J. Basic. Appl. Sci. Res., 2(2)1839-1841, 2012

ISSN 2090-4304
Journal of Basic and Applied Scientific Research
www.textroad.com

Exchanging Forces at the Planck Regime

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ABSTRACT

A new approach to unifying the fundamental forces is developed. In continue the unification problem is viewed as inversion of geometrical separation of fundamental forces. Both the quantum mechanical and the quantum gravitational uncertainties are employed to calculate the range of exchange forces. It is shown that there is a new unification of fundamental forces in the Planck regime. It is interesting that the range of the unified force is received a new correction.
KEY WORDS: *fundamental forces, unification, uncertainty principle*

INTRODUCTION

It is believed that the unification of fundamental forces may accurse at the Planck regime. In this scenario, at the Planck energy, all four fundamental forces unifies to a one force. However this picture of unification may be an incomplete picture because in this scenario, our focus is related to the energy analysis only. In this letter we have developed a theory related to the unification focusing on the effective range of forces. In the other word the geometrical analysis of exchange forces in the Planck regime is considered. Quantum field theory explains the exchange of energy during the interactions via the *force carriers*, called bosons. The mechanism is based on the emitting of the virtual particles, particles that have no reality except to push or pull matter with the exchange of momentum. All fundamental forces are involving the exchange of one or more particles. For example the underlying color force which is presumed to hold the quarks together to make up the range of observed particles, is involve an exchange of particles labeled by gluons. Such exchange force may be either attractive or repulsive, but is limited in the range by the nature of exchange force that is constrained by the uncertainty principle.

The separation of fundamental forces in the early universe may be related to the separation of exchanging range of virtual particles based on the spontaneous symmetry breaking mechanism [1,2,3,4,5]. Alternatively, this may be viewed as a mechanism to separation of fundamental forces. For example the range of color force is the shortest range and the range of gravity is the longer range. But in the early universe or in a very high energy probe there is unification between fundamental forces. To obtain a complete picture of the range of exchange forces in a high-energy probe, it is important to consider both the quantum mechanical and quantum gravitational effects, by imposing the minimal length uncertainty relation. The problem is related to computing the range of exchange forces based on the minimal length uncertainty.

Let us begin with the minimal length uncertainty relation. An exciting quantum mechanical implication of the microphysics space is a modification to the usual space time uncertainty as [6,7,8],

$$\Delta x \geq \frac{\hbar}{\Delta p} + \alpha' \frac{\Delta p}{\hbar} \tag{1}$$

Where $\sqrt{\alpha'}$ is the Planck length. Dividing both side of relation (1) to the speed of light, we obtain a deformed form of usual time energy uncertainty as [9],

$$\Delta t \geq \frac{\hbar}{\Delta E} + t' \frac{\Delta E}{\hbar} \tag{2}$$

Where $\sqrt{t'}$ is the Planck time. Putting the natural units as $\alpha', c, \hbar = 1$, eq. (2) reads,

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$$\Delta t \geq \frac{1}{\Delta E} + t'\Delta E \tag{3}$$

Solving (3) to minimum energy we obtain,

$$\Delta E \approx \frac{\Delta t}{2t'}(1 - \sqrt{1 - \frac{4t'}{(\Delta t)^2}}\ ) \tag{4}$$

Expanding (4) around $t'=0$, obtains,

$$\Delta E \approx \frac{1}{\Delta t} + \frac{t'}{(\Delta t)^3} \tag{5}$$

If a force involves the exchange of a particle, it must fit within the constraints of the uncertainty principle. According to Einstein theory of special relativity a particle with mass of m have a rest energy as $E = mc^2$. This particle can be exchanged if it doesn't go outside the bounds of the uncertainty principle,

$$\Delta E \Delta t = mc^2 \Delta t \tag{6}$$

Combining (5) and (6) we give,

$$(1 + \frac{t'}{(\Delta t)^2}) = m\ c^2 \Delta t \tag{7}$$

A particle which can exist only within the constraints of the uncertainty principle is called a *virtual particle* and the time in the expression above represents the maximum lifetime of the virtual exchange particle. Since this exchange particle can not exceed the speed of light and cannot travel faster than the speed of light c times than lifetime. Since the maximum range of a force ($Range \approx c\Delta t$) would be

$$Range \approx c\Delta t \approx \frac{1}{mc}(1 + \frac{t'}{(\Delta t)^2}) \tag{8}$$

