Simulating muon spins - QUANTUM

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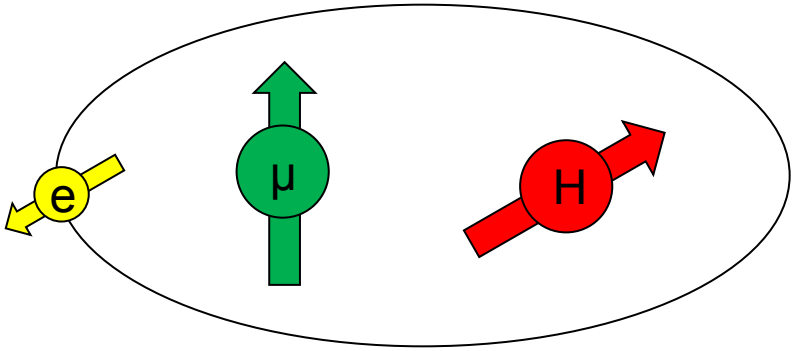
The problem

- Muon + nearby nuclei and electrons
- Variety of interactions
  - dipolar, hyperfine, quadrupole
- Static and RF magnetic fields
- Diffusion
- How does the muon's spin evolve?



Quantum mechanics

- $H\psi=E\psi$
- $P(t) = \langle\psi|S_\mu|\psi\rangle$

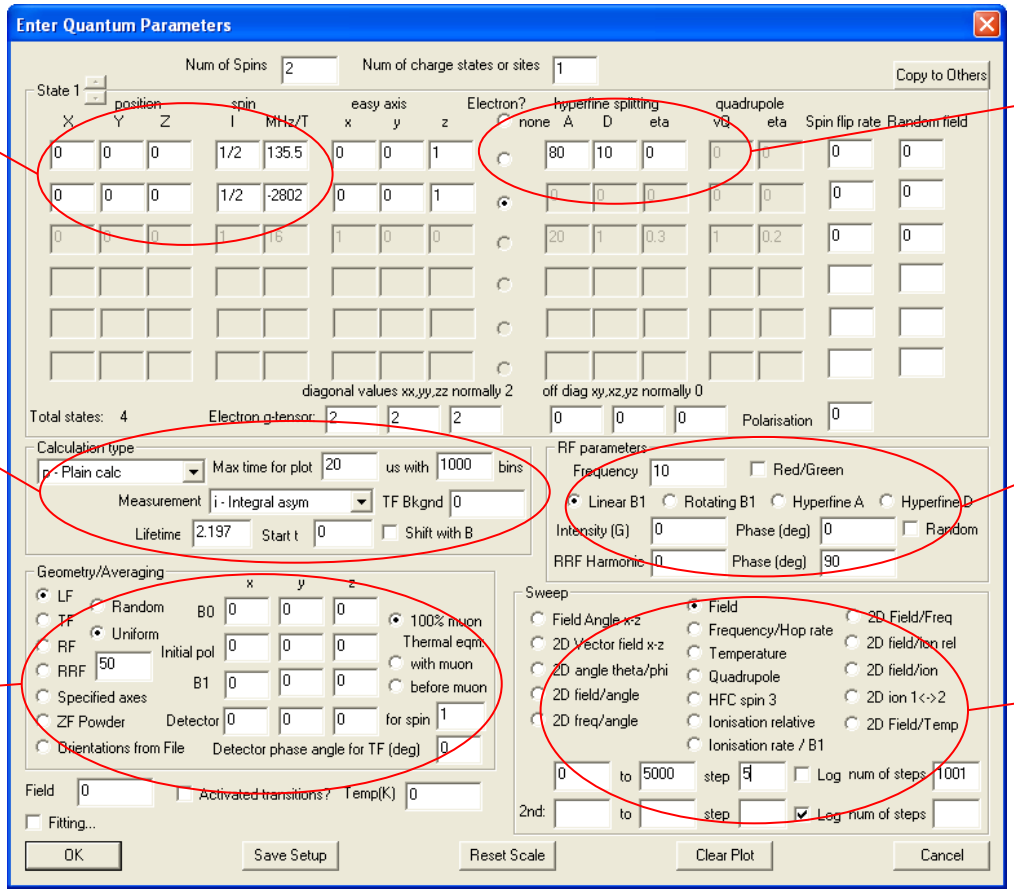
- $\psi = a_1|\uparrow\uparrow\rangle + a_2|\uparrow\downarrow\rangle + a_3|\downarrow\uparrow\rangle + a_4|\downarrow\downarrow\rangle$
- $H = \begin{vmatrix} a & b & c & d \\ b^* & e & f & g \\ c^* & f^* & h & i \\ d^* & g^* & i^* & j \end{vmatrix}$
- $P(t) = p_1 \cos(\omega_1 t+\phi_1) + p_2 \cos(\omega_2 t+\phi_2) + p_3 \cos(\omega_3 t+\phi_3) \ldots$

