Thermostated quantum dynamics using squeezed coherent states

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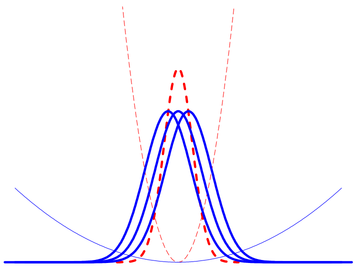


Problem: The evaluation of the partition function of interacting fermions or bosons is almost impossible.

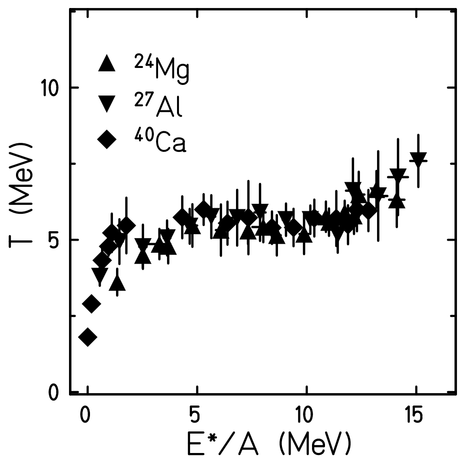
Idea: In classical mechanics this problem is circumvented with the use of time averages, e.g. Nosé-Hoover-thermostat. In quantum mechanics one faces the difficulty, that the time-evolution cannot be solved either.

Solution: Use the time-dependent variational principle with (antisymmetrized) product states of squeezed coherent states for an approximate time evolution. Couple the investigated system to a thermometer degree of freedom in order to determine thermal properties.

$$\delta \int_{t_1}^{t_2} \mathrm{dt}\ \langle\, Q(t) \,|\, i\frac{d}{dt} - \underset{\sim}{H} \,|\, Q(t)\,\rangle = 0\ , \quad |\, Q(t)\,\rangle = |\, system\,\rangle \otimes |\, thermometer\,\rangle$$

Nuclear liquid-gas phase transition

- **excited nucleus:** self-bound liquid drop in a large container (harmonic oscillator) $\underset{\sim}{H}_{\mathrm{N}} = \underset{\sim}{T}_{\mathrm{N}} + \underset{\sim}{V}_{\mathrm{NN}} + \underset{\sim}{V}(\omega)$,
- **thermometer:** single wave packet in a second oscillator with ω_{Th}, ideal gas thermometer $\underset{\sim}{H}_{\mathrm{Th}} = \underset{\sim}{T}_{\mathrm{Th}} + \underset{\sim}{V}_{\mathrm{Th}}$,
- **coupling** of all nucleons to the thermometer wave packet: $\underset{\sim}{V}_{\mathrm{N-Th}}$, $\quad \underset{\sim}{H} = \underset{\sim}{H}_{\mathrm{N}} + \underset{\sim}{H}_{\mathrm{Th}} + \underset{\sim}{V}_{\mathrm{N-Th}}$,



It is assumed that both subsystems approach the same T, which can be read off from the mean energy of the thermometer.

Thermostated dynamics of four fermions

Use the actual temperature T_{th} of the thermometer subsystem for feedback, drive the original system to equilibrium T via complex time steps.

$$d\tau = dt - i d\beta\ , \quad d\beta \propto (T_{th} - T)/T_{th}\ , \quad |\, Q(t)\,\rangle \rightarrow |\, Q(t+d\tau)\,\rangle$$