# :Commitator

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## 1 Enter the hydrogen atom with Abbas Abedini

Click on the link.

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I say that the uncertainty principle of momentum and position can be stated with certainty, but under one condition.

$$\Delta A \, \Delta B \geq \frac{1}{2} \left| \langle [\hat{A}, \hat{B}] \rangle \right|$$

The uncertainty principle for position and momentum follows from this.
If you take momentum in a different coordinate than position, we can say that we have certainty.

$$[\hat{p}_y, \hat{x}] = 0$$

But if we do a general calculation, the situation will be different.
Email me so I can send you the calculations:
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$$\Delta x \, \Delta p_x \geq \frac{\hbar}{2}$$

I'm going to teach the commutator.
Commutator God:

$$[A, B] = AB - BA$$

Learn the commutator here. Written by me:
https://github.com/AbbasAbedini8/Commitator
If you look at page 240 of Griffiths, it doesn't have a good definition of M.
M is the number of rounds.

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If you want to know where this came from, email me.

$$L_z = i\hbar \frac{\partial}{\partial \phi}$$

$$\psi = e^{im\phi}$$

The sphere rotates in an oscillating orbit, and the number of revolutions it takes to return to its original position is m.

$$\cos(m\phi) + i\sin(m\phi)$$

$$e^{im\phi} = e^{im(\phi+2\pi)}$$

$$1 = \cos(m2pi) + i\sin(m2pi)$$

m=+-1.+-2.+-3... The cosine is even and we also have a negative.

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$$[\hat{H}, a]$$

Commutator doesn't just mean moving, it also means influencing the operator.

$$Let\hat{H} = \hbar\omega\left(a^{\dagger}a + \frac{1}{2}\right).[\hat{H}, a].$$

$$[\hat{H}, a] = \left[\hbar\omega\left(a^{\dagger}a + \frac{1}{2}\right), a\right] = \hbar\omega[a^{\dagger}a, a] + \hbar\omega\left[\frac{1}{2}, a\right]$$

$$\left[\frac{1}{2}, a\right] = 0$$

$$[\hat{H}, a] = \hbar\omega[a^{\dagger}a, a]$$

$$[a^{\dagger}a, a] = a^{\dagger}[a, a] + [a^{\dagger}, a]a = 0 - a = -a$$

$$[\hat{H}, a] = \hbar\omega(-a) = -\hbar\omega a$$

$$[\hat{H}, a] = -\hbar\omega a$$

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Here you can clearly understand what I said about the impact of operators.

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$$[\hat{H}, L_z]$$

Does the rotation of the electron around the z axis cause changes in the system?

$$[\hat{H}, L_z] = 0$$

no...