A job for a computer!

Details of muon/nucleus /electron spins

What to calculate

LF/TF and powder averaging options



Hyperfine coupling

RF settings

Scan fields or other parameters

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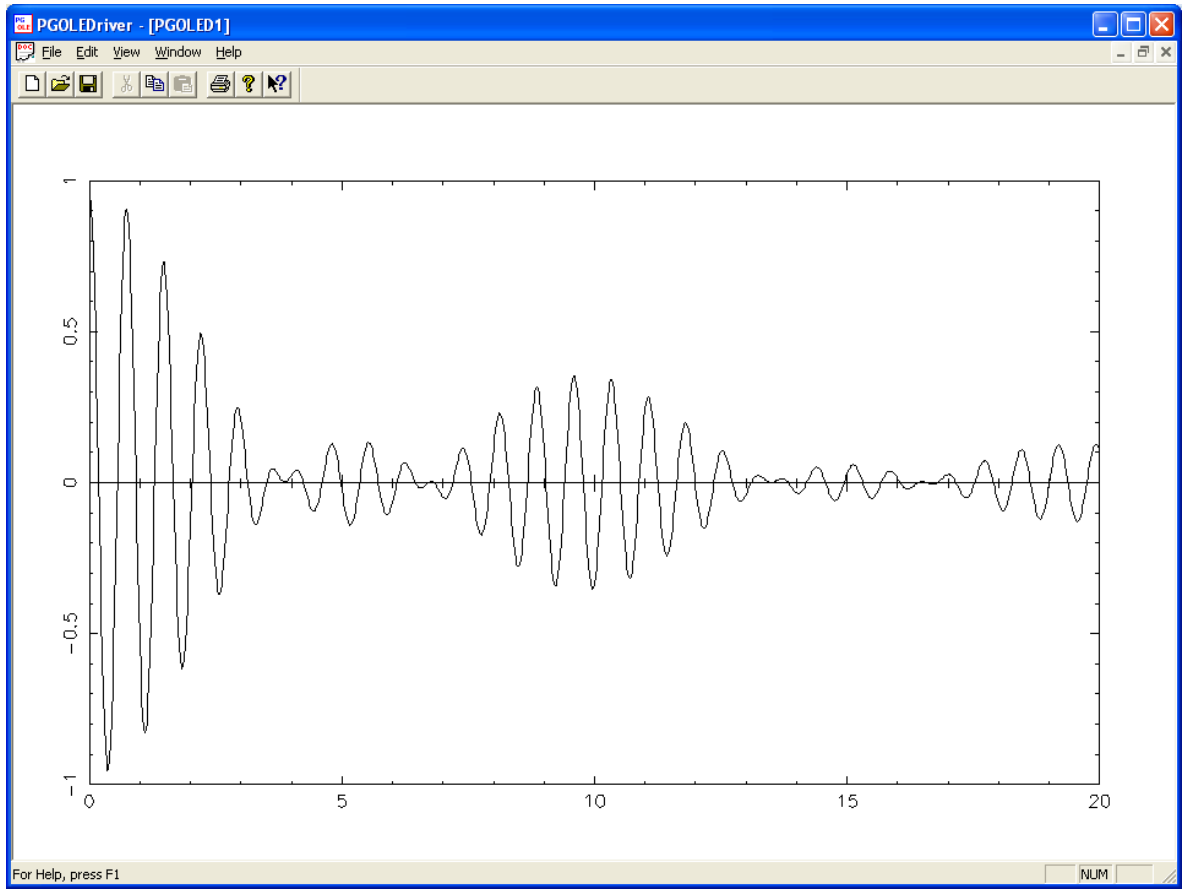
Transverse field spectra

