Origin of the Gravitational Force

- Derivation from the Fundamental Force -

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Between energies,

Gravitational force: act on amounts of energy

Fundamental force: act on momentums (movements of energy)

Ultimate question:

Is the **gravitational force** **derived from the fundamental force**,

or

does it exist **independently as a law**?

< Energy Circulation Theory (ECT) >

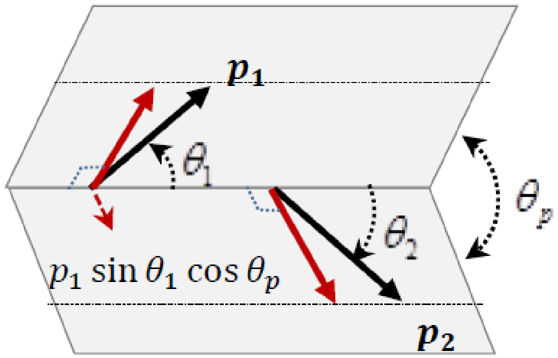
ECT: logical development from two premises

Premises:

(1) Energy can be expressed by an intrinsic energy and its velocity.

$$E = E_1 {V_1}^2 = E_2 {V_2}^2 = mc^2$$

(2) Force works between momentums (Fundamental Force).



$$F = K_f \frac{{}_{r}\mathbf{p}_1 \cdot {}_{r}\mathbf{p}_2}{d^2} = K_f \frac{p_1 p_2}{d^2} \cos\theta_p \sin\theta_1 \sin\theta_2$$

${}_{r}\mathbf{p}$: orthogonal momentum to the distance ${}_{r}p = p \sin\theta$

Intra-circulation force: (form an energy circulation)

Between local momentums $\mathbf{\Delta p_0}$ and $\mathbf{\Delta p_\theta}$: (μ: radius) (See Fig. on p13)

$$\Delta F = K_f \frac{\Delta p_0 \Delta p_\theta}{d^2} \sin\frac{\theta}{2} \sin\frac{-\theta}{2} = -K_f \frac{\Delta p_0 \Delta p_\theta}{4\mu^2}, \qquad d = 2\mu \sin\frac{\theta}{2}$$

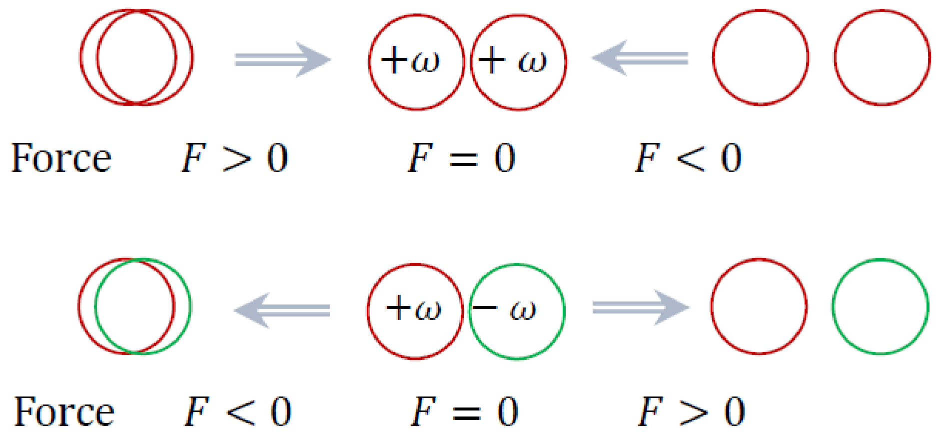
Centripetal force on $\mathbf{\Delta p_0}$ from the whole circulation:

$$cF_\perp = -K_f \frac{\Delta p_0}{4\mu^2} \int_0^{2\pi} \Delta p_\theta \sin\frac{\theta}{2} d\theta = -K_f \frac{p \Delta p_0}{2\pi\mu^2}$$

Inter-circulation force:

(1) Orthogonal interaction

(2) Flat interaction



< Cosmic separation >

Energy: Continuum vibrating in multiple (M) dimensions

Can be expressed in any number of dimensions

2D expression: $E\psi_2 = E[X_1 \quad X_2] = E\mu(\cos\omega t + i\sin\omega t) = E\mu\exp(i\omega t)$

