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Newton-Fermi versus Fermi-Planck compactification: superunification by scaling electrical with earth-bound gravitational forces.

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in memory of Arend Rutgers, deceased in 1998

Abstract. Absolute scaling electrical with gravitational forces has remained unsuccessful until today. Using recent results on scaling spectroscopic constants, we now scale the internal electrical potential of a two-particle system by its gravitational potential at the surface of the earth. This relative scaling is based upon classical equilibrium conditions. Compactifying earth-bound gravitation (the Newton-scale) to the Fermi-scale in particle interactions is of the same order of magnitude as going down from the latter to the Planck-scale. The unification scale factor for gravitational and electromagnetic forces is of the order of 2?. The unification scale factor for two vibrating particles is the reciprocal of Sommerfeld?s fine structure constant and gravitational forces are then weak electromagnetic forces. The earth-bound gravitational energy asymptote is the natural energy unit for the relativistic fine structure and the magnetic spin-orbit interaction in atoms. Maybe, in the Standard Model and beyond, one has been looking in the wrong direction for compactification to attempt superunification.

Introduction

Despite early attempts by Weyl, Kaluza and Klein, unifying gravitational and electromagnetic forces is still the Holy Grail of Physics[1]. Superunification remains the ultimate scaling challenge in science, since 3 fundamental forces (electromagnetic, weak and probably also strong) can be unified in the Standard Model [2,3,4]: only gravitation always stands aside. Formal unification attempts[1] by Weyl, Kaluza and Klein in the beginning of this century remained unsuccessful largely because of scale differences. In fact, using first principles, the ratio of electrical and gravitational asymptotes for protons

$$e^2/Gm^2_p = 1.26*10^{36} \quad (1)$$

even increases with a factor of 1836^2 for electrons. A proton-electron system still gives a very large number, $2.27*10^{39}$. These immense figures reflect a basic need for compactification as a conditio sine qua non for unification. According to (1), gravitation is by far the weaker force and large energies (TeV) are now being explored to detect gravitation effects in particle interactions. It is expected that the 4 forces converge at the Planck-scale, determined by the Planck mass $M_P = ((hc/2\ ?\ )/G)^{1/2}$, obtained from an equation similar to (1). As an example, M_P determines the string scale in weakly coupled heterotic string theory. These expectations are based upon a compactification of the Fermi-scale (10^{-10} cm) down to the Planck-scale (10^{-33} cm). At this scale, superunification may well be achieved, looking at the consecutive successes of supersymmetric, string and superstring theories[3,4]. Nevertheless, gravitation always gives attraction whereas electrical forces are either attractive or repulsive. On the other hand, weak[5] and strong[6] anthropic cosmological principles[7] and the concept of viable domains might give an alternative explanation for the values of the fundamental constants, if these are indeed linked to the development of life. Anthropic principles have many pros and cons but will not be discussed here.

In this paper, we argue that (1) is not a valid scaling operation. First principles can lead to relative scaling of gravitational with electrical forces using a different compactification scheme. We will call this Newton-Fermi instead of Fermi-Planck compactification. The Newton-scale refers to the gravitational equipotential surface of the earth.

Absolute and relative scaling: the Kratzer potential as an example

Scaling by first principles as in (1) remains difficult to justify as early recognized, also formally, by Weyl, Kaluza and Klein. Part of our argumentation is based upon recent results for scaling unrelated asymptotes in molecular spectroscopy[8]. For decades, a low parameter universal potential (here called the Holy Grail of Spectroscopy[9]) is badly needed to scale the spectroscopic constants. Dunham?s oscillator representation[10] reproduces the lower order spectroscopic constants almost exactly but behaves completely wrong at large separations, where it leads to infinity instead of to the observed dissociation limit. Many believe a sophisticated potential is needed[9,11,12] to scale Dunham?s properly. However, we showed[8] that even a simple Kratzer potential[13], for which the wave equation can be solved, has the required universal characteristics. In classical form, Kratzer?s function (2a)

