THREE MAGNETIC DIPOLES PROVIDE A PHYSICALLY REALISTIC SIMULATION OF THE REPULSIVE-ATTRACTIVE NATURE OF THE STRONG FORCE AND OF THE CABIBBO ANGLE

Vladimir F. Tamari
http://vladimirtamari.com/physicsandmath.html
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ABSTRACT

The Strong Force is unique in that it changes from repulsive to attractive as the distance between two quarks increases, and rapidly approaches a steady level thereafter. Unlike the inverse square law related to the surface area of a sphere, there is as yet no simple physical explanation for this phenomenon. It is demonstrated that the inductive forces between three magnetic dipoles symmetrically arrayed and tilted around a circle, will result in a repulsive force acting radially on any one one of them at close proximity, that changes to an attractive force with increase of distance. The forces are most like the Strong Force when the tilt is at around 13°, remarkably similar to the Cabibbo Angle[1] relating the Strong and Weak reactions. These results encourage development of Tamari's *Beautiful Universe*[2] *(BU)* model of a universal lattice entirely made up of magnetic dipoles.

I – INTRODUCTION

Classical gravitational, magnetic and electric forces obey the inverse-square law. As the distance between two particles increases, the attractive or repulsive force between them diminishes according to the well-known rule first suggested for gravitation by Hook, Newton and others. The physical reason for this is that the potential field is spherically symmetrical and diminishes as the radius (r) increases and the potential energy is spread on an increasing spherical surface area $4\pi r^2$.

The case of the Strong Force presents a unique phenomena whereby in theory two quarks experience a mutually repulsive force when they are very near to each other, but as their separation increases the force becomes attractive (Fig. 1). While the Strong Force is well understood in terms of the abstract mathematical concepts of the Standard model, there is no simple physically realistic explanation for such a behavior. It is demonstrated here that such a repulsive-to-attractive transition occurs with an increase of radial distance when

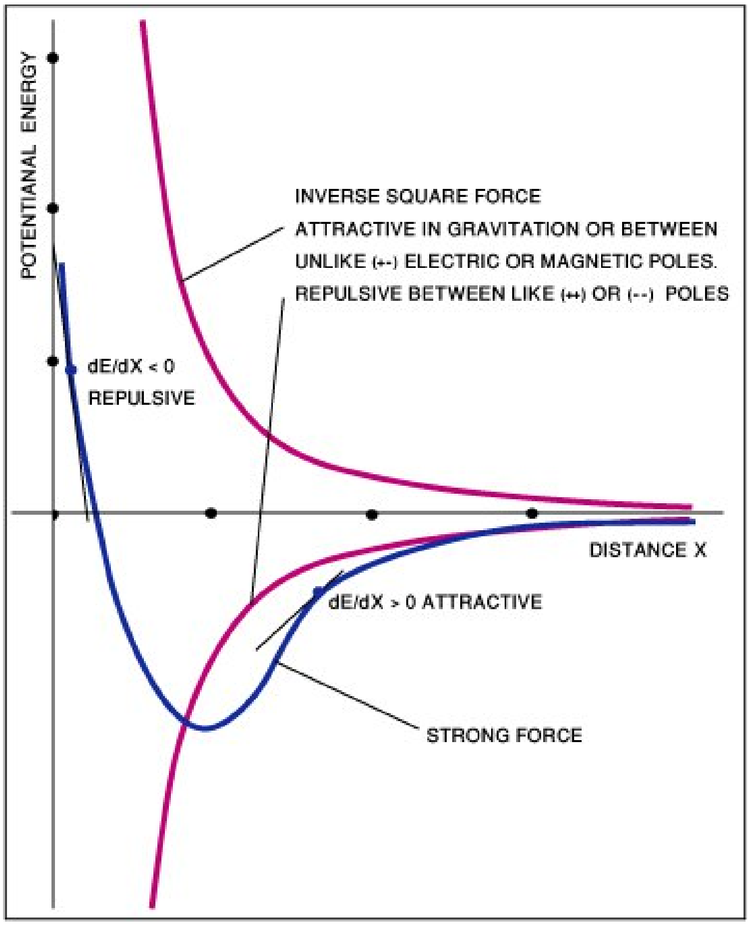


FIG. 1. The Inverse square law of the gravitational and electromagnetic fields is readily explainable by the spherical symmetry of the potential. No such simple physical explanation applies to the Strong Force which changes between repulsive and attractive as the distance changes.

