Stability criteria for Skyrme energy functionals

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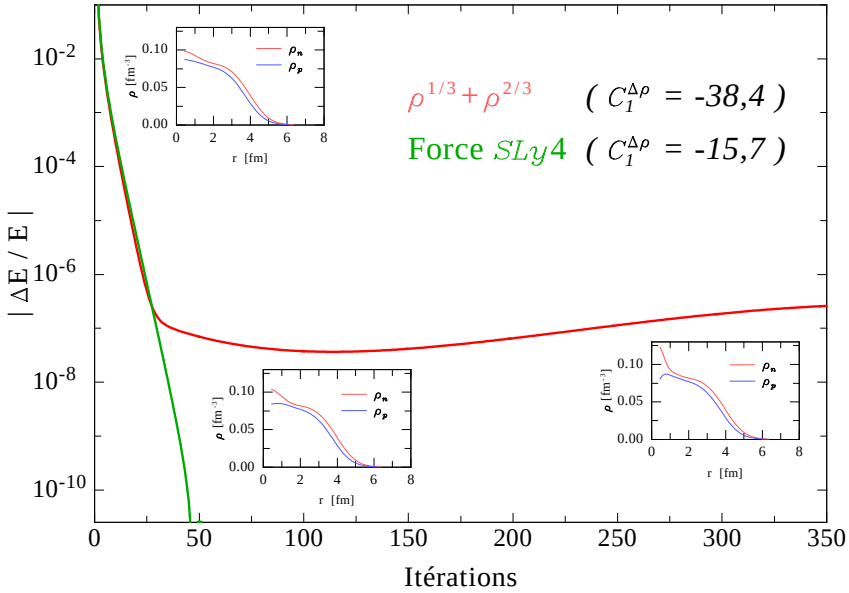
Several
even-even nuclei
(spherical)
+ Saturation point
+ E.o.S, ...

⟹ **HF(B) calc.** ⟹ functional $E[\rho]$

- Systematic calculations
- Pairing, deformation, ...
- Odd nuclei, cranking

But sometimes { nucleons align their spins (**ferromagnetism**)
or protons and neutrons split up (**segregation**)



- If you don't reach the minimum your calculation is **meaningless**
- Don't blame the code
- There's an easy way to avoid it...

Linear response of the system to a perturbation described by:

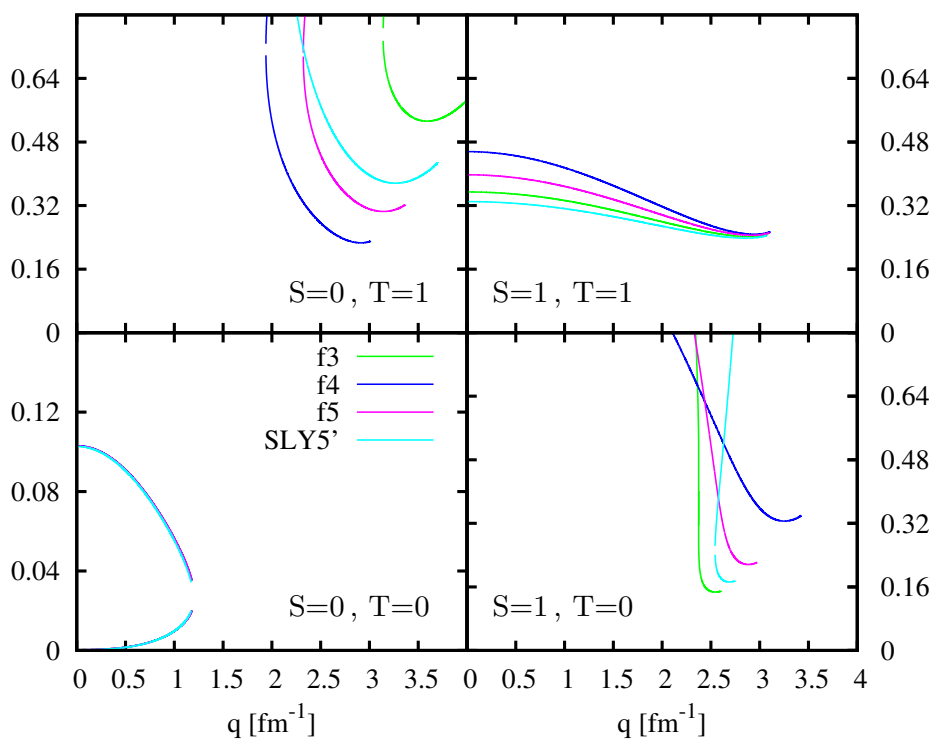
$$\mathcal{Q}^{(\alpha)} = \sum_a e^{i\mathbf{q}\cdot\mathbf{r}_a}\ \Theta_a^{(\alpha)}\ ,$$

$$\Theta_a^{\rm ss} = 1_a, \quad \Theta_a^{\rm vs} = \boldsymbol{\sigma}_a, \quad \Theta_a^{\rm sv} = \vec{\tau}_a, \quad \Theta_a^{\rm vv} = \boldsymbol{\sigma}_a\vec{\tau}_a$$

The *response fonctions* are defined by

(Cf. C. Garcia–Recio *et al.*, Ann. of Phys. 214 (1992) 293–340)

$$\chi^{(\alpha)}(\omega,\mathbf{q}) = \frac{1}{\Omega}\sum_n |\langle n|\mathcal{Q}^{(\alpha)}|0\rangle|^2 \left(\frac{1}{\omega - E_{n0} + i\eta} - \frac{1}{\omega + E_{n0} - i\eta}\right)$$



- Predict instabilities which occur in finite size systems
- Easy too implement
- Almost no computation time
- Can be crucial with tensor interaction