$$U(R) = -a/R + b/R^2 \quad (2a)$$

is valid for atoms (rotators) and is a generalization of Bohr's atomic model, with the quantum hypothesis included[8,14]. The reduced form (2b)

$$U(R)/U(R_e) = (1-R_e/R)^2 \quad (2b)$$

applies to more complex systems (rotating vibrators), such as molecules[8], if the a-value in (2a) is adapted. Now, (2b) is a very simple potential, but it is nevertheless superior[8], in a generalized form due to Varshni[11], to the well-known Morse-potential, believed to be one of the best available in molecular spectroscopy. But (2b) refers to a not observable, virtual ionic external asymptote, which is different from the observed asymptote, the atomic dissociation limit. The Kratzer asymptote in (2b) is always close to e^2/R_e and, despite this simple form, scales the constants of hundreds of molecules efficiently[8]. Absolute scaling as in (1) is not in line with the universal character of the Kratzer potential. In fact, the reduced form (2b) gives a description of the general implications of two-dimensional scaling. With a=2b and $R = nR_e$, n being a number, we obtain (3)

$$U(R)/(a/R_e) = (1-1/n)^2 \quad (3)$$

In the case of (1), a in (3) is either e^2 or Gm_p^2, *whereby R_e is assumed the same in both cases*. We are indeed free to use any asymptote (a/R_e), as long as it correctly accounts for the shape of the observed potential energy curve (PEC) (3), whatever the scale used. Applying these minimal scaling conditions to different a-values, it is readily verified that scaling e^2 with Gm_p^2 is not allowed, unless the particle separation in the two force fields is scaled accordingly or is, eventually, *compactified*. Eqn. (1) seems based on first principles, but in reality it is not and the large number 10^{36} it produces has no real physical meaning, if the scales of the two force fields are very different. This is apparently the case:

compactification can not be avoided in any attempt at superunification. Eqn. (3) states that the universal PEC is given by $(1- 1/n)^2$, or, instead of (1), relative scaling is to be used

$$e^2/R_{e1} = Gm^2/R_{e2}$$

The equilibrium bond length in one system R_{e1} is not equal to R_{e2} in the other, unless (1) is equal to 1, which it is obviously not the case. Alternatively, Eqn. (1) gives the ratio of two equilibrium distances for the same system

$$e^2/Gm^2 = R_{e1}/R_{e2} \quad (4a)$$

in properly scaled potentials: one of them refers to the real, the other to a compactified system. The value of this ratio, 10^{40} is still beyond imagination. For the Planck-scale, compactification is of the order 10^{21} with respect to the Fermi-scale. The problem is to find out if and how gravitational and electrical forces can be scaled in an alternative way, reminding that the description of the PEC of the system with either force must be the same. Absolute scaling (1) leads to unrealistic results. Relative scaling of a/R with a'/R' is the only scaling process allowed.

In modern physics, compactification consists in scaling the Fermi-scale of 10^{-10} cm down to the Planck-scale of 10^{-33} cm. This requires the invention and the intervention of an extremely heavy particle with mass M_P and an incredibly small interaction range, both not yet observed. In this work, we compactify systems in the opposite way and use observed ranges and (particle) masses. We zoom in from gravitationally earth-bound particles (which we call an earth- or Newton-scale) down to the Fermi-scale. There is classical evidence that this is an allowed compactification scheme, i.e. from the extremely large to the normal (Fermi). The Standard Model and beyond relies upon compactification in the opposite direction, i.e. from he normal to the extremely small (Planck).

Compactifying the gravitational equipotential surface of the earth down to the Fermi-scale

Reminding that the underlying physics of a Kratzer potential is Coulomb attraction between two point charges[8], the corresponding classical asymptote e^2/r_e governs interatomic molecular vibrations[8,14]. However, *external* effects of comparable energy, such as heat also balance these *internal* interatomic vibrations.

In classical and well-known Boltzmann distributions[15] heat (thermal agitation, kT) is a scaling aid for these two totally different asymptotes:

a) for *internal* energies, as in the Planck-Einstein[15] quantum theory of the specific heat of diatomic molecules, and

b) for *external* energies, as in earth-bound gravitation.

