

PARTICLE PHYSICS 1 : EXERCISE 13

1) Hypothetical spin-zero quarks

If quarks and antiquarks were spin-zero particles, what would be the multiplicity of the $L = 0$ multiplet(s)? Remember that the overall wavefunction for bosons must be symmetric under particle exchange.

2) Baryon wavefunctions for a colourless model

If the colour did not exist, baryon wavefunctions would be constructed from

$$\psi = \phi_{\text{flavour}} \chi_{\text{spin}} \eta_{\text{space}}$$

Taking $L = 0$ and using the flavour and spin wavefunctions derived in the lectures :

- (a) Show that it is still possible to construct a wavefunction for a spin-up proton for which $\phi_{\text{flavour}} \chi_{\text{spin}}$ is totally antisymmetric.
- (b) Predict the baryon multiplet structure for this model.
- (c) For this colourless model, show that the proton magnetic moment μ_p is negative and that the ratio of the neutron and proton magnetic moments would be

$$\frac{\mu_n}{\mu_p} = -2.$$