

Part II

Chapter 11

$r < r_H$ Application implies Cosmology

9.1 $r < r_H$ Application of Equation 1.9 Using Sections 3.4 and 9.2 Results

Here we multiply section 1.3 chain rule result $p\psi = -i\hbar\partial\psi/\partial x$ by ψ^* and integrate over volume to define the expectation value:

$$\int \psi^* p_x \psi dV \equiv \langle p_x \rangle = \langle p, t | p_x | p, t \rangle \text{ of } p_x. \quad (11.1)$$

In general for any QM operator A we write $\langle A \rangle = \langle a, t | A | a, t \rangle$. Let A be a constant in time (from Merzbacher, pp.597). Taking the time derivative then:

$$\begin{aligned} i\hbar \frac{d}{dt} \langle a, t | A | a, t \rangle &= i\hbar \frac{d}{dt} \langle \Psi(t), A\Psi(t) \rangle = \left(\Psi(t), A i\hbar \frac{\partial}{\partial t} \Psi(t) \right) - \left(i\hbar \frac{\partial}{\partial t} \Psi(t), A\Psi(t) \right) \\ &= (\Psi(t), AH\Psi(t)) - (\Psi(t), HA\Psi(t)) = i\hbar \frac{d}{dt} \langle A \rangle = \langle AH - HA \rangle \equiv [H, A] \end{aligned}$$

In the above equation let $A = \alpha$, from equation 1.9 Dirac equation Hamiltonian H, $[H, \alpha] = i\hbar d\alpha/dt$ (Merzbacher, pp.597).

The second and first integral solutions to the Heisenberg equations of motion (i.e., above $[H, \alpha] = i\hbar d\alpha/dt$) is:

$$\begin{aligned} \mathbf{r} &= \mathbf{r}(0) + c^2 \mathbf{p}/H + (\hbar c/2iH) [e^{(i2Ht/\hbar)} - 1] (\alpha(0) - c\mathbf{p}/H) \\ \mathbf{v}(t)/c &= c\mathbf{p}/H + e^{(i2Ht/\hbar)} (\alpha(0) - c\mathbf{p}/H) \end{aligned} \quad (11.2)$$

Alternatively the analyticity of our Z plane (in sect.1.1) implies the Laplace equation and thereby this wave equation Heisenberg equations type of motion result. Use equation 1.9a and 1.9 and sect1.2 chain rule to get 4D massless and nonzero mass D'Alembertian on A_μ . In the QM operator formulation of R_{ij} the equation 9.2 zitterbewegung oscillation makes GR **ungauged** since the harmonic gauge in $R_{ij}=0$ can be replaced with the zitterbewegung oscillation of equation 9.2 as in section 25.7. Also taking the bilinear operator expectation values of equation 9.2 (and the rest of the $R_{ij}=0$ equations) gives us the Maxwell equations in the weak field approximation (section 25.4) with the excess above coulomb potential giving the lamb shift after energy expectation values are taken for the $\psi_{2,0,0}$ eigenstates. After taking expectation values $\psi^* \psi = e^{-i\omega t} \psi^*(r, \theta, \phi) e^{i\omega t} \psi(r, \theta, \phi) = |\psi(r, \theta, \phi)|^2$ the time dependence of the zitterbewegung goes away, becomes random for the observer, as in the standard QM (but with our Maxwell equations 17.2 and Ungauged GR of section 12.3 still holding). Note also from equations 18.1, 18.2 that:

$$(dt/ds) \sqrt{\kappa_{00}} = 1/\sqrt{\kappa_{00}} \quad (11.3)$$

is where the energy was in the old Dirac equation. Thus $\langle H \rangle = E = 1/\sqrt{g_{00}}$ (with $g_{00} = 1 - r_H/r$) the imaginary part of ω *outside* ($r > r_H$) becomes the real part *inside* ($r < r_H$) the horizon since the square root of a negative number (here g_{00}) is imaginary. Thus $\omega \rightarrow i\omega$ and so the above complex conjugation does not occur and so there is "observed" motion (for $r < r_H$) with $e^{\omega t} - 1$ below in equation 1.9. Taking $\omega \rightarrow i\omega$ and the real part of r in equation 9.2 (setting $r(0)=0, p=0$) gives us the physics inside:

$$[(r(0) + c^2 \mathbf{p}/H + (\hbar c/2iH) [e^{(i2Ht/\hbar)} - 1] (\alpha - c\mathbf{p}/H)] = (\hbar c/2iH) [e^{(i2Ht/\hbar)} - 1] \alpha$$

Thus with above $\omega \rightarrow i\omega$ (in eq.9.2) as we go inside the horizon then this equals

$$= (c/i2\omega) [e^{(i2\omega t)} - 1] \alpha = [(c/2\omega) [e^{2\omega t} - 1] \alpha = r \quad (11.4)$$

with the e^{kt} dependence of r consistent with equation 1.14.

Recall from the above we can use the quantum mechanical

Recall we used the quantum mechanical $[A,H]|a,t\rangle=(\partial A/\partial t)|a,t\rangle$ Heisenberg equations of motion. Note the commutation relation and so second derivatives (H relativistic Dirac eq. iteration 2nd derivative) taken twice and subtracted. $(\partial A/\partial t)|a,t\rangle$ For example if A is momentum $p_x = -i\partial/\partial x$.H= $\partial/\partial t$ then $[A,H]|a,t\rangle=(\partial A/\partial t)|a,t\rangle=(\partial/\partial t)(\partial/\partial x)-$

$(\partial/\partial x)(\partial/\partial t)=p\dot{}$. But $\sqrt{\kappa_{\mu\mu}}$ is in the kinetic term in in the new pde so we must use the equations of motion for a curved space. In this ordinary QM case I found for $r<r_H$ that $r=r_0e^{wt}$ with merely perturbative $t'=t\sqrt{\kappa_{00}}$
 But using the C^2 of properties of operator A (C^2 means continuous first and second derivatives) in a curved space time we can generalize the Heisenberg equations of motion to curved space **non**perturbatively with: $(A_{i,jk}A_{i,kj})|a,t\rangle=(R^m_{ijk}A_m)|a,t\rangle$ where R^a_{bcd} is the Riemann Christoffel Tensor of the Second Kind and $\kappa_{ab}\rightarrow g_{ab}$. Note all we have done here is to identify A_k as a quantum vector operator, which it should be. Note again the second derivatives are taken twice and subtracted looking a lot like a generalization of the above Heisenberg equations of motion commutation relations. Note also R^m_{ijk} could even be taken as an eigenvalue of pdot since it is zero when the space is flat, where force is zero.. These generalized Heisenberg equations of motion reduce to the above QM form in the limit $\omega\rightarrow 0$, outside the region where angular velocity is very high in the expansion (now it is only one part in 10^5).

ω was much larger earlier because of angular momentum conservation with also initial condition $\epsilon=1$ at $r=r_{bb}$ in $\kappa_{00}=\sqrt{(1\pm\epsilon)}$, the singularity. We can then contract this $R^m_{ijk}A_m|a,t\rangle$ tensor to get the Ricci tensor R_{ij} (here $R_{ij} = R^m_{ijm}$).

Recall the ambient metric at $r=$ infinity is not flat so in eq. 4.11 we have $\mu=\lambda+C$ and the C is not zero as $r\rightarrow\infty$, and so $R_{ij}\neq 0$. Also from our fractal theory for the oscillatory outside observer $\mu\rightarrow i\mu$ in e^μ at $r=\infty$. Also $R_{11}=R_{rr}=0$. Thus $R_{22}=e^{-\lambda}[1+1/2 r(\mu'-1)]-1\neq 0$ (eq.4.6) we get for imaginary μ in e^μ that for imaginary e^μ that $R_{22}=-isun\mu$. Recall that $isinh\mu=sini\mu$. So inside r_{M+1} $i\mu\rightarrow\mu$:

$$R_{22}=\sinh\mu$$

Rewriting this equation we get:

$$e^\mu d\mu/(1-\cosh\mu)=dr/r \tag{11.5}$$

Integrating from $\epsilon=1$ to the present ϵ value we get: $\ln(r_{M+1}/r_{bb})+2=[1/(e^\mu-1)-\ln[e^\mu-1]]2$

Recall object B is close by so we must include the small Kerr metric oblation term $a\cos\theta=.9602$ in $r_{bb}^2 = r^2+a^2\cos^2\theta$ that gives an added $\Delta\epsilon$ when it is inserted.

So substituting into $\ln(r_{M+1}/r_{bb})+2=[1/(e^\mu-1)-\ln[e^\mu-1]]2$ using the r_{bb} value= $\sim 30M$ miles to the present $r_{M+1}= 13.7X10^9LY$ value for the case with and without the oblation term gives $\ln(r_{M+1}/r_{bb})=36.06$ and current value $\epsilon=.06$, and $\Delta\epsilon=.00058$ from the oblation term. Note that all the 10^{80} baryons at r_H ($\sim 10^{-15}m$)separation were packed into this $(4\pi/3)r_{bb}^3$ volume and so not violating baryon conservation since from the fractal theory these objects originated from a previous collapse.

Equation 11.5 is our generalized Heisenberg equations for a spherical expansion.

Chapter 12

12.1 $r<r_H e^{\omega t} -1$ Coordinate transformation of $Z_{\mu\nu}$: Gravity Derived

Summary:

Fractal Scale Content Generation From Generalized Heisenberg Equations of Motion

Specifically C in equation 1 applies to “observable” measurement error. But from the two “observable” fractal scales (N,N+1) we can infer the existence of a 3rd next smaller fractal N-1 scale using the generalized Heisenberg equations of motion giving us $(\partial x_{0N})/(\partial x_{0N+1}) (\partial x_{0N})/(\partial x_{0N+1}) T_{00N} - T_{00N} = T_{00N-1}$ which is equation 12.4 below. Thus we can derive the content of the rest of the fractal scales by this process.

Derivation of Terms in Equation 12.4

The Dirac equation object has a radial center of mass of its zitterbewegung. That radius expands due to the ambient metric expansion of the next larger nth fractal scale. We define a Z_{00} E&M energy-momentum tensor 00 component replacement for the G_{00} Einstein tensor 00 component. The energy is associated with the Coulomb force here, not the gravitational force. The dyadic radial coordinate transformation of Z_{ij} associated with the expansion creates a new z_{00} . Thus transform the dyadic Z_{00} to the coordinate system commoving with the radial coordinate expansion and get $Z_{00} \rightarrow Z_{00} + z_{00}$. The new z_{00} turns out to be the gravitational source with the G in it. The mass is that of the electron so we can then calculate the value of the gravitational constant G. From Ch.1 the object dr as see in the observer primed nonmoving frame is: $dr = \sqrt{\kappa_r} dr' = \sqrt{(1/(1+2\varepsilon))} dr' = dr'/(1+\varepsilon)$. $1/\sqrt{(1+.06)} = 1.0654$. Also using $S_{1/2}$ state of equation 2.6. $\varepsilon = .06006 = m_\mu + m_e$

From equation 11.4 and $e^{i\omega t}$ oscillation in equation 11.4. $\omega = 2c/\lambda$ so that one half of λ equals the actual Compton wavelength in the exponent of equation 11.4. Divide the Compton wavelength $2\pi r_M$ by 2π to get the radius r_M so that $r_M = \lambda_M/(2(2\pi)) = h/(2m_e c 2\pi) = 6.626 \times 10^{-34} / (9.1094 \times 10^{-31} \times 2.9979 \times 10^8 \times 4\pi) = 1.9308 \times 10^{-13}$

From the previous chapter the Heisenberg equations of motion give $e^{i\omega t}$ oscillation (zitterbewegung) both for velocity and position so we use the classical harmonic oscillator probability distribution of radial center of mass of the zitterbewegung cosine oscillation lobe. So the COM (radial) is: $x_{cm} = (\sum x_m)/M = \frac{\int \int \int r^3 \cos r \sin \theta d\theta d\phi dr}{(\int \int \int r^2 \cos r \sin \theta d\theta d\phi dr)} = 1.036$. As a fraction of half a wavelength (so π phase) r_m we have $1.036/\pi = 1/3.0334$ (12.1)

Take $H_t = 13.74 \times 10^9$ years $= 1/2.306 \times 10^{-18}$ /s. Consistent with the old definition of the 0-0 component of the old gravity energy momentum tensor G_{00} we define our single $S_{1/2}$ state particle (E&M) energy momentum tensor 0-0 component From eq.4.3 Z_{00} and 2.6a we have: $c^2 Z_{00}/8\pi \varepsilon = 0.06$, $\varepsilon = 1/2 \sqrt{\alpha}$ = square root of charge.

$Z_{00}/8\pi = e^2/2(1+\varepsilon)m_p c^2 = 8.9875 \times 10^9 (1.6 \times 10^{-19})^2 / (2c^2(1+\varepsilon)1.6726 \times 10^{-27}) = 0.065048/c^2$

Also from equation 1.12 the ambient metric expansion component Δr is: Also from

$$\text{eq.1.12 } \Delta r = r_A (e^{\omega t} - 1) \quad (12.2)$$

To find the physical effects of the equation 11.4 expansion *we must* do a dyadic radial coordinate transformation (equation 11.4) on this single charge horizon (given numerical value of the Hubble constant $H_t = 13.74$ bLY in determining its rate) in eq.4.2. In doing the time derivatives we take the ω as a constant in the linear t limit:

$$\frac{\partial x^\alpha}{\partial x'^\mu} \frac{\partial x^\beta}{\partial x'^\nu} Z_{\alpha\beta} = Z'_{\mu\nu} \quad \text{with in particular } Z_{00} \rightarrow Z'_{00} \equiv Z_{00} + z_{00} \quad (12.3)$$

After doing this Z'_{00} calculation the resulting (small) z_{00} is set equal to the Einstein tensor gravity source ansatz $G_{00} = 8\pi G m_e/c^2$ for this *single* charge source m_e allowing us to solve for the value of the Newtonian gravitational constant G here as well. We have then derived gravity for **all** mass since this single charged m_e electron vacuum source composes all mass on this deepest level as we noted in the section 4.2 discussion of the

equivalence principle. Note Lorentz transformation similarities in section 2.3 between $r=r_0+\Delta r$ and $ct=ct_0+c\Delta t$ using $D\sqrt{1-v^2/c^2} \approx D(1-\Delta)$ for $v \ll c$ with just a sign difference (in $1-\Delta$, + for time) between the time interval and displacement D interval transformations. Also the t in equation 10.2 and therefore 12.3 is for a light cone coordinate system (we are traveling near the speed of light relative to $t=0$ point of origin) so $c^2dt^2=dr^2$ and so equation 11.4 does double duty as a $r=ct$ time x_0 coordinate. Also note we are trying to find G_{00} (our ansatz) and we have a large Z_{00} . Also with $Z_{rr} \ll Z_{00}$ we needn't incorporate Z_{rr} . Note from the derivative of $e^{\omega t}-1$ (from equation 11.4) we have slope $=(e^{\omega t}-1)/H_t = \omega e^{\omega t}$. Also from equation 2.4a we have $\delta(r) = \delta(r_0(e^{\omega t}-1)) = (1/(e^{\omega t}-1))\delta(r_0)$. Plugging values of equation 12.1 and 12.2 and the resulting equation 10.2 into equation 12.3 we have in $S_{1/2}$ state in equation 4.3:

$$\frac{8\pi e^2}{2(1+\varepsilon)m_p c^2} \delta(r) = Z_{00} = R_{00} - \frac{1}{2} g_{00} R, \quad \frac{\partial x^0}{\partial X^\alpha} \frac{\partial x^0}{\partial X^\beta} Z_{\alpha\beta} = Z'_{00} = Z_{00} + z_{00} \approx (12.4)$$

$$\frac{\partial x^0}{\partial [x^0 - \Delta r]} \frac{\partial x^0}{\partial [x^0 - \Delta r]} Z_{00} = \frac{\partial x^0}{\partial \left[x^0 - \frac{r_M}{3.03(1+\varepsilon)} [e^{\omega t} - 1] \right]} \frac{\partial x^0}{\partial \left[x^0 - \frac{r_M}{3.03(1+\varepsilon)} [e^{\omega t} - 1] \right]} Z_{00} = Z'_{00} =$$

$$\left[\frac{1}{1 - \frac{r_M \omega}{3.03c(1+\varepsilon)} e^{\omega t}} \right]^2 \frac{8\pi e^2}{2(1+\varepsilon)m_p c^2} \delta(r) \equiv \left(\frac{8\pi e^2}{2(1+\varepsilon)m_p c^2} \delta(r) + 8\pi G \left(\frac{m_e}{c^2} \right) \delta(r) \right)$$

So setting the perturbation z_{00} element equal to the ansatz and solving for G :

$$2 \left(\frac{e^2}{2(1+\varepsilon)m_p} \right) \left(\frac{r_M}{3.03m_e c(1+\varepsilon)} \right) \omega e^{\omega t} =$$

$$\left(2 \left(\frac{e^2}{2(1+\varepsilon)m_p} \right) \left(\frac{r_M}{3.03m_e c(1+\varepsilon)} \right) ([e^{\omega t} - 1] / H_t) \right) \delta(r) =$$

$$= 2 \left(\frac{e^2}{2(1+\varepsilon)m_p} \right) \left(\frac{r_M}{cm_e 3.03(1+\varepsilon)} \right) ([e^{\omega t} - 1] \delta(r_0) / ([e^{\omega t} - 1] H_t)) = G \delta(r_0)$$

Make the cancellations and get:

$$2(.065048) [(1.9308 \times 10^{-13} / (3 \times 10^8 \times 9.11 \times 10^{-31} \times 3.0334(1+.0654))] (2.306 \times 10^{-18}) =$$

$$= 2(.065048)(2.2 \times 10^8)(2.306 \times 10^{-18}) = 6.674 \times 10^{-11} \text{ Nm}^2/\text{kg}^2 \equiv G \quad (12.5)$$

from plugging in all the quantities in equation 12.4. This new z_{00} term is the classical $8\pi G\rho/c^2 = G_{00}$ source for the Einstein's equations and we have then **derived gravity** and incidentally also derived the value of the Newtonian gravitational constant since from our postulate the m_e mass (our "single" postulated source) is the *only* contribution to the Z_{00} term. Note Dirac equation implies +E and -E solutions for -e and +e respectively and so in equation 12.5 we have $e^2 = ee = q_1 X q_2$ in eq.12.5. So when G is put into the Force law $Gm_1 m_2 / r^2$ there is an *additional* $m_1 X m_2$ thus the resultant force is proportional to $Gm_1 m_2$

$= (q_1 X q_2) m_1 m_2$ which is always positive since the paired negatives always are positive and so the gravitational force is always attractive.