Through the intermediary of kT, this implicit classical connection between in- and external forces is in support of relative scaling (4b) at the expense of absolute scaling (1) and, implicitly, of compactification *avant la lettre*.

The distribution of molecules in the external gravitational field of the earth, if $h = R-R_E$, is given by

$$n(0).e^{-mgh/kT} \quad (4b)$$

or, the external earth-bound gravitational energies of molecules are balanced by thermal agitation kT (heat).

The distribution of the internal energy levels of molecules is similarly given, if f is the frequency of vibration, by:

$$n(0).e^{-hf/kT} \quad (4c)$$

or, the internal molecular energies (levels) of the same molecules, obeying (4b), are also balanced by kT as in (4b).

Eliminating kT from (4b) and (4c) gives a dependency as a function of

$$\sim (e^{mgh/hf}) \quad (4d)$$

These two energies (or asymptotes) are:

a) *mgh*, a difference in earth bound gravitational potential energies for molecules with mass m, of which the eigenvalue is clearly Newton's

$$-GM_Em/R_E \quad (4e)$$

if M_E and R_E are the earth's mass and radius respectively;

b) *hf*, a difference of the internal energy levels of a quantum system, say a diatomic molecule with mass m. Although this is a more complicated matter, we expect the leading term here to be expressible in terms of a Coulomb eigenvalue

$$-e^2/r_e \quad (4f)$$

where e is the elementary charge and r_e the interatomic distance. This first order approximation is justified by recent results on the spectroscopic constants of hundreds of diatomics[8] using the Kratzer potential (see above).

For almost a century, the validity of the two distribution laws (4b-c) is well established. Hence, Eqn. (4a) can be valid, whatever its consequences. One of these is the direct confrontation of (4e) with (4f) or we can ask if the identity

$$-GM_Em/R_E = e^2/r_e \quad (4g)$$

makes sense. This new version of (4a) refers to an inverted, i.e. Newton-Fermi, compactification

scheme, which we will examine here in the context of superunification.

We observe that the ratio $(M_E/R_E)/(m_p/r_B)$ is about 10^{36}, of the same order as (1). This means that the center of mass of a system m_p,M_E is not given by its classical definition $m_pR_E = M_Er_B$ but by a scaled definition, whereby the scale factor is of the order of (1). For an electron-proton system, this could bring us from absolute scaling (1) to relative scaling, like in (4h)

$$GM_E(m_p+m_e)R_E = e^2/r_B \quad (4h)$$

We show below that scaling these asymptotes leads to very manageable scale factors. Beyond any doubt, earth-bound gravitational forces play and have always played a basic role in various (historical) experiments. These apply to particles, to various electrical and magnetic phenomena (of which the simple necessity of grounding electrical apparatus is a practical consequence), to intra- and intermolecular behavior and even to the determination of the values of fundamental constants, such as Avogadro's and the elementary charge (Millikan's experiment). Our observations are always, in some way, scaled by constants related to (the gravitational field of) the earth. Newton?s constant G and even its earth bound local derivative g are listed invariantly as fundamental constants[16].

We will base our discussion mainly on a comparison of energies (asymptotes), easily obtained classically and from first principles. This will help to decide whether our scheme of relative scaling is useful for superunification or not. We will not discuss the transformations, symmetry effects or other side-aspects accompanying this relative scaling operation, which are well known. In fact, in their formal unification attempts, Weyl, Kaluza and Klein described the transition from gravitational to electromagnetic systems many years ago by showing that adding a fifth dimension to the classical four of GTR (space-time) suffices. Their unification attempts, however, failed because of the large-scale difference (1) between the forces.

Scaling down the level of earth bound gravitation (Newton-scale) to that of electrical particle interactions (Fermi-scale) does not require any new or unknown quantities (except the scale factor itself), whereas scaling from the Fermi-scale down to the Planck-scale does. Nevertheless, the order of magnitude of compactification in either case is almost the same (about 10^{21}). If valid, the direction of compactification in the Standard Method and beyond may be in need of revision. If not, there must at least be some kind of symmetry or an analogy between the two compactification schemes.

