TRINITY COLLEGE FOR WOMEN NAMAKKAL

Department of Physics

QUANTUM MECHANICS-II

19PPH07-ODD Semester

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SYMMETRIC WAVE FUNCTION

A wave function is symmetric if the interchange of any pair of particles among its arguments leave the wave function unchanged

If P is an exchange operator ,then

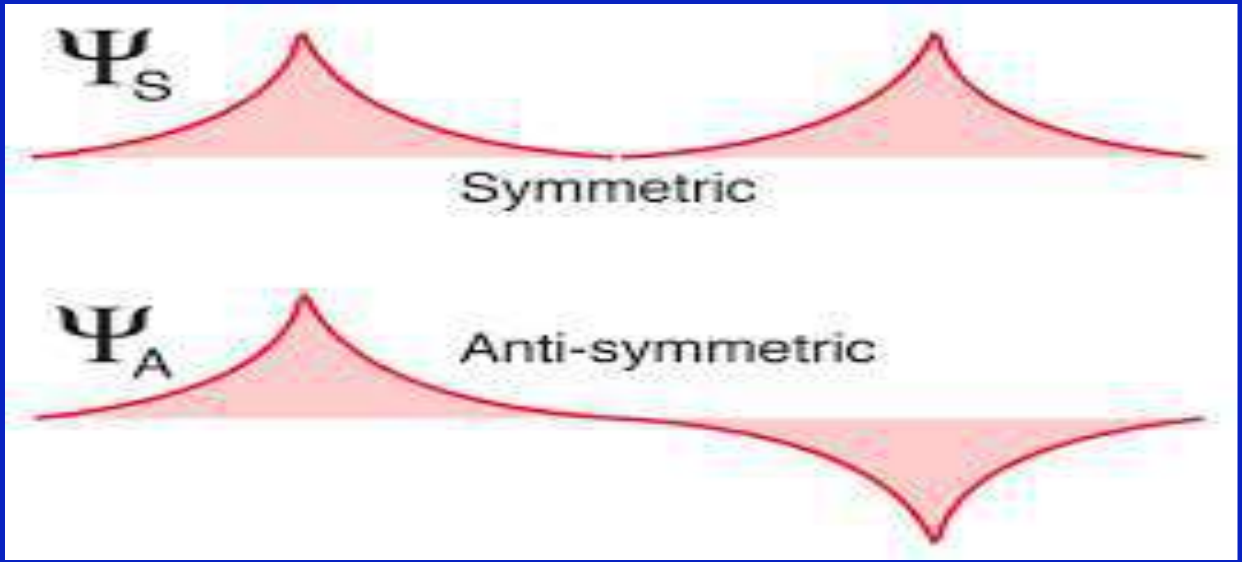
$$P\Psi S\ (1,2) = \Psi S\ (2,1)$$

ANTISYMMETRIC WAVE FUNCTION

A wave function is antisymmetric if the interchange of any pair of particles among its arguments changes the sign of the wave function

If P is an exchange operator , then

$$P\Psi A\ (1,2) = -\Psi A(2,1)$$


Ψ_S
Symmetric
Ψ_A
Anti-symmetric

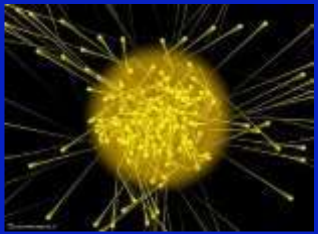
POSTULATES OF SYMMETRIC WAVE FUNCTION

The identical particles having an integral spin quantum number Are described by symmetric wave function

$$P\Psi S\ (1,2,3,\ldots r,\ldots s,\ldots n) = +\Psi S\ (1,2,3,\ldots s,\ldots r,\ldots n)$$

This class of particles,i.e the particles described by symmetric Wave functions are known as Bose particles or Bosons and obey Bose-Einstein Statistics.

The examples of Bosons are photons(spin 1),neutral helium atoms in Normal state(s=0) etc



POSTULATES OF ANTISYMMETRIC WAVE FUNCTION

The identical particles having half odd integral spin quantum number are described by antisymmetric wave function,i.e.

$$P\Psi A(1,2,3,\ldots r,\ldots s,\ldots n) = -\Psi A\ (1,2,3,\ldots s,\ldots r,\ldots n)$$

This class of particles,i.e the particles described by antisymmetric Wave function obey Fermi-Dirac statistics and the particles are known as Fermi particles or Fermions

The examples of Fermions(spin ½) are electron,protons,neutrons,muons

EXCHANGE SYMMETRY

The exchange symmetry says that **the swapping of two identical particles should leave their combined wave function unchanged**—except for an overall phase. For fermions, this phase makes the combined wave function antisymmetric under the swapping, and as a result, the particles cannot occupy the same state.

SYMMETRIC NORMALISED EIGEN FUNCTION

$$\langle P_S \rangle = \int \Psi_S^* \, P \, \Psi_S \, dx$$

A little consideration shows that for symmetric solution an exchange of coordinates of particles leaves both ΨS and ΨS * unaltered

ANTISYMMETRIC NORMALISED EIGEN FUNCTION

$$\langle PA \rangle = \int \Psi A \, {*} \, P \, \Psi A \, dx$$

In the case of antisymmetric solution an exchange of coordinates Changes the signs of both ΨA and ΨA * consequently <PA> again remains unchanged.

THANK YOU

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