An example of using superpositions of energy eigenstates

Recall: 1) \( <q_m|q_n> = \delta_{mn} \)

2) Any \( \psi \) can be expressed as a superposition of energy eigenstates, i.e.

\[
\psi = \sum_n c_n \psi_n
\]

\( \Rightarrow \quad <q_m|\psi> = <q_m|\sum_n c_n \psi_n> = c_n \)

This is how we determine the expansion coefficients \( c_n \).

\[\psi = \sum_n c_n \psi_n \]

\[c_0 = <\psi_0|\psi> = \int_{-\infty}^{\infty} \psi_0 \psi \, dx \]

\[\psi_0 = (\frac{m\omega_s}{\hbar \pi})^{1/4} e^{-m\omega_s x^2 / 2\hbar} \]

\[
\psi(x,t) = \sum_n c_n \psi_n e^{-i\lambda_n t}
\]

\[
\psi_{rough}(x,t) = \sum_{n=0} c_n \psi_n e^{-i\lambda_n t}
\]

To very roughly see the time dependence, \( \psi_{rough}^2 \) at different times:

\[
\text{Stearn-Gerlach exp: 1922}
\]

\[
\text{version w/ hydrogen atoms: Phipps & Taylor 1927}
\]

\[
V_{mag} = -\mu . B \Rightarrow \text{lowest energy when } \mu || B
\]

\[
\text{By applying a non-uniform } B, \text{ can exert a net force on an object, proportional to the component of } \mu \text{ in the direction of } B
\]