The relation of colour charge to electric charge


\[
\left(\frac{E}{c}\right)^2 - P^2 - Q^2 - R^2 - \left(mc\right)^2 I = \left(E/c + rJP + gKQ + bLR + mcsM\right)\left(E/c - rJP - gKQ - bLR - mcsM\right)
\]

This is true for all \(3! = 6\) permutations of J,K,L where r,g,b and s equal +1 or -1. The set \{I, J, K, L\} forms the basis of a 4-dimensional real vector space.

For leptons r,g,b all equal -1 and for quarks two of r,g,b are equal to +1 and the third equals -1. The signs are all negated for anti-particles as in the equation above.

The 3 cyclic permutations JKL = LJK = KLJ count the number of plus signs (say) for r,g,b which is 0 for leptons and 2 for quarks.

The 3 cyclic permutations LKJ = KJL = JKL count the number of minus signs (say) for r,g,b which is 3 for leptons and 1 for quarks.

For material particles r,g,b all equal -1 which is always true for leptons and true for three distinct quarks with r,g,b equal to -1 separately or a quark and an appropriate anti-quark.

Similarly, for material gauge bosons, the 3 cyclic permutations of JKL squared (which all equal -I) count the number of plus signs (say) for r,g,b which is 0 for the Z boson and the 3 cyclic permutations of LKJ squared (which all equal -I) count the number of minus signs (say) for r,g,b which is 3 for the W boson.

The photon, having zero rest mass, carries no electric charge.

The 6 permutations of JKL raised to power zero (which all equal I) present (say) a material particle which carries no electric charge.

The 6 permutations of JKL raised to power four (which all equal I) present (say) a particle with zero rest mass which carries no electric charge.

A charged particle moving in an electromagnetic field will have E, P, Q, R modified to \(E, P, Q, R\) by the scalar and vector potentials of the field where \(E, P, Q, R\) do not commute with each other. Let JKL = N, then:

\[
\left(\frac{E}{c}\right)^2 - P^2 - Q^2 - R^2 - \left(mc\right)^2 I = \left(E/c + rJP + gKQ + bLR + mcsM\right)\left(E/c - rJP - gKQ - bLR - mcsM\right)
\]

\[
= \left(\frac{E}{c}\right)^2 - P^2 - Q^2 - R^2 - \left(mc\right)^2 I
- \left[rJ \left(\frac{E}{c}P - PE\right) + gK \left(EQ - QE\right) + bL \left(ER - RE\right)\right]/c
- gbKL \left(QR - RQ\right) - brLJ \left(RP - PR\right) - rgJK \left(PQ - QP\right)
\]

\[
\left(E/c\right)^2 - P^2 - Q^2 - R^2 - \left(mc\right)^2 I
- \left[rJ \left(\frac{E}{c}P - PE\right) + gK \left(EQ - QE\right) + bL \left(ER - RE\right)\right]/c
+ N\left[rJ \left(QR - RQ\right) + gK \left(RP - PR\right) + bL \left(PQ - QP\right)\right]
\]