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Weight diagram of meson and baryon octet

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The Mendeleev of elementary particle physics was Murray Gell-Mann, who introduced the so-called Eightfold Way in 1961 (Essentially the same scheme was proposed independently by Ne' eman in 1962). The Eightfold Way arranged the baryons and mesons into weird geometrical patterns, according to their charge and strangeness. The matrix array contains a total of eight states and is known as octet.

The eight lightest baryons fit into a hexagonal array with two particles at the center. This group is known as the **baryon octet**.

Gell-Mann and Ne'eman pointed out that baryon also formed an octet array which corresponded with the octet representation of SU (3). The octet array is:

$$\begin{Bmatrix} (\Sigma^\circ/\sqrt{2}+\Lambda/\sqrt{6}) & \Sigma^+ & p \\ \Sigma^- & (-\Sigma^\circ/\sqrt{2}+\Lambda/\sqrt{6}) & n \\ \Xi^- & \Xi^0 & -2\,\Lambda/\sqrt{6} \end{Bmatrix}$$

These are eight in no. (p, n, $\Lambda^o, \Sigma^+, \Sigma^-, \Sigma^0, \Xi^-, \ \Xi^0$).For these $j^\pi = \frac{1}{2}^+$, B = 1. The eightfold way arrangement of this baryon octet is shown in

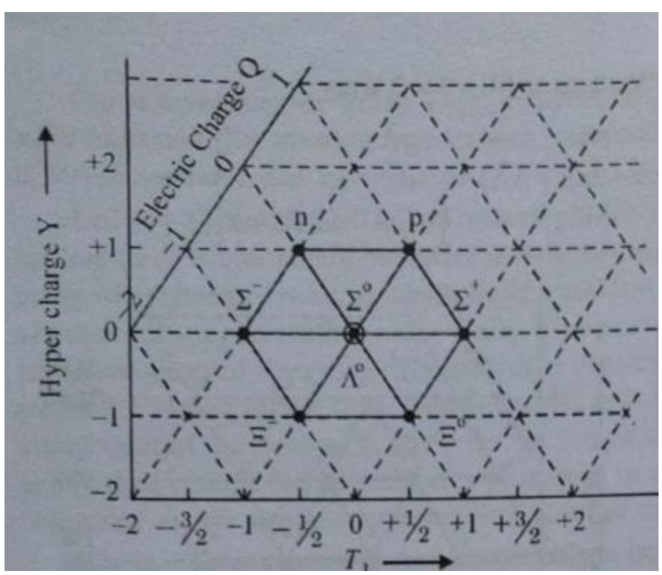

Fig1. Baryon octet

Figure1. It shows that particles of like charge lie along the downward-sloping diagonal lines: Q = +1 (in units of the proton charge) for the proton and the Σ^{+}, Q = 0 for the neutron, the lambda Σ^{0} and the Ξ^{0} Q = −1 for the Σ^{-} and the Ξ^{-}. Horizontal lines associate particles of like strangeness: S = +1 for the proton and neutron, S = 0 for the middle line and S = −1 for the two Ξ's.

Meson octet

The eight lightest mesons fill a similar hexagonal pattern, forming the (pseudo-scalar) meson octet.

It can be identified with spin zero mesons

$$\begin{Bmatrix} \frac{\pi^0}{\sqrt{2}} + \frac{\eta^0}{\sqrt{6}} & \pi^+ & K^+ \\ \pi^- & -\frac{\pi^0}{\sqrt{2}} + \frac{\eta^0}{\sqrt{6}} & K^0 \\ K^- & \overline{K}^0 & -\frac{2\eta^0}{\sqrt{6}} \end{Bmatrix}$$

The neutral π and η mesons are now written as

$$\pi^0 = (p\bar{p} - n\bar{n})/\sqrt{2}$$

$$\eta = (p\bar{p} + n\bar{n} + \Lambda\bar{\Lambda})/\sqrt{6}$$

In the case for meson B= 0, $j^{\pi} = 0^{-}$ and the eight member is ($\pi^-, \pi^0, \pi^+, K^0, K^+, K^-, \overline{K}^0, \eta^0$) .

This eighth meson was based η^0- meson. Octets of metastable meson (zero intrinsic spin) is shown in fig.2

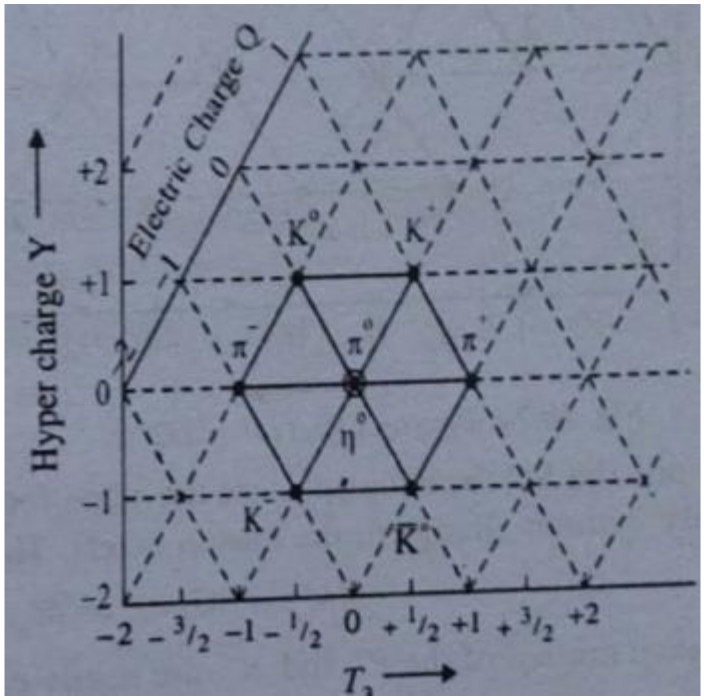

Fig.2 meson octet

Fig2. shows that diagonal lines determine charge, and horizontals determine strangeness; but this time the top line has S = 1, the middle line S = 0, and the bottom line S = - 1.

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