Exotic Quarks

$qq\overline{qq}$ and $qqqq\bar{q}$

$qq\overline{qq}$

Bound state or ”molecular” state of mesons.

Consider 3 flavored quarks:

$$3 \otimes 3 \otimes \bar{3} \otimes \bar{3} = ?$$

Jaffe – Wilczek model

Di quarks
uu ud dd us ds ss

$$3 \otimes 3 = 6 \otimes \bar{3}$$

6-symmetric
uu dd ss (ud+du)/√ 2
(us+su)/√ 2 (ds+sd)/√ 2
3-antisymmetric
[ud]=(ud-du)/√ 2
[us]=(us-su)/√ 2
[ds]=(ds-sd)/√ 2

Spin, colour and antisymmetric wavefunction gives the 3 antisymmetric most deeply bounded

$$3 \otimes \bar{3} = 1 \otimes 8$$

Ligth nonet of dimesons

	I	Function
Octett	1/2	[ud]([ds]*)
	1/2	[ud]([us]*)
	1/2	[us]([ud]*)
	1/2	[ds]([ud]*)
	1	[us]([ds]*)
	1	[ds]([us]*)
	1	1/√ 2(([us]([us]*)-[ds]([ds]*)))
	0	1/√ 3 (([us]([us]*)+[ds]([ds]*)-2[ud]([ud]*)))
singlett	0	1/√ 3 (([us]([us]*)+[ds]([ds]*)+[ud]([ud]*)))

Experiment

The s-quark mass breaks down the Su(3) algebra.
One expert to isosinglett the ligth [ud]([ud]*)
And the heavy [us]([us]*)+ [ds]([ds]*)

Experimentaly data that fits this picture:
A0(980) corresponds to the isotripplet
F0(600) ligth isosinglett
F0(980) heavy isosinglett

One also expect a κ(800) for the isodublett

Pentaquarks - qqqqq

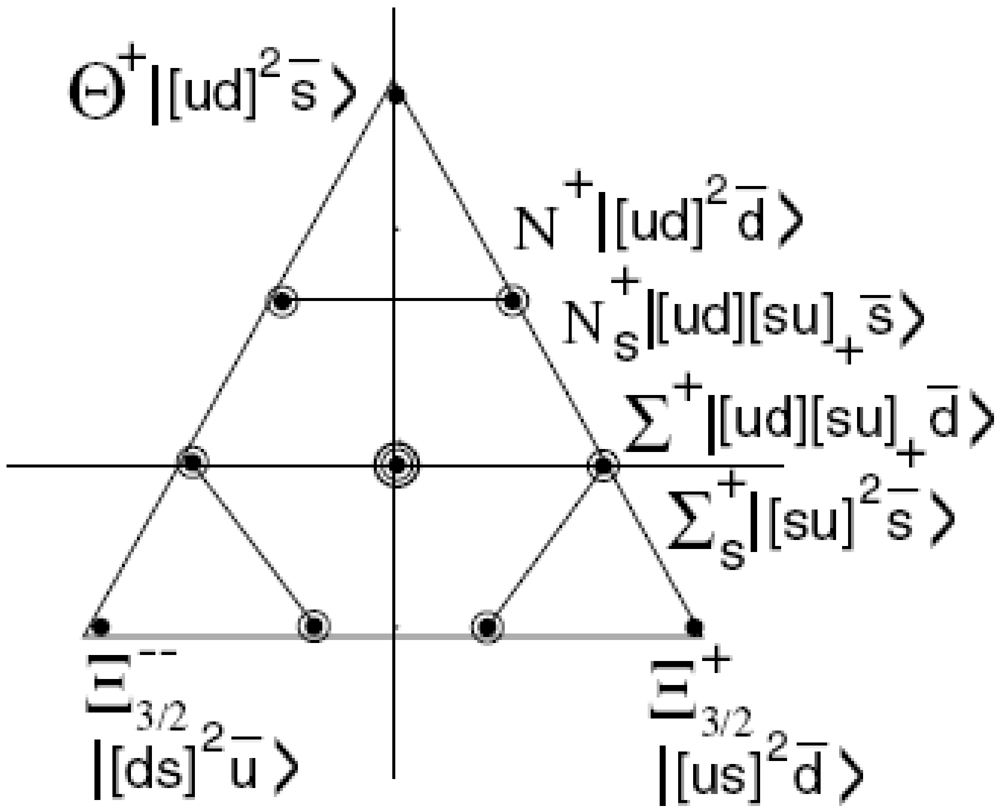
Starting with the qqqq and the diquarkmodel:

$$3 \otimes 3 = 6 \otimes \bar{3}$$

For the ligthest pentaquark (spin ½) the symmetric flavor function should bee used. Combined with three antiquarks it a degenerd octett and decouplett:

$$\bar{6} \otimes 3 = \overline{10} \otimes 8$$

The degenerd pentaquark octett and decuoplett



For spin 3/2 the antisymmetric flavor funtion is used:

$$3 \otimes 3 = 1 \oplus 8$$

And it gives a octett and singlett:

	(Y, I)	I_3	Flavor wave functions	Masses (MeV)
p_8	$(1,\frac{1}{2})$	$\frac{1}{2}$	$[su][ud]_{-}\bar{s}$	1460
n_8		$-\frac{1}{2}$	$[ds][ud]_{-}\bar{s}$	1460
Σ_8^+	(0,1)	1	$[su][ud]_{-}\bar{d}$	1360
Σ_8^0		0	$\frac{1}{\sqrt{2}}([su][ud]_{-}\bar{u} + [ds][ud]_{-}\bar{d})$	1360
Σ_8^-		-1	$[ds][ud]_{-}\bar{u}$	1360
Λ_8	(0,0)	0	$\frac{[ud][su]_{-}\bar{u}+[ds][ud]_{-}\bar{d}-2[su][ds]_{-}\bar{s}}{\sqrt{6}}$	1533
Ξ_8^0	$(-1,\frac{1}{2})$	$\frac{1}{2}$	$[ds][su]_{-}\bar{d}$	1520
Ξ_8^-		$-\frac{1}{2}$	$[ds][su]_{-}\bar{u}$	1520
Λ_1	(0,0)	0	$\frac{[ud][su]_{-}\bar{u}+[ds][ud]_{-}\bar{d}+[su][ds]_{-}\bar{s}}{\sqrt{3}}$	1447