Flavor Physics – Exercise Sheet 3 – SomSem 2015

Discussion: 22/05 during the tutorial

Exercise 1: Vector meson mixing angle

The physically observed vector mesons ω and ϕ are mixtures of the SU(3) flavor states ϕ_8 and ϕ_1:

$$\phi = \phi_1 \sin\theta - \phi_8 \cos\theta$$

$$\omega = \phi_8 \sin\theta + \phi_1 \cos\theta$$

where the SU(3) flavor states ϕ_8 (octet) and ϕ_1 (singlet) are defined as:

$$\phi_8 = \frac{1}{\sqrt{6}} \left(|u\bar{u}\rangle + |d\bar{d}\rangle - 2|s\bar{s}\rangle \right)$$

$$\phi_0 = \frac{1}{\sqrt{3}} \left(|u\bar{u}\rangle + |d\bar{d}\rangle + |s\bar{s}\rangle \right)$$

Show that if one uses the ideal mixing angle $\cos\theta = 1/\sqrt{3}$ in the above meson mixing one obtains pure flavor states:

$$\phi = s\bar{s}$$

$$\omega = \left(u\bar{u} + d\bar{d} \right) / \sqrt{2}$$

Exercise 2: Extending SU(3) to include Charm

How are the possible meson states grouped if in addition to iso-spin and strangeness also the charm quantum number is considered as quantum number. How man states exist? For more information, look at the Particle Data Book (Chapter 14: Quark model).