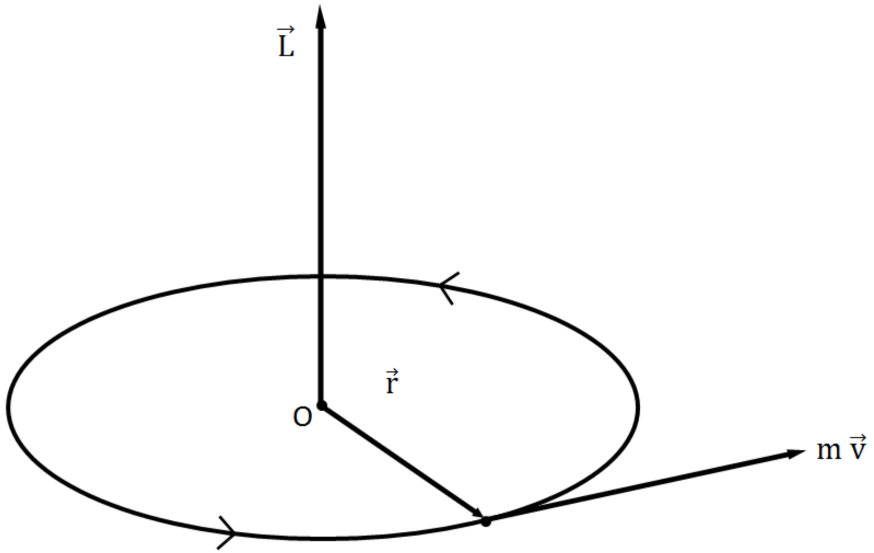
INTRODUCTION TO NUCLEAR PHYSICS
PHY3C10

ANGULAR MOMENTUM

- *Angular momentum is a conserved quantity* (i.e. the quantity remains constant since the system evolves until and unless an external force acted upon it.) hence it is important in both classical as well as quantum physics