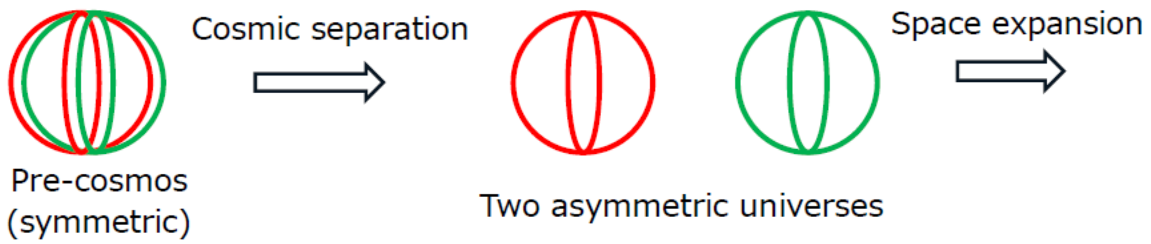
Pre-cosmos: Symmetric – coupled pairs of conjugate circulations

$$E_{pre}\psi_2 = E_{pre}\mu(\varphi : \varphi^*) , \qquad \varphi = \exp(i\omega t), \varphi^* = \exp(-i\omega t)$$

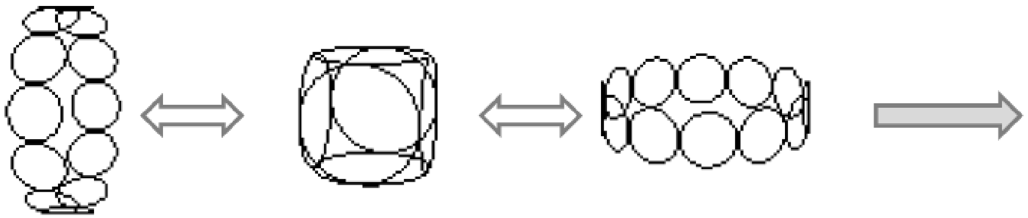
$$E_{pre}\psi_M = E_{pre}\mu(\varphi_{12} : \varphi_{12}^* + \varphi_{34} : \varphi_{34}^* + \varphi_{56} : \varphi_{56}^* \cdots)$$

Cosmic separation to two universes:

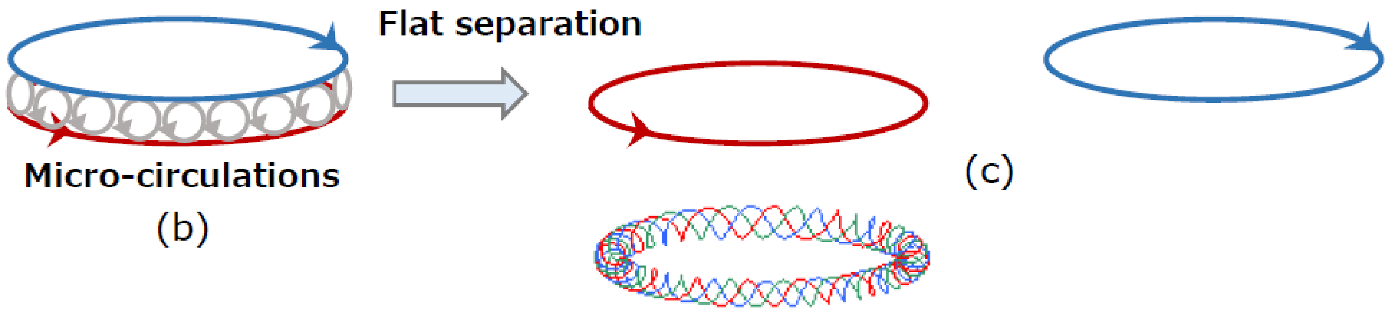
$$E\mu_{pre}(\varphi_{12} : \varphi_{12}^* + \varphi_{34} : \varphi_{34}^*) \longrightarrow \frac{E}{2}\mu_u(\varphi_{12} + \varphi_{34}) + \frac{E}{2}\mu_u(\varphi_{12}^* + \varphi_{34}^*)$$



< Orthogonal dimension of a conjugate pair of circulations >



(a) A conjugate pair in the Pre-cosmos



(b) (c) (d)

1D stretch in $\mathbf{X_1}$ larger than the threshold amplitude (radius in (b)):

