Question 37352

Since in quantum mechanics, linear momentum and position do not commute ($[x, p_x] = i\hbar$), it is not possible to measure the same component of momentum and position of a quantum object at the same time. Hence, while measuring momentum and position, there is an uncertainty of measurement. According to Heisenberg uncertainty principle, this uncertainty is $\Delta x \Delta p_x \geq \frac{\hbar}{2}$, or in terms of energy $\Delta E \Delta t \geq \frac{\hbar}{2}$. These relations might be derived by different ways in wave mechanics or in matrix mechanics. Sometimes, one might accept this principle as a postulate of quantum mechanics.

In wave mechanics formulation, it is possible to find the “minimizing wave packet” - the wave packet, which minimizes uncertainty (for which $\Delta x \Delta p_x = \hbar$). It is quite easy to show that this packet is a Gaussian function.