

升降算符计算

$$\begin{aligned}
 & (\hat{a}\hat{a}\hat{a}\hat{a} + \hat{a}^\dagger\hat{a}\hat{a}\hat{a} + \hat{a}\hat{a}^\dagger\hat{a}\hat{a} + \hat{a}\hat{a}\hat{a}^\dagger\hat{a} + \hat{a}\hat{a}\hat{a}\hat{a}^\dagger + \hat{a}^\dagger\hat{a}^\dagger\hat{a}\hat{a} + \hat{a}\hat{a}^\dagger\hat{a}^\dagger\hat{a} + \hat{a}\hat{a}\hat{a}^\dagger\hat{a}^\dagger + \hat{a}^\dagger\hat{a}\hat{a}^\dagger\hat{a} + \\
 & \hat{a}\hat{a}^\dagger\hat{a}\hat{a}^\dagger + \hat{a}^\dagger\hat{a}\hat{a}\hat{a}^\dagger + \hat{a}^\dagger\hat{a}^\dagger\hat{a}^\dagger\hat{a} + \hat{a}^\dagger\hat{a}^\dagger\hat{a}\hat{a}^\dagger + \hat{a}^\dagger\hat{a}\hat{a}^\dagger\hat{a}^\dagger + \hat{a}\hat{a}^\dagger\hat{a}^\dagger\hat{a}^\dagger + \hat{a}^\dagger\hat{a}^\dagger\hat{a}^\dagger\hat{a}^\dagger)|2\rangle = \\
 & \sqrt{2}|0\rangle + \sqrt{8}|0\rangle + \sqrt{18}|0\rangle + \sqrt{4}|2\rangle + \sqrt{36}|2\rangle + \sqrt{144}|2\rangle + \sqrt{16}|2\rangle + \sqrt{81}|2\rangle + \sqrt{36}|2\rangle + \\
 & \sqrt{48}|4\rangle + \sqrt{108}|4\rangle + \sqrt{192}|4\rangle + \sqrt{300}|4\rangle + \sqrt{360}|6\rangle
 \end{aligned}$$