To summarize we have then just done a coordinate transformation to the moving frame to find the contributing fields associated with the moving frame. Analogously one does a coordinate transformation to the charge comoving frame to show that current carrying wires have a magnetic field, also a 'new' force, around them. Also note that in the second derivative of eq.11.1 $d^2\mathbf{r}/dt^2 = \mathbf{r}_o \omega^2 e^{\omega t} = \mathbf{radial\ acceleration}$. Thus in equations 10.2 and 12.5 (originating in section 1.4 and thus in equation 1.2b) **we have a simple account of the cosmological radial acceleration expansion (discovered recently) so we don't need any theoretical constructs such as 'dark energy' to account for it.**

If r_o is the radius of the universe then $r_o \omega^2 e^{\omega t} \approx 10^{-10} \text{m/sec}^2 = a_M$ is the acceleration of all objects around us relative to a inertial reference frame and comprises a accelerating frame of reference. If we make it an inertial frame by adding gravitational perturbation we still have this accelerating expansion and so on. Thus in gravitational perturbations $n a_M = a$ where n is an integer.

Note below equation 12.5 above that $t = 13.8 \times 10^9$ years and use the standard method to translate this time into a Hubble constant. Thus in the standard method this time translates into light years which are $13.8 \times 10^9 / 3.26 = 4.264 \times 10^9$ parsecs = 4.264×10^3 megaparsecs assuming speed c the whole time. So $3 \times 10^5 \text{km/sec} / 4.264 \times 10^3 \text{ megaparsecs} = 70.3 \text{km/sec/megaparsec} = \text{Hubble's constant for this theory.}$

12.2 Cosmological Constant In This Formulation

In equation 4.6 r_H/r term is small for $r \gg r_H$ (far away from one of these particles) and so is nearly flat space since ϵ and $\Delta\epsilon$ are small and nearly constant. Thus equation 4.5 can be redone in the form of a Robertson Walker homogenous and isotropic space time. Given (from Sean Carroll) the approximation of a (homogenous and isotropic) Robertson Walker form of the metric we find that:

$$\frac{a''}{a} = -\frac{4\pi G}{3}(\rho + 3p) + \frac{\Lambda}{3}$$

$\Lambda = \text{cosmological constant}$, $p = \text{pressure}$, $\rho = \text{density}$, $a = 1/(1+z)$ where z is the red shift and 'a' the scale factor. G the Newtonian gravitational constant and a'' the second time derivative here using cdt in the derivative numerator. We take pressure $= p = 0$ since there is no thermodynamic pressure on the matter in this model; the matter is commoving with the expanding inertial frame to get the a'' contribution. The usual 10 times one proton per meter cubed density contribution for ρ gives it a contribution to the cosmological constant of $4.7 \times 10^{-36} / \text{s}^2$.

Since from equation 12.1 $a = a_o(e^{\omega t} - 1)$ then $a'' = (\omega^2/c^2) \sinh \omega t = a(\Lambda/3) = (\Lambda/3) \sinh \omega t$ and there results:

$$\Lambda = 3(\omega^2/c^2)$$

From section 12.1 above then $\omega = 1.99 \times 10^{-18}$ with 1 year = 3.15576×10^7 seconds, also $c = 3 \times 10^8$ m/s. So:

$$\Lambda = 3(\omega^2/c^2) = 1.32 \times 10^{-52} / \text{m}^2, \text{ which is our calculated value of the cosmological constant.}$$

Alternatively we could use $1/\text{s}^2$ units and so multiply this result by c^2 to obtain:

$$1.19 \times 10^{-35} / \text{s}^2. \text{ Add to that the above matter (i.e., } \rho) \text{ contributions to get } \Lambda = 1.658 \times 10^{-35} / \text{s}^2 \text{ contribution.}$$

12.3 Ungauged Theory

Solve the Heisenberg equations of motion $[H, r] = i\hbar dr/dt$ using the Hamiltonian H of equation 1.9 and get $r = (r(0) + c2p/H + (\hbar c/2iH)[e^{(i2Ht/\hbar)} - 1](\alpha - cp/H))$. (9.2). Recall the detailed calculations in chapter 10 above. In the QM operator formulation of $R_{ij}A_j|a, t\rangle$ in section 4.3 the zitterbewegung (harmonic oscillation) coordinate system of equation 1.9 has a $\square^2 g_{ii} = 0$ inside the harmonic (gauge) component (see also section 25.7) of R_{ij} . The phase in each sinusoidal zitterbewegung component is unknown so we sum over all such k components to get the zitterbewegung cloud. Thus $\sum_k R_{ij}A_j|\psi\rangle = \sum_k [R_{ij}(\text{nonharmonic terms}) + \square^2 g_{ii}]A_j|\psi\rangle = \sum_k [R_{ij}(\text{nonharmonic terms}) + 0]A_j|\psi\rangle$. So $\langle\psi|\sum_k R_{ij}A_j|\psi\rangle = \langle\psi|\sum_k R_{ij}(\text{nonharmonic terms}) + 0]A_j|\psi\rangle$ with ungauged GR harmonic term still being zero. After taking probability density expectation values $\psi^*\psi = e^{-i\omega t}\psi^*(r, \theta, \phi)e^{i\omega t}\psi(r, \theta, \phi) = |\psi(r, \theta, \phi)|^2$ the time dependence of the zitterbewegung indeed conjugates out, becomes random for the observer, as in the standard QM but with our Maxwell equations and UNgauged GR remaining in the geometry component in front of the QM operator A in section 4.3. Alternatively the lack of phase information in the zitterbewegung sine wave coming out of equation 10.1 give this random motion cloud result. However from equation 10.2 we see that for the inside observer $r < r_H$ the $\omega \rightarrow i\omega$ and so the above complex conjugation does not occur and so there is “observed” motion (for $r < r_H$) that does move with $1 + \sinh\omega t$ in equation 10.2. Note that there are then no ‘gauges’ in this theory in any case.

Note in chapter 1 that equations 1.5 are used in section 16.2 to derive Maxwell equations in 4 vector potential form (A_x, A_y, A_z, V) . Thus this is the physics of potentials (A, V) that cannot be added to or subtracted from which is also consistent with this being an UNgauged field theory (can't add stuff to 'A' there either). In any case for the Aharonov-Bohm effect there is a lingering nonzero vector potential 'A' outside the B flux tube causing the neutrons moving in those opposite directions around the flux tube to interfere in an anomalous way on the other side. But in the standard theory it is only B that matters and there is very little or no B field in that region. In fact Aharonov-Bohm's successful minimal interaction idea totally neglects the residual B contribution and just adds a plus or minus KA_V to the wave number in the phase thereby giving this neutron interference result. Thus you cannot add nontrivial gauge partial derivatives to the 'A' they chose since the phase difference is set by the numerical value of 'A'. Anyway, in the context of this theory at least, the Aharonov Bohm effect is further evidence of the UNgauged aspect of the physics of this new pde. Note also section 21.3 on the covariant *gaugeless* quantization of the electromagnetic field. See 25.6 and 25.9 for more *ungauged* theoretical physics discussion. In any case we have then shown that gauges are not needed anywhere in theoretical physics.

References

Merzbacher, *Quantum Mechanics*, 2nd Ed, Wiley, pp.597

Chapter 13

r<r_H Application: Rotational Selfsimilarity With pde Spin: CP violation

13.1 Fractal selfsimilar spin

The fractal selfsimilarity with the spin in the (new) Dirac equation 1.9 implies a cosmological ambient metric (Kerr metric) rotation as well as in section 2.1. Thus there will be $2ds, ds_\phi$ rotation metric cross terms with the dt (without the square) implying time T reversal nonconservation and therefore CP *non*conservation since CPT is always conserved. We thereby derive CP nonconservation from first principles. This adds another matrix element of magnitude $\sim 1/3800$ (section 16.3) for Kaon decays thus adding off diagonal elements to the CKM matrix.

Or for Kerr rotator use

$$ds^2 = \rho^2 \left(\frac{dr^2}{\Delta} + d\theta^2 \right) + (r^2 + a^2) \sin^2 \theta d\phi^2 - c^2 dt^2 + \frac{2mr}{\rho^2} (a \sin^2 \theta d\theta - c dt)^2, \quad (13.1)$$

$$\rho^2(r, \theta) \equiv r^2 + a^2 \cos^2 \theta; \quad \Delta(r) \equiv r^2 - 2mr + a^2, \text{ or}$$

$$ds^2 = dr^2 + dt^2 + 2dtdr + ..$$

In a polarized state ($\theta = 0^\circ, 180^\circ$) in 25.3, 25.25 the off diagonal elements are proportional to $\phi = (\phi + c)e^{-C}$. Thus if the charge e is conjugated (C , e changes sign), if dr changes sign (P , parity changes sign) and dt is reversed (t reversal) then the ds quantity on the left side of equation 1.3 is invariant. But if dr (P) changes sign by itself, or even e and P together (CP) change sign then ds is not invariant and this explains, in terms of our fractal picture, why CP and P are not conserved generally. P becomes maximally nonconserved in weak decays as we saw in above. The degree to which this nonconservation occurs depends on the “ a ” (in equation 23.1) transfer <final lal initial> (equation 3.2) which itself depends on the how much momentum and energy is transferred from the S_{M+2} to the S_{M+1} fractal scales as we saw in this section. Recall chapter 5 alternative derivation of that new (dirac) equation pde (eq.1.9) **linearization of the Klein Gordon equation** ($c=1, \hbar=1, m=1$, eq.5.5):

$$\left(-\alpha_1 i \frac{\partial}{\partial x_1} - \alpha_2 i \frac{\partial}{\partial x_2} - \alpha_3 i \frac{\partial}{\partial x_3} + \beta \right) \left(-\alpha_1 i \frac{\partial}{\partial x_1} - \alpha_2 i \frac{\partial}{\partial x_2} - \alpha_3 i \frac{\partial}{\partial x_3} + \beta \right) = \quad (13.2)$$

$$-\alpha_1^2 \frac{\partial^2}{\partial x_1^2} - \alpha_2^2 \frac{\partial^2}{\partial x_2^2} - \alpha_3^2 \frac{\partial^2}{\partial x_3^2} + \beta^2 + 2 \sum_{\mu=1}^3 \sum_{\nu=1}^3 \alpha_\mu \alpha_\nu \frac{\partial}{\partial x_\mu} \frac{\partial}{\partial x_\nu} + 2 \sum_{\mu=1}^3 \beta i \alpha_\mu = -\frac{\partial^2}{\partial t^2}. \text{ This}$$

equals

$= c^2 p_1^2 + c^2 p_2^2 + c^2 p_3^2 + m^2 c^4 = E^2$ if the off diagonal elements zero (with 23.3) which is the condition used in the standard Dirac equation derivation of the α s and β . Note that from appendix A that the off diagonal elements $2 \sum_{\mu=1}^3 \sum_{\nu=1}^3 \alpha_\mu \alpha_\nu \frac{\partial}{\partial x_\mu} \frac{\partial}{\partial x_\nu} + 2 \sum_{\mu=1}^3 \beta i \alpha_\mu$ are

equivalent to the off diagonal elements in equation 5.1 (and are corrections to 5.2 in fact) so *are not* zero for parity and CP NONconservation in this context (in a rotating universe). So in the context of the Dirac equation the CP violation term

$e_s(dr)dt \rightarrow (dr/ds)(dt/ds) \rightarrow pE\chi$ (after division by ds^2). Thus CP violation goes up as the square (pE) of the energy (so should be larger in bottom factories). The section 13.2 below Cabbibo angle calculation (not rotation related however) is an example of how this method can give the values of the other terms in the CKM matrix. They arise from calculation of $\langle Z \rangle$ between higher order m harmonics.

This section is important in that we see that CP violation is explainable and calculable in terms of perturbative effects on the ambient metric (and therefore the Dirac equation) of a rotating universe with nearly complete inertial frame dragging (section 22.1 in the E&M form), CP violation doesn't need yet more postulates as is the case with the GSW model. In fact the whole CKM matrix is explainable here as a consequence of this perturbation.

Note the orientation relative to the cosmological spin axis is important in CP violation. Integration of the data over a 3 month time (at time intervals separated by a sidereal day) is going to yield different CP violation parameters than if integration is done over a year.

Chapter 14

14.1 Potential Energy Formulation in $E^2 = p^2 c^2 + m_0^2 c^4$

(From 104.10, 105.9, Sokolnikov, Tensor Analysis, 2nd Ed. Wiley) we have $dt/ds = 1/\kappa_{00}$.

Also from the first term in equation 18.1 we can compare the location of the energy E term in the ordinary Dirac equation with equation 18.1 and find that $E = (dt/ds)\sqrt{\kappa_{00}}$

$= (1/\kappa_{00})\sqrt{\kappa_{00}} = 1/\sqrt{\kappa_{00}}$ with $\kappa_{00} = 1 - r_H/r$

From the energy component of polarized representation of equation 18.1, 18.2: and using iterated (as in bosonic) section 19.13 $E^2 = p^2 c^2 + m^2 c^4 =$

$$E^2 = \left(\frac{1}{\sqrt{\kappa_{00}}} \right)^2 = \frac{1}{1 - \frac{r_H}{r}} = \frac{r}{r - r_H} = \frac{r}{r - r_H} - \frac{r - r_H}{r - r_H} + 1 = \frac{r_H}{r - r_H} + 1 = V + k \quad (14.1)$$

Note the resemblance of $E^2 = p^2 c^2 + m^2 c^4$ to the Schrodinger equation if the $E^2 = k + 1/(r - r_H)$ of equation 14.1 is substituted into it. The system can then be treated as nonrelativistic even if the internal electron motion is ultrarelativistic. This is the reason that the Schrodinger equation can be used as the starting point of nuclear shell model calculations. The Proca equation $\square^2 A_\mu + E_m^2 A_\mu = 0$ comes out of this formulation for spin 1 field also using the E of equation 14.1. We use the equation 14.1 integer spin source and proceed in the usual way of Bjorken and Drell [13] to construct the one vertex S matrix for the triplet state (spin = $1/2 + 1/2$) Dirac equation but for integer spin sum. The results are those of a radially displaced Schrodinger equation Hydrogen atom. This V is an application to the chapter 6 alternative $\Sigma(1/r)^n$ geometric series expansion method if by mistake a gauge is added.

Also if we iterate equation 1.9 (square it) in the form of the separated 'r' dependence of 18.1 and 18.2 we also get 14.1 nonzero positive integer spin Proca Equation and the chapter 15 and chapter 16 results. To insert angular momentum $L=1$ in the S matrix in chapter 16 the De Broglie $\lambda = 2\pi r$ must additionally be used in $p = \hbar k = (2\pi/\lambda)\hbar$

Chapter 15

$r > r_H$ Application: New Potential in New PDE Implies No Running Coupling Constant

15.1 No Need for a Running Coupling Constant

If the Coulomb $V = \alpha/r$ is used for the coupling instead of $\alpha/(k_H - r)$ (Equation 14.1) then we must multiply α in the Coulomb term by a floating constant (K) to make the coulomb V give the correct potential energy. Thus if an isolated electron source is used in Z_{00} we have that $(-K\alpha/r) = \alpha/(k_H - r)$ to define the running coupling constant multiplier “K”. The distance k_H corresponds to about $d = 10^{-18} \text{m} = ke^2/m_\tau c^2$, with an interaction energy of approximately $hc/d = 2.48 \times 10^{-8} \text{joules} = 1.55 \text{TeV}$. For 80 GeV, $r \approx 20$ ($\approx 1.55 \text{TeV}/80 \text{Gev}$) times this distance in colliding electron beam experiments, so $(-K\alpha/r) = \alpha/(r_H - r) = \alpha/(r(1/20) - r) = -\alpha/(r(19/20)) = (20/19)\alpha/r = 1.05\alpha/r$ so $K = 1.05$ which corresponds to a $1/K\alpha \approx 1/\alpha \approx 130$ also found by QED (renormalization group) calculations of (Halzen, Quarks). Therefore we can dispense with the running coupling constants, higher order diagrams, the renormalization group, adding infinities to get finite quantities; all we need is the correct potential of equation 4.1.