1 Cabibbo Angle: http://en.wikipedia.org/wiki/Cabibbo%E2%80%93Kobayashi%E2%80%93Maskawa_matrix
2 Tamari, Vladimir *Beautiful Universe: Towards Reconstructing Physics from New First Principles* http://vixra.org/abs/1012.0017

three magnetic dipoles are symmetrically arrayed along the rim of a circle, and tilted at equal angles with respect to normals on it, and with the polarity of one of the three reversed. It was found that the fit with the Strong Force curve of Fig. 1, was critically dependent on the tilt angles, and the best fit was for tilts of around 13°. Remarkably that is almost identical to the Cabibbo Angle that links the Strong nuclear interaction with the Weak Interaction of radioactivity.

This naive simulation is for exploratory purposes only. Just one of the known quark characteristics was modeled here: that they are found in triplets (having quantum spin of up-up-down or down-down-up). Many other assumed quark attributes such as mass, color, charm, and the action of gluons are absent here. Specifically the 3/2 charge attributes of the up quarks have not been included in this model, where unit charges for all three magnets are assumed. This study was made to explore the possibilities of Tamari's *Beautiful Universe* theory (BU) of a universal lattice where matter is made up of polygonal arrangements of identical rotating dielectric nodes twisting at various angles and affecting those of neighboring nodes in a universal 'domino effect' mediated by induction.

The forces between *two* magnetic dipoles at a given distance and mutual orientation angles (t) and are calculated in Section II. The quasi Strong Force model using an arrangement between three dipoles inclined at angles (t) and (g) is presented in Section III. These results are discussed in Section IV Appendices I and II provide the BASIC programs used to calculate the force functions.

II THE FORCE BETWEEN TWO MAGNETIC DIPOLES

The classical forces acting on one of a pair of dipoles having unit charges and a unit half-length at given distances (x) and a mutual twist angle (t) are calculated. For the heuristic purposes of this study it was sufficient to assume that the force F equals the inverse square of the distance between poles and only the resultant of F parallel to x is calculated (See Appendix I for details of the program used) . F is positive or negative depending on the polarity of the two interacting poles, as shown in Fig. 2. It is found this in this configuration too a change from repulsive to attractive forces acting parallel to the axis joining the center of the two dipoles as their separation and twisting increase. It became apparent that it is the twisting (i.e. the mutual angle between the two dipoles) is the key factor in determining these forces. Had the dipoles remained parallel the forces between them would have resembled the inverse-square curve, decreasing or increasing with distance (depending on whether like or unlike + - poles face each other). The fields would have cancelled out irrespective of distance if t=90°. Twisting of t = x = (0 to π), (2π to 3π), (4π to 5π) ... between magnetic dipoles will result in a repulsive force. While in the regions where the twisting ranges between t x = (π to 2π), (3π to 4π), (5π to 6π) there will be an attractive force as in Fig. 3.

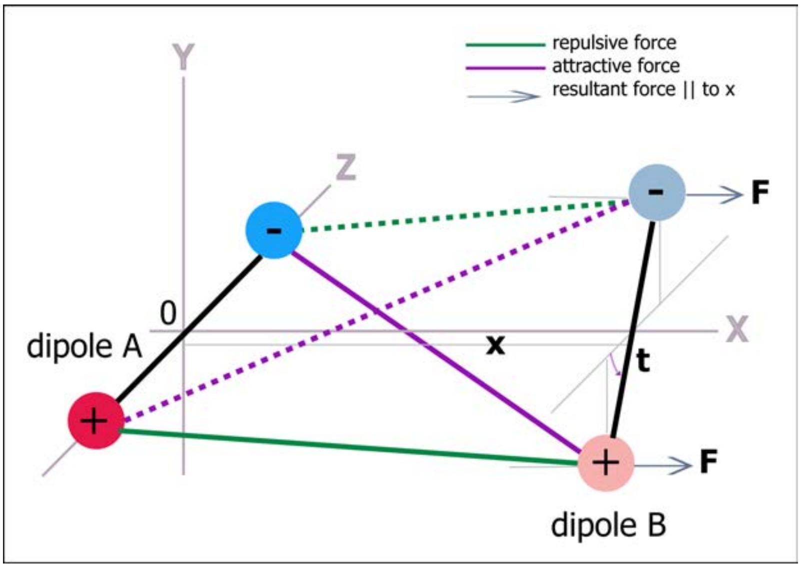


FIG. 2 The forces between two dipoles as the distance between their centers increase and one of them twists at an angle t that increases linearly with the distance x.