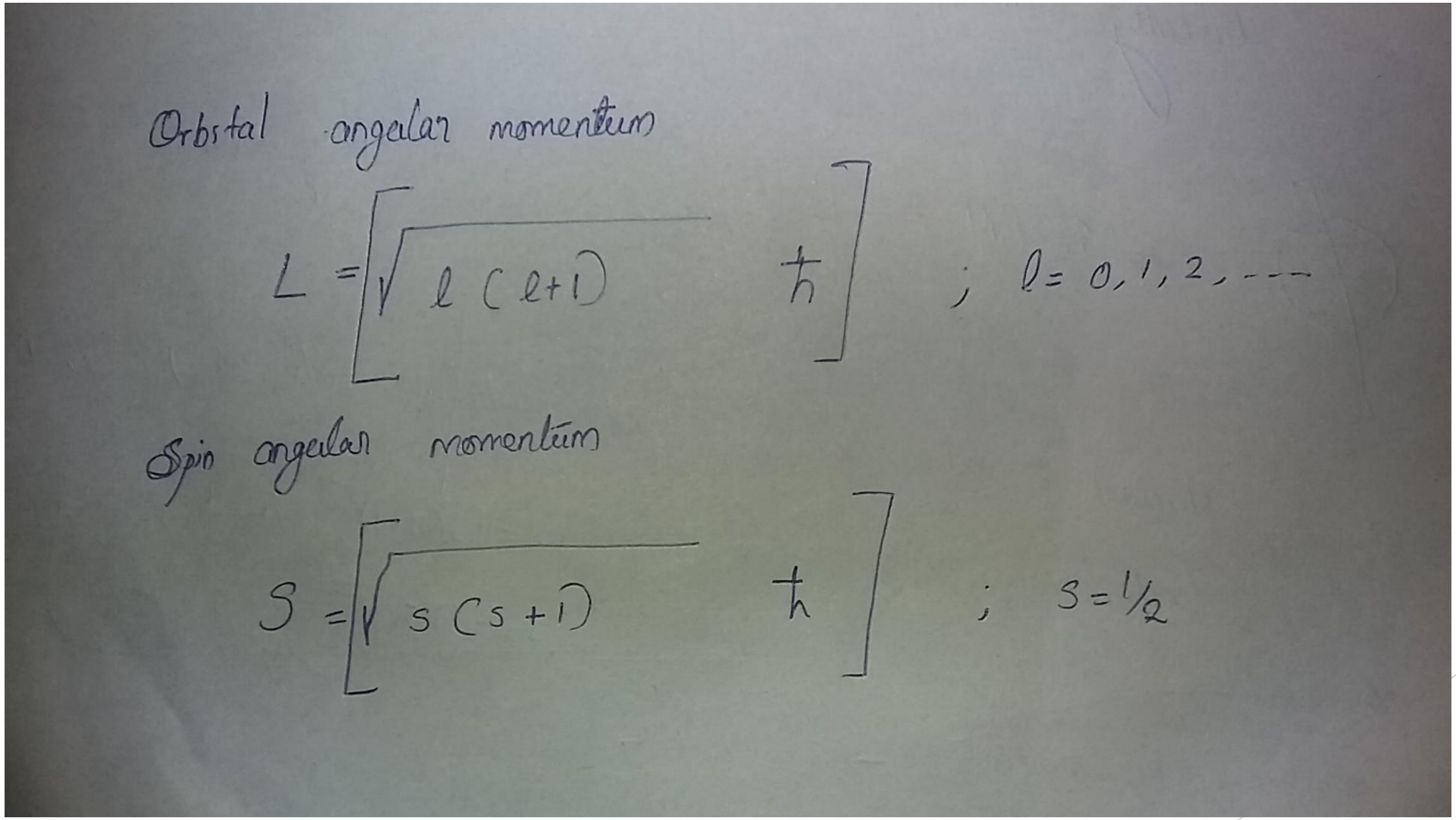
NUCLEAR ANGULAR MOMENTUM

- Nucleus is basically a collection of 2 types of particles called protons and neutrons
- These particles have spin ½ i.e. they posses intrinsic spin angular momentum
- In certain kinds of nuclear model it is assumed that potential inside nucleus id central potential field hence solution of Schrodinger eqn. leads to the orbital angular momentum of nucleus.
- Nuclear angular momentum is the vector sum of orbital and spin angular momentum of constituent particles.

Total angular momentum, $\boldsymbol{J} = \boldsymbol{L} + \boldsymbol{S}$

NUCLEON ANGULAR MOMENTUM

- Inside the nucleus, each nucleon has Orbital” angular momentum



NUCLEON ANGULAR MOMENTUM

Direction of Orbital angular momentum

$L_z = m_l \hbar \quad ; \quad m_l = -l \rightarrow l \quad |\Delta m_l| = 1$

Direction of spin angular momentum

$S_z = m_s \hbar \quad ; \quad m_s = \pm 1/2$

NUCLEON ANGULAR MOMENTUM

Total angular momentum $\vec{J} = \vec{L} + \vec{S}$

$\therefore J^* = \sqrt{j(j+1)}\,\hbar$; $j \to (l-s) \to (l+s)$

&

Direction along z axis.

$J_z = m_j \hbar$; $-j \le m_j \le j$; $j = n/2$; $n = 1, 2 \ldots$

NUCLEAR ANGULAR MOMENTUM

- The experimental evidence for the existence of nuclear angular momentum comes from the hyperfine structure of atomic spectral lines using very high resolution spectrometer.
- In nuclear physics the word spin frequently refers to the total angular momentum of nucleus (I).
- I has all the usual properties of quantum mechanical angular momentum vectors.

NUCLEAR ANGULAR MOMENTUM

Total nuclear angular momentum

$$I^* = \sqrt{I(I+1)}\,\hbar \quad ; \quad \vec{I} = \sum_{Z} \vec{J}_P + \sum_{N} \vec{J}_N$$

Nuclear angular momentum z-axis projection.

$$I_z = m_I \hbar \quad ; \quad -I \le m_I \le +I$$

Relation connecting - Mass no. ‘A’ and Nuclear angular momentum ‘I’

- For even no of nucleons i.e. even A nuclei - *I is integral*

- For odd no of nucleons i.e. odd A nuclei – *I is half integral*

NUCLEAR PARITY

- Parity is a fundamental nuclear property associated with each particle's wave function.
- we have wave function which depends on space co ordinates(x, y, z)
- If the change of sign of space co ordinates does not change the wave function then the particle is said to be ***positive*** **or** ***even parity***
- If ,on the other hand, wave function changes with the sign the particle is said to be ***negative*** or ***odd parity***