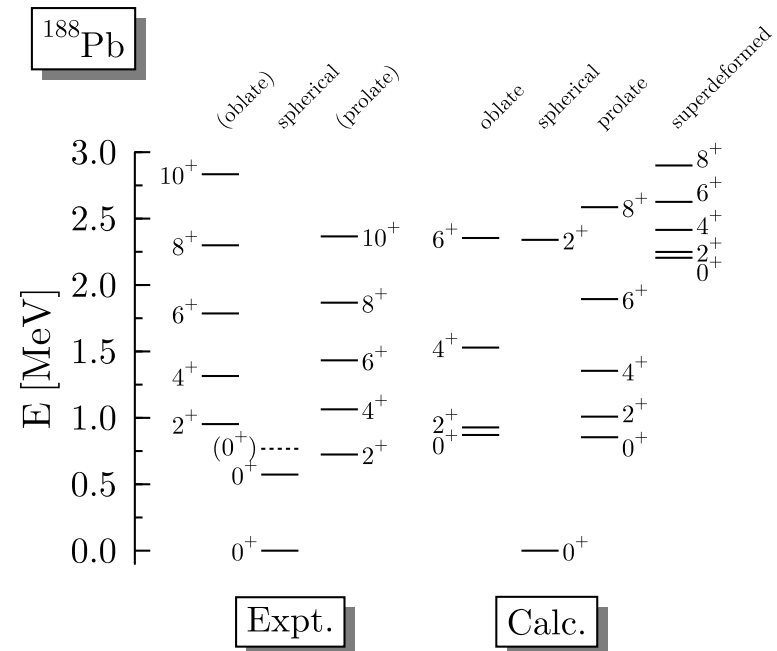
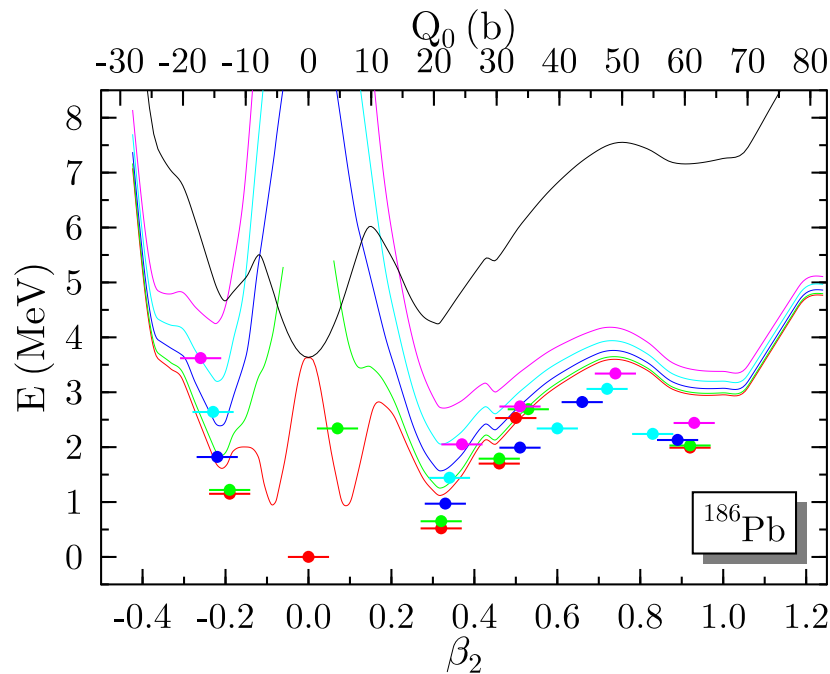
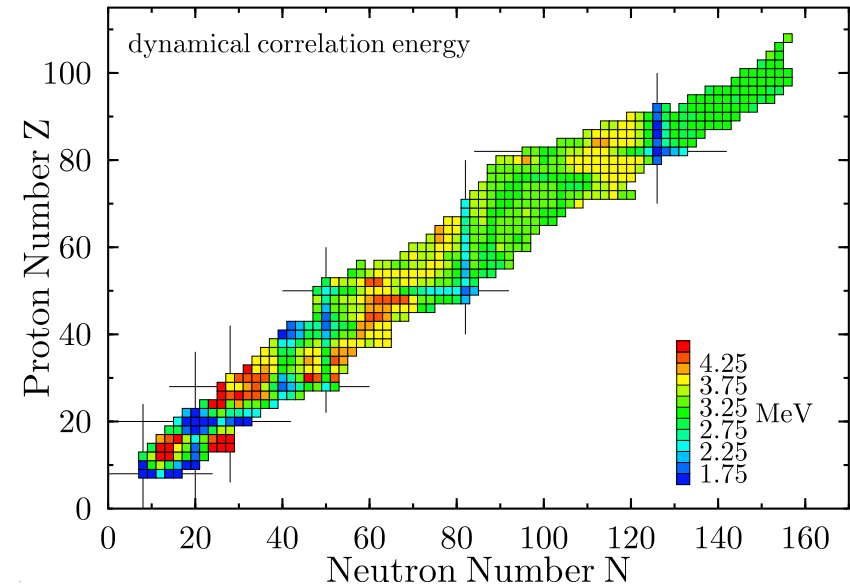
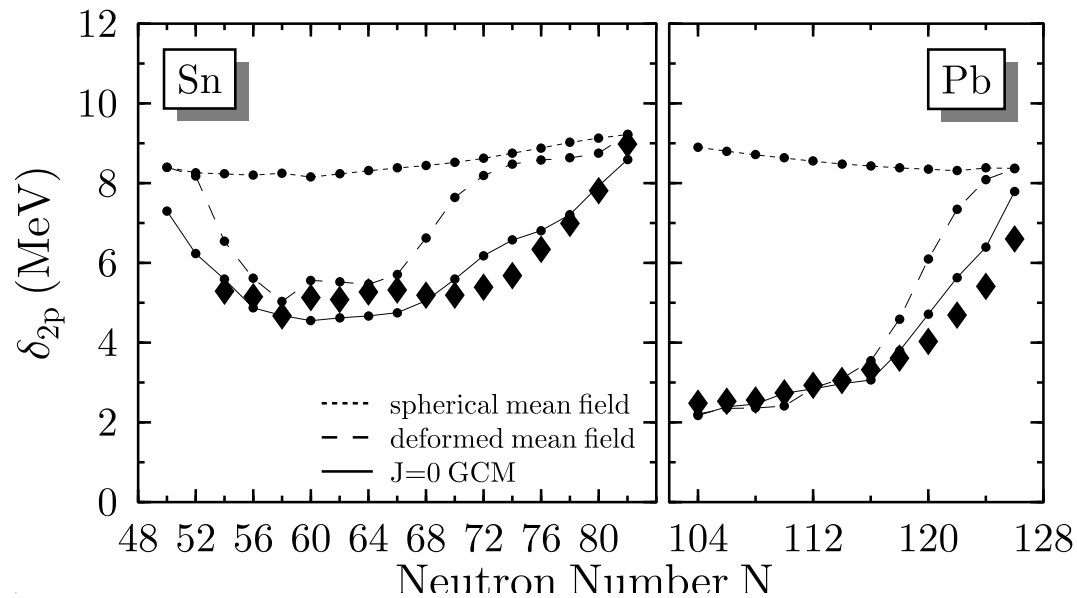