This analysis is relevant to the *Beautiful Universe* (BU) theory where the relative twisting of nodes in the lattice is an essential feature defining gravitational and electromagnetic potential. Nodes in

(BU) have fixed position in the lattice and only change by twisting and/or rotating in place. The two-dipole system described in this section not only twist, but the distance between them increases linearly with the twisting. Nevertheless this quantitative study of the inductive forces due to twisting will give a good idea of how forces act in (BU) between neighboring nodes, which has hitherto has only been described qualitatively. The success of the two-dipoles in modeling a force that alternates between repulsive and attractive as the distance and twisting increases between them encouraged the study of the more complicated case of three dipoles in Section III.

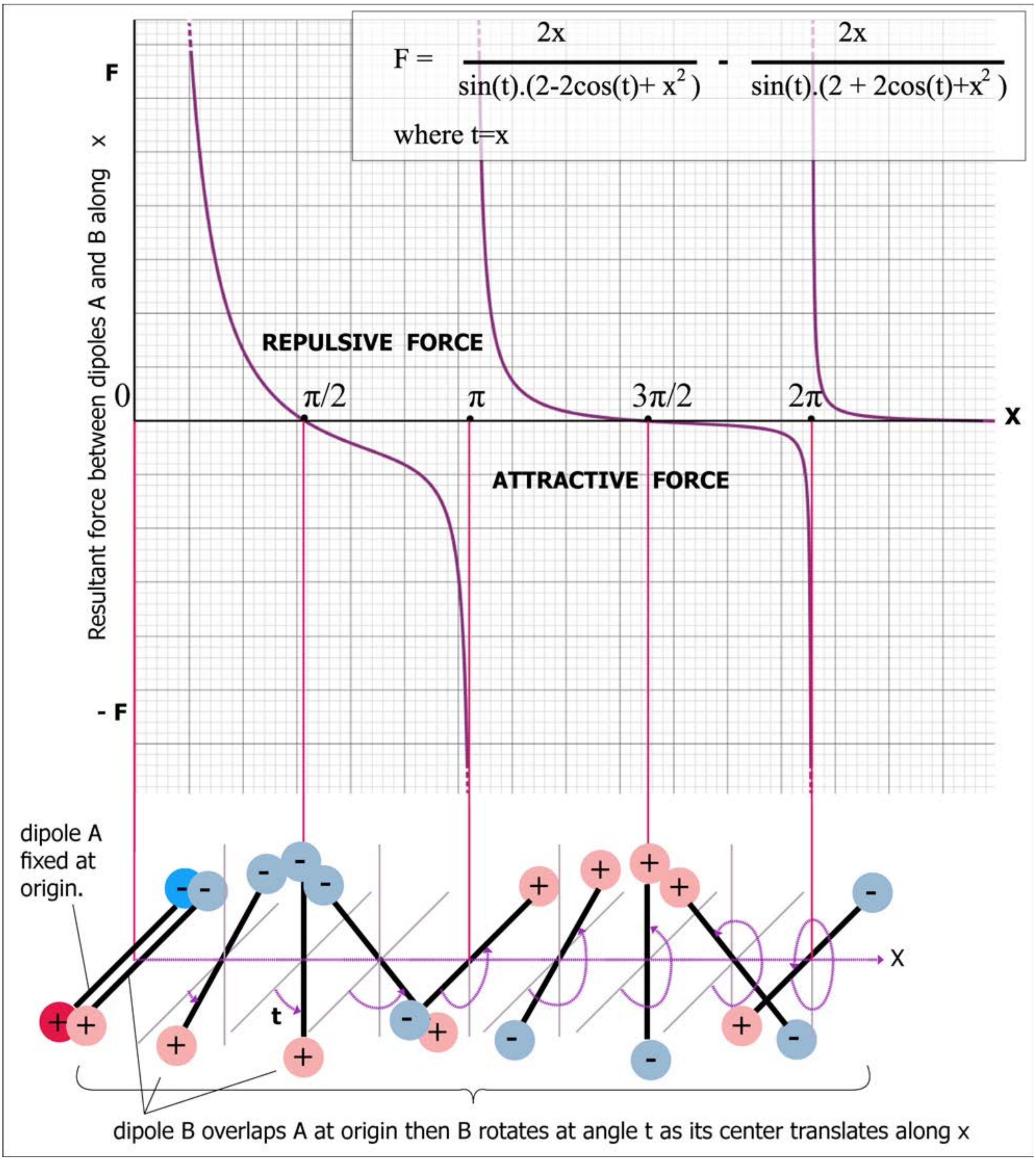


FIG. 3 The resultant of the forces between the two dipoles of Figure 2 parallel to the x-axis. Dipole A is fixed at the center straddling the z- axis,. Initially Dipole B overlaps A then starts rotating at angles (t) and moving to the right at a rate t ≡ x. The resultant of the force between the four poles changes periodically from repulsive to attractive as shown. (plot is from a Grapher output).