Note that the $\alpha' = \alpha/(1 - [\alpha/3\pi(\ln\chi)])$ running coupling constant formula (Faddeev, 1981) doesn't work near the singularity (i.e., $\chi \approx e^{3\pi/\alpha}$) because the constant is assumed small over all scales (therefore there really *is no formula to compare* $\alpha/(r - r_H)$ to over all scales) but this formula works well near $\alpha \sim 1/137.036$ which is where we used it just above.

Chapter 16

Incorporating Heisenberg's Equations Of Motion Into The Analyticity of Z

For two bodies we have $\kappa_{oo}=1-r_H/r \approx 1/\kappa_{rr}$ and we then have the forces and accelerations from the geodesic equations in the classical limit for example. But if we want to (as we said we don't have to) we can construct the field theory with the $\delta\delta Z=0$ analyticity and $\delta Z=0$ of chapter 1 as the fundamental building blocks. The analyticity of Z and the $dr/dt=\text{constant}$ extrema (sect.1.1) provide the core components of the electroweak equations as we saw in section 2.4. The Heisenberg equations of motion gives the nonhomogenous Helmholtz equation contribution and the modulation due to the new pde S matrix resonance directly gives the Electroweak version for $\phi=\pi$. $\phi=0$ is the Maxwell's equations.

Here we have real analyticity of Z since Z is exponential. So we have the Laplace equation. Note in the Heisenberg equations of motion application that the phase in A_μ (required for the quantization, ch.20) or analyticity of Z goes as phase $=kx+\omega t$. We then adopt an ansatz (equation 10.1) $g_{oo}=e^{iA_o/v_o}$ (or the Fourier series sum). Also recall from equation 1.6 that from $dr/dt=\text{constant}$ we get that $\kappa_{rr}\kappa_{oo}\equiv g_{oo}g_{rr}$ is a constant. So we can do the equation 1.3 variation with respect to time (and not r) just as in classical Hamiltonian theory. So from equation 3.5 we have $\delta(g_{oo}g_{rr})=0=(\partial(g_{oo}g_{rr})/\partial t)dt$
 $=((\partial g_{oo}/\partial t)g_{rr})dt+((\partial g_{rr}/\partial t)g_{oo})dt =((g_{oo}\partial iA_o/c\partial t)g_{rr})dt+ (g_{rr}\partial iA_r/v\partial r)(dr/dt)g_{oo}dt=$
 $(g_{oo}(\partial iA_o/c\partial t)g_{rr})dt+ (g_{rr}(\partial iA_r/\partial r)g_{oo})dt$. Multiplying both sides by $1/cg_{oo}g_{rr}idt$ gives us:

$$\partial A_o/c\partial t + \partial A_r/\partial r=0 \quad (16.1)$$

From the Heisenberg equations of motion (equation 11.2) the phase A_j/v_j term itself is oscillatory $e^{A_i/v_i}=e^{ikr}=\exp(ik((1/i)(e^{ikt}-1)))=e^{-k}\exp(ik((1/i)(e^{ikt})))=e^{-k}e^{k+A/v}=e^{-k}\exp(k\cos(kr-\omega t)+k\sin(kr-\omega t))$. e^{-k} is just a normalizing term A_{i0} .

So we can define:

$A_r/v_r=A_{roi}(\cos(kr-\omega t)+i\sin(kr-\omega t))$, $A_t/v_t=A_{to}(\cos(kr-\omega t)+i\sin(kr-\omega t))$, But from the weak field equation 4.11b or the analyticity of Z: $\partial e^{A_j/v_j}/\partial t=(\partial A_j/\partial t)e^{A_j/v_j}$, so $\partial^2 e^{A_j/v_j}/\partial t^2=(1/v_j)(\partial(\partial A_j/\partial t)/\partial t)e^{A_j/v_j}+(\partial A_j/v_j)/\partial t^2 e^{A_j/v_j}=$
 $(1/v_j)(\partial^2 A_j/\partial t^2)e^{iA_j/v_j}+(\sin^2(kx-\omega t)+2i\sin(kr-\omega t)\cos(kr-\omega t)+\cos^2(kx-\omega t))e^{A_j/v_j}$.
 Also: $\partial e^{A_j/v_j}/\partial r=i(\partial A_j/\partial r)e^{A_j/v_j}$; so: $\partial^2 e^{A_j/v_j}/\partial r^2=\partial((\partial A_j/v_j/\partial r)e^{A_j/v_j})/\partial t=$
 $(\partial(A_j/v_j)/\partial r)^2 e^{A_j/v_j}+(1/v_j)(\partial^2 A_j/\partial r^2)e^{A_j/v_j}=$

$(\sin^2(kr-\omega t)+2i\sin(kr-\omega t)\cos(\omega t-kx)+\cos^2(kr-\omega t))e^{A_j}+(1/v_j)(\partial^2 A_j/\partial r^2)e^{A_j}$
 From the Laplace equation then $(1/v_j)(\partial^2 A_j/\partial t^2)e^{A_j/v_j}+(1/v_j)(\partial^2 A_j/\partial r^2)e^{A_j/v_j}=$

$\Sigma(\cos^2+\sin^2)e^{A_j/v_j}$. where we took the real part of both sides eliminating the cross terms.

We then add the \cos^2 to the \sin^2 in both terms to get $\cos^2+\sin^2=1$ and multiply both sides by v_j allowing pure current density on the right side. The v_j in the second derivative term gets canceled and all we are left with is the v_j term on the right side: $v_j(\cos^2+\sin^2)=(1)v_j$ which becomes our $j_i=(1)ev_j$ current density. The right side then becomes a function only of the current density. Thus the $j_i(\cos^2+\sin^2)=(1)j_i$ constant term generates the 2D currents j in

$$\partial^2 A_o/c^2\partial t^2-\partial^2 A_o/\partial r^2 =j_o \text{ and } \partial^2 A_r/c^2\partial t^2-\partial^2 A_r/\partial r^2=j_r \quad (16.3)$$

We then get the usual (Lorentz gauge, Pugh, pp.270) inhomogenous Helmholtz equation and so weak field formulation of the free space E&M (spin 1) Lorentz gauge form of the Maxwell's equations in 2D here. v_i is on the light cone so constant.

$$\delta\delta Z=\partial^2(A_1/v_1)/\partial x_1^2 +\partial^2(A_2/v_2)/\partial x_2^2 +\partial^2(A_3/v_3)/\partial x_3^2 +\partial^2(A_4/v_4)/\partial x_4^2$$

$$=(1/c)[\partial^2 A_1/\partial x_1^2 + \partial^2 A_2/\partial x_2^2 + \partial^2 A_3/\partial x_3^2 + \partial^2 A_4/\partial x_4^2]$$

For low temperatures and off the light cone we have instead:

$$\frac{\partial^2 \left(\frac{A_i}{v_i} \right)}{\partial t^2} = \frac{\partial \left[\left(\frac{1}{v_i} \frac{\partial A}{\partial r} \right) - A \frac{\left(\frac{\partial v_i}{\partial r} \right)}{v_i^2} \right]}{\partial t} = \left[\frac{\partial^2 A}{\partial t^2} \frac{1}{v_i} - \frac{1}{v_i^2} \frac{\partial v_i}{\partial t} \left(\frac{\partial A}{\partial t} \right) - \left(\frac{\partial A}{\partial t} \right) \frac{\partial v_i}{\partial t} \frac{1}{v_i^2} - A \frac{\partial v_i}{\partial t} \frac{\partial^2 v_i}{\partial t^2} + 2A \frac{\left(\frac{\partial v_i}{\partial t} \right)^2}{v_i^3} \right]$$

$$\frac{\partial^2 \left(\frac{A_i}{v_i} \right)}{\partial r^2} = \frac{\partial \left[\left(\frac{1}{v_i} \frac{\partial A}{\partial r} \right) - A \frac{\left(\frac{\partial v_i}{\partial r} \right)}{v_i^2} \right]}{\partial t} = \left[\frac{\partial^2 A}{\partial r^2} \frac{1}{v_i} - \frac{1}{v_i^2} \frac{\partial v_i}{\partial r} \left(\frac{\partial A}{\partial r} \right) - \left(\frac{\partial A}{\partial r} \right) \frac{\partial v_i}{\partial r} \frac{1}{v_i^2} - A \frac{\partial v_i}{\partial r} \frac{\partial^2 v_i}{\partial r^2} + 2A \frac{\left(\frac{\partial v_i}{\partial r} \right)^2}{v_i^3} \right]$$

$$\text{Laplace equation} = \frac{\partial^2 \left(\frac{A_i}{v_i} \right)}{\partial t^2} + \frac{\partial^2 \left(\frac{A_i}{v_i} \right)}{\partial r^2} = \frac{\partial^2 A}{\partial t^2} \frac{1}{v_i} - \frac{1}{v_i^2} \frac{\partial v_i}{\partial t} \left(\frac{\partial A}{\partial t} \right) - \left(\frac{\partial A}{\partial t} \right) \frac{\partial v_i}{\partial t} \frac{1}{v_i^2} - A \frac{\partial v_i}{\partial t} \frac{\partial^2 v_i}{\partial t^2} + 2A \frac{\left(\frac{\partial v_i}{\partial t} \right)^2}{v_i^3} +$$

$$\frac{\partial^2 A}{\partial r^2} \frac{1}{v_i} - \frac{1}{v_i^2} \frac{\partial v_i}{\partial r} \left(\frac{\partial A}{\partial r} \right) - \left(\frac{\partial A}{\partial r} \right) \frac{\partial v_i}{\partial r} \frac{1}{v_i^2} - A \frac{\partial v_i}{\partial r} \frac{\partial^2 v_i}{\partial r^2} + 2A \frac{\left(\frac{\partial v_i}{\partial r} \right)^2}{v_i^3}$$

Given the primed origin observer system (Section 1.1) we must replace the 2D dot product divergence k_r with the 4D $k_x x + k_y y + k_z z$ and $k_r^2 A_r$ with $k_x^2 A_x + k_y^2 A_y + k_z^2 A_z$, thereby generating the 4D Maxwell equations.

Another way of writing a wave equation separation of variables solution in 4 space is the Fourier Decomposition: $A_u = A_{u0} e^{i\omega t} e^{ik_x x} e^{ik_y y} e^{ik_z z} e^{i\omega t}$ where in this case we have a $e^{i\omega t}$ oscillation S matrix *receiver* cross-section modulating the A_i intensity contribution from the new pde S matrix resonance equation 16.6 contribution. Thus $\text{Re}(e^{i\omega t}) = \cos(MKt) = 1 - (MKt)^2/2 + \dots$ neglecting the much smaller dt^3 term here) in $\square^2 A_\mu = 0$ (eq.16.3). The D'Alembertian second derivative of t^2 with respect to t is a constant so this gives rise to the Proca equation:

$$\square^2 A_\mu + ((KM)^2 A_\mu = 0 \quad (16.4)$$

=massive spin 1 particle (the W). See also section 25.4. If $\phi=0$ in equation 16.4 (so $M=0$) we are back to the old Maxwell equation 16.4 spin 1 massless field. Thus we have derived both the Proca equation for spin 1 mass M of eq.16.4 and the Maxwell equations for the allowed $\phi=0$, $M=0$ case of 16.3.

16.2 $r > r_H$ Application: New Potential V in New PDE Implies New S Matrix with W and Z as Resonances. Find Expectation Value of ϵ In W Region

We added a second point in section 1 to get equation 4. our pde and that 4 degrees of freedom. So in $dr+dt=dr-\epsilon/2 +dt+\epsilon/2$ we are still in the Z plane since two points and the origin are still in a plane, Thus in the case of a second point we have dr plus something and dt plus something. So we have a first point plus something (that is not out of the plane) so that

$$\begin{aligned} (dr-\epsilon/2+dt+\epsilon/2)+(dr-\epsilon/2) \pm \epsilon'/2 + (dt+\epsilon/2) \pm \epsilon'/2 &= \\ dr' + dt' + dr' \pm \epsilon'/2 + dt' \pm \epsilon'/2 &= \\ dr' + dt' + dr'' + dt'' & \end{aligned}$$

which is equivalent to just adding another point dr'', dt'' in 2D. $\epsilon = .06$ here.

So $\kappa_{\mp} = (dr/dr'')^2 = (dr/(dr-\epsilon/2 \pm \epsilon'/2))^2$ and so the sign on the $\pm \epsilon$ determines whether the charge is zero or unit e. We use this result in our S matrix derivation. Also

$$((dr-\epsilon/2) \pm \epsilon'/2)^2 + ((dt+\epsilon/2) \pm \epsilon'/2)^2 = dt^2 + dr^2 + ((-\epsilon/2) \pm \epsilon'/2)dr - ((-\epsilon/2) \pm \epsilon'/2)dt =$$

Note we can have a zero and nonzero charge in the 3rd quadrant (where $dt=dr$) massive Proca boson case given the possibilities in sign we have for $\pm \epsilon'/2$ in

$$((-\epsilon/2) \pm \epsilon'/2)dr - ((-\epsilon/2) \pm \epsilon'/2)dt.$$

In the first quadrant $ds=0$ again (section 1) so they have to add to zero.

No spectacular result here but at least we see why the plus and minus in $\pm \epsilon$ determines whether you have zero or nonzero charge in multiparticle systems. This result is used a lot in Part III also.

We use the equation 14.1 source and proceed in the usual way of Bjorken and Drell (here $1/r \rightarrow 1/(r-k/2)$) to construct the one vertex S matrix for the new Dirac equation 1.9. Recall the $1/2$ came from the square root in equation 14.1. Thus the k in the integrand denominator is found from the result of our $V = -1/(r-r_H/2)$ potential in equation 14.1 instead of the usual Coulomb potential $1/r$ in the large r limit. (so a free electron otherwise):

$$S_{if} \equiv iZ \frac{1}{V} \sqrt{\frac{m^2}{E_f E_i}} \bar{u}(p_f, s_f) \gamma^0 u(p_i, s_i) \int_0^{\infty} \frac{e^{i(p_f - p_i)x}}{\sqrt{1 - r_H/r}} dx^4 \equiv if(u) \int_0^{\infty} \frac{\sqrt{r} e^{i(p_f - p_i)x}}{\sqrt{r - r_H}} dx^4 \quad (16.5)$$

rescaling $r \rightarrow r' + r_H = r$ and $t \rightarrow t' + (r_H/c) = t$ to minimize the resonance energy in $p_f - p_i$. We then obtain::

$$S_{if} \equiv iZ \frac{1}{V} \sqrt{\frac{m^2}{E_f E_i}} \bar{u}(p_f, s_f) \gamma^0 u(p_i, s_i) e^{i r_H q} \int_0^{\infty} \frac{\sqrt{r} e^{i(p_f - p_i)x}}{\sqrt{r - r_H}} dx^4 \equiv if(u) e^{i q r_H} \int_0^{\infty} \frac{\sqrt{r + r_H} e^{i(p_f - p_i)x}}{\sqrt{r}} dx^4$$

For from chapter 14 we have for integer spin $\frac{1}{\sqrt{1 - \frac{r_H}{r}}} \rightarrow 1 + \frac{1}{r - r_H}$ so:

$$\begin{aligned} S_{if} &\equiv if(u) \left[\int_0^{\infty} \frac{e^{i(p_f - p_i)(x' - r_H/2)}}{|x'|} dx^4 - \int_0^{\infty} \frac{e^{i(p_f - p_i)(x' + r_H/2)}}{|x'|} dx^4 \right] \approx \\ &if(u) e^{i(r_H/2)q} \left(\int_0^{\infty} \frac{e^{i(p_f - p_i)(x')}}{|x'|} dx^4 - 2\pi(r_H)^3 \right) \end{aligned} \quad (16.6)$$

Note that $\bar{u}(p_f, s_f) \gamma^0 u(p_i, s_i) = (1 - \beta \sin^2 \frac{\theta}{2}) = \text{Mott scattering term with the } e^{i(\tau\hbar/2)q}$ our

resonance term. The other left side coefficients and inverse $|x|$ part of S_{ij} comprise the well known Rutherford scattering term

$d\sigma/d\Omega = [(Z_1 Z_2 e^2)/(8\pi\epsilon_0 m v_o^2)]^2 \csc^4(\phi/2) = 1.6 \times 10^4 (\csc(\phi/2)/v_o)^4$. (Note that equation 16.5 applies to the $2P_{1/2}-2P_{3/2}$ state electron-electron interaction (i.e., neutron) in section 20.3).