Relative scaling of particle properties with the compactified equipotential gravitational field of the earth

(i) First, consider a particle with mass m at the equipotential surface of the earth and let the mass of the earth be concentrated at the center of an empty sphere. There is no friction between the particle and this imaginary earth-surface. We deal with a vacuum (an atom like system). The particle is bound to the earth (center of mass reference frame, rotation) and moves with a velocity v_g, obeying the classical equilibrium condition (5)

$$m?v_g^2 = GM_Em/R_E \quad (5)$$

where the reduced mass m' is $M_Em/(M_E+m)$. The velocity v_g is

$v_g = (GM_E(1+m/M_E)/R_E)^{1/2} = (GM_E/R_E)^{1/2}$ (6)

since $M_E >> m$. This velocity is independent of particle mass, especially if m is a (sub-) atomic particle, and applies to any location on the imaginary earth surface. The particle would be free to move with this velocity (6) in any direction, as long as it remains on the equipotential surface of the sphere.

(ii) Two particles with the same mass m in the same situation, i.e. having the earth as a common center of attraction, will form a system of coupled resonating oscillators in a degenerate state, since the initially uncoupled frequencies and velocities are equal, see (6). Whatever the particles' initial separation (maximum half the earth?s circumference, projection its diameter) and whatever the initial direction of their movements, the slightest attractive force (gravitational coupling) between the two will govern their motion on the surface. This will bring them closer together on that surface, at an equilibrium distance largely determined by the particles' dimensions (masses*). This is an almost natural compactification process, so badly needed to achieve superunification.* Ultimately, this will lead to a system consisting of two bound particles with an apparent *internal* potential energy and a center of mass reference frame of its own, exactly as the one needed for our purpose. The connection between the internal and the external potential energy of the two-particle system is the gravitational field of the earth. A repulsive force would keep the particles apart at the maximum separation possible on the equipotential surface (half the earth?s circumference, projection its diameter). In either case, the earth bound gravitational potential energy is conserved throughout, since m/M_E is negligible for atomic particles, as long as both particles remain on the surface of the sphere. Since a Kratzer potential applies for rotators as well as for vibrators (see above), similar asymptotes can be used for describing both (i) and (ii).

(iii) But, the earth does not have a smooth surface and its mass is not concentrated at the center. Particles at the surface of the earth do not move with a velocity (6), required by (5). Particles at the surface of the earth are at rest, if we neglect the rotation of the earth. Weyl and Kaluza once described this as *Ruhe im Grob en*. Close to one another and at most with a virtual velocity (6), particles remain at rest due to the close packing at the earth surface (almost like in a traffic jam, where cars are at rest with the engine still running). In fact, each particle theoretically still belongs to a center of mass reference frame with the earth, as under (i)-(ii), see (6). Their bonding partner, the earth, secures that the two particles can still be considered as coupled but, in reality, as extremely damped oscillators, in contrast with the ideal situations (i)-(ii).

(iv) Particles at rest on the surface of the earth can only show their damped earth-coupled vibrations (now *Unruhe im Kleinen*) in a smaller or compactified, system with a new center of mass reference frame. This is a scaled projection of the gravitationally bound systems (i)-(ii). When this new system is properly excited, its characteristics must become visible. If our derivations are valid, one of these characteristics should be an apparent, though scaled, connection with earth bound gravitation. In fact, also the new and compactified center of mass reference frame remains coupled with the mass of the earth. Combining (i)-(iv) with the discussion of the two Boltzmann distributions given above, validates our attempt to apply relative instead of absolute scaling or to apply a Newton-Fermi compactification scheme.

Results of relative scaling

(a). A hydrogen-like system, described by Newton and by Coulomb forces.