III THREE MAGNETIC DIPOLES SIMULATE THE REPULSIVE – ATTRACTIVE NATURE OF THE STRONG FORCE

The methods of Section II were used to calculate the force acting radially on one of three magnetic dipoles arrayed symmetrically around a circle at a radial distance (x) from its center and tilted at angles (t) and (g) as shown in Fig. 4. As before the poles have unit half-lengths. Two of the dipoles have their positive poles in the +y sectors, while the third has its (-) pole there, following the up-up-down or down-down-up rule for quark triplets. The total radial resultant of the forces acting on one of the three dipoles (P1M1) due to the attractive and repulsive inductive forces between its (+) and (-) poles and those of the other two dipoles is plotted in Fig. 5. Apart from a dip in the force near the origin the calculated force at t=13° and g=13° is remarkably similar to the theoretical Strong Force curve of Fig. 1, and F levels off two at distances of about two dipole lengths. Similar curves were obtained when t= 10° and g= -20° and for other (but not all) angles within this range. The curve rapidly changes shape for other inclination angles. (See Appendix II for the program used to make the calculations)

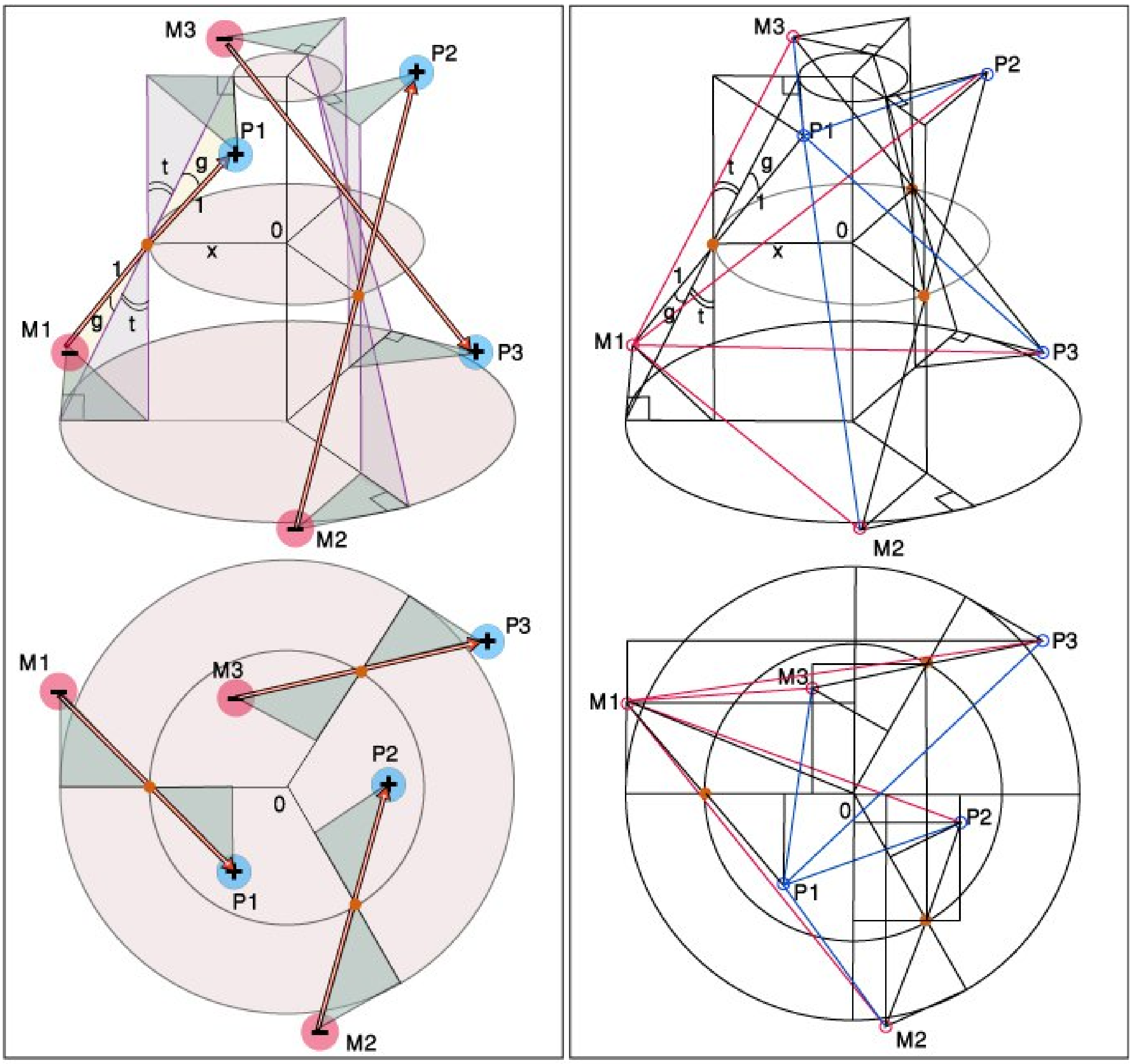


FIG. 4 Diagrams showing the orientation of the three magnetic dipoles with plus (+) poles P and minus (-) poles M. The dipoles have a unit half-length and their centers are on a circle in the y=0 plane equidistant from the center and each other. Unlike the other two dipole M3P3 has its (-) and (+) poles 'flipped' – emulating the assumed (uud) or (ddu) spin of quark triplets. The repulsive and attractive forces on P1 and M1 due to P2, M2, P3 and M3 are calculated and their resultants parallel to x are summated. See Appendix III for the similarity of this configuration to Snelson's tensegrity structures.

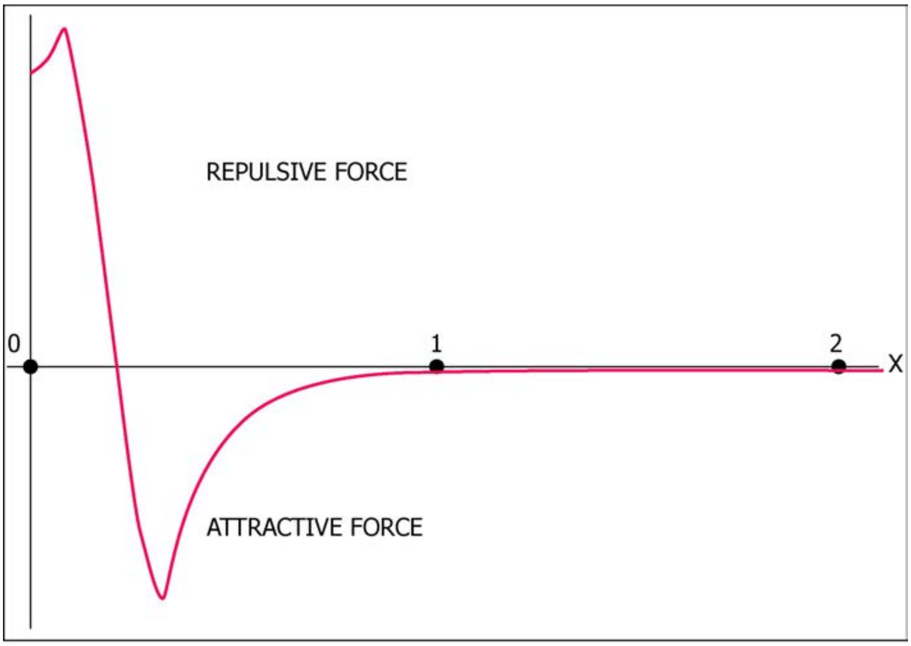


