Collective coupling between pairing correlations and global rotation modes revisited

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This presentation will review two different aspects of the collective coupling between pairing correlations and global rotation modes.

1) Such a coupling is expressed in terms of the Chandrasekhar's S-ellipsoid interaction between global rotation and intrinsic vortical divergence-free currents[1]. From that point of view, a third order Harris-type polynomial analytical expression of the energy as a function of the square of the lab angular velocity is derived. The numerical values of its coefficients associated with a given ground state rotational band of an even-even deformed nucleus, do not result from a fit of all the energies in the band but are calculated from three pieces of experimental data : the odd-even mass difference around the considered nucleus, its quadrupole moment and the excitation energy of its first 2^+ state. The results obtained for a large sample of deformed rare earth and actinide nuclei is very good indeed up to very high spins until the appearance of physical effects not pertaining to this particular collective coupling (as e.g. back bending effects).

2) In the seminal paper[2] introducing the description of pair correlated ground states the authors based their BCS ansatz on three experimental facts. Two of them are easily accessible to mean field microscopic approaches using phenomenological effective nucleon-nucleon interactions as Hartree-Fock plus BCS calculations. One is the quenching of the moments of inertia due to the coupling between pairing correlations and global rotation modes. The other is the mass differences between odd and even-even A nuclei. We have performed two separate fits of a simple residual interaction within the above quoted microscopic approaches on each of these quantities strongly dependent on pairing correlations (mass differences and moments of inertia) for a large sample of relevant deformed rare earth nuclei. The results of these two fits are found to be very consistent (within 0.1 % for neutrons and about the double for protons). This result conforts both, if needed, the usual physical ideas behind the coupling between pairing correlations and global rotation modes as well as our crude but apparently efficient way to describe them.

[1] See P. Quentin, H. Lafchiev, D. Samsoen and I.N. Mikhailov, Phys. Rev. C69 (2004) 054315 and refs. quoted therein.

[2] Aa. Bohr, B.R. Mottelson and D. Pines, Phys. Rev. 110 (1958) 936.