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The subtleties of pairing and collective structures in deformed nuclei

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It is well known that simple monopole pairing is a pretty crude approximation. It can account for the observations that the ground states of all even-even nuclei have spin-parity 01+ and that there is a pairing gap above the ground state in deformed nuclei before particle-hole (p-h) configurations can be excited. As an approximation it is best for proton and neutron mid-shell nuclei where the available single particle Nilsson wavefunctions have large overlaps. However at the beginning of regions of deformation, where high-K orbitals can be bought to the Fermi surface from a lower shell, simple monopole pairing is inadequate in describing the physics of the observed data. This is because the overlap of the wavefunctions is small for low-K deformation driving prolate orbitals and high-K oblate orbitals extruded from a lower shell. This was initially pointed out by Griffin, Jackson and Volkov [1] and used to account for the back-bending frequencies of bands based on high-K orbitals by Jerry Garrett [2].
More recently, with a considerable increase in the quantity and quality of experimental data available, configuration dependent pairing has been used to account for the properties of low-lying first excited 02+ states in N=88 and 90 nuclei at the onset of deformation in the rare earths [3,4]. The properties of 02+ states in these and other nuclei at the start of regions of deformation and the effects blocking of pairing leading a decrease in the back-bending critical frequencies in odd nuclei will be presented.
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[2] J D Garrett et al., Phys. Lett. B118, 297 (1982).
[3] J F Sharpey-Schafer et al, Eu. Phys. J. A47, 5 (2011).
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