FIG. 5 The calculated force on dipole P1M1 of Fig. 4. acting radially (here along the x-axis). The distances on the x-axis are in units of the dipole's half-length. This graph is based on the simulation detailed in Appendix II for the case when t=13° and g=13°, the theoretical Cabibbo Angle.

IV DISCUSSION

It was shown that a simple classical physical model can explain the attribute that uniquely distinguish quarks from other particles in the Standard Model – that they cluster together without merging completely into one (because of the repulsive force at close quarters- (or rather thirds!) and yet do not disengage from each other and fly apart, because of the attractive force as the distance increases. The serendipitous discovery that the best fit of the tilting angle was 13° to the vertical, very close to the Cabibbo Angle, encourages further study. In this regard the words of Roger Penrose should be borne in mind: "...the Standard model is clearly not the 'ultimate answer', with regard to particle physics, because it contains many unexplained features and 'ragged edges', despite its undoubted success. It involves about 17 unexplained parameters that simply need to be taken from observation (such as the Cabibbo and Weinberg angles, the masses of the quarks and leptons and a number of other features)." [3]

It is to be noted that by limiting the calculations to the resultant of the force along the radial direction, only forces that act inside the polyhedron with apexes defined by the six poles of the 3 dipoles of Fig. 4 have been considered, providing this primitive model for a Strong Force. On the surface of this volume there are torque forces acting to increase or decrease the twisting of the dipoles. It is speculated whether such torque forces contribute to the instability of nuclear interactions and may be the basis of the Weak Force. This would explain why the Cabibbo Angle may represent an actual relation between the Strong and Weak Force and not merely an abstract mathematical relation emerging from the eigenvalues of certain Standard Model assumptions.

