35 Indirect Gravitation

Two special gravitational fields may be defined;

- a Schwarzschild field (indirect gravitation)
- a Plank field (direct gravitation)

The two fields may be related if a "Plank particle" is considered to be the mediator of gravitational force. The Schwarzschild field may be considered to be the maximum value of a statistical distribution of acceleration.

Two observable "massive objects" (primary objects) have a gravitational interaction, they interact indirectly. The primary objects each interact with a third massive object (the Plank particle) which has Plank mass. Each interaction may be represented as a gravitational force.

An energy potential exists between each primary object and the Plank particle. Gravitation (between primary objects) may be represented as a force which is related to the product of potential energies. This force will approximate to the Newton force equation.

A gravitational field may also be represented as a vector of acceleration. The gravitational field of a primary object may be represented as a statistical distribution of acceleration with respect to components of space-time. This distribution will approximate to the Newton field equation.

The representation of a field as a distribution overcomes the problem of a singularity which is associated with the Newton field equation.

Mass;

Two primary objects (P_1, P_2) interact directly with a "Plank particle" (P_3) and indirectly with each other. Each object has mass;

m_1, m_2 are mass associated with the primary objects (P_1, P_2)

m_P is Plank mass associated with the Plank particle (P_3)

$m_P = (\hbar c/G)^{1/2}$ and; $Gm_P = (\hbar cG)^{1/2}$

Where; G is the gravitational field constant

c is the light constant

ђ is the reduced Plank constant

The Schwarzschild Radius;

The Schwarzschild radius (r_S) is defined as; $r_S = 2Gm/c^2$

Any massive object (P_n) with mass (m_n) has a Schwarzschild radius (r_{Sn}); $r_{Sn} = 2Gm_n/c^2$

The Schwarzschild Field;

Schwarzschild acceleration (g_{Sn}) may be considered to be the maximum value of a gravitational field associated with an object (P_n). It occurs at the Schwarzschild radius.

Schwarzschild acceleration is defined as; $g_{Sn} = 2Gm_n/r_{Sn}^2 = c^2/r_{Sn}$

The Plank Field;

Plank acceleration (g_P) may be considered to be the maximum value of a gravitational field associated with the plank particle (P_n).

Plank acceleration is defined as; $g_P = 2Gm_P/R^2 = 2(\hbar cG)^{½}/R^2$

Where; R is a radial distance

The Field Vector;

Acceleration may also be represented as a 3D vector ($\boldsymbol{g_x}$) associated with space-time;

$$\boldsymbol{g_x} = g_{x1}\boldsymbol{e_{x1}} + g_{x2}\boldsymbol{e_{x2}} + g_{x3}\boldsymbol{e_{x3}}$$

Where; $\boldsymbol{e_{x1}}$, $\boldsymbol{e_{x2}}$, $\boldsymbol{e_{x3}}$ are directional vectors in 3D (unit vectors)

g_{x1} , g_{x2} , g_{x3} are scalar components of acceleration

The vector has a magnitude; $|\boldsymbol{g_x}| = g_{x4}$

The components are related to the magnitude; $g_{x1}^2 + g_{x2}^2 + g_{x3}^2 = g_{x4}^2$

Sub-components of acceleration (g_{x5}, g_{x6}) are defined as; $g_{x5}^2 = g_{x1}^2 + g_{x2}^2 = g_{x4}^2 - g_{x3}^2$

$$g_{x6}^2 = g_{x2}^2 + g_{x3}^2 = g_{x4}^2 - g_{x1}^2$$

Angular Geometry;

The vector includes four "sub-component angles" (A_{x1}, A_{x2}, A_{x3}, A_{x4}).

The vector ($\boldsymbol{g_x}$) has scalar parts (g_{xN}) associated with the component angles (A_{xN});

$g_{x1} = g_{x5}Cos(A_{x1})$ and $g_{x2} = g_{x5}Sin(A_{x1})$

$g_{x5} = g_{x4}Cos(A_{x2})$ and $g_{x3} = g_{x4}Sin(A_{x2})$

$g_{x2} = g_{x6}Cos(A_{x3})$ and $g_{x3} = g_{x6}Sin(A_{x3})$

$g_{x6} = g_{x4}Cos(A_{x4})$ and $g_{x1} = g_{x4}Sin(A_{x4})$

Angular geometry includes one important condition; $A_{x4} = 2A_{x1}$

Space-Time;

