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Lecture for M.Sc. Physics II Semester students

Paper – III Quantum Mechanics – II

Unit- III: Identical Particle

SPIN FUNCTION for 3 Electron SYSTEM:-

The 3 spin electron system can be considered as a 1+2 e^- combination. It means we can combine electron ($S=\frac{1}{2}$) with the triplet two electron function ($S=1$) & with the singlet function ($S=0$). In the first case, we get two groups of three electron spin function that corresponds to $S=\frac{1}{2}$ & $S=\frac{3}{2}$. In the second case, we get $\frac{2}{a}$ single ^{2}group that corresponds to $S=\frac{1}{2}$. Thus, we get one quarted group ^{2}of spin state $S=\frac{3}{2}$ & two distinct triplet group of spin state $S=\frac{1}{2}$ or a total of $4+2+2=8$ state. individual of three electron spin state. This must be expressed as linear combination of the $2^3=8$ products of one electrons spin functions. We thus obtain.

	$(S_1+S_2+S_3)^2$	$S_{1z}+S_{2z}+S_{3z}$
$(+++)$	$15/4\hbar^2$	$3/2\hbar$
$3^{-1/2}[(+++)+(+--)+(-+-)$	$15/4\hbar^2$	$1/2\hbar$
$3^{-1/2}[(-++)+(--+)+(+--)]$	$15/4\hbar^2$	$-1/2\hbar$
$(---)$	$15/4\hbar^2$	$-3/2\hbar$

$6^{-1/2}[2(-++)-(++-)-(+-+)]$	$3/4\hbar^2$	$1/2\hbar$
$6^{-1/2}[(-++)+(--+)-2(+-+)]$	$3/4\hbar^2$	$-1/2\hbar$
$2^{-1/2}[(++-)-(+-+)]$	$3/4\hbar^2$	$1/2\hbar$
$2^{-1/2}[(-+-)-(--+)]$	$3/4\hbar^2$	$-1/2\hbar$

The first four quadrate states are symmetric in the interchange of any pair of particles. The division of the four triplet states into two pair in such that the first is symmetric in the interchange of particle 2 & 3. and second pair is anti-symmetric 2 & 3. The symmetry with respect to the interchange of other two pairs is characterized the 2x2 matrix. The matrix Operate on either pair of triplet spin state that have the same value.