Here $p_f = p = q$. Note in equation 16.6 the factor $i e^{ikq} = i(\cos kq + i \sin kq)$. Here we find the rotational resonances at the $2P_{3/2} r = r_H$ lobes associated with maximizing the imaginary part which is $i \cos kq$ to obtain absorption scattering (at $kq = \pi$), which here will then be the masses exchanged in inverse beta decay. Also a solution to the Dirac component is always a solution to equation 14.1 (but not vice versa) if we invoke an integer spin in this resonance term. Here also the p part uses the old De Broglie wave length to connect to the $p = h/\lambda$. In that regard recall that $h\nu/c = h/\lambda = p$ and for a DeBroglie wave fundamental harmonic resonance we have $\lambda_{rot} = 2\pi r$ for a stationary particle of **spin 1** = L (ambient E&M field source gives $L=1$ De Broglie).). Recall $J=L+S$. Alternatively recall from section 16.1 that:

Proca equation $J = \text{total } J = (\text{for single particle exchange}) = \text{spin}\psi + \text{field}$.

For high energy S state also $J = \text{total } J = (\text{for available two particle exchange of low energy P and S state singlets}) = \text{spin}\psi_1 + \text{spin}\psi_2 + \text{field}$

1) For P state (eq.2.6, 4.11) = $\text{spin}1 + \text{spin}0$. Recall for P states $r_H \rightarrow r_H/2$,

Thus field $\text{spin}=0$ and De Broglie $2r=2\lambda$ out and in states.

2) For S state = $(\text{spin}0_1 + \text{spin}0_2) + \text{spin}1$. Recall from eq. 2.2 that for S states

$r_H \rightarrow r_H(m_e/m_p)$,

Thus field $\text{spin}=1,0$ and De Broglie $2r=2\lambda$ in state and $2r=2\lambda$ and $2\pi r = \lambda$ out states.

Thus for the S state below we have two such $\text{spin}1/2$ particles spread out over a diameter $2\lambda = 2r$ being equivalent to one spin 1 particle with $\lambda_{rot} = (L+1)\pi r$ and so $h/\pi r(L+1) = p_{rot}$ which gives the $2P_{3/2}$ eigenfunction and its trifolium structure in which case we must be in resonance with an individual lobe. The wavelength of an individual $2P_{3/2}$ trifolium lobe is $\lambda_{lobe} = \lambda_{rot}/3$ (i.e., true P wave scattering).

Also from just above equation 4.11 (note $1 \pm \epsilon$ term there) we have $Z_{oo} =$

$k = \alpha \hbar c (1 \pm \epsilon) / (2(m_p c^2)) \equiv k_s$, with the spin 1 coming out of the triplet state and the $1 \pm \epsilon$ from equation 4.12. So for the S state two spin $1/2$ particles in a traveling wave (of our S matrix) are physically identical to one spin 1 particle in circumferential motion scattering. Thus for $L=1$ $h q = p = h/\lambda = h/\text{diameter} = (\text{two wavelengths across diameter})$

$= (2)h/2r = (2\pi h)/(L+1)\pi r = 2\pi(h/\lambda_{rot}) = 2(\pi p_{rot})$. with then $p_{lobe} = 3p_{rot}$. Given for **S=1** we have $Mc = h/2\pi r$ (because of the S state spin 1 Proca equation) we therefore have for the equation 16.2 first resonance phase at $\phi = \pi = k_r q = k_s (2p_{lobe}/\hbar) =$

$$2k_s \pi (3p_{rot}/\hbar) = [(\alpha \hbar c (1 \pm \epsilon) / (2m_p c^2))] ((3)\pi (Mc^2 / ((L+1)\hbar c)) \quad (16.6a)$$

Formula 16.6a gives a LS para $L=1/2$ at 142Gev. so that $J=S+L=0$ so for minimal spin orbit interaction energy. Thus $J=0$ for this particle. Charge=0 as well. first we start with $ksp=0$ resonance condition. We plug the resulting mass term=0 into our Proca equation (section 16.1) and get the standard Maxwell equations!

The next resonance is at $k, p = \pi$ and we solve then for the S and P state subcases in which the Proca equation then gives a massive spin 1 particle (W). Thus in the P state we can keep the λ as $2r$ but in the S state to make λ we need to make $\lambda = 2\pi r$.

- 1) The P state ortho triplet states π^+ and π^0 . That singlet para K_0 , which is both a particle and an antiparticle. Our state is still $r = \lambda$. Recall for P states you have a $r_H \rightarrow r_H/2$,
- 2) The S state ortho triplet states W^\pm , and Z_0 . That singlet para at 142 GeV (the spin 0_2 above) should be both a particle and an antiparticle $2r = 2\lambda$. W, Z are out states $2\pi r = \lambda$. The quark top (the 6th P state) spin 0_2 also originates just as the Kaon state also has a K^+ , K^- split and strangeness (bottom and charm P states are pumped using that harmonic oscillator mechanism coming arising out of that Taylor expansion eq. 19.5).

Thus there is a quite interesting dichotomy here:

$$\pi^\pm, \pi^0, K^0 \rightarrow W^\pm, Z_0, 142 \text{ GeV meson(s)}.$$

Note there should also be a resonance at $\phi = 3\pi = k, q$ gives a new W at 273 GeV and thus a new high energy weak interaction causing new asymmetries in antiparticle-particle decay directions.

References

- Pugh, Pugh, *Principles of Electricity and Magnetism*, 2nd Ed. Addison Wesley, pp.270
 Bjorken and Drell, *Relativistic Quantum Mechanics*, pp.60
 Sokolnikoff, *Tensor Analysis*, pp.304

16.2 ϵ Expectation Value In W Region

For the q s that maximize the above $\text{Im } i e^{i k s q} = \cos k q$ term for scattering in S_{ij} . Note the \pm in equation 4.11.

Thus there is a plus and a minus solution to equation 16.3. The minus applied to negative components. With $L=1$ (so $K=1$) charge $(+\epsilon)$: $M c^2 = K 2 m_p c^2 / (3\alpha(1+\epsilon)) = \mathbf{M_W = 80.7 \text{ GeV}}$. Alternatively with zero charge $(-\epsilon$ in equation 4.11)

$$M c^2 = 2 m_p c^2 / (3\alpha(1-\epsilon)) = 137.026 \cdot 938.27 \text{ MeV} / (1.5 \cdot (1-.06)) = \mathbf{M_Z = 91.2 \text{ GeV}}.$$

Also $kq=0$ obtain photon mass=0. Thus we have the *mass energy of the W and Z* involved in beta decay. Recall the central role ϵ played in decay in chapter 13. We take the expectation value of ϵ ($E=107 \text{ MeV}$) in chapter 1 operating inside the region occupied by a W ($r \approx 1/100 \text{ F}$). Thus in equation 16.3 G in the 4 body ϵ (in W volume) interaction operator is then given by $E V = \epsilon (W, F)^3 = 107 \text{ MEV} ((1/100) F)^3 \approx 10^{-4} \text{ MeV} \cdot F^3 = G$ that must be used since the ψ s are normalized for V in the 4 body Fermi interaction integral $\int \psi_1 \psi_2 G \psi_3 \psi_4 dV$ we got from applying inverse separability on the Dirac left handed doublet (section 2.2) using equation 3.2. Thus we have the interaction ϵ operating in W radius using the doublet of section 1.4.

In general then we have obtained an ortho triplet state here since we are merely writing the Clebsch Gordon coefficients for this addition of two spin $1/2$ angular momentums:

$$|1/2, 1/2, 0, -1\rangle, \dots |1/2, 1/2, 0, 0\rangle, \dots |1/2, 1/2, 0, 1\rangle, \dots \text{ or } +W, Z_0, -W.$$

Note the electron has to have jumped to the metric quantization ϵ value and has to be a nearly free (muon, tauon, electron in the neutron, etc.). If ϵ is zero and the electron is *not* free the W doesn't exist. In the case of the Z the charge is zero and the electrons can interact.

The quadrant 1 and 2 particles are always solutions to the new (fractal) pde $\delta d\theta=0$, $\delta ds=0$. At the near zero energy of free space only the photon (the iterated 1 quadrant

version), electron and neutrino coexist. Also only unit jumps in angular momentum $L=1$ are allowed in ordinary hydrogen atom QM since photons must be given off to conserve angular momentum (and energy).

In the neutron for $E > \varepsilon$ the neutrino and electron can have the $1/(1-\varepsilon-r) = PE$ (giving spin 1, not spin 1/2 interaction) in the Bjorken and Drell S matrix. However infinitesimally small that S matrix actually is. The W,Z resonance term is required to get rid of the ε in this denominator so we can solve the integral in the standard ways. The beta decay left handed helicity of both the electron and neutron conserves angular momentum. since spin 1 comes in ($2P_{1/2}$ state) and spin 1 goes out.

Anyway, this small S matrix involves the neutrino and so can allow spin 1/2 neutrino emission jumps instead of just the usual E&M spin 1 jumps. 100km/sec metric quantization translates to a neutrino rest mass of .165eV.

Excited Z States

This 127Gev is a coupled spin $1/2$ pair of particles forming a singlet and is a heavy Z_0 state we call Z' since

$-\varepsilon \rightarrow -2\varepsilon$ (see below discussion of angular momentum conservation implications of changing $\varepsilon \rightarrow 2\varepsilon$). The principle quantum numbers are $N=1$, for $\varepsilon \rightarrow 0$ with perturbations $\Delta\varepsilon$ (electrons); $N=2$ for ε (e.g., baryons and $2P_{3/2}$ state at $r=r_H$), $N=3$ for 2ε . Note that since the Higgs mass was unknown and it had the decay properties of this 127Gev particle the Higgs will be misidentified as this particle. This Z' decays into Z_0 and then $\gamma\gamma$ or $-e+e-\mu+\mu$.

Put m_e in Equation 4.1

If the scattering is $2P_{3/2}$ instead $m_p \rightarrow m_e$ and so S state 142Gev \rightarrow 135Mev for P state, the uncharged spin0 pion and the same ortho-para organization applies but at these far lower energies. Note the common denominator between the Fermi interaction term (the one with the G) and the W, Z mass scattering is the electron scattering in a $2P_{3/2}$ lobe: they are the same interaction analyzed two different ways. So we say that the W or Z were 'exchanged' in the Fermi interaction or that a left handed electron and left handed neutrino took part in that G, 4 body interaction, same thing.

The beautiful thing to be noted here is that for the doublet resonance with the $2P_{3/2}$ lobe at $r=r_H$ that minimizes energy you get the spin 1 W and Z and the value of the Fermi G! We have also shown that this doublet interaction corresponds to the exchange of massive spin 1 particles (recall spin $1/2$ s forbidden by that $j-1/2$ factor).

Probability for $2P_{3/2}$ Giving One Decay 1S Product at $r \approx r_H$ In W Region

In equation 4.12 we note that invariance over 2π rotations using $(1+2\varepsilon)d^2\theta$ does not occur anymore thus seemingly violating the conservation of angular momentum. To preserve the conservation of angular momentum the additional angle ε must then include its own angular momentum conservation law here meaning intrinsic spin $1/2$ angular momentum in the S state case and/or isospin conservation in the $2P_{3/2}$ case at $r=r_H$. In any event we must also integrate to $C=\varepsilon$. Here we do the E&M component decay given by equation 3.2.

Plug in $S_{1/2} \propto e^{i\phi/2}$, $1/2(1-\gamma^5)\psi = \chi$ into equation 3.2. In that regard note that the expectation value of γ^5 is proportional to $v \propto$ Heisenberg equation of motion derivative of $2P_{3/2} \propto e^{i(3/2)\phi}$. We integrate $\langle \text{lepton} | \text{baryon} \rangle$ over this W exchange region where we note $(\sim 1/100)F$ for 90Gev particle, so $dV = ((1/100)F)^3 = V_0 dW$. Also $ck_0 = \varepsilon = 106\text{Mev}$ from

section 2.1. From section 1.5 on the vacuum constituents e and v we note that $\iiint d\tau = \text{Vol}$, χ is defined as the vacuum eigenfunction. Vacuum expectation equation 4.15:

$\Sigma \langle \text{vac}_M | \varepsilon | \text{vac}_{M+1} \rangle = \langle \iiint \psi^* \varepsilon \chi_e dV \rangle = \langle \text{Pot} \rangle = \varepsilon \text{Volume of } W$. This application of eq.16.1 for example applies to the $2P_{1/2} - 2P_{3/2}$ electron-electron scattering state inside the neutron $\langle \text{Proton } 2P_{3/2} | \text{Pot} | \text{Neutron } 2P_{1/2} - 2P_{3/2} \rangle$. Also we can get a weak, strangeness changing (second term below), decay from a $2P_{1/2} - 2P_{3/2} > m_p$ to the S state branch equation.1.9 expectation values from equation 3.2. $= \Sigma \langle \text{lepton} | \text{vac} \rangle | \varepsilon | \langle \text{vac} | \text{baryon} \rangle$
 $= \text{Fermi interaction integral} = \int \psi_1^* \psi_2 \psi_3 k_o c \chi dV = \iiint \psi_1^* (\varepsilon \text{Vol} W) \chi dV = \iiint \psi_1^* (\varepsilon \text{Vol} W) \chi dV$.
 Also $dV = dA d\phi = K d\phi$.

So the square root of the probability of being in the final state is equal to the Fermi integral = $\int \psi_1^* (\text{Pot}) \chi dV = \int \psi_1^* \psi_2 \psi \varepsilon \Delta V_w \chi dV =$

$$= \int K \langle e^{i\phi/2} | (\varepsilon \Delta V_w) | 1 - (\gamma^5 i e^{i(3/2)\phi}) \rangle dt dV = \int K \left[\varepsilon \left(\frac{F}{100} \right)^3 \right] \langle e^{i\phi/2} - \gamma^5 i e^{i4/2\phi} \rangle d\phi$$

$$\varepsilon \text{Vol} W = \int K \left[\varepsilon \left(\frac{F}{100} \right)^3 \right] \langle e^{i\phi/2} - \gamma^5 i e^{i4/2\phi} \rangle d\phi$$

$$= K G_F \int \langle e^{i\phi/2} - \gamma^5 i e^{i4/2\phi} \rangle d\phi = K G_F \left(\frac{2e^{i\phi}}{i} \Big|_0^{2\pi+C} - \frac{2\gamma^5 e^{i4\phi}}{i4} \Big|_0^{2\pi+C} \right) \quad (16.7)$$

with $\langle \text{initial} | c | \text{final} \rangle^2 \approx$ transition probability as in associated production with the separate 2P proton ground state transition being the identity ($\Delta S=0$). Factoring out the 2 and then normalizing 1 to .97 simultaneously normalizes the 1/4 to .24 in equation 13.2. With this normalization we can set $\cos\theta_c = .97$ and $\sin\theta_c = .24$. Thus we can identify θ_c with the *Cabbibo angle and we have derived its value*. We can then write in the weak current sources for hadron decay the **VA structure**: $|\cos\theta_c - \gamma^5 \sin\theta_c|$. Thus with the above Cabbibo angle and this CP violation and higher order $(r_H/r)^n$ terms in equation 3.2 we have all the components of the CKM matrix. Note we have also derived the weak interaction constant G_F here.

Given the role ε plays here in decay we find the expectation value of energy ε within the S matrix scattering region in chapter 16.

Recall from section 1.2 the possible mixing of real and imaginary terms in that energy coming out of that first order Taylor expansion. There we found the $1+x$ and $1-x$ solutions cancel and we could ignore the $1+1=2$ term as it is still a flat metric.

Also there are still extra terms provided by the 'small' higher order r^2 terms in that Taylor expansion so that "higher and lower" than the speed of light mixed condition still can exist (for $\Delta G \neq 0$. See end of section 4.6 and 16.6). In that regard note for the next higher order Taylor term at largest curvature $d^2(1/k_{\tau})/dr^2$ is large negative and r^2 is positive implying a net negative term and therefore a neutral charge (see case 2, of section 19.6)! In that case the perturbative squared r term appears to overwhelm the rest since the lower order terms then cancel. Note from the above we put these neutral conditions also into that decay since net charge is zero in the Cabbibo angle derivation. This then appears to be the beta decay condition *where the neutrino (higher than c) and the electron, (lower than c), decay from this neutral particle condition* (bottom of section 16.6). The beginning $2P_{3/2}$ ground state still exists however in the respective Cabbibo angle calculation. Thus those real and imaginary terms coming out of that Taylor expansion provide the explanation for beta decay.

