Isorotational and pair rotational bands near N=Z

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The isovector pair field breaks the isotropy in isospace. A sufficiently strong anisotropy leads to the appearance of isorotational bands. As discussed in [1], these bands consist of states of increasing isospin T and fixed number parity of Z and N, which are good quantum numbers of the intrinsic state. The ground states of the nuclei in an isobaric chain group into such bands. Analogous to ordinary rotational bands, there is a near-linear relation $T + \Delta T \approx \theta\mu$ between T and the isorotational frequency $\mu(T) = dE/dT \approx (E(T+1) - E(T-1)/2$ (cf. Fig. 1). A systematic analysis of the ground state energies [2] has been carried out. It permitted us a careful subtraction of the Coulomb energy, which turned out important. Fig. 2 shows the experimental vales of the constant ΔT for N, Z even. For strong anisotropy the value 1/2 is expected, which corresponds to the well known $T(T+1)$ dependence of the energy of collective rotation. The second term in the experimental energy dependence $(T^2 + 2\Delta T)/2\theta$ is known as Wigner energy. In the region $60 < A < 80$, where nuclei have a stable (spatial) deformation and a stable isovector pair field, $\Delta T \approx 1/2$, which corresponds to rigid isorotation. Larger values of ΔT near the magic numbers $Z = N = 20$ and 28, can be explained as a consequence of a soft pair field that increases with T. Quasirotational ground bands in soft nuclei show the analogous behavior. The bands with even-Z odd-N and even-N odd-Z have a similar distribution of ΔT as in Fig. 2. However, they scatter more, which can be understood as a consequence of blocking the pair correlations in one nucleon system. The yet stronger scatter found in the Z, N odd bands is in accordance with blocking both systems. Isocranking calculations were carried out in order to support the interpretation on a microscopic basis. The large values of ΔT for $A > 80$ remain a challenge: The experimental values are based on extrapolated masses. Possibilities for a theoretical interpretation will be discussed.

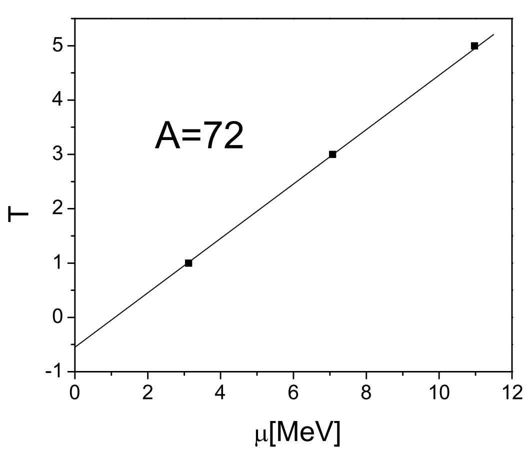

Figure 1: *Isospin as function of the isorotatinal frequency for even-even nuclei with* $A = 72$.

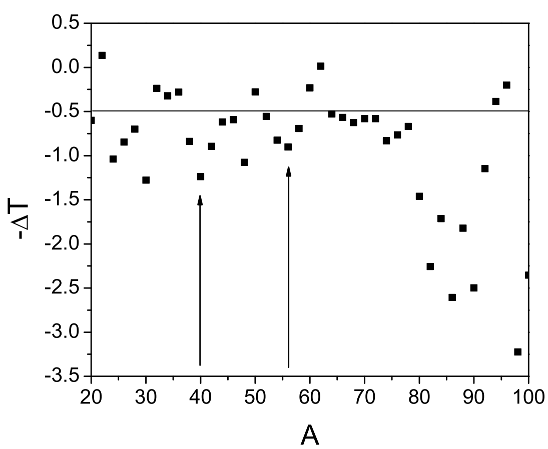

Figure 2: *Coefficient* ΔT *of the term linear in* T *of the ground state energies of even-even nuclei near* $N = Z$.

The nuclei along the $N = Z$ line join into pair rotational bands with fixed parity of N and Z. Bands with different number parity are well separated by their differences in paring energy. This is strong evidence for the absence of an isoscalar pair field, which breaks the symmetries implying number parity conservation [3]. The dependence of pair rotational and isorotational bands on angular momentum provides evidence for the quenching of the isovector pair field. The possible appearance of an isoscalar pair field at at finite angular momentum will be discussed.

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