

Local and non-local potentials

In terms of Schrödinger equations:

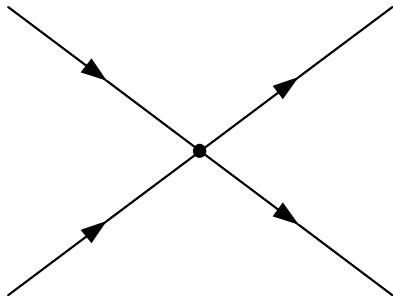
$$-\frac{\hbar^2}{M}\nabla^2\psi(r)+V(r)\psi(r)=E\psi(r)$$

with a local potential

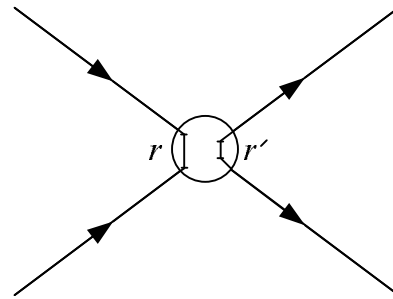
$$-\frac{\hbar^2}{M}\nabla^2\psi(r)+\int r^2 dr V(r,r')\psi(r')=E\psi(r)$$

with a non-local potential

Both potentials depict the scattering as follows:



Local



Non-local

The local potential is when $r = r'$. The non-local expresses two extra distances. r is the relative distance between two in-coming particles; and r' is the relative distance between two out-going particles as shown.

The relation between local and non-local potentials is

$$V(r) = V(r,r') \frac{\delta(r-r')}{r^2}$$