B(E2)$ values deduced from experimental lifetime measurements indicate the need for a more refined treatment of transition matrix elements close to termination in the CNS calculations, and the inclusion of the complete sd-pf model space in the shell-model diagonalization. In this presentation, I will discuss the experimental results for ^{36}Ar, the successes, and limitations, of current theoretical models, and possible directions toward a more complete microscopic description of this highly-collective rotational band.

$\boxed{\text{Invited talk.}}$