The Experimental Data Validation of Modern Newtonian Gravitation over General Relativity Gravitation

Roger Ellman

Abstract

The paper *Connecting Newton's G With the Rest of Physics – Modern Newtonian Gravitation Resolving the Problem of "Big G's" Value* derived the value of the gravitation constant "Big G", G of Newton's Law of Gravitation, directly from other physics fundamental constants but left it to a subsequent paper to experimentally validate the derived G. The present paper performs that validation by examining various past experiments intended to measure "Big G", in each case determining the acceleration, a_g, as found per Einstein's General Theory of Relativity versus per Modern Newtonian Gravitation for that case. The ratio of those two times the reported measured "Big G" value yields a result identical to the G determined from the derived formulation for G, within the error range of the reported measured "Big G" measurement. That thus validates the correctness of the derived formulation for G.

The next important issue, what causes gravitation, how does the effect take place, is addressed and resolved in the paper *The Mechanics of Gravitation – What It Is; How It Operates,* which is available on the ResearchGate website at *https://www.researchgate.net/profile/Roger_Ellman/info*.

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I – Introduction and Summary

The theory of gravitation presented by General Relativity [GR], although highly successful at treating phenomena resulting from gravitation, fails to obtain precise measurement of "Big G", the Newtonian constant of gravitation, has failed to connect "Big G" to the rest of physic's fundamental constants, proffers no cause or mechanism for the operation of gravitation, and consequently prevents any development of means of controlling or modifying gravitation.

The Modern Newtonian [MN] theory of gravitation overcomes all of those GR failures.

The difference between the two theories is in the interpretation of Newton's formula for gravitational action, equation *(1)* below, specifically the interpretation of the $1/d^2$.

(1)
$$a_g = G\cdot\frac{M}{d^2} \qquad\qquad F = G\cdot\frac{M\cdot m}{d^2}$$

In GR the separation distance, d, between the gravitating objects' masses, M and m, is the distance between the centers of the two.

In MN each of the objects is composed of myriad particles, atoms, each of which performs equation *(1)* between itself and each of the particles in the other object, individually, one-on-one as an independent pair. Each such pair has its particular separation distance. The inverse separation distance squared, $1/d^2$, of equation *(1)* is the overall average of the myriad individual inverse separation distances squared, corrected to the vector component parallel to the centerline between the objects, $Avg[1/d^2]$.

To convert a measurement of "Big G" done using the GR version of equation *(1)* to the value that would have been obtained if the measurement had been done using the MN version of equation *(1)* it is only necessary to multiply the GR version measurement by the GR inverse separation distance squared, $1/d^2$, divided by the MN average of the squared inverse separation distances, $Avg[1/d^2]$.

The paper *Connecting Newton's G With the Rest of Physics – Resolving the Problem of "Big G's" Value*[1] presents a formula for calculating "Big G" from other fundamental physics constants. From that the correct value of "Big G" is $6.636,046,823 \times 10^{-11}\ m^3\ kg^{-1}\ s^{-2}$. In converting GR "Big G" measurements to MN the GR are not precise due to their various measurement errors so that those converted to MN per the above procedure will not arrive at the above precise "Big G" from fundamental constants but will deviate because their other measurement errors will still be present.

The results of some such conversions, from GR to MN, are presented in Table I, below. Note the variations in the "Corrected" values around the "Big G from fundamental constants" $6.636,046,823 \times 10^{-11}$ value. The variations in the "Corrected" are caused by the original measurements' variations.

TABLE I – SUMMARY OF TESTS RESULTS

All Data in SI Units: meters, kilograms, seconds $* = \times 10^{-11}$

Measurement	Description of Experiment	Year	GR 1/D^2	MN AvgD	Gm as * Measured	Corrected G *
						Correct = 6.636,046,823
Cavendish	Sphere on sphere torsion balance, deflection	1798	18.90	20.355,903,3	6.754	6.272
Rose	Sphere on cylinder, off-set by angular acceleration	1969	33.029,464,1	33.243,545,7	6.674	6.631
Luther	Sphere on torsion pendulum, oscillation frequency	1982	202.359,259,3	203.647,993,0	6.672,6	6.630,4
Bagley 1	Sphere on torsion pendulum, time-of-swing	1997	193.388,696,3	194.648,677,3	6.676,1	6.632,8
Bagley 2	Sphere on torsion pendulum, time-of-swing	1997	204.919,773,9	206.216,007,9	6.678,4	6.636,4
Gundlach	Sphere on cylinder, off-set by angular acceleration	2000	15.081,535,4	15.178,361,1	6.674,215	6.631,639
Schlamminger	A Configuration of Cylinders, beam balance	2006	20.020,909,8	20.149,705,7	6.674,252	6.631,591
Quinn	Cylinders torsion pendulum, average of fixed deflection and period of oscillation	2013	0.138,195,9	0.139,108,2	6.675,66	6.631,67

The conclusion is that the cited paper and its formulation for "Big G" in terms of other fundamental physics constants is valid and correct. That which GR could not produce has been produced and resolved by MN gravitation which consequently must supersede GR gravitation.

