

# Physics 237 Problem Set #7

In preparation for the quiz on Tuesday, 17 March 2026

From chapter 3 of Griffiths & Schroeter:

3.42

From the Beyond:

B. Show for the coherent state  $|\alpha\rangle$  of  $N$  two-level harmonic oscillators, squeezed by  $z = re^{i\theta}$  with  $r$  and  $\theta$  both real, the raising operator is as given in [Lecture 13](#):  $S(z)^\dagger \hat{a}_+ S(z) = \hat{a}_+ \cosh r - \hat{a}_- e^{-i\theta} \sinh r$ .

C. For the coherent state  $|\alpha\rangle$ , the dimensionless position operator  $\hat{X}_1 = \frac{1}{2}(\hat{a}_- + \hat{a}_+)$ , and squeezing by  $S(z)$ , with  $z = re^{i\theta}$  and  $\theta = 0$ , show that  $\langle\alpha|S(z)^\dagger \hat{X}_1 S(z)|\alpha\rangle = \langle\alpha|\hat{X}_1|\alpha\rangle e^{-r}$ . Use the result of B, and of [Lecture 13](#)'s green pages.

From chapter 4 of Griffiths & Schroeter:

4.2

4.6

4.8

4.9

4.11