Orthogonal separation of conjugate pair in X_3-X_4: $\mathbf{X_1}$ is orthogonal

Single circulation: helical motion in X_3, X_4, X_1

Flat separation of conjugate pair in X_1-X_2: $\mathbf{X_5}$ is orthogonal

Single circulation: helical motion in X_1, X_2, X_5

< Galactic evolution >

Space expansion:

Decoupled conjugate pairs $\rightarrow$ 4 dimensions expand

$\rightarrow$ no longer can keep as a continuum

Energy distribution just after the cosmic separation:

< 4D polar > $\mathbf{X} = [\mu_u \quad \theta_1 \quad \theta_2 \quad \theta_3] = [\mu_u \quad \omega t \quad \theta_2 \quad \omega t]$

< 4D cartesian > $\mathbf{X} = \mu_u \begin{pmatrix} \cos\omega t + i\sin\omega t\cos\theta_2 + j\sin\omega t\sin\theta_2\cos\omega t \\ +k\sin\omega t\sin\theta_2\sin\omega t \end{pmatrix}$

Energy distributed in 3D surface of a sphere in 4D:

< Take new base vectors for circulation $\mu_u\theta_1$ >

$$\mathbf{e_0} \equiv \cos\theta_1 + i\sin\theta_1 \ \ (\textbf{radius})$$

$$\mathbf{e_1} \equiv \cos(\theta_1 + \pi/2) + i\sin(\theta_1 + \pi/2) = i\mathbf{e_0} \ \ (\textbf{arc})$$

< 3D cartesian coordinates for 3D surface >

$$\mathbf{X} = \mu_u\big(\omega t\mathbf{e_1}\cos\theta_2 + \sin\theta_2\,(j\cos\omega t + k\sin\omega t)\big)$$

$$= \mu_u[\omega t\cos\theta_2 \quad \sin\theta_2\cos\omega t \quad \sin\theta_2\sin\omega t]$$

Space energy / Apparent energy:

Symmetric part of cosmic energy → **Space energy** (energy of vacuum space)
Asymmetric part → **Apparent energy** (observable energies)

Spacia: Space energy in one minimum space unit (radius μ_0)

$$E_\mu \psi_\mu = E_\mu [X \quad H] = E_\mu \mu_0 \big(\exp(i\omega_0 t) + \exp(-i\omega_0 t)\big)$$

$$v_c = \pm \mu_0 \omega_0 = \pm c \,, \qquad E_\mu = m_\mu {\mu_0}^2 {\omega_0}^2 = m_\mu c^2$$

Cyclic decomposition / Division of energy circulations:

Initial apparent energy → repeat cyclic decompositions → **galactic seeds** → galactic seed division/separation → release **stellar seeds** → release daughter circulations → repeat cyclic decompositions → **elementary circulations**

Elementary single circulations; iS, S:

Minimum radius equal to μ_0 of spacia

$$E_{(iS)} \psi_{iS} = E_{(iS)} \mu_0 \exp(i\omega_0 t) = E_{(iS)} [X \quad H] = E_{(iS)} \mu_0 [\cos \omega_0 t \quad \sin \omega_0 t]$$

$$E_{(S)} \psi_S = E_{(S)} \mu_0 \exp(i\omega_0 t) = E_{(S)} [X \quad Y] = E_{(S)} \mu_0 [\cos \omega_0 t \quad \sin \omega_0 t]$$

$$E_{(iS)} = E_{(S)} = m_0 {\mu_0}^2 {\omega_0}^2 = m_0 c^2$$

Particle: defined as an energy circulation

- Can be static to the space energy.
- Keeps a constant radius determined by its energy amount.
- Interacts with another circulation to show a force (attractive / repulsive).

Elementary circulations: single or double circulations, or their excitations

$$iS, S, iD\left(iS\colon \overline{iS}\right), D\left(S\colon \overline{S}\right), iD^{\#}, D^{\#}$$

Quantum particle: composition of elementary circulations in a single spacia

Mesons, Baryons

< Types of dimensions >

M dimensions

4 expanded dimensions

$X_1 - X_2$

$X_3 - X_4$

$(M-4)$ **rest dimensions**

X_5, X_6, X_7, - - - X_M

4D **spherical** space

3 **space dimensions** (surface)

$\mathbf{e_1}, j, k$ (X,Y,Z)

1 **hidden dimension** (radius)

$\mathbf{e_0}$ (H)

Their energy functions as an intrinsic energy for motions in 4D space

Fifth dimension X_5 (see p5): **circular momentum**

Other rest dimensions $\mathbf{X_{od}}$: **no momentum** (conjugate pair)

< Momentums in the Fifth Dimension X_5 >

(1) Just after the cosmic separation

Local intrinsic energies were helically moving on X_1-X_2.