Further, this MN validation also "legitimizes" the *Gravito-Electric Power Generation* and the *Gravitation Deflection Deep Space and Planet Surface Flying Vehicle Drive* proposed in the paper *Gravitational and Anti-Gravitational Applications*[2] which applications should be tested.

II – On the Theory of Measuring "Big G"

There is only one universal correct value of "Big G". Except for various errors and inaccuracies in conducting the measurement every measurement must provide that exact same result. While the gravitational acceleration or force acting between objects varies according to Newton's Law that variation is due to varying values of the masses involved and the separation distance not the value of "Big G" which is a fixed constant.

But, in the MN conception of the operation of Newton's Law the separation distance is not the simple distance between the centers of the two gravitating masses; it is the average of the inverse square separations particle to particle, one on one, of all of the particles making up the masses. Therefore different configurations of the gravitating masses produce different gravitational acceleration and force for the same GR values of the masses with the same GR center to center separations.

Nevertheless, whatever the values of the masses are and whatever the configuration of their particles and whatever the resulting gravitational acceleration and force, the measurement of "Big G" must produce the same universal value. Any deviations or discrepancies from the correct value can only be due to measurement errors and inaccuracies.

Consider two measurement alternatives both having the same masses acting and the same GR separation distance between the centers of those masses, but the configurations of the MN interacting particles making up the masses are different. For example, alternative #1 is two spheres whereas alternative #2 is two cylinders.

It might be thought that the measured gravitational acceleration or force would be the same for the two alternatives because in the GR conception of Newton's Law of Gravitation the two alternatives are identical, not a little different. But regardless of the GR thinking, the actual measurements will be different because <u>it is the MN gravitational action that operates</u>, <u>always</u>.

The MN average inverse square separation, $Avg[{}^1/_{d^2}]$, in the two alternatives must be at least a little different. The MN difference in the two alternatives will produce accordingly different resulting gravitational acceleration or force which will result in accordingly different values for "Big G" calculated by GR.

The formula for correcting those GR values of "Big G" to the MN values for the two alternatives results in the same value for "Big G" always.

$$\text{Correct "Big G"} = \begin{matrix}\text{Spheres GR Measured "Big G"}\\ \text{Unknowingly Using}\\ \text{Spheres MN Particles Action}\end{matrix} \times \frac{\text{GR Inverse Square Separation}}{\text{Spheres MN } Avg[{}^1/_{d^2}]}$$

$$\text{Correct "Big G"} = \begin{matrix}\text{Cylinders GR Measured "Big G"}\\ \text{Unknowingly Using}\\ \text{Cylinders MN Particles Action}\end{matrix} \times \frac{\text{GR Inverse Square Separation}}{\text{Cylinders MN } Avg[{}^1/_{d^2}]}$$

In both alternatives the formula cancels out the GR ${}^1/_{d^2}$ [used to calculate "Big G" from the actually measured gravitational acceleration or force observed] replacing it with the [$Avg[{}^1/_{d^2}]$] that was actually operating when the measurement was made.

The problem in making this correction is to accurately calculate $Avg[^1/_{d^2}]$, that is to exactly reproduce the particle-by-particle, particle-to-particle, one-on-one action that actually operates in the Newtonian gravitational interaction, that actually operated in each experimental result to be converted.

III – The Point-on-Point Gravitational Interaction Between Objects

In this "Big G" Calculation, each of the particles in M is paired, one at a time, with every particle in m. The particle-to-particle separation distance in their 3-dimensional space is determined from the 3-dimensional Law of Pythagoras. That distance is then squared and its reciprocal taken producing the equivalent of gravitation's $^1/_{d^2}$. corresponding to the contribution to f_{grav} of the particular particle pair of one particle of M interacting with one particle of m. The components of this gravitational action that are perpendicular to the center-to-center line have no net effect because over all of the particle-to-particle interactions and the symmetry of the configuration they cancel out. Only the component of the gravitational action between two particles that is parallel to the center-to-center line is effective gravitation. That component is evaluated by projecting the 3-dimensional line of each particle-to-particle interaction onto the center-to-center line.

The average of the accumulation of all of these [MN] particle-to-particle results is then compared to the corresponding [GR] center-to-center results.

This calculation is part of the calculating of the particle-on-particle interactions between the particles of a "source" gravitating object and the "encountered" gravitating object the particles represented by approximating samples [dealing with "points" is impossible; there are an infinite number]. The objects are deemed monolithic solids of purely one kind of particle. The particles are expressed in terms of a set of 3 - dimensioning axes: x, y, and z.

The origin of those coordinates is at the center of the **s**ource object. The coordinates are xs, ys, and zs designating individual points in the source object.

For the purpose of referring to particles in the **e**ncountered object a secondary origin is taken at the center of that object and the coordinates there are xe, ye, and ze.

