Answer on question #44165, Physics, Mechanics, Kinematics, Dynamics

what is the physical signification of momentum ?

In classical mechanics, **linear momentum** or **translational momentum** (pl. momenta; SI unit kg m/s, or equivalently, N s) is the product of the mass and velocity of an object. For example, a heavy truck moving quickly has a large momentum—it takes a large or prolonged force to get the truck up to this speed, and it takes a large or prolonged force to bring it to a stop afterwards. If the truck were lighter, or moving more slowly, then it would have less momentum.

Like velocity, linear momentum is a vector quantity, possessing a direction as well as a magnitude

$$\mathbf{p} = m\mathbf{v}.$$

Linear momentum is also a *conserved* quantity, meaning that if a closed system is not affected by external forces, its total linear momentum cannot change. In classical mechanics, conservation of linear momentum is implied by Newton's laws; but it also holds in special relativity (with a modified formula) and, with appropriate definitions, a (generalized) linear momentum conservation law holds in electrodynamics, quantum mechanics, quantum field theory, and general relativity.

In quantum mechanics, momentum is defined as an operator on the wave function. For a single particle described in the position basis the momentum operator can be written as

$$\mathbf{p} = \frac{\hbar}{i}\nabla = -i\hbar\nabla\,,$$

Then the average value of the moment is:

$$< P >= \int_{-\infty}^{\infty} \psi(r) P \psi * (r) dr$$

$< P >$ that was calculated by the integral must be equal to $< P >$ that was found on experiment.