An important caveat regarding this study is that the models presented in this paper are strictly classical: they interact in an assumed vacuum so that as the dipoles separate there is nothing in the space between them that mediates their forces such as the gluons of the Standard Model. Such intermediate 'particles' do indeed exist in the Beautiful Universe (BU) model: they are the

3 Penrose, Roger. *The Road to Reality* Section 25.8 p.651 (2004) Borzoi/Knopf

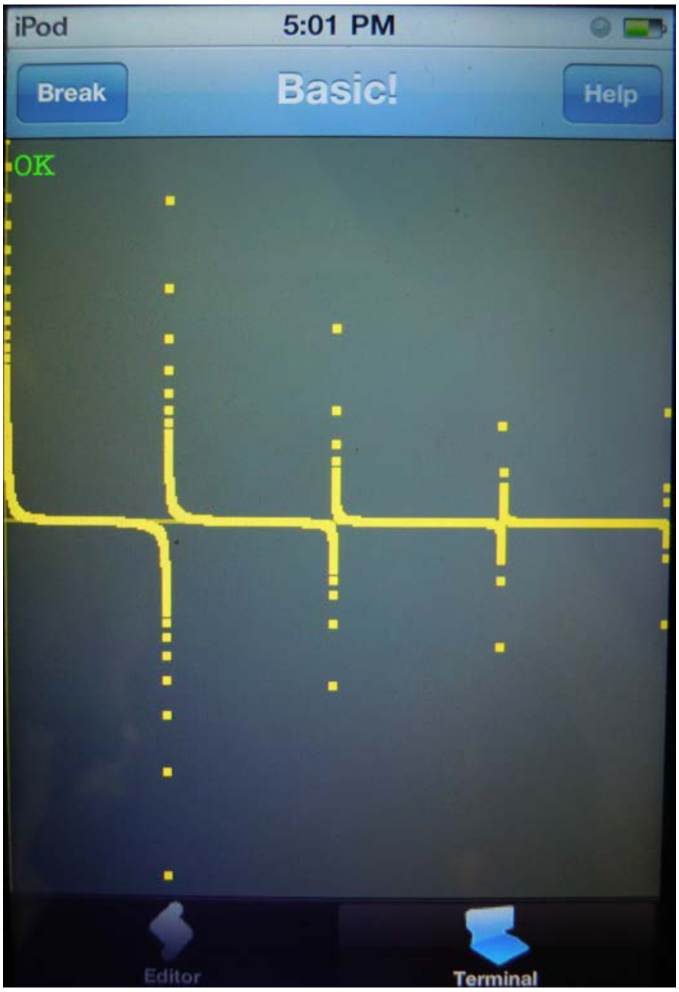
spherically-symmetrical dielectric dipolar particles transferring angular momentum to their neighbors in units of Planck's constant (h) that constitute the lattice itself. The forces acting on these intermediate particles will prevent the Strong Force from diminishing to zero as in Fig. 1, and explain the puzzling assumption that beyond a certain point the Strong Force remains strong, constant and attractive even as the distance between the quarks increases.

Particle configurations are yet to be studied in detail using the (BU) paradigm where a polyhedral arrangement of several dipoles (not just one as in this paper) may well provide an accurate working model of a quark and other particles as well. It is hoped that the success of this study to demonstrate a physically realistic model for the attractive-repulsive force similar to that of the Strong Force and the serendipitous finding that the tilt of the dipoles in this model is very close to the Cabibbo Angle, will encourage more sophisticated studies along these lines, to try to model other nuclear particles and forces.