The center-to-center (origin-to-origin) separation distance of the two objects is the distance D. In terms of source dimensioning the origin of the encountered object is located at $xs = -D$. Any encountered coordinate designation is referred to the source dimensioning by adding "$-D$" to the xe dimension.

The total particle-on-particle interaction is obtained by summing the individual contributions of each source point interacting with each encountered point. The scanning process selects successive values of zs, each value representing a 2-dimensional "slice" of the source object. The slice is then scanned into successive values of ys representing 1-dimensional lines making up the slice. Each line is then scanned into successive values of xs representing 0-dimensional points making up the line.

Each of those source points then interacts with each of the points of the encountered object selected by the same slice - line - point type of scanning process as used for the source object. When the currently selected source point i, which is zs_i, ys_i xs_i, has interacted with every one of the encountered object points successively one at a time then the scan proceeds to source point $(i+1)$ and its interaction with every one of the encountered object points.

The entire process is extremely lengthy. To shorten it, which corresponds to speeding it up, the portion of the process that is most used, the xe $scan$, is replaced by developing a formula that gives the same result as the xe $scan$ it replaces. This procedure has two advantages, the first being that calculating the effect of an entire line of points "in one fell swoop" is much faster than calculating that entire line one point at a time.

The second advantage is as follows. There are an infinite number of points in a line and they cannot be individually addressed. Rather the line must be divided into a number of sequential identical segments they being samples of the line. The more segments the line is represented by the greater the precision of the samples accurately representing the line. The replacement of `xe` sampling with "one fell swoop" calculation also produces the maximum precision.

The same necessity for sampling applies to the succession of lines as the `ye-variable` progresses and to the succession of "slices" as the `ze-variable` progresses. Therefore each sample "point" is actually a sample volume, a *cuboid* (or *rectangular parallelepiped*) of which the "point" is the location of the *cuboid* center and which *cuboids* all taken together are the volume of the object.

A spherical quadrant is each of four parts of a sphere divided by two planes at right angles to each other. In the present 3-dimensional x, y, z coordinate system let the two planes be the x-y plane and the x-z plane as in the left figure below. Taking advantage of the symmetry of the two spheres addressing each other along a line connecting their centers as in the right figure below, that center line their common x-axis, each sphere has four such quadrants and if the entire source sphere is scanned then, because of the symmetry, each of the encountered sphere's four quadrants produces the same effect and only one of them need be scanned.

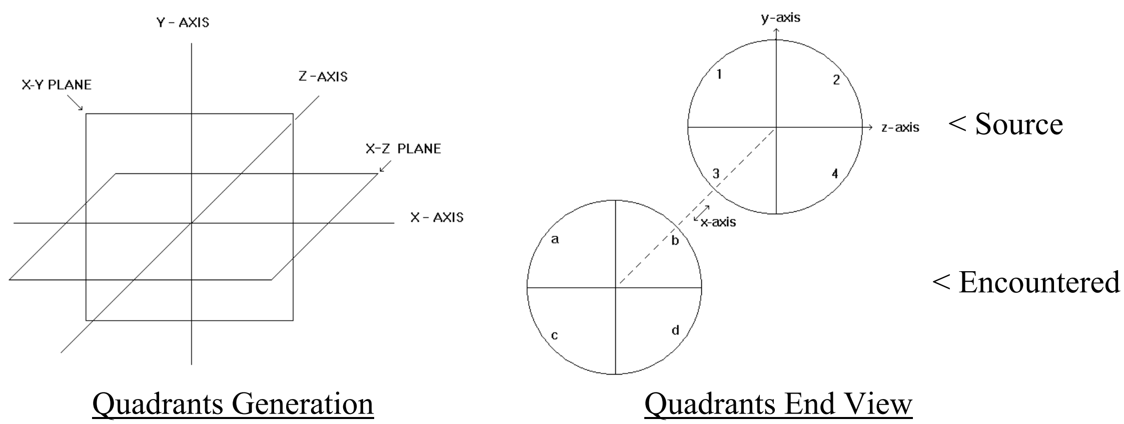

Figure 1

Furthermore, the source sphere need be scanned in only one of its four quadrants, that involving `+ys` and `+zs` the other three quadrants then being selected by successively choosing `–ys` with `+zs`, `–ys` with `–zs`, and `+ys` with `–zs`.

Finally because of the symmetry the interaction of `Q1` with `Qb` is the same as `Q1` with `Qc` so that only one of those two need be calculated, the result of that being doubled.

The `xe scan` is for one single point of the source sphere, that is one single set of values for `xs`, `ys`, and `zs`. It is for one single line parallel to the x-axis, that line for one single set of values of `ye` and `ze`, the scan replacing sampling values of `xe` with a single overall value for that line calculated by integration.

The above simplification due to quadrants symmetry applies also to any non-spherical form so long as it is symmetrical relative to the x-axis.