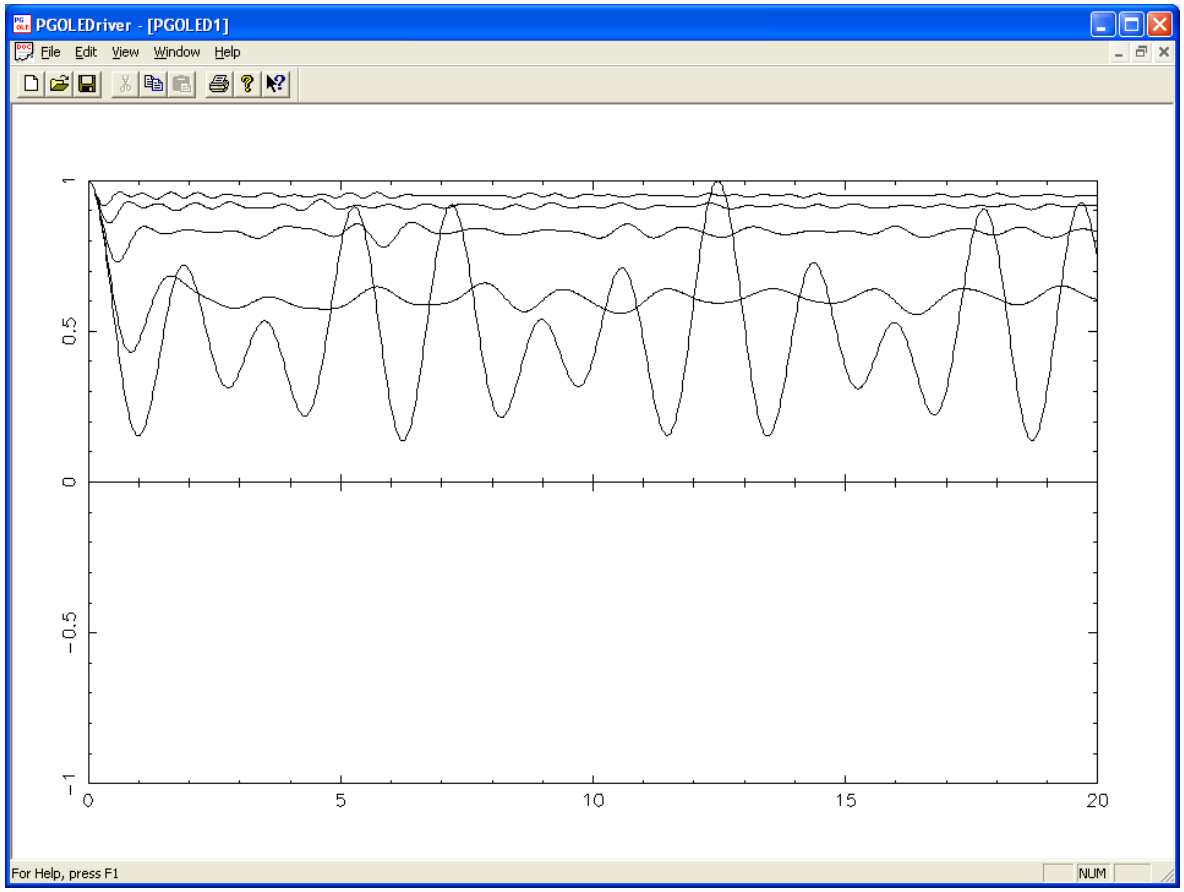


Polarisation

Time

Simulation for CdS including both Mu+ and Mu0, with conversion

Dipolar - FμF



Polarisation

Time

Longitudinal Fields 0,25,50,75, 100G

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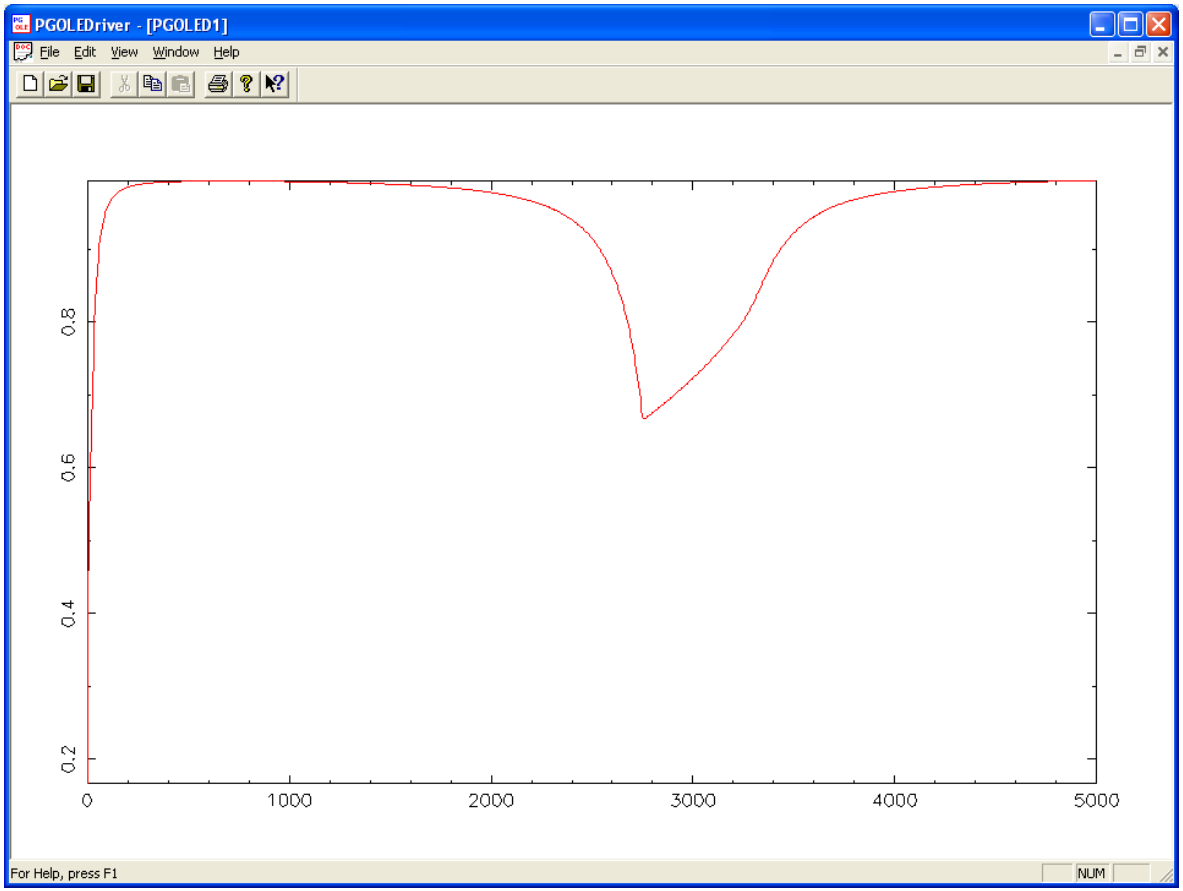
Level crossing



Options

Simulations giving

- Time spectrum P(t)
- Integral asymmetry
- Relaxation rates, frequencies
- Frequency spectrum

Scan field or other parameters

Fitting to

- Integral asymmetry, relaxation rates
- Raw data sets P(t)

Vary almost any parameter(s)