The *r.h.s* of relation (8) have two term, the first term $\frac{1}{mc}$ is the usual range of exchange force and $t'/mc(\Delta t)^2$ is a new term, this new term is obtained from the correction based on the minimal length uncertainty analysis. Eq. (8) has an interesting feature that is exhibits the so called new unification of fundamental forces. An important problem in the standard model is study of the unification of all fundamental forces at the Planck time. If the separation of fundamental forces be viewed as the separation of range of exchange forces, our picture of unification may obtains a new unification that is based on the new term of (8). According to (8) each force contains two ranges of exchange, $\frac{1}{mc}$ and $\frac{t'}{mc(\Delta t)^2}$ .if $t' \to 0$, then eq. (8) reads the usual range as,

$$Range^{usual} \to \frac{1}{mc} \tag{9}$$

At the Planck time when $\Delta t \to \sqrt{t'}$, eq. (8) reads,

$$Range^{planckregime} \to \frac{2}{mc} \tag{10}$$

Comparing (9) with (10) we have,

$$Range^{planckregime} = 2\ Range^{usual} \tag{11}$$

From (11) it may be concluded that at the Planck regime, the range of forces is 2- factor larger than the usual range of forces. The unification accurse at,

$$R^{electromagnetic} \approx R^{gravity} \approx R^{colour} \approx R^{coulomb} \tag{12}$$

From eq. (8) and (12) it is found that in the unification picture of fundamental forces, the mass of the carrier forces (bosons) is an effective parameter in the separation process. This may shows a new light on the spontaneous symmetry breaking.

Conclusion

The unification of fundamental forces may be viewed as a simple inversion of geometrical separation of fundamental forces. In this paper, the quantum and gravitational uncertainties are employed to calculate the range of exchange forces, which is presented here.

REFERENCES

[1] S. R. Coleman and E. Weinberg, Phys. Rev. D7, 1888 (1973).

[2] [1] J. Goldstone, Nuovo Cim. 19, 154 (1961). J. Goldstone, A. Salam, and S. Weinberg, Phys. Rev.127, 965 (1962). J. Nambu and G. Jona-Lasinio, Phys. Rev.

122 (1961) 345.

[3] H. B. Nielsen and S. Chadha, Nucl. Phys. B105, 445(1976).

[4] P. Gaete and E. I. Guendelman, Phys. Lett. B640, 201 (2006) P. Gaete, E. Guendelman, E. Spallucci, Phys. Lett. B649: 218-224, 2007 V. A. Miransky and I. A. Shovkovy, Phys. Rev. Lett. 88,111601 (2002). T. Brauner, Phys. Rev. D72, 076002 (2005),J. van Wezel, J. van den Brink, arXiv:physics/0609177, H. Fritzsch, M. Spannowsky, Europhys.Lett. 75 (2006) 882-886, X. Calmet Eur. Phys. J. C, 28 (2003) 451-454 ; X.Calmet and J.F. Oliver hep-ph/0606209 (2006).

[5] S. Glasho, H. Georgi, Phys. Rev. Lett. 32, 438 (1974), H. Fritzsch and P. Minkowski, Annals Phys. 93 (1975) 193; H. Georgi, in Particles and Fields, (AIP, New York, 1975). H. Georgi, H. R. Quinn and S. Weinberg, Phys. Rev. Lett. 33 (1974) 451. P. Cziffra, M. H. MacGregor, M. J. Moravcsik, H. P. Stapp, Phys. Rev. 114(1959)880 P. Signell, Phys. Rev. Lett. 5(1960)1474 J. Binstock, R. Bryan, Phys. Rev. D 4(1971)1341 J. L. Friar, B. F. Gibson, G. L. Payne Phys. Rev. C 30 (1984)1084,

[7] R. Adler, Mod. Phys. Lett .A 14 (1999)1371, R. Adler, P. Chen, D. Santiago, Gen. Rel. Grav. 33 (2001) 2101, A. Kempf, G. Managano, Phys. Rev. D 55 (1997) 7909, M. Maggior, Phys. Rev. D 49(1994)5182

[8] S. Hossenfelder *et al*, Phys.Rev. D73 (2006) 105013, Phys.Lett. B632 (2006) 379-383, A. Farmany, EJTP 3 (2006) 12

[9] A. Farmany. S. Abbasi, A. Naghipour, Phys. Lett. B 650(2007)33, *ibid* Erratum 659 (2008) 913.