IV –X-SCAN INTEGRAL

Developing the Integrand

The quantity to be calculated is $Avg[1/d^2]$, by the accumulation of `Incr` [below] over the entire scan as follows.

$$\text{AvgD}_i = \text{AvgD}_{i-1} + \text{Incr}_i$$

$$\text{Incr}_i = \left[\frac{\text{x} - \text{Component}}{\text{Particle Separation}}\right]\cdot\left[\frac{\text{Inverse Square}}{\text{Separation}}\right]$$

$$\text{Incr}_i = \left(\frac{\Delta x}{d}\right)\cdot\left(\frac{1}{d^2}\right) \qquad \Delta x \equiv [xs - xe + D] \qquad \Delta y \equiv [ys - ye] \qquad \Delta z \equiv [zs - ze]$$

$$d = \sqrt{\Delta x^2 + \Delta y^2 + \Delta z^2}$$

$$\text{Incr}_i = \left(\frac{xs - xe + D}{\sqrt{\Delta x^2 + \Delta y^2 + \Delta z^2}}\right)\cdot\left(\frac{1}{\Delta x^2 + \Delta y^2 + \Delta z^2}\right)$$

Define: $X \equiv xs + D$ $\qquad$ $Y \equiv \Delta y^2 Z \equiv \Delta z^2$

Therefore $\qquad$ $\Delta x = [X - xe]$

$$d = \sqrt{[X - xe]^2 + Y + Z}$$

$$\text{Incr}_i = \left(\frac{X - xe}{\sqrt{[X - xe]^2 + Y + Z}}\right)\cdot\left(\frac{1}{[X - xe]^2 + Y + Z}\right)$$

Let: $\qquad$ $x \equiv [X - xe]$ $\qquad$ $K \equiv Y + Z$

Then:

$$\text{Incr}_i = \frac{x}{[x^2 + K]^{3/2}}$$

In terms of the variable of integration, *xe*, [*x* below] and relative to its "encountered" origin the range of the *xe* scan excursion is:

$$\text{from} \quad -\sqrt{\left(Re^2 - ze^2\right) - ye^2} \equiv -R \qquad \text{to} \qquad +\sqrt{\left(Re^2 - ze^2\right) - ye^2} \equiv +R$$

but, the overall integration is in the source frame of reference and the range must so be. Therefore, the range is from $[-R - D]$ to $[+R - D]$.

The integral is then:

$$\text{Incr} = \frac{1}{2\cdot R}\cdot\int_{-R-D}^{+R-D} \frac{x}{[x^2 + K]^{3/2}}\cdot dx$$

where for scanning a single encountered x-line for a single source point [at zs, ys, xs] the encountered ze and ye are constants. The only variable is xe as x.

The above derivation assumes the spheres case as in Figure 1; however, the same general procedure applies to any form having the same x-axis symmetry. The only modification needed is the range of the integration.

Evaluating the Integral

To integrate a function containing $[x^2 + K]^{3/2}$ the procedure is to make the substitution:

$x^2 + K = y^2$ $\quad$ from which: $\quad$ $x^2 = y^2 - K$ $\quad$ and: $\quad$ $2x\cdot dx = 2y\cdot dy$.

The above integrand then transforms as follows:

$$\frac{x\cdot dx}{[x^2+K]^{3/2}}=\frac{y\cdot dy}{y^3}=\frac{dy}{y^2}$$

The right hand expression of the integrand integrates as follows.

$$\int\frac{1}{y^2}\cdot dy=\int y^{-2}\cdot dy=\frac{y^{-1}}{-1}=-\frac{1}{y}$$

Reverting back through the substitution to a function of x:

$$\int\frac{x}{[x^2+K]^{3/2}}\cdot dx=-\frac{1}{\sqrt{x^2+K}}$$

But, this $K = Y + Z = \Delta y^2 + \Delta z^2 = [ys - ye]^2 + [zs - ze]^2$ and is a constant relative to integrating on x.

Further x is $[xs - xe + D]$ where xe is the variable and xs a constant; therefore:

$$Incr=\frac{1}{2\cdot R}\cdot\int_{-R+D}^{+R+D}\frac{x}{[x^2+K]^{3/2}}\cdot dx=\frac{1}{2\cdot R}\cdot\left[-\frac{1}{\sqrt{x^2+K}}\right]\begin{matrix}|+R-D=+\sqrt{(Re^2-ze^2)-ye^2}-D\\|-R-D=-\sqrt{(Re^2-ze^2)-ye^2}-D\end{matrix}$$

$$=\frac{1}{2\cdot\sqrt{(Re^2-ze^2)-ye^2}}\cdot\left[-\frac{1}{\sqrt{[xs-xe+D]^2+[ys-ye]^2+[zs-ze]^2}}\right]\begin{matrix}|+\sqrt{(Re^2-ze^2)-ye^2}-D\\|-\sqrt{(Re^2-ze^2)-ye^2}-D\end{matrix}$$

$$=+\frac{1}{2\cdot\sqrt{(Re^2-ze^2)-ye^2}}\cdot\left[-\frac{1}{\sqrt{\left[xs-\left[+\sqrt{(Re^2-ze^2)-ye^2}-D\right]+D\right]^2+[ys-ye]^2+[zs-ze]^2}}\right]$$

