

HOME WORK 4 - PHYS 502 2018

Problem 1.

Calculate the differential cross-section for a central Gaussian potential $V(r) = (V_0/\sqrt{4\pi})e^{-r^2/4a^2}$ under Born approximation.

Problem 2.

For the Yukawa potential $V = V_0 e^{-r/a}$ obtain the total scattering cross-section by Born approximation.

Problem 3

Prove the following properties of the permutation operator P .

- (a) If $\psi(1, 2, \dots, N)$ is an eigenfunction of H with an eigenvalue E then $P\psi$ is also an eigenstate of H with the same eigenvalue.
- (b) $\langle \phi | \psi \rangle = \langle P\phi | P\psi \rangle$. (c) $\langle P\psi_i | O | P\psi_j \rangle = \langle \psi_i | O | \psi_j \rangle$.

Problem 4

Determine the nature of the wave function obtained by applying (i) the symmetrising and (ii) the antisymmetrising operators to an arbitrary linear combination of $\psi(1, 2)$ and $\psi(2, 1)$.

Hint: For a system of two identical particles, $S_s = [I + P_{12}]/2$ and $S_a = [I - P_{12}]/2$.

Calculate for example $S_s(c_1\psi(1, 2) + c_2\psi(2, 1))$