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Nuclear Rotation: New Perspectives at Low Energy and Low Spin

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Nuclear rotation is one of the fundamental low-energy collective modes established in nuclei. It has been a major organizing framework for the structure of deformed nuclei for over 50 years. This is manifested in the observation of numerous rotational bands in nuclei, primarily via energy patterns which very closely follow an "I(I+1)" pattern. (Among the structural insights provided, a leading one which rotational energy spacings reveal is that not all of the nucleus is rotating.) Nuclei that do not follow a rotational energy pattern are classified as "vibrational" (very few examples) or "rotational-vibrational" (many examples), with correspondingly more complicated theoretical descriptions. A recent survey of electric quadrupole transition probabilities in nuclei[1] reveals that rotational values persist far into non-rotational regions. This raises the question of whether energy patterns are a reliable indicator of rotational behavior. The nuclear rotational degree of freedom will be introduced, the transition probability data will be presented, and some ideas about what may be happening will be suggested.
[1] J.L.Wood, W.D.Kulp, and J.M.Allmond, Bull.Am.Phys.Soc. 49 (2004), p.42.