$$\ldots\left[xs-\sqrt{(Re^2-ze^2)-ye^2}+D+D\right]^2\ldots$$

$$-\frac{1}{2\cdot\sqrt{(Re^2-ze^2)-ye^2}}\cdot\left[-\frac{1}{\sqrt{\left[xs-\left[-\sqrt{(Re^2-ze^2)-ye^2}-D\right]+D\right]^2+[ys-ye]^2+[zs-ze]^2}}\right]$$

$$\ldots\left[xs+\sqrt{(Re^2-ze^2)-ye^2}+D+D\right]^2\ldots$$

V – Scanning and Calculating the X-Scan Integral

The remaining procedure is to calculate the above evaluated integral in conjunction with scanning the *M* and *m* objects. Appendix B is a Basic Language program for performing the scanning and calculating the x-scan for each pair of particles selected.

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APPENDICES

A – Summary of Tests Results

B – A Sample Typical Basic Program File: Luther.bas .

C – Comparison of Tests Parameters

Appendix A – Big G Calculation Tests Summary of Tests Results

Newton's Law of Gravitation is $a_g = G\cdot\frac{M}{d^2}$. That, with Law of Motion, F = m·a, is $F = [m]\cdot\left[G\cdot\frac{M}{d^2}\right] = G\cdot\frac{M\cdot m}{d^2}$

Measurement = which experiment

D = spheres center-to-center separation distance

GR = General Relativity calculation of gravitation, $^1/_{d}2 = {}^1/_{D}2$

AvgD = Calculated average of parallel-to-centerline-components of reciprocal separation distances squared is $^1/_{d}2$.

MN = Modern Newtonian calculation of gravitation using AvgD

Gm = reported measured "Big G"

Gc = Gm · [$^{GR}/_{MN}$] = Gm · [$^1/_{D^2}$ / AvgD]

G from its relation to other fundamental constants = $6.636{,}046{,}823 \times 10^{-11}$

SUMMARY OF TESTS RESULTS

All Data in SI Units: meters, kilograms, seconds * = × 10^{-11}

Measurement	Description of Experiment	Year	GR 1/D^2	MN AvgD	Gm as * Measured	Corrected G *
						Correct = 6.636,046,823
Cavendish	Sphere on sphere torsion balance, deflection	1798	18.90	20.355,903,3	6.754	6.272
Rose	Sphere on cylinder, off-set by angular acceleration	1969	33.029,464,1	33.243,545,7	6.674	6.631
Luther	Sphere on torsion pendulum, oscillation frequency	1982	202.359,259,3	203.647,993,0	6.672,6	6.630,4
Bagley 1	Sphere on torsion pendulum, time-of-swing	1997	193.388,696,3	194.648,677,3	6.676,1	6.632,8
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Schlamminger	A Configuration of Cylinders, beam balance	2006	20.020,909,8	20.149,705,7	6.674,252	6.631,591
Quinn	Cylinders torsion pendulum, average of fixed deflection and period of oscillation	2013	0.138,195,9	0.139,108,2	6.675,66	6.631,67

Experiments Calculated

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Appendix B - *A Sample Typical Basic Program File: Luther.bas*

This program is a sample typical of the programs used for calculating the various experiments. It was prepared and run using the PowerBASIC Consol Compiler Integrated Development Environment (IDE) version 6.03 from PowerBASIC Inc.

