
Exercises for
Advanced Quantum Theory

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Exercise 1

Show that and how the single particle Hamiltonian

$$H = \frac{1}{2m} \left(\frac{\hbar}{i} \nabla + \frac{e}{c} \vec{A} \right)^2$$

for the symmetric gauge

$$\vec{A} = \frac{B}{2} (y\vec{e}_x - x\vec{e}_y)$$

can be written in the form

$$H = \frac{1}{2} \hbar \omega_c [z^* z + z^* \partial_{z^*} - z \partial_z - \partial_z \partial_{z^*}]$$

and further

$$H = \hbar \omega_c \left(a^\dagger a + \frac{1}{2} \right)$$

with $[a, a^\dagger] = 1$, see eqs (5.26) to (5.34) in the script.

Exercise 2

As a preparation for the exam, discuss any question you have concerning the course with the other students and with your tutor.