

Nuclear structure
symmetries
and double beta
decay.

Subjects

- Basic Notions about symmetries
- Isospin and gauge symmetries
- The enlargement of the Hilbert Space
- Some examples
- Pairing-isospin problem
- Double Fermi and Gamow-Teller Decays
- Coulomb isospin breaking
- Conclusions

Scheme

- The strategy is based on a trade-off of constraints (like usual Lagrange multiplier) by operators (fields) and by the corresponding enlargement of the Hilbert space (BRST supersymmetry).
- Alternatively, one may introduce counter-terms to restore symmetries which are violated by the interactions or by the mean field approximations

Examples

- Treatment of nuclear interactions beyond the mean field approximation and the associated symmetry breaking:
 - Pairing (Isospin, Gauge)
 - Center of mass motion (Galilean and translational invariance)
 - Nuclear deformations (Rotational invariance)
 - Coulomb effects (Isospin)

Relevance for DBD studies

- Symmetry breaking effects and spurious effects in RPA and QRPA calculations
(like the mode instabilities in the QRPA and spurious effects in 0^+ , 1^- , 0^+ and 1^+ channels, ad-hoc attempts to go beyond the RPA or QRPA approaches).

Pairing-isospin

The treatment of the pairing interaction, in a fully symmetric way, must obey the invariance against gauge (particle number) and isospin transformations. This is not the case of the standard approach (either BCS or Shell Model in truncated valence spaces). The formal steps (to fulfill the symmetries) are:

- a) transformation of the Hamiltonian to the intrinsic frame
- b) separation of collective and intrinsic components of the operators and wave functions

conclusions

- The observance of symmetries is crucial to calculate correctly nuclear observables (like DBD ones)
- The collective treatment of DBD transitions is feasible, like it was in the case of nuclear rotations (Copenhagen Unified Model).
- The use of the formalism fixes without ambiguities the value of all the involved couplings.