APPENDIX I
BASIC SIMULATION OF FORCE BETWEEN 2 ROTATED DIPOLES

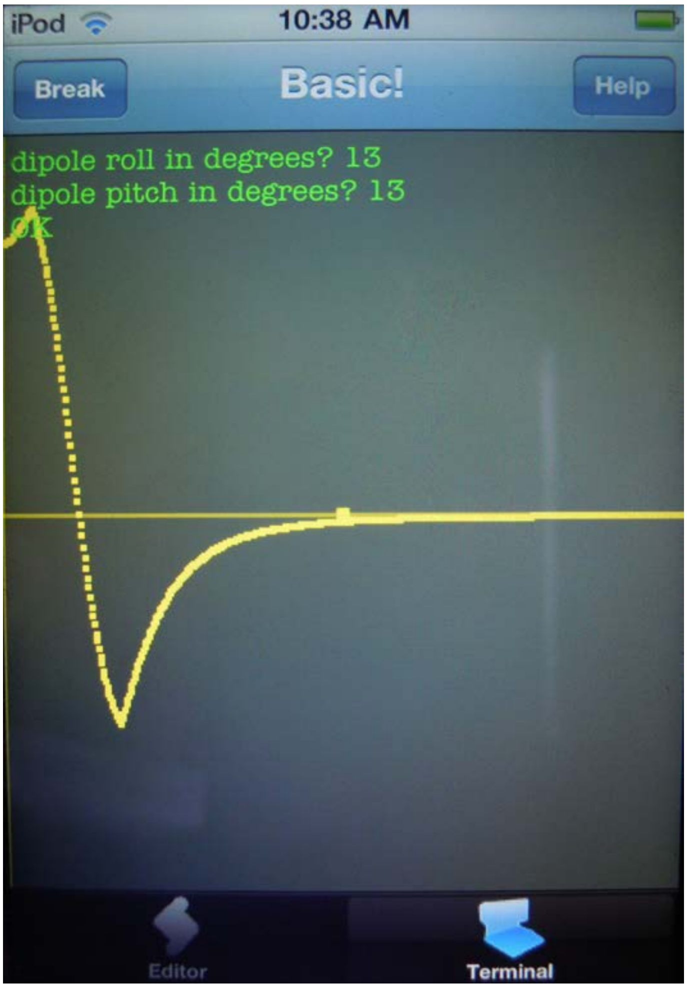
A BASIC program to simulate the force between two magnetic dipoles constrained to rotate only a line normal to their centers (the x-axis) as described in Section II. The relative angle (t) they form between them measured in the (y-z) planeis linearly dependent on the distance between them. One of the dipoles is fixed along the y-axis and the other forced to move away from it and rotate in yz planes.The program calculates the repulsive force (a) between a (++) pair as proportional to the inverse of the square of the distance between them , and the attractive force (b) between the same (+) pole and the (-) of the other. The other set of (- -) and (- +) yield the same result and are ignored. Initial condition is that the axes and polarity of the two dipoles overlap. The force component of (a) along the x-axis is subtracted from that of (b) and this resultant is plotted against the x distance between the dipoles. It is found that at x=0 t=0 (f) is infinite but as t=pi/2 and f=0 and becomes negative at t=pi . qualitatively this repulsion at close proximity and repulsion at a distance resembles that of the strong nuclear force. This pattern of repulsion and attraction continues albeit at smaller strengths as x increases. (implemented on the ipod touch BASIC! App) See Fig. 2 and Fig. 3.

```
REM strong force dipole
BCOLOR  90,100,90
w=ScreenWidth
h=ScreenHeight
LINE 0,h/2,w, h/2
LINE 0,h,0,-h
FOR x= 0  TO w STEP 0.05
   g= 4*x/w
   t=g*22/7
   a= g/(SIN(t)*(2+2*COS(t) + g^2))
   b= g/(SIN(t)*(2-2*COS(t) + g^2))
   f= (a-b)
   POINT x, f+(h/2) ,4
NEXT  x
END
```



APPENDIX II
BASIC SIMULATION OF FORCE BETWEEN 3 ROTATED DIPOLES

BASIC program to simulate force between three symmetrically placed tilted dipoles equidistant from a point. (implemented on the ipod touch BASIC! App)
(See Fig. 4 and Fig. 5)