Example**Proton:**

The electron model of the proton has two positrons moving in two $2P_{3/2}$ trifolium lobes 120° apart (objects A and C). The proton is 1836X the mass of the electron so the two positrons (each mass being $(1836/2)m_e$) are moving ultrarelativistically ($v/c=.9999994$) so the otherwise isotropic field is Fitzgerald contracted to very thin plane wave pulse 'plates'. The central mass (object B) is a nonrelativistic negative particle (electron). Note the field of object A then does not intersect object C and vice versa so the force is (nearly) zero between objects A and C. The force between central negative object B and each of the two positive objects A and C is then purely attractive, negative attracts positive. Thus we have a **bound state**. Contrast this case with the (nonrelativistic) hydrogen atom having an extra electron, clearly an unbound state. Also object A (and C) experience the force from only object B with object C making the center of mass close to object B and so making this a **two body problem**. Also positrons A and C cannot annihilate with electron object B because they are constrained to move at $r=r_H$ by the new pde.

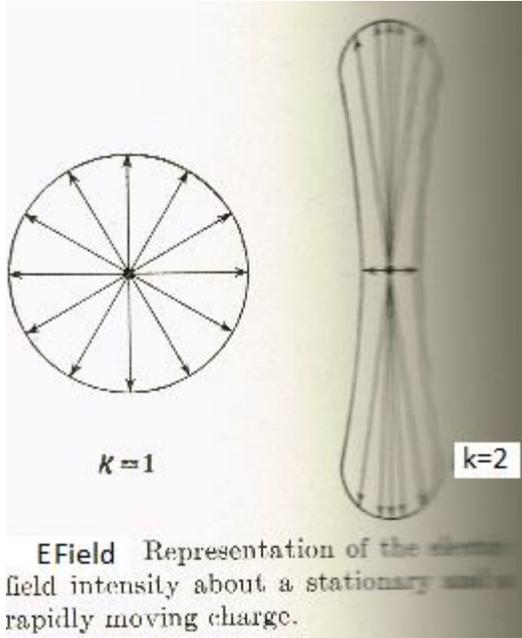
The time metric component is zero at $r=r_H$ making the proton dilation infinite and therefor making the **proton completely stable**. with net **spin $^{1/2}$ positive charge**.

Neutron:

We fill in the next orbital in our ultrarelativistic aufbau principle, the $2P_{1/2}$ state. In this P state we have an additional electron in a $2P_{1/2}$ y axis lobe position just above the other nonrelativistic electron and still at the intersection of the object A and C 'plates'. The center of mass remains in the same position. This second electron is not at $r=r_H$ so the stability is not assured. The electron has clearly jumped to ϵ metric level (Sect.2.3) and the two electrons in $\langle H_e | W | H_e \rangle$ can engage in that S matrix scattering and so the W since the electron is nearly free as in the previous S matrix calculation (Sect.16.2). Note this loosely held extra electron H_e allows us to now use section 4.5 equation 4.13

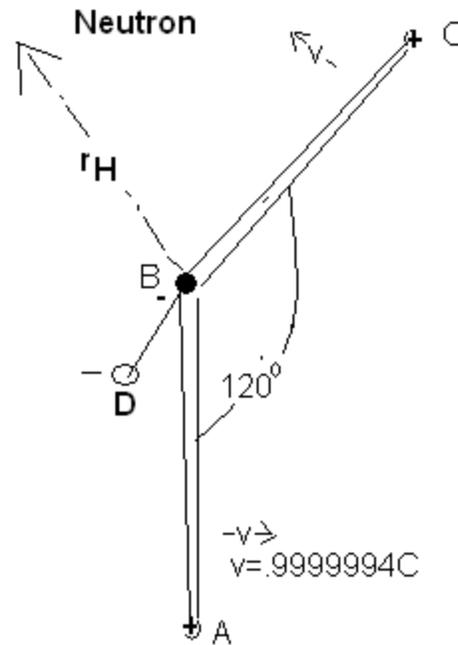
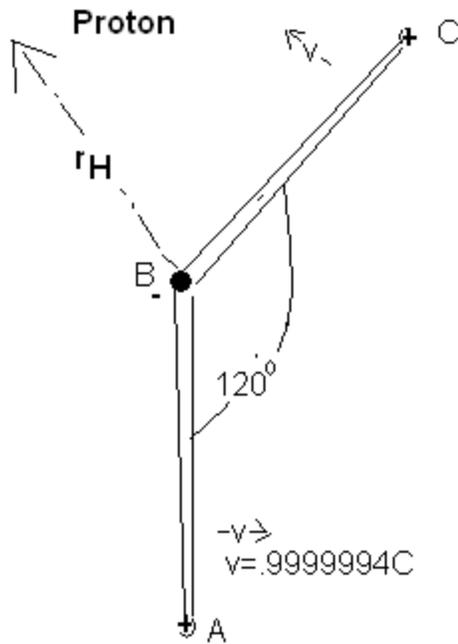
$H_v + H_e = 0 = G_{00}$ giving a left handed, nearly massless H_v (neutrino).

The muon (which also exceeds the ϵ) also has a loosely 'held' electron and so the $H_v + H_e = 0 = G_{00}$ and the W in $\langle H_e | W | H_e \rangle$ scattering interaction of that S matrix the H_e . There is no loose electron in the proton and all the ultrarelativistic particles are at $r=r_H$. so no W here.



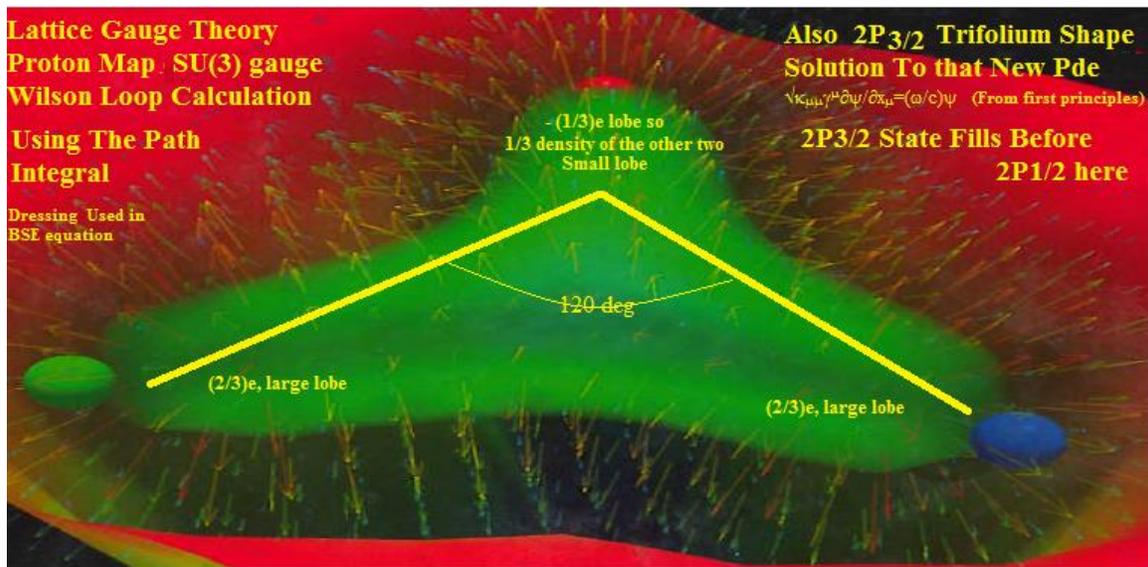
Second diagram is the E field of a ultrarelativistic charged particle (“Electronic Motion”, McGraw Hill, Harman)

Thus the neutron charge configuration allows for the creation of both the W and the H_ν and the proton charge configuration does not allow this.



$2P_{3/2}$ at $r=r_H$
 positive 1e charge
 $J_A + J_C + J_B =$
 $(-.5+1)+(-.5+1)-.5=.5$ spin
 ultrarelativistic electron motion gives
 correct mass.
 plate field from object A does not intersect
 particle C so bound state.

$2P_{3/2} + 2P_{1/2}$
 D not bound so He
 $H_v + H_e = 0$
 So left handed neutrino
 exceeds epsilon so W S
 Matrix



By the way in this theory high energy pairs of antiparticles, exceeding the muon mass energy, are mesons!

Normed Division Algebra, Octonians, E8XE8 and SU(3)XSU(2)XU(1) Basis Change

Note from the above that the new pde fractal theory generated the electron with mass, the near zero mass left handed neutrino. Recall also from above the $\kappa_{oo}=\sqrt{(1-\epsilon-r_H/r)}$. The W was generated from a nonzero ambient metric ϵ in that S matrix derivation part of the metric coefficient $\kappa_{\mu\nu}$. Interestingly that Normed Division Algebra (NDAR) on the real numbers (as in: $\|Z_1\|*\|Z_2\|=\|Z\|$) from equation 1 implies that octonians (and thereby the *largest normal Lie group* E8XE8) are also allowed. Recall we have that SU(2) Lie group rotation for the 0° extrema imbedded in a E8XE8 rotation since one of its subgroups being SU(3)XSU(2)XU(1). This is the only subgroup we can use because it is the one that only contains that SU(2).

If κ_{ij} Set Constant Forces Are Then Zero And Masses Are Zero: The Ad hoc Patches For This Mistake Comprise The Standard Model Of Particle Physics

Need Renormalization If The Mistake is Made Of Setting $\kappa_{ij}=\text{constant}$

Recall $\Gamma^m_{ij}v^i v^j$ gives us dynamics, accelerations, with those v s limited to c. Recall $\kappa_{ij}=g_{ij}$ also contains the potentials (of the fields) A. We can then incorrectly set $\partial g_{ik}/\partial x^j=0$ since the mainstream Dirac equation formalism incorrectly made the g_{ij} constants in front of the Dirac equation kinetic term. In that case we must then set $\int g^{ij} = \int A = \infty$ in the S matrix integral context so)15) that $\Gamma^m_{ij} \equiv (g^{km}/2)(\partial g_{ik}/\partial x^j + \partial g_{jk}/\partial x^i - \partial g_{ij}/\partial x^k) = (\mathbf{1/0})(\mathbf{0}) = \text{undefined}$, but *not* zero. Thus we must take the $\partial g_{ik}/\partial x^j$ to be mere 0 *limit* values and then $\Gamma^{\alpha}_{\beta\gamma}$ becomes *finite* then. Furthermore spin0 version of equation 1.9 $A_o=1/r$ (and U(1)) and note the higher orders of the Taylor expansion of the Energy= $1/(1-1/r)$ term ($=1-1/r+(1/r)^2-(1/r)^3 \dots$ geometrical series expansion) where we could then represent these n th order $1/r^n$ terms with individual 1/r Coulomb interactions accurate if doing alternatively doing Feynman vacuum polarization graphs in powers of 1/r). Also we could subtract off the infinities using counterterms in the standard renormalization procedure. Thus in the context of the S matrix this 1st alternative could ironically give nearly the exact answers if pathologically $\int A = \infty$ and so we have explained why QED renormalization works!

Unique Mapping Of These Parameters Onto the Standard Model Of Particle Physics

On the other hand in the fractal theory the frame dragging is so large in object A that it appears (to one part in 10,000) to *not* rotate so you can regard the N+1 fractal scale psi as a Klein Gordon psi (In section 1.5). In 1964 Peter Higgs taught us that we could add in such a scalar field to give us a mass term: he called it symmetry breaking and we will use his (ad hoc) method here for doing that. Note you *cannot* do this if you had left the epsilon mass term in the metric coefficient: now you must.

. Recall from Chapter 23 that the next larger “electron” is the 10^{10} LY universe which itself is one of three that constitute a huge “proton constituting our objects A, B and C. Recall on our own fractal scale object A must move ultrarelativistically relative to object

As so the the mass of the electron is becomes much larger since the proton has a mass that is 1836X the mass of the electron. In that regard recall that object B is outside the big 10^{11} LY horizon so its state is still oscillatory in the eq.1.9 Heisenberg QM formulation for p for example $T(t)|p\rangle = p(t)\rangle$ where $T(t) = e^{iHt}$. Recall alternatively inside r_H the $i \rightarrow 1$ so the time evolution is purely exponential, hence the $r = r_0 e^{kt}$ accelerating universe expansion discovered by Perlmutter et al in 1998.

So from the fractal theory object B has to be ultrarelativistic ($\gamma = 1836$) so the time behaves like mc^2 energy: has the same gamma: $t \rightarrow t_0 / \sqrt{(1-v^2/c^2)} = KH$ since energy $H = m_0 c^2$ has the same γ factor as time does. So in the e^{iHt} of object B the $Ht = (H/\sqrt{(1-v^2/c^2)})t_0 = H^2 t_0 = \phi^2$. Define $\phi = H$. Note also ultrarelativistically that p is proportional to energy: for ultrarelativistic motion $E^2 = p^2 c^2 + m_0^2 c^4$ with m_0 small so $E = Kp$. Suppressing the inertia component of the κ thus made us add a scalar field ϕ . Thus

$$\phi' = p(t) = e^{iHt} |p_0\rangle = \cos(Ht) = \exp(iH^2 t_0) = \exp(i\phi^2) =$$

$\cos(\phi^2) = \phi' = 1 - \phi^4/2$. Thus for a Klein Gordon boson we can write the Lagrangian as $L = T - V = (d\phi/dx)(d\phi/dx) - \phi^2 = (d\phi/dx)(d\phi/dx) - \phi^2 = (d\phi/dx)(d\phi/dx) - i(1 - \phi^4)^2$. Thus we define this Klein Gordon scalar field from:

Note for $r < r_H$ equation 1.9 shows that the Heisenberg equations of motion are not oscillatory (since $\omega \rightarrow i\omega$ in $e^{i\omega t}$) so that $r = r_0 e^{\omega t}$ and we have thereby derived that accelerating cosmological expansion universe discovered by Perlmutter et al in 1998. In contrast equation 7 gives for $r > r_H$ (outside) cosmological object B a zitterbewegung that is once again oscillatory. Therefore in the Heisenberg formulation $T(t)|p\rangle = p(t)\rangle$ where $T(t) = \exp(iHt)$. For ultrarelativistic motion $t \rightarrow t_0 / \sqrt{(1-v^2/c^2)} = t_0 \gamma = KH$ since energy $H = m_0 c^2$ has the same γ factor as time does. Also from section 3.3 (eq.3.1) we noted that the value of \hbar is proportional to ambient metric expansion equation time (eg., $\hbar = Kt_0$), it changes over cosmological time. Thus $p(t) = \exp(iKH^2 t_0 / K_1 t_0) = \exp(\phi^2) = \cos(\phi^2) = \phi' = 1 - \phi^4/2$ Also for ultrarelativistic motion $E^2 = p^2 c^2 + m_0^2 c^4 = p^2 c^2 + 0$ since m_0 is then small. So $E = pc$ which then becomes the component of a Lagrangian L. Thus for a Klein Gordon boson we can write $L = T - V = (d\phi/dx)(d\phi/dx) - \phi^2 = (d\phi/dx)(d\phi/dx) - \phi^2 = (d\phi/dx)(d\phi/dx) - i(1 - \phi^4)^2$ so the phi4 Mexican hat potential addition to the background H of object A. Note in the covariant derivative of ϕ the W is needed in $W+B$ to bring in the ϵ ambient metric mass. The B component is generated from the r_H/r and the structure of the B and $A = W+B$ is needed to both have a zero charge neutrino and nonzero mass electron. In any case we can then define our Klein Gordon scalar field from:

$$(D_\mu)^\dagger (D_\mu \phi) - \frac{1}{4} \lambda (((\phi^\dagger \phi)^2 - v^2))^2$$

$$D_\mu \phi = \left[\partial_\mu + ig W_\mu + ig' \frac{1}{2} B_\mu \right] \phi$$

Need the B_μ of the form it has to make the neutrino charge zero.

Need to put in a zero charge Z given the results of section 2.1. So Define

$$A_\mu = \cos\theta_W B_\mu + \sin\theta_W W_\mu^1$$

$$Z_\mu = -\sin\theta_W B_\mu + \cos\theta_W W_\mu^1$$

The left handed doublet (eq.1.1) was given by the fractal theory (eq.1.12)

$$l_s = \begin{pmatrix} \nu_{EL} \\ e_L \end{pmatrix}$$

Need to add the second term to the Dirac equation to give the electron mass in eq.7.

$$\Delta L_s = e_R i \gamma^\mu (\partial_\mu - i g' B_\mu) e_R - f_\mu (l_s \phi_s + e_R \phi l_s)$$

The dZ now has a E8XE8 subgroups in its exponent SU(3)XSU(2)XU(1). This is the only subgroup we can use because it is the **one** that only contains that SU(2). Given the constant $\kappa_{\mu\nu}$ the derivative must be zero so the $\kappa_{\mu\nu}$ itself must be *infinite* to have a finite affine connection. Thus we must have infinite fields at least as a limit explaining why also need the Higgs and the SU(2)XU(1) subgroup to generate the W and Z (from section 2.1) in the weak interaction. In this way we showed that the Standard Model of Particle physics GSW is **uniquely** generated by this theory. We also note by setting κ_{ij} =constant we suppressed here the 10^{40} X scale enlargement fractalness, r_H hard shell, Copenhagen interpretation of QM. So we got the GSW where it worked and also the rest of physics that the GSW does not apply to.

