Department Physik
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Excercise to lecture

Theoretical Quantum Optics

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SHEET 5

A coherent state, expanded in number states, is given by

$$|\alpha\rangle \quad = \quad e^{-\frac{1}{2}|\alpha|^2} \sum_{n=0}^{\infty} \frac{\alpha^n}{\sqrt{n!}} |n\rangle \,. \tag{1}$$

1. **Coherent states**

   Prove the following identities:

   (a) $\hat{a}^\dagger |\alpha\rangle\langle\alpha| = (\partial_\alpha + \alpha^*)|\alpha\rangle\langle\alpha|$ and

   (b) $|\alpha\rangle\langle\alpha|\hat{a} = (\partial_{\alpha^*} + \alpha)|\alpha\rangle\langle\alpha|$.