Components of acceleration may be related to “parts” of space-time; (r_{Sn}, r, R, t)

The components of acceleration may be defined as;

$g_{x1} = (r/t)^2/r_{Sn}$

$g_{x2} = r_{Sn}/t^2$

$g_{x5} = (R/t)^2/r_{Sn}$

$g_{x5}^2 = g_{x1}^2 + g_{x2}^2$ giving; $R^4 = r^4 + r_{Sn}^4$

$g_{x1} = g_{x5}Cos(A_{x1})$ giving; $Cos(A_{x1}) = r^2/R^2$

$g_{x2} = g_{x5}Sin(A_{x1})$ giving; $Sin(A_{x1}) = r_{Sn}^2/R^2$

The vector condition is; $A_{x4} = 2A_{x1}$

Giving; $Cos(A_{x4}) = Cos(2A_{x1}) = (r^4 - r_{Sn}^4)/R^4$

$Sin(A_{x4}) = Sin(2A_{x1}) = 2r_{Sn}^2r^2/R^4$

Primary Interaction;

A primary object (P_n) interacts with the Plank particle (P_3) “directly”. Each direct interaction may be represented as a gravitational force (F_{Pn});

$F_{Pn} = m_n g_P = m_n(2Gm_P/R^2) = 2m_n(\hbar cG)^{½}/R^2 = 2m_n(\hbar cG)^{½}Cos(A_{x1})/r^2$

Where; m_n is a primary mass (m_1 , m_2)

g_P is Plank acceleration (maximum acceleration of the Plank field)

Signage;

A force of attraction has a negative sign, and a force of repulsion has a positive sign. Force signage will lead to complex values. It is convenient to ignore signage in this presentation.

Potential;

Energy potential (E_{Pn}) exists between the Plank particle and a primary object;

$$E_{P1} = rF_{P1} = 2m_1(\hbar cG)^{½}Cos(A_{x1})/r$$

$$E_{P2} = rF_{P2} = 2m_2(\hbar cG)^{½}Cos(A_{x1})/r$$

Secondary Interaction;

Gravitation between primary objects may be represented as a "secondary force" (F_{12} or F_{21}) which is related to the product of potential energies;

$$F_{12} = E_{P1}E_{P2}/\hbar c$$

$$F_{12} = 4Gm_1m_2Cos^2(A_{x1})/r^2$$

$$F_{12} = 4Gm_1m_2r^2/R^4$$

$$F_{12} = (2Gm_1/r_{S1}{}^2)(2r_{S1}{}^2r^2/R^4)m_2$$

$$F_{12} = g_{S1}Sin(2A_{x1})m_2$$

$F_{12} = g_{u1}m_2$ also; $F_{21} = g_{u2}m_1$

Where the secondary field equations are;

$g_{u1} = g_{S1}Sin(2A_1)$ also; $g_{u2} = g_{S2}Sin(2A_1)$

The Newton Equations;

The Newton Force Equation represents a gravitational force (F_{12} or F_{21}) between primary objects (P_1, P_2);

$F_{12} = Gm_1m_2/R_y{}^2 = g_{y1}m_2$ and; $F_{21} = g_{y2}m_1$

Where; m_n is rest mass of object P_n

R_y is the separation distance between the primary objects

The Newton Field Equation represents gravitational acceleration (g_{yn}) associated with a primary object (P_n);

$$g_{yn} = Gm_n/r_y{}^2$$

Where; r_y is the radius of a "spatial bubble" surrounding a massive object

The Newton field equation is reasonably accurate except at or near the center of the object ($r_y = 0$) where the equation gives a singularity.

The Distribution Equation;

Indirect gravitational acceleration (g_{u1}, g_{u2}) may also be represented as a distribution of acceleration over radial distance. At the center of the object (r = 0) the distribution equation gives zero acceleration. Maximum acceleration (Schwarzschild acceleration) occurs at the Schwarzschild radius. The distribution curve is an asymptote to zero with increasing radial distance beyond the Schwarzschild radius. The distribution is symmetric with respect to direction of 'r'. Acceleration is always consistent (attractive if signage is not ignored). The distribution equation will approximate the Newton Field Equation at significant distances beyond the Schwarzschild radius.