16.3 Mass Hierarchy Problem

Note the $\sqrt{g_r}$ approximation in equation 19.3 goes as $1+r/4-r^2/10+$. Thus the $r^2/10$ becomes comparable to $r/4$ when $r \approx 2$ which then corresponds to the maximum strangeness states (section 19.9) of maximum $\sim 2\text{GeV}$ (2P state $n=3$) where the $r/4$ perturbation was used. Also the S state shares an electron giving a sp^2 hybridization, thus providing a charge (nonzero Z_{00s}) even if the state is filled. We must then find the r^2 (factorized) term that gives the $1+r/4+r^2/10$ polynomial (to move up further in energy to states. Set $L = 1/2$ in equation 16.4 to get this mass. Thus the S state of equation 16.3 is exposed to scattering at the very high energy of 143Gev.

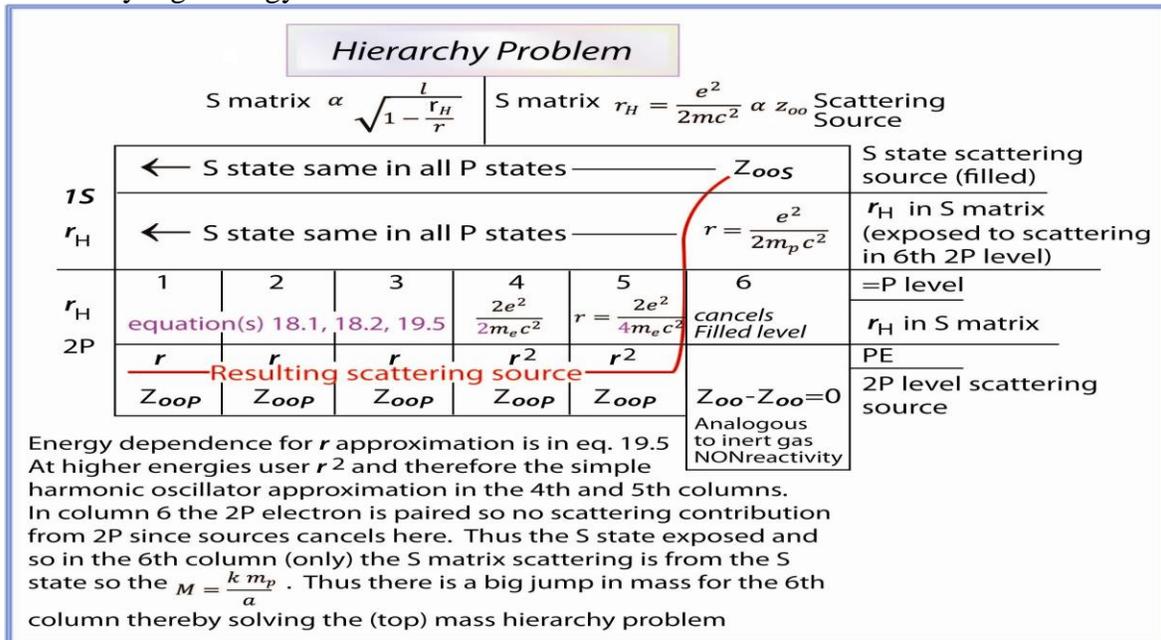
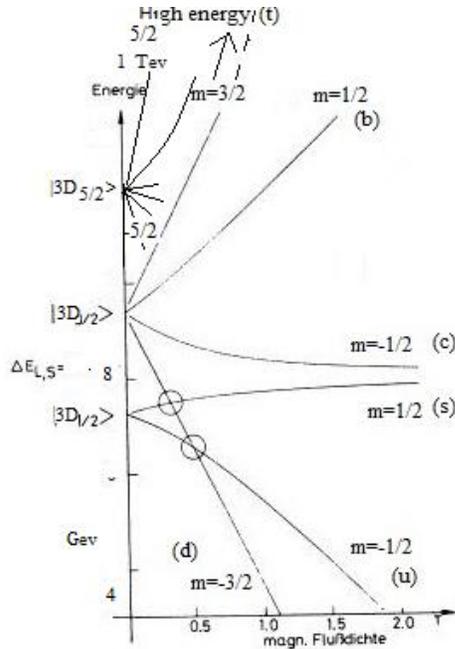


Figure 16-1 The Solution To the Mass Hierarchy Problem For the Top New Particles D States



Review
 $3D_{5/2}$ at $r=r_H$ solution to new pde pentuplet shape. So electrons spend $1/5$ time in each lobe so fractional charge for each lobe. Lobes can't leave, asymptotic freedom, D wave scattering, jets.
 $3D_{5/2}$ new pde state.
 Ultrarelativistic plate so limited azimuthal motion and large magnetic field: hence
 Paschen-Back.
 10 D states then split by this (10 flavors)
 Paschen Back effect.
 $E=E_0+a^2/2n^3\{(3/4n-[(L(L+1)-M_L^2]M_S)/(1+(1/2)(L+1))\}$
 Note the m^2 quadratic dependence of energy here.

Thus to chapter 3 we can add the solution to the mass hierarchy problem for the 6 th 2P state (top).

Note this mass hierarchy result also explains why no higher states than the 2P states are observed since that last energy level of the first 2P state is at 140 GeV.

16.4 No 3D, 4F,... States Until First principle Quantum Number Filled

In that Dirac doublet that comes out of eq.1.2d (also note section 1.5 above) there are two coupled equations. There is also that third singlet electron equation as well coming directly out of equation 1.2a.

Thus these three equations hold simultaneously. That is how I solve them in chapter 19. Note the doublet equations are coupled spinor equations, thus the answer to one effects the other as is the case with typical spinor equations. But the third singlet equation holds all by itself. For low energy and in free space the first two are solved separately from the third.

In the case of being inside r_H , when the full $1+\epsilon+\Delta\epsilon$ mass energy describes a single particle (instead of three separate particles outside r_H) those equations still are solved as two coupled spinor equations and one electron equation.

Some important consequences come out of this. For example we can still solve that single electron equation as a two body problem! Again the spinor equation is solved by itself.

The reason this is important is that we can still treat the proton as a two body problem even given a third (spinor) particle is inside r_H . Thus you can solve equation 18.1 as if it is a two body problem as is done there.

- 1) This allows us to get exact results for nucleon eigenvalues just as the two body hydrogen atom problem is for the most part exact.
- 2) Also the energy is a direct function of the principle quantum number as it is for the hydrogen atom and it cannot go down with higher J unless there is a 3 body state as with the D state. Thus (except for D, F... states) the next principle quantum number has even higher energy. This implies that the aufbau principle has to involve filling a given

principle quantum number N first and then going on to the next principle quantum number. That does not have to happen in three or more body atomic physics as in D states. For example the next principle quantum number can only start filling after the t state is filled, at 140 GeV as above. This and the Lande g factor of section 20.3 explains why there are *few* 3D, 4F, 5G states filling ahead of the first principle quantum number states as occurs in atomic physics in 3 (or more) body systems. Thus we can focus our efforts on that $2P_{3/2}$ state at $r=r_H$ as we have throughout this book.

Summary of Above Derived Particle Properties

COP means coproduction with udsctb, MQ=metric quantization giving state

Name	Energy(GeV)	Charge(e)	Spin	MQ	State	COP
+W	80.2	+1	1	0, 1+ ϵ	P	0
- W	80.2	-1	1	0, 1+ ϵ	P	0
Zo	91.2	0	1	0, 1- ϵ	P	0
T	142	0	0	1, 1- ϵ	P	1
T1	142	0	1/2	1, 1- ϵ	P	0
A1	127	0	0	0, 1-2 ϵ	Z'	0
A2	159	0	0	0, 1+2 ϵ	W'	0
+W	273	+1	1	0, 1+ ϵ $\phi=2\pi$	P	0
- W	273	-1	1	0, 1+ ϵ $\phi=2\pi$	P	0
Zo	307	0	1	0, 1- ϵ $\phi=2\pi$	P	0

The search for the Higgs focused on COP=0, Spin 0, Charge 0 and among those on the list the A1 particle at 127GeV appears to have those properties (Z' decays into Zo and then $\gamma\gamma$ or $-e+e-\mu+\mu.$) even though it is really nothing special.

16.5 Electron E&M Component Of $\sum_M H_M=0=H_N +H_{N+1}$

Section 1.5 and in equations 11.2, 4.15 H_N is the E&M component of $\sum_M H_M=0=H_N +H_{N+1}$ and H_{N+1} is the neutrino component (recall $H_{N+1} \propto \sigma \bullet p$). Thus for the vacuum $\langle H_N+H_{N+1} \rangle = \langle \sum \hbar\omega + H_v \rangle = \langle \sum \hbar\omega + \Delta\epsilon_v \rangle$. Therefore if a set of nearby grounded conducting plates ($V=0$) were set up some of the harmonics in $\sum \hbar\omega$ (given by the distance between the plates and $V=0$ at the surfaces) between the plates would not exist since they don't satisfy the boundary conditions therefore there is less E&M $\hbar\omega$ energy density between the plates than on the outside. But the H_v neutrinos would pass right through the plates therefore there would be a higher density $\hbar\omega$ (E) outside the plates than inside and this condition would be unaffected here by the H_v neutrinos. Thus an inward force on the plates can be calculated. These excluded harmonics and the resulting inward force (dE/dx) are also the assumptions used to calculate the Casimir effect (Casimir,1948). Note that the Casimir effect would exist in this situation even though in equation 4.15. $\sum_M H_M=0$ exactly *outside* this excluded region (far from the region between the plates) in the vacuum. Thus the vacuum has a net *zero* energy [recall $\sum_M H_M=0$]. This means that there is *no net zero point energy* in free space. There are many other reasons for assuming zero net energy for the vacuum (such as the fact that space is essentially 'flat', with the "flatness" problem solved trivially here by $\sum_M H_M=0$) so this *reconciliation with the Casimir effect* is important. Using the above electron $\Delta\epsilon$ and equation 4.15 for the vacuum again: $\sum H_N=H_M+H_{M+1}=0=\Delta\epsilon-\Delta\epsilon_v=0$ for homogenous isotropic background metric.

16.6 Nonhomogenous NonIsotropic Metric Gives Entangled States

By finding the implications of the entangled states in $(\sum H_N)\psi$ you can determine the physical properties of neutrinos. For example:

Entangled States and Chirality For Isotropic and Homogenous Metric

Recall we showed in section 4.6 that a isotropic homogenous space time implies $(H_M + H_{M+1})\psi=0$ (with entangled state eigenfunction $\psi=\psi_\nu+\psi_e$) which implies in turn the left handedness of the beta decay neutrino. See section 4.6 for the derivation of the left handedness.

Furthermore this nonisotropic nonhomogenous metric analysis implied the results of the Casimir experiment. See section 16.5 just above for the derivation of this result.

Entangled States and Mass For NONisotropic NONhomogenous Metric

Recall also from section 4.6 that a nonisotropic nonhomogenous metric provides a source ΔG for $(\sum H_N)\psi= (H_M + H_{M+1})\psi=\Delta G\psi$ (instead of 0ψ) with $\psi=\psi_M+\psi_{M+1}\equiv\psi_e+\psi_\nu$. $H_M\equiv H_e$, $H_{M+1}\equiv H_\nu$. For the entangled state mass m of equation 2.5 the Δm in the KE gained from the gravity potential energy at the earth's surface is $.25eV= GMm/r =\Delta G$ (where M is the mass of the earth, r =earth's radius) and *this quantity ΔG also then multiplies the neutrino eigenfunction ψ_ν* . Thus in addition to the ΔG for the electron we have $H_\nu\psi_\nu =\Delta m\psi_\nu =.25eV\psi_\nu$.and so a electron neutrino mass in the earth's gravity field is $.25eV$. It is about 28 times this value in the sun's surface gravity field. But recall these ΔG gravity fields are also quantized. (section 23.4)

The creation of electron masses in high energy particle interactions comes from the $\Delta\varepsilon$ quantization. the ε quantization is associated with the muon mass creation in these same types of events. The universe itself is associated with the tauon.

Recall that 2D isotropic-homogenous $R_{22}-\frac{1}{2}g_{22}R=\Delta G=0$ argument where the $H_n+H_e=\Delta G$ is over all observable fractal scales. ΔG is the small particle D quantized gravity contribution as well making the H_n (neutrino mass) quantized as well. This is the particle D quantization and is $1/10^5$ the $\Delta\varepsilon$ quantization $.7eV$ and gives the neutrino mass at about $1/100000$ the electron mass.

Both the neutrino and the electron masses are observable in the laboratory and so particle BC and D metric quantization are observable in the laboratory.

Speed Of A Neutrino

Recall in section S above that there is a global nonhomogenous component to gravity created by that $N+1$ fractal scale e^{-kr} expansion. Since for the N th fractal scale $r<r_H$ we have $\omega\rightarrow i\omega$ so that $E=iM_0c^2/\sqrt{(1-v^2/c^2)}$ so that for observable E we have $v>c$ so that $E=iM_0c^2/i\sqrt{(1-v^2/c^2)}$ since the imaginary denominator and numerator components cancel out here Note there that $\omega =2\pi/T$. That T is $\sim 10^{11}$ years so the imaginary proper mass m_0 is computable and very very small in $\omega=m_0c^2/hbar$.

For $m_0c^2=.03eV$ solve for v in $\hbar\omega=m_0c^2/\sqrt{(1-v^2/c^2)}$ solve for v :

$$v=1.000000000000000000000000000046c$$

Entangled States and Amplitude a_i of i th Eigenstate For Nonisotropic Nonhomogenous Metric

Recall the neutrino eigenstates of that H_{M+1} Hamiltonian in section 4.6. Note again the entangled state giving all three ψ s there (muon, neutrino, electron neutrino, tauon

neutrino in the $1+\varepsilon+\Delta\varepsilon\equiv\text{tauon}+\text{muon}+\text{electron}$ term of eq.2.5 for $r>r_H$) with the ground state electron neutrino having the largest eigenstate amplitude a_1 at lowest energy. Thus any one of the three (nth) types of neutrinos have a nth Hamiltonian:

$$H_0\psi=E_n\psi_n$$

for normalized ψ_n s. We introduce a strong *local* metric perturbation $H'=\Delta G$ due to motion through matter let's say so that:

$H'+H=H_{\text{total}}$ where $H\equiv\Delta G$ is due to the matter and H is the total Hamiltonian due to all the types of neutrino in that H_{M+1} of section 4.6. Because of this metric perturbation $\psi=\sum a_i\psi_i$ =orthonormal eigenfunctions of H_0 . $|a_i|^2$ is the probability of being in the neutrino state i . The nonground state a_i s would be (near) zero for no perturbations with the ground state energy a_i (electron neutrino) largest at lowest energy given for ordinary beta decay for example. Thus the passage through matter creates the nonzero higher metric quantization states (i.e., H' can add energy) with:

$$a_k=(1/(\hbar i))\int H'_{ik}e^{i\omega_{ik}t}dt$$

$$\omega_{ik}=(E_k-E_i)/\hbar$$

Thus in this way motion through matter perturbs these entangled eigenstates so that one type of neutrino might seemingly change into another (oscillations) when *in actuality only that particular quantum state amplitude a_k is increasing*.

Chapter 17

17.1 Implications of $g_{00} = 1 - 2e^2/rm_e c^2 = 1 - eA_o/mc^2 v^0$ For Small Relative v Low Temperature Limit

Summary

Recall from chapter 1 and equation 1.9, that new pde $\sqrt{\kappa_{\mu\nu}}\gamma^\mu\partial\psi/\partial x_\mu = (\omega/c)\psi$ contained the new κ_{ij} metric elements. . Recall one such metric term was $\kappa_{00} = g_{00} = 1 - 2e^2/m_e c^2 r$.

