

$$X = \sqrt{\frac{\hbar}{2m\omega}} (a^\dagger + a)$$

Loc = Δ

$$\begin{aligned} -\frac{1}{2} m\omega^2 X^2 &= -\frac{1}{2} m\omega^2 \frac{\hbar}{2m\omega} (a^\dagger + a)^2 \\ &= -\frac{\omega\hbar}{4} (a^\dagger a^\dagger + a^\dagger a + a a^\dagger + a a) \end{aligned}$$

$$a^\dagger (a |n\rangle) = n |n\rangle$$

$$a^\dagger a = \hat{n}$$

$$a a^\dagger |n\rangle = (n+1) |n\rangle$$

$$a a^\dagger = n+1$$

$$|+\rangle = \frac{1}{\sqrt{2}} (|n\rangle + |n+3\rangle)$$

$$aa^\dagger = a^\dagger a + 1$$

$$[a, a^\dagger] =$$

$$-\frac{1}{2} m\omega^2 X^2 = -\frac{\omega\hbar}{4} (a^\dagger a^\dagger + a a + (2n+1))$$

$$\langle m | V | n \rangle = -\frac{\omega\hbar}{4} \left[(2n+1) \langle m | n \rangle + \sqrt{n+1} \sqrt{n+2} \langle m | n+2 \rangle \right. \\ \left. + \sqrt{n} \sqrt{n-1} \langle m | n-2 \rangle \right]$$

$\delta_{m,n}$

$$n^2 + 3n + 2$$

$$n^2 + 2n + 1$$

$$n^2 + n$$

$$n^2 + n$$

$$n^2$$

$$\frac{n^2 - n}{6n^2 + 6n + 3}$$

$$\langle m | a^\dagger a | n \rangle$$