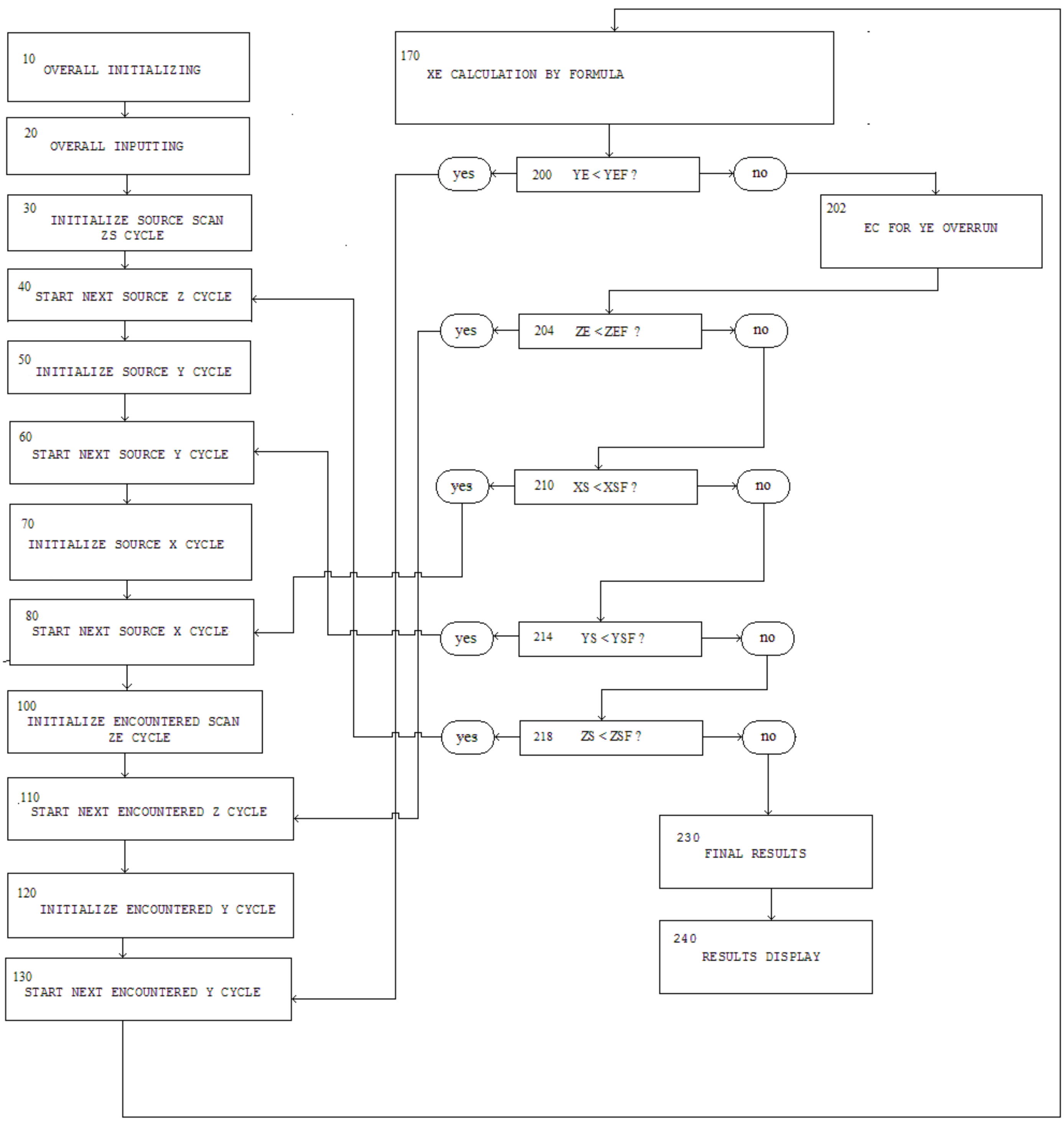
```
FUNCTION PBMAIN
1 REM  BIG  G  INTEGRATION  CALCULATION  BASIC  PROGRAM
    CONSOLE.PRINT "METHOD = SPHERE TO SPHERE"
    CONSOLE.PRINT "EXPERIMENT = LUTHER"
    CONSOLE.PRINT ""
    CONSOLE.PRINT "START:  DATE =  "; DATE$, "     TIME = "; TIME$
    BD$ = DATE$
    BT$ = TIME$
10 REM OVERALL INITIALIZING
    DIM COUNT AS DOUBLE
    COUNT = 0
    DIM AVGD AS DOUBLE
    AVGD = 0
    DIM N AS DOUBLE
    N = 100
20 REM OVERALL INPUTTING
    DIM RS AS SINGLE
    DIM RE AS DOUBLE
    DIM SEPD AS DOUBLE
    DIM GM AS DOUBLE
    RS = 0.0508255
    RE = 0.0029
    SEPD = 0.07029727
    GM = 6.6726E-11
    DIM JS AS DOUBLE
    DIM JE AS DOUBLE
    JS = RS / N
    JE = JS / 10
30 REM INITIALIZE SOURCE SCAN - ZS CYCLE
    DIM ZSF AS DOUBLE
    ZSF = RS - JS / 2
    DIM ZS AS DOUBLE
    ZS = -JS/2
40 REM START NEXT SOURCE Z CYCLE
    ZS = ZS + JS
50 REM INITIALIZE SOURCE Y CYCLE
    DIM YSF AS DOUBLE
    YSF = (SQR(RS^2 - ZS^2))-JS/2
    DIM YS AS DOUBLE
    YS = -JS/2
55 REM DISPLAY
    IF COUNT > 0 THEN
       CONSOLE.PRINT "1 OVER  SEPD^2 = "; 1 / (SEPD ^ 2), "AVGD  = "; AVGD / COUNT
       CONSOLE.PRINT "ZS = "; ZS, " OUT OF ZSF = "; ZSF
       CONSOLE.PRINT " "
    END IF
```

```
60 REM START NEXT SOURCE Y CYCLE
     YS = YS + JS
70 REM INITIALIZE SOURCE X CYCLE
     DIM XSF AS DOUBLE
     XSF = (SQR(RS^2 - ZS^2 - YS^2))-JS/2
     DIM XS AS DOUBLE
     XS = -(SQR(RS^2 - ZS^2 - YS^2))-JS/2
80 REM START NEXT SOURCE X CYCLE
     XS = XS + JS
100 REM INITIALIZE ENCOUNTERED SCAN - ZE CYCLE
     DIM ZEF AS DOUBLE
     ZEF = RE - JE / 2
     DIM ZE AS DOUBLE
     ZE = -JE/2
110 REM START NEXT ENCOUNTERED Z CYCLE
     ZE = ZE + JE
120 REM INITIALIZE ENCOUNTERED Y CYCLE
     DIM YEF AS DOUBLE
     YEF = (SQR(RE^2 - ZE^2))-JE/2
     DIM YE AS DOUBLE
     YE = -JE/2
130 REM START NEXT ENCOUNTERED Y CYCLE
     YE = YE + JE
170 REM XE CALCULATION BY FORMULA
     DIM CUMINCR AS DOUBLE
     CUMINCR = 0
     DIM RAD AS DOUBLE
     RAD = (RE ^ 2 - ZE ^ 2)
     IF RAD > YE ^ 2 THEN
       RAD = SQR(RAD - YE ^ 2)
     ELSE
       RAD = 0
       GOTO 200
     END IF
     DIM TAIL AS DOUBLE
     TAIL = XS + SEPD + SEPD
     DIM BALNC AS DOUBLE
     BALNC = (YS - YE) ^ 2 + (ZS - ZE) ^ 2
     DIM FIRST AS DOUBLE
     FIRST = 1 / (2 * RAD)
     DIM PIECEA AS DOUBLE
     PIECEA = (RAD + TAIL) ^ 2
     DIM SECOND AS DOUBLE
     SECOND = 1 / SQR(PIECEA + BALNC)
     DIM PIECEB AS DOUBLE
     PIECEB = (-RAD + TAIL) ^ 2
     DIM THIRD AS DOUBLE
     THIRD = 1 / SQR(PIECEB + BALNC)
