Schrödinger Equation

The Schrödinger Equation

The Schrödinger Equation is an equation that relates different properties of a wave function.

$$i\hbar\frac{\partial\psi}{\partial t}=\frac{-\hbar^2}{2m}\frac{\partial^2\psi}{\partial x^2}+V\psi$$

In[7]:=
```
Schro[ψ_, X_] := Solve[ⅈ ℏ ∂t ψ[x, t] == (-ℏ^2)/(2 m) (∂x ∂x ψ[x, t]) + V ψ[x, t], X];
```

In[8]:=
```
Ψ[x_, t_] := A E^((-a m x^2)/ℏ) E^(-ⅈ a t);
Part[Part[Schro[Ψ, V], 1], 1]
```

Out[9]= $V \to 2\,a^2\,m\,x^2$

Normalization

Normalization of a wave is the constant that causes the area under the curve of the squared wave function is exactly one.

$$\int_{-\infty}^{\infty} |\,\psi\,|^2\,dx=\int_{-\infty}^{\infty}\psi\psi^*\,dx=1$$

In[12]:=
```
Normalization[ψ_, X_, opts_ : {}] := FullSimplify[
    Solve[
     FullSimplify[Integrate[(ψ[x, t] // ComplexExpand)
         (Conjugate[ψ[x, t]] // ComplexExpand), {x, -∞, ∞}],
       opts] == 1,
     X],
    opts];
```

In[13]:=
```
Normalization[Ψ, A, {a > 0, ℏ > 0, m > 0}]
```

Out[13]=

$$\left\{\left\{A\to-\left(\frac{2}{\pi}\right)^{1/4}\left(\frac{a\,m}{\hbar}\right)^{1/4}\right\},\left\{A\to\left(\frac{2}{\pi}\right)^{1/4}\left(\frac{a\,m}{\hbar}\right)^{1/4}\right\}\right\}$$

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