Scaling the internal asymptote must be achieved with a new force F, with different attracting agents (charges, not masses). Using Coulomb forces, we obtain

$F = q^2e^2/r^2$ (7)

where e is the elementary charge, q a charge scale factor and r the inter-particle distance in the new system. Contrary to (1), scaling this hydrogen like system with r approximated by r_B, the Bohr-length, gives

$GM_E(m_e+m_p)/R_E = q^2e^2/r_B$ (8)

resulting in

$q = 41^{-1/2} = 1/6.4$ (9)

This scale factor of about 1/2? is certainly more manageable than 10^{39}. However, despite this efficient normalization of forces when compared with (1), result (9) in itself can not directly be correlated with existing parameters or constants (unless for a rough approximation with 2p , deviation < +2 %). This might be due in part to the fact that r in (7) is a function of the reduced mass. We can solve this using masses and velocities, since Bohr?s theory gives:

$e^2/r_x = m_x' v^2_e = m_x' a^2c^2$ (10)

where a is Sommerfeld?s fine structure constant. Eqn. (10) is similar to Eqn. (5).

(b). Scaling by asymptotes m?v^2 (reduced masses and velocities).

First, for an accurate calculation of v_g from (6), a few effects can not be neglected. Tidal effects (moon, sun?); variation of g (=GM_E/R_E^2) with latitude (oblateness of the earth of about 1/300); temperature; atmospheric conditions (friction); the fact that there is no vacuum? are the most important. A particle at the surface of the earth belongs to the earth-moon gravitational system. To simplify the argument, we assume that earth and moon were once a single planet and use the sum of the earth and moon masses, instead of the earth mass M_E alone. Introducing the ratio $M_E/M_M = 81.2$ corresponds with a maximum deviation of only +0.6 % for v_g. We use the polar radius of the earth, which results in a maximum deviation of +0.2 % for v_g, with respect to the equatorial radius. The combined deviation is about +0.8 %, which is acceptable and easily retraceable. Under these conditions[16], the value of (6) is

$v_g = 7.97*10^5$ cm/sec (11)

about 17 times the earth's rotational velocity of $4.64*10^4$ cm/sec at the equator.

Second, in view of (10), the universal electromagnetic velocity v_e of a particle in an electrically bound system (center of mass reference frame, Bohr theory) is also mass independent and is given by

$v_e = a\ c = 2.19*10^8$ cm/sec (12)

The ratio x_{eg} of these two universal velocities, electromagnetic v_e and gravitational v_g, is

$x_{eg} = v_e/v_g = 274.58$ (13)

Unlike (9), this scale factor is almost equal[17] to $m_{pion}/m_e = 273.1315$ (deviation +0.53 %), to $1+ m_{pion}/m_e$ (+0.17 %) or to[16] $2/a = 274.07$ (+0.19 %).

(c). Case (i), discussed above.

Here, for a particle with mass m_g in a M_E,m_g-system, the external gravitational potential can be scaled by the internal potential of an alternative m_1,m_2-system, wherein a particle m_1 is bound by Coulomb forces to m_2. If $m_2 >> m_1$ (rotator), equating the two asymptotes gives

$m?_g v^2_g = m_g v^2_g = m?_{12}\ v_e^2 = m_1 v_e^2/(1+m_1/m_2)$ (14a)

With m_1 equal to the electron mass m_e, we obtain for the unifying particle a mass m_g

$m_g = m_1(v_e/v_g)^2/(1+m_1/m_2) = 75{,}397.74 m_e/(1+m_e/m_2)$ (14b)

If $m_2 >> m_e$, the mass of this neutral particle is 38.53 GeV, if the electron mass is taken as the reference point. This unifying particle seems to have a mass comparable with that of expected or observed intermediary particles (Higgs, bosons) of the Standard Model. For the case of positronium (vibrator), the conversion factor reduces to 37,698.87, half the value in (14b). Using the pion mass as a reference particle, this mass increases to over 10 TeV. Intermediate values are possible, for instance for vibrators. If the unifying particle is itself a composite particle (vibrator), the conversion factor can even reduce to 18,849.43. Some results are given in Table 1.

