1)

QUARK / GLUON MODEL

Set up Evans wave equations for the quark spinor ϕ_q and the gluon spinor ϕ_g:

$$\left(\Box + kT\right)\phi_q = 0 \quad -(1)$$

and

$$\left(\Box + kT\right)\phi_g = 0. \quad -(2)$$

The spinor ϕ_q may contain up to six components, u, d, s, c, t and b, and the spinor ϕ_g three components, R, W and B. In contrast to the standard model the gluon field is massive, so kT in eqn. (2) is not zero. It is also assumed that the observed quark masses are the result of interaction between the matter field ϕ_q and the radiated field ϕ_g. In the free state each quark u, d, s, c, t and b has exactly the same mass, so the SU(n) symmetry of ϕ_q is exact. However the quark / gluon interaction is strong, so the different masses of u, d, s, c, t and b are due to different types of interaction with the gluon field ϕ_g. Apparent confinement is due to very strong attraction.

2) Now factorize eqns. (1) and (2) into Dirac type eqns:

$$(i\gamma^a \partial_a - m_f c/\hbar)\psi_f = 0 \quad -(3)$$

$$(i\gamma^a \partial_a - m_g c/\hbar)\psi_g = 0. \quad -(4)$$

Here m_f is the mass of the free quark, m_g is the mass of the gluon. In the standard model the mass of the gluon is zero, but in general relativity this is not allowed. The interaction between quark and gluon is given by:

$$(i\hbar\gamma^a(\partial_a - ig\,S_a) - m_f c)\psi_f = 0 \quad -(5)$$

$$(i\hbar\gamma^a(\partial_a + ig\,S_a) - m_g c)\psi_g = 0. \quad -(6)$$

Here g is a coupling parameter analogous to the charge e in electrodynamics, and S_a is the gluon ~~and~~ potential, analogous to A_a in electrodynamics.

The different observed quark masses are due to different coupling parameters g.

From eqn. (5) the result is obtained:

3)

$$kT = \left(\frac{m_f c}{\hbar}\right)^2 + \frac{g m_f c}{\hbar^2} \gamma^a (S_a + S_a^*) + \frac{g^2}{\hbar^2} S_a^* S^a \quad -(7)$$

and since g is different for each quark, we obtain different quark masses as observed:

$$kT = \left(\frac{m_f c}{\hbar}\right)^2_{\text{effective}} \quad -(8)$$

$$= \text{l.h.s. of eqn. (7).}$$

More generally there is also a gravitational interaction between quarks, which is described by the kT term.

So this is a simple way of saving the quark model within the unified field theory, using exact $SU(n)$ symmetries for ϕ_f and an exact $SU(3)$ symmetry for ϕ_g.

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4) In more detail:

$$\left(\Box + \kappa T \right) \begin{bmatrix} u \\ d \\ s \\ c \\ t \\ b \end{bmatrix} = 0 \quad \text{— (1a)}$$

$$\left(\Box + \kappa T \right) \begin{bmatrix} R \\ W \\ B \end{bmatrix} = 0 \quad \text{— (2a)}$$

so the interaction between u and d for example is mediated by gluons whose coupling parameters result in an observed mass for u which is different from the observed mass for d. In the free state the masses of u, d, s, c, t and b are exactly the same, so the spinor in eqn (1a) can be set up exactly.

In general the quark / gluon interaction is very complicated, resulting in the observed quark masses and elementary particle masses. It is not surprising therefore that there appear to be so many elementary particles.