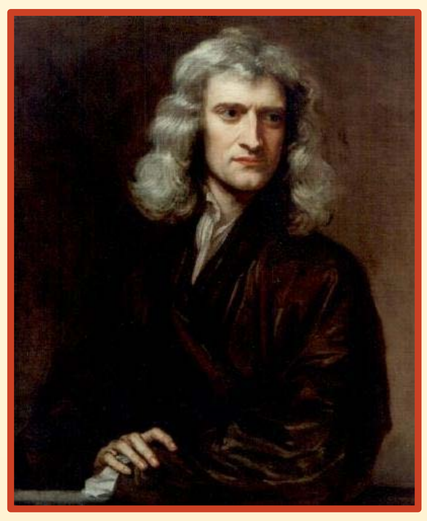
ANALOGIES IN CLASSICAL MECHANICS



Sir Isaac Newton

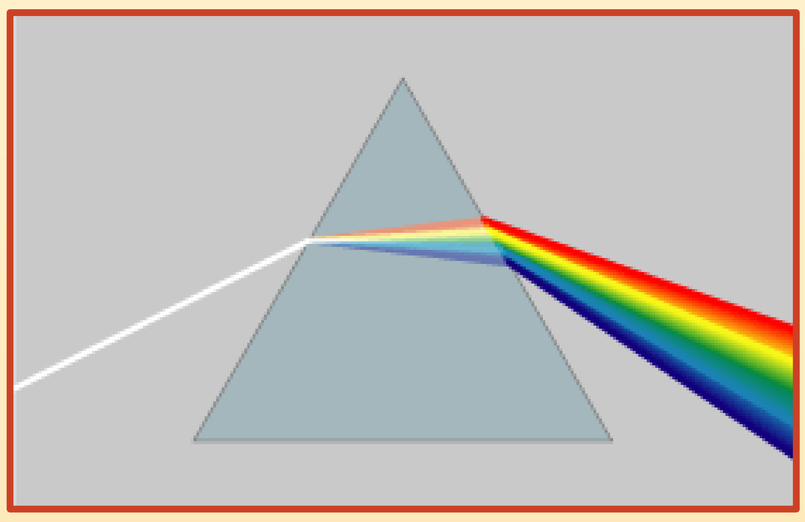
Whenever one thinks of physics, **Classical Physics** is what comes to mind. Everybody has heard of Newton and his apple, but physics has its dark side, far from being completely understood: **Quantum Physics**. Alhough they are ruled by different laws, there are some effects that are quite similar between them, let's see some of these!

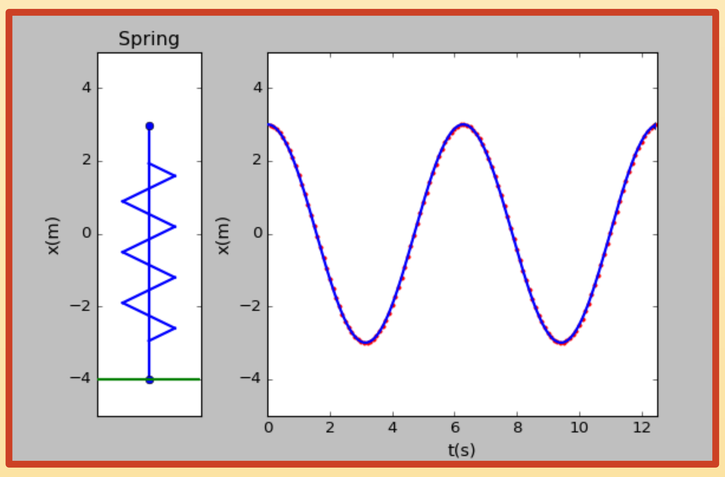
Erwin Schrödinger

$$\vec{F} = m\vec{a}$$

$$i\hbar\frac{\partial\Psi(\vec{r},t)}{\partial t} = -\frac{\hbar^2}{2m}\nabla^2\Psi(\vec{r},t)+V(x)\Psi(\vec{r},t)$$

In nature, a light beam is composed by **different frequencies**. The predominance of a certain frequency —or wavelength— over the others gives place to the concept of **colour**. This composite nature can be shown by lightening a prism with a white light beam. The incoming beam is split into its constituent colours, as in the rainbow, because the way a material transmits light depends on the colour. Or in more technical words, the refractive index of a material varies with wavelength.

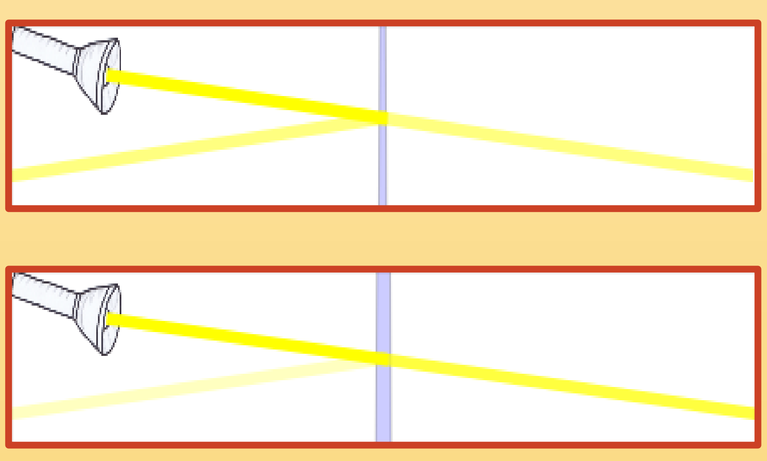




In classical physics a particle attached to a spring or under a harmonic potential evolves in time describing a **harmonic motion**. It experiences a force, given by **Hooke's law**, that tends to return the particle to its equilibrium position.

$$F_{\text{spring}} = -kX$$

In our daily life, ordinary objects do not tunnel potential barriers, e.g. a ball thrown against a wall always bounces back. So does this mean we cannot think of an analog for the **Tunnel Effect**? In fact, it can be seen that a beam of light passing through a glass surface divides its beam into two different ones, a reflected and a refracted one! It is called **reflection** and **refraction**.



Newton's Cradle is one of the most famous examples that illustrates **conservation** of **momentum** and **energy**. If the spheres have the same mass, it can be seen that the number of them which remain in motion is constant. Although this device is purely described by the laws of Classical Mechanics, a **quantum system** like a Bose-Einstein Condensate with **dark solitons** does exhibit the same properties!

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