     DIM CHG AS DOUBLE
     CHG = ABS(FIRST * (THIRD - SECOND))
     CUMINCR = CUMINCR + CHG
```

```
    BALNC = (-YS - YE) ^ 2 + (ZS - ZE) ^ 2
    SECOND = 1 / SQR(PIECEA + BALNC)
    THIRD = 1 / SQR(PIECEB + BALNC)
    CHG = ABS(FIRST * (THIRD - SECOND))
    CUMINCR = CUMINCR + CHG + CHG
    BALNC = (-YS - YE) ^ 2 + (-ZS - ZE) ^ 2
    SECOND = 1 / SQR(PIECEA + BALNC)
    THIRD = 1 / SQR(PIECEB + BALNC)
    CHG = ABS(FIRST * (THIRD - SECOND))
    CUMINCR = CUMINCR + CHG
    AVGD = AVGD + CUMINCR
    COUNT = COUNT + 1
200 REM LOGIC FOR YE SCAN
    IF YE < YEF THEN
       GOTO 130
    END IF
202 REM EC FOR YE OVERRUN
    DIM FRACT AS DOUBLE
    FRACT = (YE - YEF)/JE
    CHG = CUMINCR*FRACT
    AVGD = AVGD - CHG
204 REM LOGIC FOR ZE SCAN
    IF (ABS(ZE)) < ZEF THEN
       GOTO 110
    END IF
210 REM LOGIC FOR XS SCAN
    IF (ABS(XS)) < XSF THEN
       GOTO 80
    END IF
214 REM LOGIC FOR YS SCAN
    IF (ABS(YS)) < YSF THEN
      GOTO 60
    END IF
218 REM LOGIC FOR ZS SCAN
    IF (ABS(ZS)) < ZSF THEN
      GOTO 40
    END IF
230 REM FINAL RESULTS
    AVGD = AVGD / COUNT
    DIM WRONGD AS DOUBLE
    WRONGD = 1 / SEPD ^ 2
    DIM RATIO AS DOUBLE
    RATIO = WRONGD / AVGD
    DIM CORRECTG AS DOUBLE
    CORRECTG = RATIO * GM
240 REM  RESULTS DISPLAY
    XPRINT ATTACH DEFAULT
    XPRINT "METHOD = SPHERE TO SPHERE"
    XPRINT "EXPERIMENT = ROSE"
    XPRINT ""
    XPRINT "RS = "; RS
```

```
    XPRINT "RE = "; RE
    XPRINT "SEPD = "; SEPD
    XPRINT "GM = "; GM
    XPRINT "GR = GENERAL RELATIVITY     MN = MODERN NEWTON"
    XPRINT ""
    XPRINT "N = "; N
    XPRINT "GR RECIPROCAL  SQUARED  X-COMPONENT  DISTANCE  =  "; WRONGD
    XPRINT "MN RECIPROCAL  SQUARED  X-COMPONENT DISTANCE  =  "; AVGD
    XPRINT ""
    XPRINT "RATIO GR/MN  =  "; RATIO
    XPRINT ""
    XPRINT "CORRECTED G = "; CORRECTG
    XPRINT "FORMULA   G = "+ STR$(6.636046823E-11)
    XPRINT ""
    CONSOLE.PRINT "GR = GENERAL RELATIVITY     MN = MODERN NEWTON"
    CONSOLE.PRINT ""
    CONSOLE.PRINT "N = "; N
    CONSOLE.PRINT  "GR  RECIPROCAL    SQUARED    X-COMPONENT    DISTANCE    =    ";
WRONGD
    CONSOLE.PRINT "MN RECIPROCAL  SQUARED  X-COMPONENT DISTANCE  =  "; AVGD
    CONSOLE.PRINT ""
    CONSOLE.PRINT "RATIO GR/MN  =  "; RATIO
    CONSOLE.PRINT ""
    CONSOLE.PRINT "CORRECTED G = "; CORRECTG
    CONSOLE.PRINT ""
    FT$ = TIME$
    FD$ = DATE$
    XPRINT "START DATE WAS "; BD$; "     FINISH DATE WAS "; FD$
    XPRINT "START TIME WAS "; BT$; "     FINISH TIME WAS "; FT$
    XPRINT CLOSE
    CONSOLE.WAITSTAT
END FUNCTION
```

