

Shell Structure and High-Spin States in Nuclei

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In medium-heavy nuclei, high-spin states end with a maximum spin of the order of 100 \hbar . For light nuclei where, for example, ^{20}Ne has a maximum spin of only 8 \hbar the notion of high spin can be applied to rather low spin values. The absence of pairing in $N=Z$ nuclei makes them good candidates for observing the effects of nuclear shell structure and of the Coriolis force on the shape as the rotational frequency increases. The role of the Coriolis term can be studied best by cranking the harmonic oscillator potential, as was done previously. The cranked harmonic oscillator Hamiltonian can be analytically solved and all the quantities of interest immediately obtained. The influence of the shell structure is often discussed in terms of its A -dependence. Here, however, it is discussed for fixed A but changing oscillator frequencies. As the oscillator frequency changes with the rotational frequency, the shell correction to the energy and thus to other related quantities becomes dependent on the rotational frequency. Maximum energy gain due to the shell correction is when the ratio of frequencies in the harmonic oscillator potential is the ratio of small integers. Consequently, any departure from integer ratios diminishes the effect of nuclear shell structure and the dependence on the ratio is described in terms of trigonometric functions. The ^{20}Ne spectrum is used to illustrate the effect.