Table 1. Predicted unifying masses M_U for some reference masses M

Reference particle (type)	M (Mev)	M_U=M*75,398 (M*18849)
Electron (vibrator, positronium)	0.255	19.26 (9.63)[a] GeV
Electron (rotator)	0.51	38.53 GeV
Muon (vibrator, muonium)	52.83	3.98 (1.99)[a] TeV
Muon (rotator)	105.66	7.97 TeV
Pion (vibrator)	69.78	5.26 (2.63) [a] TeV
Pion (rotator)	139.57	10.52 TeV[a]

[a] see text.

The first two rows in Table 1 correspond with masses below the 95 CL for the Higgs mass[17]. The second is about half the lighter of the two observed gauge bosons of the Standard Model. However, if the particles in both in- and external systems have observed masses, deviations from the ideal case, x_{eg} in (13), arise from corrections for reduced masses. For instance, if in (14a) the intermediary particle $m_g = m_1 = m_e$ and if $m_2 = m_{pion}$, we obtain

$$x^2_{eg} m?_1 v^2_g = x^2_{eg} m_1 v^2_g = m?_{12} v_e{}^2 = m_1 v_e{}^2/(1+m_1/m_{pion}) \quad (14c)$$

leading to

$$x_{eg} = 274.58/(1+m_e/m_{pion})^{1/2} = 274.08 \quad (15)$$

This would reduce the deviation in (13) to +0.35 % for the ratio m_{pion}/m_e, to -0.02 % for $1+ m_{pion}/m_e$ and to 0.005 % for 2/a . If, instead of the (hypothetical) particle m_g in (14b), an electron is assumed to rotate on the earth's surface as described in (i), this can have the pion as a companion particle in the new scaled electrical system (e^-, p^+).

(d). Case (ii), discussed above.

A similar argumentation applies for case (ii), i.e. two particles with mass m_{1g} and m_{2g}. We now have, instead of (8) and (15)

$$x^2_{eg}(m?_{1g} v^2_{1g} + m?_{2g} v^2_{2g}) = m_{12}\text{'}\ a\ ^2c^2 \quad (16)$$

if x_{eg} is the same for all particles (which is likely but not certain) and neglecting possible further couplings between m_1 and m_2 in either system. If the particle masses are the same in both systems (which is not necessary, see (14)), the scale factor now becomes

$$x_{eg} = 274.58(m_1/m'_{1g})^{1/2}/((1+m_1/m_2)(1+m'_{2g}/m'_{1g})^{1/2} \quad (17)$$

Without any further constraint, we can solve (17) only when $m_1=m_2$ *in either system*, since then also x_{eg} is the same. We obtain for $m_1 = m'_{1g}$

$$x_{eg} = 274.58/2 \quad (18)$$

$$= 137.29 \quad (19)$$

quite close to the reciprocal of the fine structure constant[16], 137.0359 (deviation +0.19 %, as above). The $m_1=m_2$ case is symmetrical with electrical forces, where charges have opposite sign but are equal in magnitude. Results (14) and (19) are the most general and completely classical results possible with

relative scaling, using first principles only. Since (19) applies for $m_1 = m_2$, it probably stands for a rotating vibrator, because for a rotator this condition will always lead to less stable or unstable systems (such as positronium, see also Table 1). The Kratzer potential, being also applicable to rotating vibrators[8], a similar asymptote can be used. For m_1 not equal to m_2, Eqn. (17) is invariant to the choice of the heavier particle. Solutions are only available if one of the particles is given an explicit mass. For a proton-electron system, x_{eg} is equal to 1/q in (9). If, as in (14), the masses in the two different systems (Newton and Fermi/Coulomb) are not comparable, (16)-(17) must be adapted accordingly.

The small, usually positive deviations indicate that corrections like $1/(1+ m_1/m_2)$ might be needed. An extra but small term in (16) allowing for additional coupling could make the relative scaling process more effective (accurate).