The distribution equation is; $g_{un} = g_{Sn}\mathrm{Sin}(2A_{x1})$ (n = 1,2)

Where; $g_{Sn} = 2Gm_n/r_{Sn}^2 = c^2/r_{Sn}$

$\mathrm{Sin}(2A_{x1}) = 2r_{Sn}^2r^2/R^4$

Two key points on the distribution curve (r, g_{un}) are;

minimum field strength; (0,0)

maximum field strength; (r_{Sn}, g_{Sn})

NFE Approximation;

The distribution equation will approximate to the Newton Field Equation at significant distance beyond the Schwarzschild radius.

The distribution equation is; $g_{un} = g_{Sn}\mathrm{Sin}(2A_{x1})$ (n = 1,2)

$g_{un} = g_{Sn}(2r_{Sn}^2r^2/R^4)$

Re-arranging gives; $2g_{Sn}/g_{un} = R^4/(r^2r_{Sn}^2) = r^2/r_{Sn}^2 + r_{Sn}^2/r^2$

If; $r >> r_S$

Then; $2g_{Sn}/g_{un} \rightarrow r^2/r_{Sn}^2 + \text{"0"}$

$g_{un} \rightarrow 2g_{Sn}r_{Sn}^2/r^2$

$g_{un} \rightarrow 2(c^2/r_{Sn})r_{Sn}^2/r^2 \rightarrow 2c^2r_{Sn}/r^2$

$g_{un} \rightarrow 2c^2(2Gm_n/c^2)/r^2$

$g_{un} \rightarrow 4Gm_n/r^2$

Assume; $r = 2r_y$

Giving; $g_{un} \rightarrow Gm_n/r_y^2$ which is an approximation to the NFE.

Nomenclature;

Summary of symbols;

n is an object identifier

N is a component (or sub-component) identifier

m_1, m_2 are mass associated with the primary objects (P_1, P_2) generally (m_n , P_n)

m_P is Plank mass associated with the Plank particle (P_3)

(r_{Sn} , r , R , t) is the "set of parts" of space-time (not dimensions)

$\boldsymbol{g_x}$ is a vector of acceleration associated with space-time

A_{xN} is an angular sub-component of acceleration associated with space-time (deformation)

g_{xN} is a scalar component (or sub-component) of acceleration associated with space-time

g_P is maximum acceleration associated with a Plank particle (P_3); $g_P = 2Gm_P/R^2$

g_{Sn} is maximum acceleration associated with a primary object (P_n); $g_{Sn} = 2Gm_n/r_{Sn}^2$

g_{un} is distributed acceleration (field) associated with a primary object; $g_{un} = g_{Sn}Sin(2A_{x1})$

g_{yn} is Newton acceleration (field) associated with a primary object; $g_{yn} = Gm_n/r_y^2$

F_{Pn} is a direct interaction between a Plank particle and primary object; $F_{Pn} = g_P m_n$

E_{Pn} is an energy potential between a Plank particle and primary object; $E_{Pn} = rF_{Pn}$

F_{12} is an indirect interaction between primary objects; $F_{12} = E_{P1}E_{P2}/\hbar c$

Conclusion;

A "Plank particle" is assumed to be the mediator of gravitational force.

Relativistic Forces;

Vector components have ratios; $g_{x1} = g_{x5}Cos(A_{x1})$ and; $g_{x2} = g_{x5}Sin(A_{x1})$

Assume; $g_{x1} = v_{x1}/t$ and; $g_{x5} = v_{x5}/t = c/t$

Giving; $Cos(A_{x1}) = v_{x1}/c$

Also; $Sin(A_{x1}) = g_{x2}/g_{x5} = r_{Sn}^2/R^2$

Where; $r_{Sn}^2 = 2Gm_n/g_{Sn}$ and; $R^2 = 2Gm_p/g_P$

Giving; $\text{Sin}(A_{x1}) = m_n g_P / m_P g_{Sn} = F_{Pn}/F_{SnP}$

$\text{Sin}^2(A_{x1}) + \text{Cos}^2(A_{x1}) = 1$

Relativistic forces are; $F_{Pn} = F_{SnP}(1 - v_{x1}{}^2/c^2)^{½}$

$F_{SnP} = \gamma F_{Pn}$

Where Lorentz factor; $\gamma = 1/(1 - v_{x1}{}^2/c^2)^{½}$