Here we find the implications of $g_{00} = 1 - 2e^2/rm_e c^2 \equiv 1 - eA_o/mc^2 v^0$ for the low temperature limit

We do this by plugging $g_{00} = 1 - 2e^2/rm_e c^2 = 1 - eA_o/mc^2 v^0$ into the geodesics

$$\frac{d^2 x^\mu}{ds^2} = -\Gamma_{\nu\lambda}^\mu \frac{dx^\nu}{ds} \frac{dx^\lambda}{ds} \quad (17.1)$$

where $\Gamma_{ij}^m \equiv (g^{km}/2)(\partial g_{ik}/\partial x^j + \partial g_{jk}/\partial x^i - \partial g_{ij}/\partial x^k)$

Derivation

So in general
$$g_{ii} \equiv \eta_{ii} + h_{ii} = 1 - \frac{eA_i(x,t)}{m_e c^2 v^i}, i \neq 0, \quad (17.2)$$

$A'_0 \equiv e\phi/m_e c^2$, $g_{00} \equiv 1 - \frac{e\phi(x,t)}{m_e c^2} = 1 - A'_0$, and define $g'_{\alpha\alpha} \equiv 1 - A'_\alpha/v_\alpha$, ($\alpha \neq 0$) and

$g''_{\alpha\alpha} \equiv g'_{\alpha\alpha}/2$ for large and near constant v. In the weak field $g^{ii} \approx 1$. Also use the total

differential $\frac{\partial g_{11}}{\partial x^\alpha} dx^\alpha = dg_{11}$ so that using the chain rule gives us:

$$\frac{\partial g_{11}}{\partial x^\alpha} \frac{dx^\alpha}{dx^0} = \frac{\partial g_{11}}{\partial x^\alpha} v^\alpha = \frac{dg_{11}}{dx^0} \approx \frac{\partial g_{11}}{\partial x^0}.$$

gives a new $A(1/v^2)dv/dt$ force term added to the first order Lorentz force result in these geodesic equations (Sokolnikoff, pp.304). So plugging equation 17.2 into equation 1, the geodesic equations gives:

$$\begin{aligned} -\frac{d^2 x^1}{ds^2} &= \Gamma_{11}^1 v_1 v_1 + \Gamma_{12}^1 v_1 v_2 + \Gamma_{13}^1 v_1 v_3 + \Gamma_{10}^1 v_0 v_1 + \Gamma_{21}^1 v_2 v_1 + \Gamma_{22}^1 v_2 v_2 + \Gamma_{23}^1 v_2 v_3 + \Gamma_{20}^1 v_2 v_0 + \\ &\Gamma_{31}^1 v_3 v_1 + \Gamma_{32}^1 v_3 v_2 + \Gamma_{33}^1 v_3 v_3 + \Gamma_{30}^1 v_3 v_0 + \Gamma_{01}^1 v_0 v_1 + \Gamma_{02}^1 v_0 v_2 + \Gamma_{03}^1 v_0 v_3 + \Gamma_{00}^1 v_0 v_0 = \\ &\frac{g^{11}}{2} \left(\frac{\partial g'_{11}}{\partial x^1} \right) v_1 + \frac{g^{11}}{2} \left(\frac{\partial g'_{11}}{\partial x^2} \right) v_2 + \frac{g^{11}}{2} \left(\frac{\partial g'_{11}}{\partial x^3} \right) v_3 + \frac{g^{11}}{2} \left(\frac{\partial g'_{11}}{\partial x^0} \right) v_0 + \\ &\frac{g^{11}}{2} \left(\frac{\partial g'_{11}}{\partial x^2} \right) v_2 - \frac{g^{11}}{2} \left(\frac{\partial g'_{22}}{\partial x^1} \right) v_2 + 0 + 0 + \frac{g^{11}}{2} \left(\frac{\partial g'_{11}}{\partial x^3} \right) v_3 + 0 - \frac{g^{11}}{2} \left(\frac{\partial g'_{33}}{\partial x^1} \right) v_3 + 0 + \\ &\frac{g^{11}}{2} \left(\frac{\partial g'_{11}}{\partial x^0} \right) v_0 + 0 + 0 - \frac{g^{11}}{2} \left(\frac{\partial g'_{00}}{\partial x^1} \right) v_0 + O\left(\frac{A_i dv}{v^2 dt}\right) = v_2 \left(\frac{\partial g''_{11}}{\partial x^2} - \frac{\partial g''_{22}}{\partial x^1} \right) + v_3 \left(\frac{\partial g''_{11}}{\partial x^3} - \frac{\partial g''_{33}}{\partial x^1} \right) + \end{aligned}$$

$$\left(\frac{\partial g''_{11}}{\partial x^\alpha} v_\alpha + \frac{\partial g''_{11}}{\partial x^0} v_0 \right) - \left(\frac{\partial g''_{00}}{\partial x^1} \right) v_0 + O\left(\frac{A_i dv}{v^2 dx} \right) \approx - \left(\frac{\partial g''_{00}}{\partial x^1} \right) v_0 + v_2 \left(\frac{\partial g''_{11}}{\partial x^2} - \frac{\partial g''_{22}}{\partial x^1} \right) + v_3 \left(\frac{\partial g''_{11}}{\partial x^3} - \frac{\partial g''_{33}}{\partial x^1} \right) + O\left(\frac{A_i dv}{v^2 dt} \right) \approx \frac{e}{m_r c^2} \left(-\vec{\nabla} \phi + \vec{v} X (\vec{\nabla} X \vec{A}) \right)_x + O\left(\frac{A_i dv}{v^2 dt} \right)$$

Lorentz force equation form $\left(- \left(\frac{e}{m_r c^2} \right) (\vec{\nabla} \phi + \vec{v} X (\vec{\nabla} X \vec{A})) \right)_x$ plus the derivatives of $1/v$ which

are of the form: $\mathbf{A}_i(d\mathbf{v}/d\mathbf{r})/v^2$. **This new term $A(1/v^2)dv/dr$ is the pairing interaction.** (17.3)

creating a spin 0, boson holding a pair of electrons in a orbit around each other. The above Lorentz for approximation holds well for nonrelativistic and nearly constant velocities and low B fields but fails at extremely low velocities so it works when $v \gg (dv/dA)A$. This constraint also applies to this ansatz if it is put into our Maxwell equations in the next section. Given a stiff crystal lattice structure (so dv/dr is large also implying that lattice harmonic oscillation isotope effect in which the period varies with the (isotopic) mass.) this makes the pairing interaction force $A_i(dv/dr)/v^2$. The relative velocity “v” will then be small in the denominator in some of the above perturbative spatial derivatives of the metric $g_{\alpha\alpha}$ (e.g., the $1/v$ derivative of the terms in eq. 17.2 $(A/v^2)(dv/dr)$).

Also in some theories of superconductivity the electrons can share the pairing interaction with other electrons located far away in the superconductor. In BCS and my theory however the two pairing interaction electron bosonization is local to the particular charge perturbation created by the moving crystal lattice Brillouin zone that creates the $A(dv/dr)/(v^2)$ pairing interaction force (eq.17.2).

Note that C is extremely small with this pairing interaction $A(dv/dr)/v^2$ force Bosonization and also for orbital location as in the hydrogen atom since the electrons are then localized. For example the boson may be localized to a specific copper oxide lattice Brillouin zone. Note then for that case in the equation 1 solution $z=[1\pm\sqrt{(-1)^2-4C}]/2$ at $C<1/4$ we are thereby on the dr axis and so dt is zero. Small temperature (as in a BCC crystal) implies small C. Thus temperature will be our new boundary condition giving the C value. Also $\Delta v=a\Delta t$ so that on the r axis $\Delta t=0$ so that $\Delta v=0$ so that the above ‘a’ acceleration caused by time dependent forces has no effect. So time dependent forces ($F=ma$) don’t exist anymore for $C<1/4$. So these bosonized electrons do not (without time dependence) deflect from the atoms they encounter in a lattice, their Debroglie waves pass right by them. There is then no electrical resistance. **Thus (for bosonization states) the abrupt transition from $C > 1/4$ to $C < 1/4$ implies the onset of superconductivity and so we have thereby derived superconductivity from first principles.** Also this explains why electrons in orbits around nuclei appear to be in perpetual motion despite the possibility of collisions with other electrons in the orbitals.

This pairing interaction $A(dv/dr)/v^2$ force also implies that for extremely low relative velocities (in normal mode antisymmetric motion) large pairing interaction forces. So from the above general relativity (eq.17.2) we obtain and spin 0 (BCS) and spin 2 statesⁱ (D states for CuO_4 structure). For example the mass of 4 oxygens ($4 \times 16=64$) is nearly the same as the mass of a Cu (64) so that the SHM dynamics symmetric mode (at the same or commensurate frequencies) would allow the conduction electrons to oscillate in neighboring lattices at a relative velocity of near zero (e.g., $v \approx 0$ in $(A/v^2)(dv/dt)$ making a large contribution to the force), thus creating a large BCS (or D state) type pairing interaction using the above mechanism. Note from the dv/dt there must be accelerated motion (here centripetal

acceleration in BCS or linear SHM as in the D states) as in pair rotation but it must be of very high frequency for dv/dt (lattice vibration) to be large in the numerator also so that v , the velocity, remain small in the denominator with the phase of “A” such that $A(dv/dt)$ remain the same sign so the polarity giving the A is changing rapidly as well. This explains the requirement of the high frequency lattice vibrations (and also the sensitivity to valence values giving the polarity) in creating that pairing interaction force. Other attempts have been made to put in a nonlinear addition to the Maxwell equations (see section 17.3) that only is observable at low temperatures. For example there are the nonlinear Schrodinger equation theories. But in these theories these nonlinear terms were postulated (Chern Simons), not derived as they are here.

Thus we finally understand the pairing interaction in SCs, still the deepest mystery in standard SC theoretical speculations. A QM expectation value between quantum states s, s' : expectation value = $\langle s' | qA(dv/dt)/v^2 | s \rangle$.

Most superconductivity (other than the cuprates) is for single mass m but with alternating spin states between lattice points. Thus Niobium with possible lattice of tin or Germanium (Group 16 of the periodic table) or the nictides with iron in a lattice of arsenic or antimony (group 15). Thus here v is small because the atomic weights are the same. The correct lanthanum, fluorine, doping must be applied to give the morphology required.

Note the recently discovered transition to negative temperature force. Those potassium atoms for certain tweaks of ambient magnetic field at that negative temperature. The negative temperature might be due to jumping from a lower to higher entropy state with the energy going lower. That does happen with a few aufbau transitions in the more complicated elements. Recall the entropy of a state is rigorously defined by $S = \ln W$ where W is the number microstates in the macrostate $\partial u / \partial s = T$ at constant volume with the derivatives all partials. If u final is lower than u initial and ds increases then you have negative temperature here. The vector potential A is provided by the positive valence of those potassium atoms and the dv/dt could be provided by the circular motion $dv/dt = v^2/r$ due to the B field. In the transition to negative temperature v becomes zero in the denominator making the force term large. Since v is so small that dv/dt provided by tweaking the magnetic field could induce this sudden bump up of the energy in that $A(dv/dt)/v^2$ force term.

Also note the v in the denominator of 17.1 and 17.2 and so possible singular behavior there at the lowest temperatures. Thus at extremely low temperatures there exists some of the same type of exotic singularity behavior (e.g., chapter 19) as exhibited near r_H and so seen in high energy scattering. You are studying some of the properties of the high energy extreme then at the very lowest energy extreme!

17.3 Weak Field Approximation

We adopt an ansatz (equation 10.1) $g_{oo} = e^{iA_o}$ (or the Fourier series sum). Also recall from equation 1.6 that $dr/dt = \text{constant}$ so that $\kappa_{rr} \kappa_{oo} = g_{oo} g_{rr}$ is a constant. So we can do the equation 1.3 variation with respect to time (and not r) just as in classical Hamiltonian theory. So from equation 3.5 we have

$$\delta(g_{oo} g_{rr}) = 0 = (\partial(g_{oo} g_{rr}) / \partial t) dt = ((\partial g_{oo} / \partial t) g_{rr}) dt + ((\partial g_{rr} / \partial t) g_{oo}) dt = ((g_{oo} \partial i A_o / \partial t) g_{rr}) dt +$$

$(g_{rr}\partial_i A_r/\partial r)(dr/dt)g_{oo}dt = (g_{oo}(\partial_i A_o/\partial t)g_{rr}dt + (g_{rr}(\partial_i A_r/\partial r)cg_{oo}dt)$. Multiplying both sides by $1/cg_{oo}g_{rr}idt$ gives us:

$$\partial A_o/c\partial t + \partial A_r/\partial r = 0 \quad (17.1)$$

But from the Heisenberg equations of motion equation 10.1 $e^{iu} = e^{i\omega t} \rightarrow e^{i(\omega t - kr)}$ for observer motion v (with $kr \propto vt$) and so each g_{oo} and g_{rr} obeys a wave equation in t $\partial^2 g_{ii}/c^2 \partial t^2 - \partial^2 g_{ii}/\partial r^2 = 0$. For example in free space: $g_{oo}\partial^2 A_o/c^2 \partial t^2 - g_{oo}\partial^2 A_o/\partial r^2 = 0$ and $g_{rr}\partial^2 A_r/c^2 \partial t^2 - g_{rr}\partial^2 A_r/\partial r^2 = 0$ or

$$\partial^2 A_o/c^2 \partial t^2 - \partial^2 A_o/\partial r^2 = 0 \quad \text{and} \quad \partial^2 A_r/c^2 \partial t^2 - \partial^2 A_r/\partial r^2 = 0 \quad (17.2)$$

So we have the (Lorentz gauge, (Pugh, pp.270)) weak field formulation of the free space E&M Maxwell equations in 2D and can generalize to 4D as before.

References

Pugh, Pugh, *Principles of Electricity and Magnetism*, 2nd Ed. Addison Wesley, pp.270

Bjorken and Drell, *Relativistic Quantum Mechanics*, pp.60

Sokolnikoff, *Tensor Analysis*, pp.304

17.4 Recall from section 2.2 The S State Fitzgerald Contraction

S state and equation 1.9: r_H is Lorentz contracted by just NONrotating, straight line $\sqrt{(1-v^2/c^2)}$ from the Lorentz transformation and is again given by $r \rightarrow r_H$ using equation 2.5 multiplication with $1+\epsilon$ (i.e., gives that above $N=2 m_p$ eigenvalue). So for S states and the multiple charges of the tauon, muon and electron:

$$r_S = (2e^2)/(2(1+\epsilon+\Delta\epsilon) m_p c^2) \quad (2.4)$$

Also recall the 2,0,0 state hydrogen eigenfunction

$$\psi_{2,0,0} = \frac{2}{(2a_o)^{3/2}} (1 - r/2a_o) e^{-r/2a_o}$$

Next find center of charge value of $r = \langle r \rangle =$

$$\begin{aligned} \langle r \rangle &= \int_0^\infty r \psi_{2,0,0}^* \psi_{2,0,0} r^2 dr = \frac{4}{(2a_o)^3} \int_0^\infty r (1 - r/2a_o) e^{-r/2a_o} (1 - r/2a_o) e^{-r/2a_o} r^2 dr = \\ &= 4 \frac{(2a_o)^4}{(2a_o)^3} \int_0^\infty r^3 (1 - 2r/2a_o + r^2/a_o^2) e^{-2r/a_o} dr = \frac{4(2a_o)^4}{2(2a_o)^3} \int_0^\infty \left(\frac{r^3}{8} - 2\frac{r^4}{16} + \frac{r^5}{32} \right) e^{-r} dr = \frac{8a_o}{2} \left(\frac{6}{8} - \frac{48}{16} + \frac{120}{32} \right) = \end{aligned}$$

$6a_o$ to find the position of an electron that gives the same QM state energy if put in the classical potential energy analogous to how the role the center of mass plays in torque theory. This is a different radius than the 1,0,0 orbital position at the peak of $\psi^*\psi$, which is the Bohr radius. In contrast for this 2,0,0 state however the radius of its respective 'Bohr orbit' is $4a_o$. Also $6a_o$ is measured from the Compton wavelength λ_c so $6a_o \rightarrow 6a_o + \lambda_c$. Recall from the position that it holds in the standard Dirac equation that the energy (in equation 2.6) goes as:

$$\frac{1}{\sqrt{\kappa_{oo}}} = \frac{1}{\sqrt{1 - \frac{r_H}{r}}} = 1 + \frac{r_H}{2r} - \frac{3}{8} \left(\frac{r_H}{r} \right)^2 - \dots \text{evaluate } r > r_H \text{ at } \langle r \rangle \text{ for 2 charges } (2e) \text{ to reduce to}$$

the ordinary large central mass Coulomb potential in the first order term. Again $1 + \varepsilon = 1.06$. From section 3 of chapter 2 set total energy equal to $[2(1 + \varepsilon + \Delta\varepsilon)m_p c^2]$ and set k to get the Coulomb potential energy for electron moving around heavy central mass

$$2(1 + \varepsilon + \Delta\varepsilon)m_p c^2 / \sqrt{\kappa_{oo}} = \frac{2(1.06)m_p c^2}{\sqrt{1 - \frac{r_H}{6a_o}}} = 2(1.06)m_p c^2 + \frac{4e2e}{2(6a_o)} 2(1.06)m_p c^2$$

$$E_t = -\frac{3}{8} \left(\frac{\frac{4e2e}{k2(1.06)m_p c^2}}{6a_o} \right)^2 2(1.06)m_p c^2 + \dots$$

Note that a 2 gets canceled in the Coulomb term. We are left with $4e^2/r$ in that term and the mass of a tauon, muon, and two electrons plus the 3/8 term. Next subtract off the tauon, muon, masses and their respective $e^2/r + e^2/r = 2e^2/r$ potential energies leaving two electron masses and their $2e^2/r$ contribution. Then divide the 3/8 contribution and what was leftover in the other terms by two to get the single electron mass and standard Coulomb potential contribution. The second term is the ordinary Coulomb potential at $r = 6a_o$ average electron distance for $\psi_{2,0,0}$, given by $e^2/r = e^2/6a_o$ for an electron moving around heavy central mass. Thus to get the hydrogen atom 2S state electron contribution coming out of this we apply this energy relation to just the electron mass energy component in the first term. The last term then equals:

$$\left(\frac{1}{2} \right) \frac{3}{8} \left(\frac{8(8.98 \times 10^9)(1.602 \times 10^{-19})^2}{6((53 \times 10^{-10} + 2.42 \times 10^{-12})2(1.06))(1.673 \times 10^{-27}(3 \times 10^8)^2)} \right)^2 2(1.06)(1.67 \times 10^{-27})(3 \times 10^8)^2$$

$$= 1.83 \times 10^{-26} =$$

$$= hf = 6.626 \times 10^{-34} 27,400,000 \text{ so that } f = 27 \text{ Mhz}$$

Recall also the 1000Mhz component is due to the electron zitterbewegung cloud itself taking up space which we get by adding the Compton wavelength directly into the Coulomb potential radius at $6a_o$.