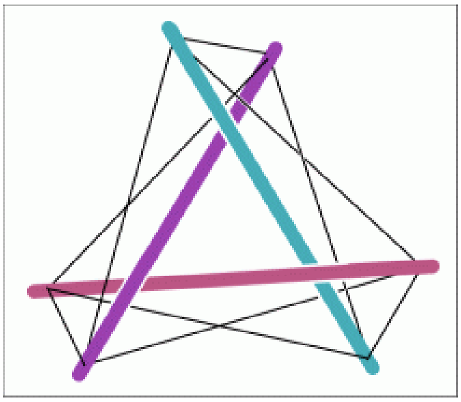

```
REM 3  dipoles  strong force dipole sim
BCOLOR  90,100,90
sw=ScreenWidth
sh=ScreenHeight

LINE 0,sh/2,sw, sh/2
LINE 0,sh,0,0
pi = 3.14159265
INPUT "dipole roll in degrees" g
INPUT "dipole pitch in degrees" t
g= g* pi/180
t = t * pi/180
a= SIN( g)
c=COS (g)
b= SIN (t)*c
h= SQR(c^2-b^2)
e= SQR(a^2+b^2)
j=ATN(a/b)
p=pi/6
d= (j- p)
FOR q=0  TO sw    STEP  sw/500
  REM  dipole coordinates p=plus pole m=minus pole
  x= q* 2/sw

 REM the figure defines max distance from 0
  p1x = b-x
  p1y = -a
  p1z = h
  m1x = -( x + b )
  m1y = a
  m1z = -h
  p2x = x * SIN (p) + e*SIN(d)
  p2y = - ( x * COS (p) - e * COS (d) )
  p2z = h
  m2x = x * SIN(p) - e* SIN (d)
  m2y = - x * COS (p)-  e * COS (d)
  m2z = - h
  p3x = x * SIN (p) + e * COS (d)
  p3y = x * COS (p) + e * SIN (d)
  p3z = - h
  m3x = - (e * COS (d) - x * SIN (p))
  m3y = x * COS (p) - e * SIN (d)
```

```
m3z = h

REM typical lengths between poles
REM p1p2 = p1m3 ; m1m3 = m2p1 ; p1p3 = m1p2 ; m1m2 = m1p3

p1p2  = SQR ((p2x - p1x ) ^ 2 + (p2y - p1y ) ^2 + (p2z - p1z )^2 )
m1m3 =  SQR ((m3x - m1x ) ^ 2 + (m3y - m1y ) ^2 + (m3z - m1z )^2 )
p1p3 =  SQR ((p3x - p1x ) ^ 2 + (p3y -p1y ) ^2 + (p3z - p1z )^2 )
m1m2  = SQR ((m2x - m1x ) ^ 2 + (m2y - m1y ) ^2 + (m2z - m1z )^2 )

REM  angles subtended to x-axis
am1p3 = ATN ( (p3y - m1y ) / (p3x - m1x) )
am1m3 = ATN ( (m3y - m1y ) / (m3x - m1x) )
am1p2 = ATN ( (p2y - m1y ) / (p2x - m1x) )
am1m2 = ATN ( (m2y - m1y ) / (m2x - m1x) )
ap1m3 = ATN ( (m3y - p1y ) / (m3x - p1x) )
ap1p3 = ATN ( (p3y - p1y ) / (p3x - p1x) )
ap1p2 = ATN ( (p2y - p1y ) / (p2x - p1x) )
ap1m2 = ATN ( (m2y - p1y ) / (m2x - p1x) )

REM forces are the inverse square of the lengths between poles but only parrallel to x-axis
considered. polarity defines positive or negative force. substitute equal lengths used when known

fm1p3 = COS (am1p3 )* ((m1m2) ^ ( -2))
fm1m3 =  - COS (am1m3) * ((m1m3) ^ ( -2))
fm1p2 = COS (am1p2) *( (p1p3) ^ ( -2))
fm1m2 =  - COS (am1m2) * ((m1m2) ^ ( -2))

fp1m3 = COS (ap1m3) * ((p1p2) ^ ( -2))
fp1p3 =  - COS (ap1p3 )* ((p1p3) ^ ( -2))
fp1p2 = - COS (ap1p2) * ((p1p2) ^ ( -2))
fp1m2 = COS (ap1m2) * ((m1m3) ^ ( -2))

REM total force on dipole 1 || to x-  axis
f =( fm1p3 + fm1m3 + fm1p2 + fm1m2 + fp1m3 + fp1p3 + fp1p2 + fp1m2)* 25
REM PRINT "x=" x+sw/2, "f="  f
POINT q, sh/2-f,    3
IF x >1      THEN
   CIRCLE  sw/2, sh/2, 3
NEXT  q
END
```

APPENDIX III
SNELSON'S TENSEGRITY STRUCTURES AS INSPIRATION FOR THE 3-DIPOLE QUARK MODEL

(Added January 3, 2016)

In hindsight, the 3-dipole configuration analyzed in Section III is now seen to be strikingly similar to Kenneth Snelson's tensegrity structure of three rods under compression held together without touching by wires under tension. The structure shown here was based on Snelson's basic triangulated tension network[4] . As Fig. 12 in the author's own *Beautiful Universe* model,[5] it was used to show how attractive (+-, -+) and repulsive (++,--) Coulomb forces similarly hold the dialectric nodes in the universal lattice. Snelson was acutely aware of the importance of such magnet-like interactions in physics and has developed his own sophisticated models of atomic electron orbits. [6]



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4 Snelson, Kenneth, *Weaving, Triangulated ension Networks,* http://www.kennethsnelson.net/icons/struc.htm
5 Tamari, V. *Beautiful Universe* Op. Cit.
6 Snelson, Kenneth, *An Artist's Modest Proposal a Visual Model of the Atom Homage to Prince Louis de Broglie* http://kennethsnelson.net/articles/KSnelson_Paper_FQXi_updated.pdf