"Beyond-Mean-field" calculations: status

I. Projected-GCM calculations using realistic functionals

- ♣ **PAV** / Π / axial. sym. HFB / **GCM** Q_{30} / Gogny-Skyrme / "Spanish"- "Francophone" groups
- ♣ **PAV** / **N, Z, J** / axial. sym. HFB / **GCM** Q_{20} / Skyrme / "Francophone" group
- ♣ **PAV** / **N, Z, J** / axial. sym. HFB / **GCM** Q_{20} / RHB / "German" group
- ♣ **PAV** / **J** / axial. sym. HFB / **GCM** Q_{20} / Gogny / "Spanish" group
- ♣ **VAP** / **N, Z** / axial. sym. HFB / Skyrme / "Polish" group
- ♣ **VAP** / **P** / spher. sym. HF / Skyrme / "Spanish"- "German" group
- ♣ **PAV** / **J** / triax. cranked HF / Skyrme / "Polish" group





II. Results (not only ground-state bulk properties)

- ♣ Low-energy spectroscopy ; i.e. vibrational and rotational states including their coupling
- ♣ E.M. transition probabilities in the laboratory frame of reference
- ♣ Extend the applicability of EDF to light nuclei ; i.e. spectroscopy of ^{16}O
- ♣ Study of disappearance of magic shells including dynamical correlations ; i.e. $\sim {}^{32}\text{Mg}$
- ♣ Shape coexistence of complicated systems ; i.e. $\sim {}^{186}\text{Pb}, {}^{72}\text{Kr}$
- ♣ Isomers and fission barriers including correlations ; i.e. ${}^{240}\text{Pu}$
- ♣ Correlation energies, r.m.s radii, S_{2N} ; i.e. systematic over ~ 500 even-even nuclei

III. Achievements and limitations at this point

- ♣ Spectroscopy is coming out **good** on a qualitative level without any adjustment but:
 - Not all type of states available (i.e. γ bands)
 - Only even-even nuclei
 - Too spread out spectra
 - Mixing of shapes not always good (see $B(E\lambda)$)
 - Overall precision to be improved
- ♣ Correlation energies **improve** mass/radii systematics but
 - Not good enough yet

IV. Extending the calculations

- ♣ Projection and mixing of cranked/triaxial states... *underway but difficult*
- ♣ More modes coupled together: GCM on Q_{2m} , Q_{30} and Δ + corresponding projections... *feasible*
- ♣ Odd and odd-odd nuclei... *difficult*

V. Formal questions and difficulties

- ♣ Most remaining defects are due to deficiencies of the starting functional
- ♣ Not a density functional... **no HK theorem** to back up our "beyond-mean-field" calculations
- ♣ Following the phase of $\langle \Phi_L | \Phi_R \rangle$ become difficult in more involved cases
- ♣ Symmetry restorations need to be formulated in a general way **for an functional approach**
- ♣ Extension from $\mathcal{E}[\varphi, \Omega, \dots; \varphi, \Omega, \dots]$ to $\mathcal{E}[\varphi', \Omega', \dots; \varphi, \Omega, \dots]$ unclear \Rightarrow **contractions to be used?**
- ♣ Calculations are **ill defined** in the functional context...