Geoff's Paper PhL 6.11.08

He seems to be playing with group theory in an attempt to support S-matrix theory, somehow. The paper spends most of it's time reviewing another paper known as Reference 2. My first reaction is that the paper is a hoax that seems real only because the author makes no spelling or grammatical errors.

The term **preon** refers to sub-quark objects or alternatives to quarks that are supposed to provide a simple theory of particles. Wiki suggests that preons are not very well accepted by the physics "community", no surprise there.

A **Fock space** is the particle Hilbert space we always use. A Fock space vector might be $|n_1, n_2, ...>$ where the n_i are the numbers of each non-interacting particles . Think of a direct product of single particle states.

The **Lorentz Group** (without reflections) has irreducible representations usually indicated as **(m,n)**. Parity takes this and turns it into (n,m). The Dirac electron is (1/2,0) x (0,1/2) for this reason. The generators of the Lorentz group Lie algebra are the 6 distinct objects $M^{\mu\nu}$ and we can find in these the three rotation generators J_i and the three boost generators K_i. In general, the Casimirs here are associated with "spin".

The **Poincare group** takes the 6 generators just mentioned, the $M^{\mu\nu}$ of the Lorentz group, and adds to them the four generators P^μ of translations in space and time to get the 10 parameter Poincare group. Here is the familiar Lie algebra of the Poincare group:

The **Poincaré algebra** is the Lie algebra of the Poincaré group. In component form, the Poincaré algebra is given by the commutation relations:

- $[P_\mu, P_\nu] = 0$
- $[M_{\mu\nu}, P_\rho] = \eta_{\mu\rho} P_\nu - \eta_{\nu\rho} P_\mu$
- $[M_{\mu\nu}, M_{\rho\sigma}] = \eta_{\mu\rho} M_{\nu\sigma} - \eta_{\mu\sigma} M_{\nu\rho} - \eta_{\nu\rho} M_{\mu\sigma} + \eta_{\nu\sigma} M_{\mu\rho}$

where P is the generator of translation, M is the generator of Lorentz transformations and η is the Minkowski metric (see sign convention).

One Casimir of the Poincare group is $P_\mu P^\mu = m^2$, **mass** (squared). Wigner is associated with this group theory stuff.

The phrase "discrete quantum cosmology" seems to be a Geoff term only.

The names Gelfand and Naimark are associated with a fancy theorem in the world of algebra involving rings and such, with emphasis on "C* algebras".

I suspect that Reference 2 is an earlier paper that Geoff wrote and which I found on line, has a few more equations.

The term "left Lorentz group" relates to combining groups to somehow represent physics. Here is some text from a paper

This suggests a first possible model, where we take two of the toy models considered in the previous section, with opposite chiralities, and join them to construct a semirealistic model of gravi-weak unification where fermions can have masses. Because infinitesimal Lorentz transformations are identified in one case with the M_j^+ generators and in the other case with M_j^-, we have to assume independent Lorentz groups for the two chiralities. Thus we start from a group $SO(4,\mathbb{C})_L \times SO(4,\mathbb{C})_R$ where the left graviweak group $SO(4,\mathbb{C})_L$ contains the left-Lorentz group $SL(2,\mathbb{C})_L$ and the weak gauge group $SU(2)_L$, while the right-graviweak group $SO(4,\mathbb{C})_R$ contains the right-Lorentz group $SL(2,\mathbb{C})_R$ and the internal gauge group $SU(2)_R$. In the low energy broken phase the physical Lorentz group will have to be identified with the diagonal subgroup of $SL(2,\mathbb{C})_L \times SL(2,\mathbb{C})_R$.

Here we need left and right groups because we need two "chiralities". Typical gobbledygook.

Milne died in 1950. " From 1932 he also worked on the problem of the "expanding universe" and in *Relativity, Gravitation, and World-Structure* (1935), proposed an alternative to Albert Einstein's general relativity theory. His later work, concerned with the interior structure of stars, aroused controversy. Milne was president of the Royal Astronomical Society, 1943–1945."

So doubtless an interesting fellow. He wrote a book in 1935 called

Gravitation, Cosmology and World Structure
A. E. Milne, 1935
Oxford University Press

in which he built a model for the universe consistent with special relativity.