UNIVERSITY OF CALIFORNIA, SAN DIEGO
LA JOLLA, CALIFORNIA

DEPARTMENT OF PHYSICS
SCHOOL OF SCIENCE AND ENGINEERING

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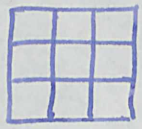
Dear Feza

It was a great joy to get your long letter. Also to hear that you are working actively on the relativistic SU_6 theory in spite of all the slings and arrows of outrageous fortune. I do not understand how anybody can work in the middle of such crises as you describe. You must have an iron will.

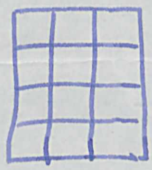
I had Luigi here for a week and enjoyed that very much. In spite of all our conversations and in spite of your Abstract, I remain skeptical concerning the importance of making the SU_6 theory formally relativistic. It is of course possible that a relativistic scheme will lead to new insights, but I find the theory equally interesting even if no strictly relativistic version exists.

Xuong and I have pursued the "molecular" aspects of SU_6 a little further. The possible antisymmetric 3-baryon representations are

$$9240 + 6160 + 11340 + 980$$

of which the 980 =  = [00300]

is presumably the low-lying one. For 4-baryon states one has similarly

$\overline{490}$ =  = [00030].

There is thus a duality between 2-baryon states in 490 and 4-baryon states in $\overline{490}$.

In particular, the $Y = 3$ states in 980 belong to $[T, J] = [\frac{1}{2}, \frac{1}{2}] + [\frac{3}{2}, \frac{3}{2}]$,

so that we predict a $[\pi^+ He_3]$ resonance which probably was the cause of the confusion in the old Abashian Booth and Crowe experiment

$$p + d \to He_3 + \pi^+ + \pi^- .$$

$T = \frac{3}{2}$

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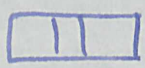
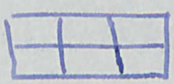
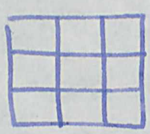
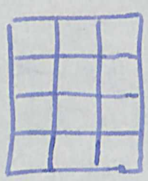
In the 4-baryon representation $\overline{490}$ there is only a pure SU_4 singlet $T = J = 0$ with $Y = 4$, and this is our old friend the α-particle. We predict no resonances of any sort in the system $\pi + He^4$.

If these speculations prove correct, it is significant that the representation

 $56 = (8,2) + (10,4)$

 $490 = (28,1) + (35,3) + (27,1+5) + (\overline{10},3+7) + (10,3) + (8,3+5) + (1,1)$

 $980 = (64,4) + (35+\overline{35},2) + (27,2+4+6) + (10+\overline{10},4) + (8,2+4+6+8) + (1,4+6+10)$

 $\overline{490} = (\overline{28},1) + \cdots$

are the low-lying ones. This certainly supports your model of repulsive quarks held together by an attractive core. In this connection I found an interesting formula in the Feenberg-Wigner article in Reports of Progress in Physics for 1941.

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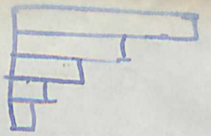
Given any Young tableau 

let N_r be the number of pairs of cells lying in the same row (pairs of symmetrized quarks) and let N_c be the number of pairs of cells lying in the same column (pairs of antisymmetrized quarks). Let Λ be the total number of cells, n the dimension of the group SU_n. Then the first Casimir operator has the value

$$C_2^{(n)} = 2\left[N_r - N_c\right] + \Lambda n - \frac{\Lambda^2}{n}.$$

$C_2^{(6)} = 2[N_r - N_c) + 6\Lambda - \frac{\Lambda^2}{36}$ $\quad \Lambda = 9$ $\quad N_r = N_c$

$C_2^{(6)} = 6 \times 9 - \frac{81}{36} = 54 - \frac{9}{4} = 51\frac{3}{4}$

So the representations 490, 980, $\overline{490}$ etc. are automatically chosen if we assume <u>either</u>

(i) Quarks prefer to be antisymmetrized as much as possible except inside a single baryon, <u>or</u> equivalently (ii) The mass formula for molecules in SU_6 contains a big term proportional to $C_2^{(6)}$ with a positive coefficient.

All this is amusing but not profound.

I look forward to seeing your magnum opus when it is ripe.

Love from all of us to Suha, Yusuf and not least to you.

Yours ever

Freeman (Dyson)

Happy Christmas!