Discussion

We can hardly believe the results of inverted compactification are accidental. The seemingly forbidden, almost annoying relative scaling operation is much too easily justified classically (by Boltzmann distributions and by classical equilibrium conditions), derives from first principles and its results are too easily interpreted in terms of available fundamental constants. The unifying particle masses it predicts compare with those of the Standard model and beyond (see Table 1). Relative scaling with the earth as a reference turns out to be a very defendable, be it inverted, compactification process. In any case, it leads to a comfortable situation, when compared with absolute scaling (1) and with Fermi-Planck compactification. Yukawa's particle, the mediator of the strong force, appears as a scale factor for a rotating electron (the coupling constant is then very close to ratio m_{pion}/m_e). The gravitational potential of the earth can be scaled with $4p\ ^2e^4/(h^2c)$, the ratio of the most important constants e and h in quantum theory, appearing in the fine structure constant. According to (19) and instead of (6), a universal gravitational velocity v_g appears

$$v_g = (GM/R_E)^{1/2} = 2p\ a\ e^2/h \quad (20)$$

which, after scaling with c becomes

$$v_g/c = (GM/R_E)^{1/2}/c = a^{\ 2} = a\ v_e/c \quad (21)$$

According to (12), the equivalent of this ratio in electromagnetism is Sommerfeld?s constant. The gravitational velocity, just like the electromagnetic, is related to the fine structure constant and becomes a fundamental constant on its own. The three parameters in the left-hand side of (20), i.e. G, M and R_E, are related by definition and, hence, v_g, just like v_e, can indeed have universal characteristics. For rotating vibrators, Eqn. (19) and (21) suggest gravitation is a weak(er) electromagnetic force when the particles in the two systems have comparable masses.

Given the fact that v_g largely surpasses the earth?s rotational velocity (see above), we must not exclude the interference of (fictitious) Coriolis forces for particles at rest but with a virtual velocity. We also remark, see (19) and (21), that earth bound gravitational energies (asymptotes) a $^4mc^2$ reduce to the natural energy unit for the relativistic fine structure and the magnetic spin-orbit interactions, as observed

in atoms.

Reminding (1), compactification is unavoidable in order to achieve superunification. We must nevertheless say that this operation can be realized in two ways (directions):

a) from the Fermi-scale (10^{-10} cm) down to the Planck-scale (10^{-33} cm) or, inversely

b) from the earth-bound Newton-scale (10^{8} cm) down to the Fermi-scale (10^{-10} cm).

In either way, the degree of compactification is of the same order of magnitude and an increase in dimensions is required. We believe scheme b) is the more natural as there is no need for new particle physics to obtain superunification in this way.

Conclusion

Inverted compactification based upon scaling seemingly unrelated asymptotes leads to very surprising results. Our superunification scheme is rather classical, was implicitly present in the Boltzmann-distribution laws and illustrates the role constants of the earth have always played for our understanding of nature. Whether Newton's or Coulomb's law is the more fundamental, remains uncertain, although the scale factor obtained here is in favor of the latter. As with Fermi-Planck compactification, we find unifying intermediate particles with large masses (GeV/TeV range), for which the superunification scale factor is unity. Relative scaling applied to the same particles in both in- and external systems reproduces known dimensionless numbers as scale factors: about 2?, the pion-electron mass ratio for rotators and the reciprocal of the fine structure constant for rotating vibrators. It seems that molecules behave like *strings*, when looked at from the equipotential gravitational field of the earth. Apart from including the magnetic field of the earth in the present scheme, many questions remain on the consequences of this relative scaling process, especially when viewed in the context of the Standard Model and beyond. We could not yet answer the question whether or not gravitational forces are only attractive. This will be answered in a forthcoming paper[20]. Nevertheless, if valid, our results are important for a TOE[4], even for the anthropic principle but certainly for superunification at large. Maybe, there is a hidden symmetry and if not, there is certainly an analogy between the gravitationally small (the Planck-scale) and the gravitationally large or normal (the earth- or Newton-scale) when looking at the two from in between, the Fermi-scale.

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