8.701

Introduction to Nuclear and Particle Physics

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0. Introduction

0.9 Spin

Spin vector, length, and eigenvalues

In quantum mechanics, the spin vector **S** is quantised in terms of its length and its components.

Total length is $\sqrt{s(s+1)}\hbar$

For components along any axis, e.g. z, eigenvalues can be

$$s_z = -s\hbar, -(s-1)\hbar, -(s-2)\hbar, \ldots, (s-2)\hbar, (s-1)\hbar, s\hbar$$

with 2s+1 possible values.

Immediate question is which axis is a sensible choice?

Orbital and total angular momentum

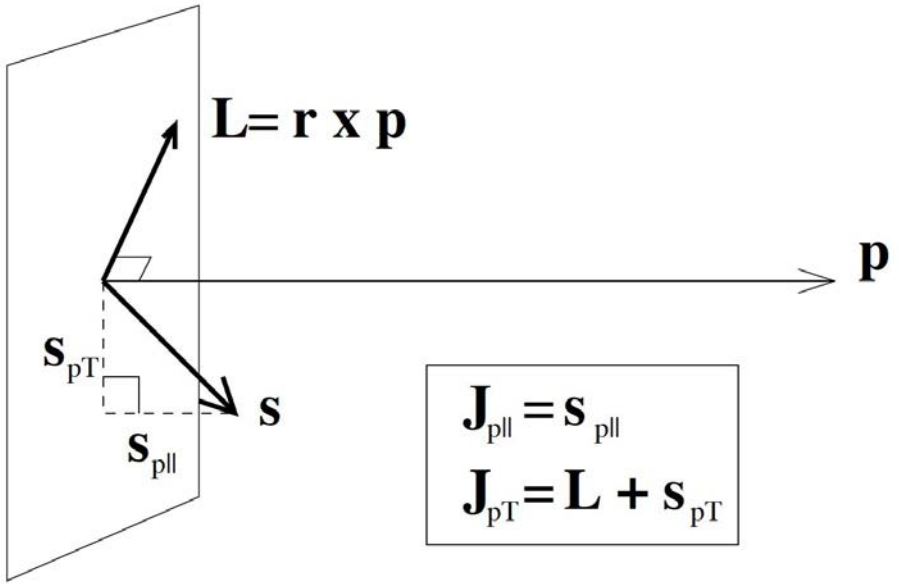
Orbital angular momentum is

$$\boldsymbol{L} = \boldsymbol{r} \times \boldsymbol{p}$$

Total angular momentum

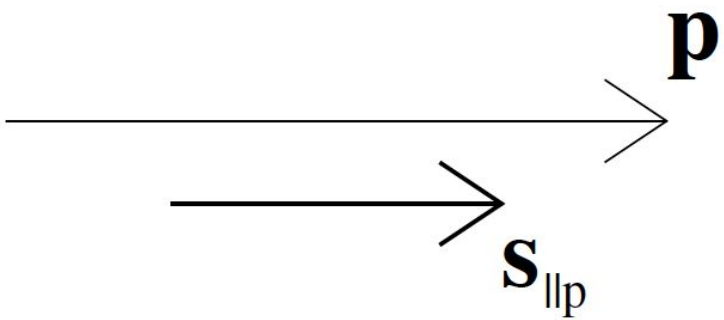
$$\boldsymbol{J} = \boldsymbol{L} + \boldsymbol{S}$$

Consider free particle

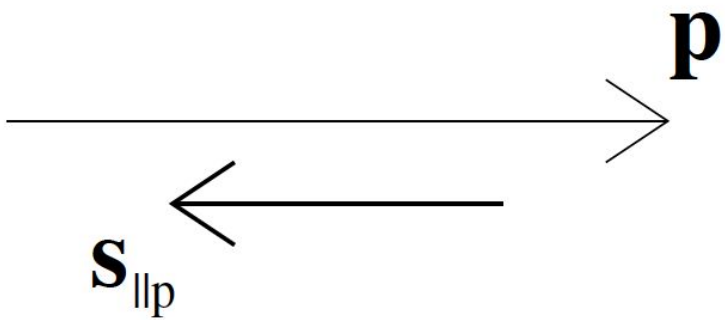


Helicity

$$h = \frac{\boldsymbol{S}.\boldsymbol{p}}{|\boldsymbol{p}|}$$



h = + 1/2



h = - 1/2

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