BIG G CALCULATION BASIC FLOW DIAGRAM



Appendix C – Comparison of Parameters

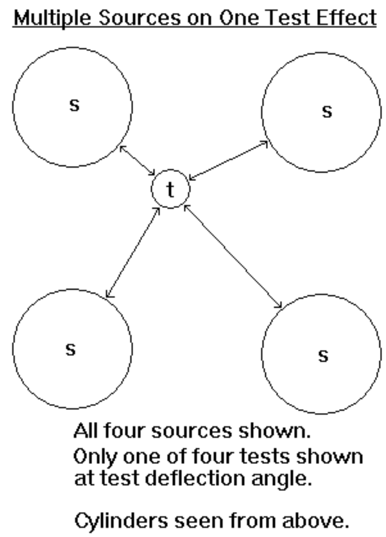
All dimensions in meters.

		Per Experiment Published Paper		As These Calculations Run	
Test	Variable	Notes	Value	Value	Notes
Rose	Rs	Large attraction less small repulsion +/- due to spheres acting on each side of small narrow rod- pendulum to net fixed deflection.	0.0508	0.0508	
	Re		Equivalent Sphere[1]	0.0066	Per mathcad equivalent sphere.
	SepD		0.12	0.174	Per narrow rod pendulum +/- effect.
Luther	Rs	Pendulum oscillates therefore SepD varies with pendulum oscillation.	0.0508255	0.0508255	
	Re		Equivalent Sphere	0.0029	Per mathcad equivalent sphere.
	SepD		0.07029727	0.07029727	
Bagley 1	Rs	Partially same set-up as in Luther	0.0508255	0.0508255	
	Re		Equivalent Sphere	0.0029	Per mathcad equivalent sphere.
	SepD		0.0719092	0.0719092	
Bagley 2	Rs	Partially same set-up as in Luther	0.0508255	0.0508255	
	Re		Equivalent Sphere	0.0029	Per mathcad equivalent sphere.
	SepD		0.0698567	0.0698567	
Gundlach	Rs	Large attraction less small repulsion +/- due to spheres acting on each side of flat thin pendulum to net fixed deflection.	0.06245	0.06245	
	Re		Equivalent Sphere	0.0104	Per mathcad equivalent sphere.
	SepD		Anomalous	0.2575 *	Per flat thin pendulum +/- effect. * & Comp for angle to centerline.
Schlam'ger	Ls	Approximately half of the small encountered cylinder overlaps the larger by being inside at one end of its central cavity. Thus SepD is indeterminate as is the point-on-point action there.	0.7	0.7	
	Le		0.077	0.077	
	Rs		0.523	0.523	
	Ri		0.050	0.050	
	Re		0.0225	0.02215	
	SepD		0.3465	0.22349	Evaluated to compensate overlap.
Quinn	Ls	1. Test cylinders oscillate therefore SepD varies with oscillation. 2. Large attraction less smaller repulsion +/- due to source cylinders acting opposite, and at an angle on each side of, test cylinder.	0.115	0.115	
	Le		0.055	0.055	
	Rs		0.060	0.060	
	Re		0.0275	0.0275	
	SepD		0.214	2.690	Per "Notes" column 3 and below.

[1] Equivalent sphere is a sphere of the same total volume as the actual encountered test mass [and therefore it has the same number of interacting particles as the actual] and, to the extent possible, located with its center at the encountered test mass end of the actual SepD [producing the same average separation].

NOTES re QUINN

In the Quinn experiment 4 larger field masses confront 4 smaller test masses as in the figure below.



Because the modeling for the Modern Newtonian Calculation is of one field mass acting on one test mass the model incorporates only the upper left field [source] mass. the effect of the other 3 field masses and of the other 3 test masses, not shown, is to oppose, that is to reduce, the overall gravitational effect of the upper left field mass on its test mass.

The model of only one field mass accounts for that by a much greater value of SepD for the calculations.