If two operators commute then both quantities can be measured at the same time, if not then there is a tradeoff in the accuracy in the measurement for one quantity vs. the other.

### Introduction

Operators are commonly used to perform a specific mathematical operation on another function. The operation can be to take the derivative or integrate with respect to a particular term, or to multiply, divide, add or subtract a number or term with regards to the initial function. Operators are commonly used in physics, mathematics and chemistry, often to simplify complicated equations such as the Hamiltonian operator, used to solve the Schrödinger equation.

### Operators

Operators are generally characterized by a hat. Thus they generally appear like the following equation with \(\hat{E}\) being the operator operating on \(f(x)\)

\[
\hat{E} f(x) = g(x)
\]

For example if \(\hat{E} = d/dx\) then:

\[
g(x) = f'(x)
\]

### Commuting Operators

One property of operators is that the order of operation matters. Thus:

\[
\hat{A}\hat{E} f(x) \neq \hat{E}\hat{A} f(x)
\]

unless the two operators commute. Two operators commute if the following equation is true:

\[
[\hat{A}, \hat{E}] = \hat{A}\hat{E} - \hat{E}\hat{A} = 0
\]

To determine whether two operators commute first operate \(\hat{A}\hat{E}\) on a function \(f(x)\). Then operate \(\hat{E}\hat{A}\) the same function \(f(x)\). If the same answer is obtained subtracting the two functions will equal zero and the two operators will commute.

\[
[i\hbar, \hat{L}_y, \hat{L}_z] = i\hbar \hat{L}_x
\]