1.5: Uncertainty

A wave of sharp frequency has to last infinitely long, and is thus completely delocalised. What does this imply for matter waves? One of the implications is the uncertainty relation between position and momentum

$$\Delta x \Delta p \gtrsim \frac{1}{2}\hbar. \tag{1.5.1}$$

This implies that the combined accuracy of a simultaneous measurement of position and momentum has a minimum. This is not important in problems on standard scales, for the following practical reason. Suppose we measure the velocity of a particle of 1 g to be $1 \pm 10^{-6}\ \mathrm{m/s}$. In that case we can measure its position no more accurate that $5 \cdot 10^{-26}\ \mathrm{m}$, a completely outrageous accuracy (remember, this is 10^{-16} times the atomic scale!)