Thus we account for the entire Lamb shift without evaluating any higher order diagrams as mentioned earlier in section 3.3. We don't need renormalization anymore. We also do not require renormalization and higher order diagrams for the derivation of anomalous gyromagnetic ratio as we see in the next chapter (ch.18). Even though, in principle, we do not need it in general it is better to use it since the fine structure constant α is all that is needed in that multi diagram method and α is accurately known. Recall we derived that old method in chapter 6.

17.5 S Matrix at Energies $\gg 1\text{TEV}$

As in equation 14.1 and section 16.1 even in the ultrarelativistic limit: total energy equals

$$\frac{dt}{ds} \sqrt{g_{oo}} \rightarrow \frac{1}{\sqrt{1 - \frac{\alpha}{r}}} e^{ikr} = V \text{ where we have included the zitterbewegung oscillation } ck \text{ here.}$$

But the mass term must be subtracted to get the potential. With electron rest mass

$$\text{neglected. In this limit } V \text{ is large and can be replaced with } \text{real}V = \left(\frac{dt}{ds} \sqrt{g_{oo}} - 1 \right) \cos kr$$

$=V$ so in the one vertex S matrix we have then to evaluate the integral of

$$\left(\frac{dt}{ds} \sqrt{g_{oo}} - 1 \right) \cos kr \text{ instead of the integral of the usual coulomb } V \text{ as in standard QED.}$$

In evaluating this integral we use the integrals in spherical coordinates

$dVol = r^2 \sin \theta dr d\theta d\phi$. So in the one vertex S matrix the integral coefficient goes for the r component:

$$\int V dVol = \int \left(\frac{1}{\sqrt{1 - \frac{\alpha}{x}}} - 1 \right) x^2 \cos kx dx =$$

$$\int \left(\frac{x^2}{\sqrt{1 - \frac{\alpha}{x}}} - x^2 \right) \cos kx dx = \int \left(\frac{x^{5/2}}{\sqrt{x - \alpha}} - x^2 \right) \cos kx dx$$

But for $k=p/\hbar \rightarrow \infty$ we have a very rapid oscillation allowing us to write the integral for the envelope and then divide by 2 at the end to get an approximate value of the integral magnitude which is all we need here to demonstrate asymptotic behavior. Thus for $k \rightarrow \infty$ we can drop the $\cos kx$ term.

So we have (recall $\int x^2 dx = x^3/3$) we

$$\int \left[\frac{x^{5/2}}{\sqrt{x - \alpha}} - x^2 \right] dx = \frac{x^{5/2} \sqrt{x - \alpha}}{3} + \frac{5\alpha}{6} \int \frac{x^{3/2}}{\sqrt{x - \alpha}} dx - \frac{x^3}{3} =$$

$$\frac{x^{5/2} \sqrt{x - \alpha}}{3} - \frac{x^3}{3} + \frac{5\alpha}{6} \left(\frac{2x^{3/2} \sqrt{x - \alpha}}{4} + \frac{3}{4} \frac{2\alpha}{\sqrt{-1}} \ln(\sqrt{x} + \sqrt{x - \alpha}) \right)$$

In the limit of high energy and closest approach impact parameter (so $x \rightarrow \alpha$) this equals

$$-\frac{\alpha^3}{3} + \left(\frac{3}{4} \frac{2\alpha}{\sqrt{-1}} \ln(\sqrt{\alpha}) \right) = \text{constant cross-section with that underlying rapid } \cos kx \text{ oscillation.}$$

Including the effect of the usual resonances for proton, CBR photon interaction we must go

$$\text{one step further and equation 19.22 note } \frac{dt}{ds} \sqrt{g_{oo}} \rightarrow \frac{1}{\sqrt{1 - \frac{\alpha}{r}}} \rightarrow \frac{1}{\sqrt{1 - \frac{\alpha}{r} - \epsilon'}} \text{ with } \epsilon' = (4/3)\epsilon.$$

and the pion mass calculation $=\varepsilon'$ resulting in equation 19.22 center of mass energy 1.08 GeV and so the Δ resonance pion photo-production put in:
(Pion photoproduction Energy)/CBRphoton energy = $2.23 \times 10^{-11} / 2 \times 10^{-22} =$
GZK/(Proton rest mass Energy) = $GZK / 1.5 \times 10^{-10}$. So $GZK = 1.04 \times 10^{20}$ eV.
Need to include pion photoproduction of the Δ energy in this S matrix for completeness.

P Wave Scattering and Jets In 100GeV Gold-Gold Collisions

Let $\langle A' |$ represent the outgoing scattering wave immediately after a incident plane wave scatters off V. Let $|A\rangle$ be the $2P_{3/2}$ hyperon state for $r=r_H$ having the V. Thus at $r=r_H$ V itself will have the $2P_{3/2} * 2P_{3/2} = \psi * \psi$ trifolium shape and thus commute with $|A\rangle$ since they constitute the same structure ($2P_{3/2}$ commutes with itself). So since V commutes with $|A\rangle$ then $\langle A' |$ also is a $2P_{3/2}$ state or we have $\langle A' | V | A \rangle = 0$ and so no scattering into such states. Thus a type of 'P wave scattering' results from an incident plane wave. Thus we explain the origin of the 'jets' that are otherwise ascribed to scattering off quarks. Note that when the mean free path d during the interaction time is very short ($d \ll (1/3) 2\pi r_H$) there is no more smearing between the $2P_{3/2}$ lobes and we have scattering off of independent point particles and the $2P_{3/2}$ state ceases to be relevant in the scattering and so the jets disappear. (jet quenching). Thus at extremely high energy the scattering is from charge e (not $1/3e$) again and there are no more jets above top energy. LEP actually observed this effect just before it was shut down.

17.6 Separation of Variables On Equation 1.9

Recall for object A B and C that object A and C in the $2P_{3/2}$ state are ultrarelativistic. Thus they are plates and each only intersects object B. Thus they do not repel each other and so we can have a bound state. Note that all object A sees of object is its effect on the inertial on object B, effectively making object B appear heavier with object C's field a mere perturbation. Thus we can treat this three body baryon problem as a really a two body (two point) problem with a field perturbation. In that regard recall we added a second point in section 1 to get equation 4.our pde and that 4 degrees of freedom. So in $dr+dt=dr-\varepsilon/2 + dt+\varepsilon/2$ we are still in the Z plane since two points and the origin are still in a plane, Thus in the case of a second point we have dr plus something and dt plus something. So we have a first point plus something (that is not out of the plane) so that

$$\begin{aligned} (dr-\varepsilon/2+dt+\varepsilon/2)+(dr-\varepsilon/2) \pm \varepsilon'/2 + (dt+\varepsilon/2) \pm \varepsilon'/2 &= \\ dr' + dt' + dr' \pm \varepsilon'/2 + dt' \pm \varepsilon'/2 &= \\ dr' + dt' + dr'' + dt'' & \end{aligned}$$

which is equivalent to just adding another point dr'', dt'' in 2D. $\varepsilon = .06$ here.

So $\kappa_\pi = (dr/dr'')^2 = (dr/(dr-\varepsilon/2 \pm \varepsilon'/2))^2$ and so the sign on the $\pm \varepsilon$ determines whether the charge is zero or unit e. We use this result in our S matrix derivation. Also

$$((dr-\varepsilon/2) \pm \varepsilon'/2)^2 + ((dt+\varepsilon/2) \pm \varepsilon'/2)^2 = dt^2 + dr^2 + ((-\varepsilon/2) \pm \varepsilon'/2)dr - ((-\varepsilon/2) \pm \varepsilon'/2)dt =$$

Note we can have a zero and nonzero charge in the 3rd quadrant (where $dt=dr$) massive Proca boson case given the possibilities in sign we have for $\pm \varepsilon'/2$ in

$$((-\varepsilon/2) \pm \varepsilon'/2)dr - ((-\varepsilon/2) \pm \varepsilon'/2)dt.$$

In the first quadrant $ds=0$ again (section 1) so they have to add to zero.

No spectacular result here but at least we see why the plus and minus in $\pm \varepsilon$ determines whether you have zero or nonzero charge in multiparticle systems. This result is used a lot in Part III below also.

Separation Of Variables

Here we use separation of variables on

$$\Sigma_{\mu}(\sqrt{\kappa_{\mu\mu}}\gamma^{\mu}\partial\psi/\partial x_{\mu})-\omega\psi=0, \text{ with } \kappa_{00}=1/\kappa_{rr}=1-r_H/r \quad (1.9)$$

Note from chapter 5 we can begin the derivation of equation 1.9 with:

$$ds^2 = \kappa_{rr}dr^2 + r^2d^2\theta + r^2\sin^2\theta d^2\phi - \kappa_{00}c^2 dt^2$$

$\kappa_{00} = 1-r_H/r$ and $\kappa_{rr} = 1/\kappa_{rr}$. Note in the linearization no κ_{ij} s will be in front of the angle terms. Thus we can show that we can separate out (i.e., use separation of variables) the angle terms and that the ψ will then be of the form $\psi=F(r,t)\Theta(\theta)\Phi(\phi)$. Thus our $2P_{3/2}$ state at r_H result is indeed a solution to equation 1.9. We also can write:

$$ds^2 = \kappa_{rr}dr^2 + r^2d^2\theta + r^2\sin^2\theta d^2\phi - \kappa_{00}c^2 dt^2 = dr'^2 + r^2d^2\theta + r^2\sin^2\theta d^2\phi - c^2 dt'^2$$

When the quantum operator condition is used $p_r \rightarrow \sqrt{\kappa_{rr}} p_r = \sqrt{\kappa_{rr}} \partial/\partial r \equiv \partial/\partial r'$. Thus using r' and t' we can do the standard separation of variables for the standard Dirac equation. At the end the $\sqrt{\kappa_{rr}}$ s are put back in and we get for the radial component of the Dirac equation:

$$\left[\left(\frac{dt}{ds} \sqrt{g_{00}} m_p \right) + m_p \right] F - \hbar c \left(\sqrt{g_{rr}} \frac{d}{dr} + \frac{j+3/2}{r} \right) f = 0$$

$$\left[\left(\frac{dt}{ds} \sqrt{g_{00}} m_p \right) - m_p \right] f + \hbar c \left(\sqrt{g_{rr}} \frac{d}{dr} - \frac{j-1/2}{r} \right) F = 0$$

We next take into account that r' denominator in the centripetal term. We do this by finding the gyromagnetic ratios gy for the spin polarized $F=0$ case. Recall the usual calculation of rate of the change of spin S gives $dS/dt \propto m \propto gyJ$ from the Heisenberg equations of motion. We note that $1/\sqrt{g_{rr}}$ rescales dr in $\left(\sqrt{g_{rr}} \frac{d}{dr} + \frac{J+3/2}{r} \right) f$. Thus to

have the same rescaling of r in the second term we must multiply the second term denominator (i.e., r) and numerator (i.e., $J+3/2$) each by $1/\sqrt{g_{rr}}$ and set the numerator equal to $3/2+J(gy)$, where gy is now the gyromagnetic ratio. This makes our equation compatible with the standard Dirac equation. The effect of this r' term then is to alter the gyromagnetic ratio from the nominal value of 2. This method is used in the next chapter. Note the direct derivation of the low temperature results (section 17.1) and high energy results summarized in chapter 3. See figure 17.1 for how this contrasts with the mainstream approach.

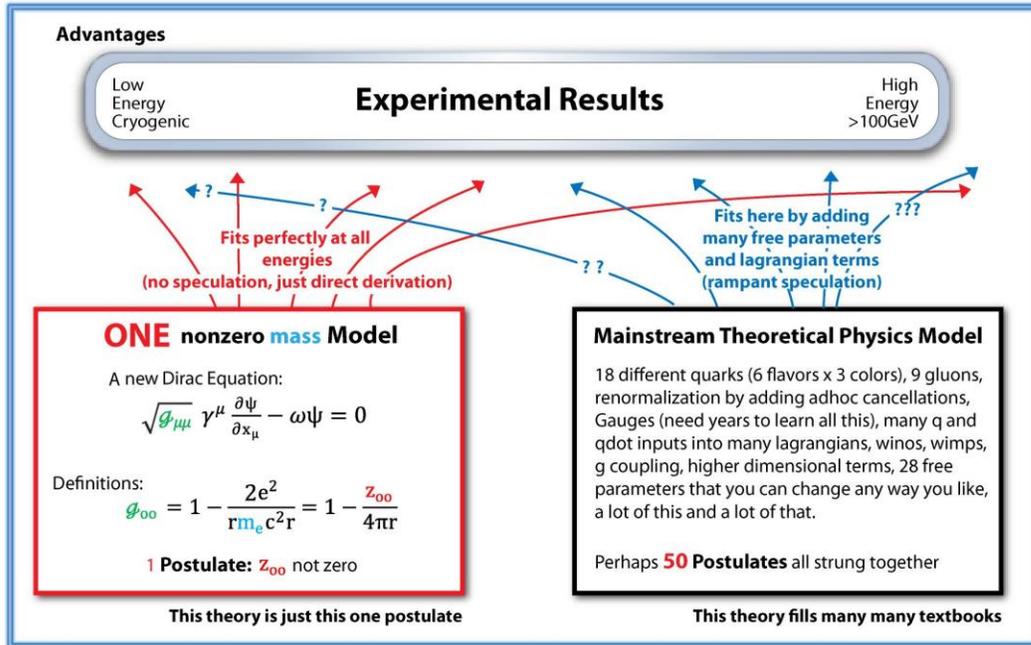


Figure 17-1 Comparison of new pde model with standard model and strings
17.7 Summary of Derivations From the New Pde

Even though there are no gauges in this theory the consequences of the SM standard gauges (such as SU(3)) can be derived from this theory as we have seen. In figure 17.1 below is a summary of these derivations. For example SU(3) comes from that new pde (equation 1.9) $2P_{3/2}$ at $r \approx r_H$. as we see in figure 17-2.

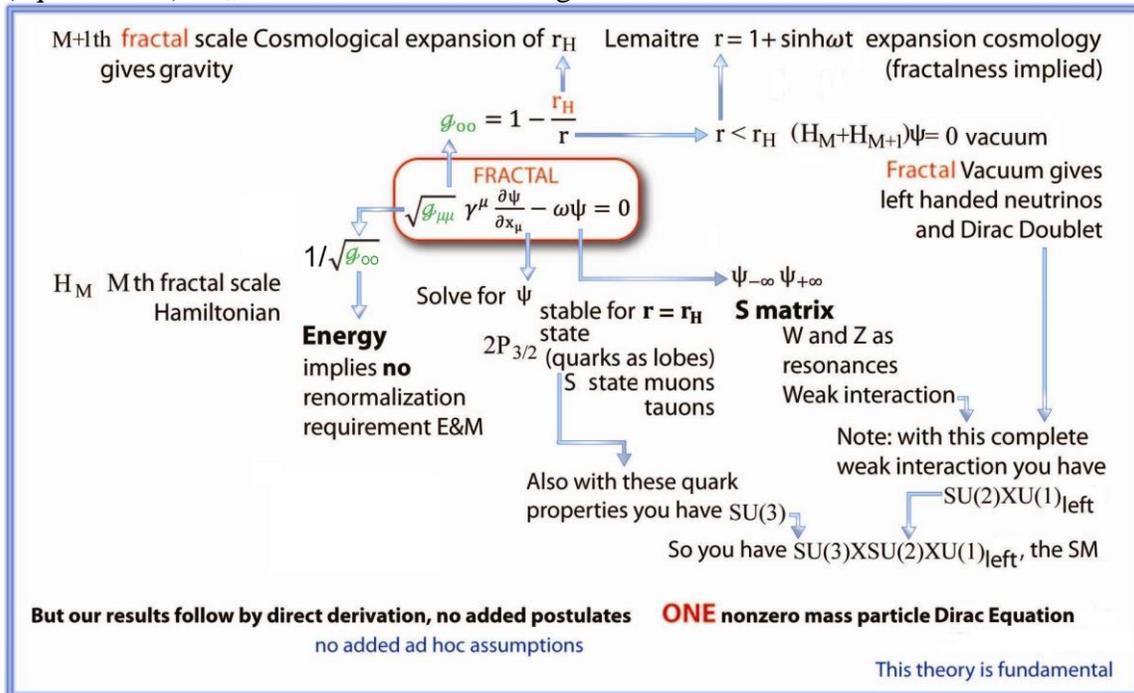


Figure 17-2 Summary of Derivations from equation 1.9

ⁱ Weinberg, Steve, *General Relativity and Cosmology*, P.257