ΔE: Energy of **one cycle** of **local circulation** including X_5

$$\Delta E = \Delta M({\mu_0}^2{\omega_5}^2 + {\mu_u}^2\omega^2)$$

μ_u: Radius of main circulation (universe) ⟶ rapidly **expand**

μ_0: Radius of local circulation including X_5 ⟶ remain **constant**

Momentum in X_5 of one local circulation:

$$\Delta p_5 = \Delta M \mu_0 \omega_5$$

Force between **2 halves** of circle (**linear approximation**):

$$F = K_f \frac{p_{5.1}p_{5.2}}{d^2}, \qquad (\cos\theta_p \sin\theta_1 \sin\theta_2 = 1)$$

$$F_5 \approx -K_f \frac{(\Delta M \mu_0 \omega_5/2)^2}{(2\mu_0)^2}$$

(2) With space expansion and galactic evolution

- ✧ Number of spacias increases.
- ✧ Number of local circulations including X_5 increases.
- ✧ The radius remains constant as μ_0.
- ✧ The intrinsic energy ΔM remains constant.
- ✧ The frequency ω_5 decreases.

Momentums in X_5: spread, incorporated in **all intrinsic energies**

Within one **elementary single circulation**:

Energy of the particle: $E = m_0 {\mu_0}^2 {\omega_0}^2 = m_0 c^2$

Intrinsic energy m_0 is derived from motions in the **rest dimensions**.

$$m_0 = E_5 + E_{od} = m_5 c^2 + m_{od} c^2$$

$$k \equiv (m_s + m_{od})/m_s > 1$$

$$m_5 = \frac{m_0}{kc^2}$$

m_5: intrinsic energy in X_5, m_{od}: intrinsic energy in other rest dimensions

< Gravitational force - 1 >

Definition of the **gravitational force**:

Fundamental force acting between **momentums** in the **fifth dimension**

Gravitational force within an **elementary single circulation** ($E = m_0 c^2$):

$$E_5 = m_5 c^2$$

$$m_5 = \frac{m_0}{kc^2}$$

Call E_5 as **g-circulation**: m_5 is circulating with μ_0 and ω_0 in X-X_5.

X: Distance direction in 3D space

$$E_5 \psi_5 = E_5 [X \quad X_5] = E_5 \mu_0 [\cos \omega_0 t \quad \sin \omega_0 t]$$

$$E_5 = m_5 {\mu_0}^2 {\omega_0}^2 = m_5 c^2$$

We will calculate the force in X between two halves of g-circulation.

< Fundamental force between two halves of circulation >

Divide a circulation to two halves:

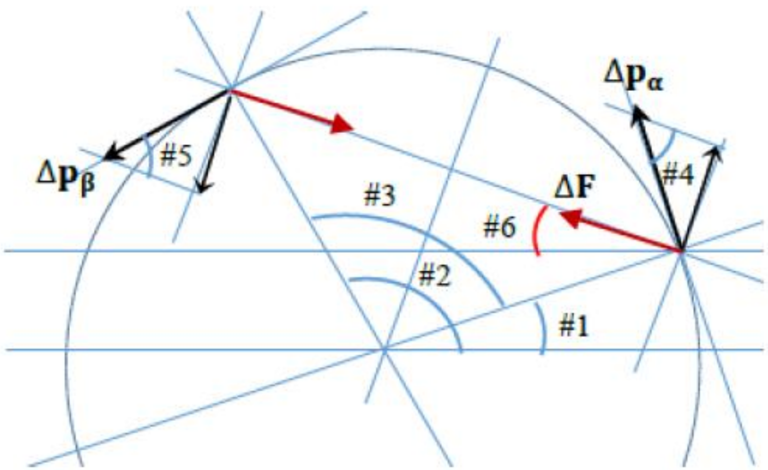
$$-\frac{\pi}{2} \leq \alpha \leq \frac{\pi}{2}\,, \qquad \frac{\pi}{2} \leq \beta \leq \frac{3\pi}{2}\,, \qquad \theta \equiv \beta - \alpha$$

Force between $\boldsymbol{\Delta p_\alpha}$ and $\boldsymbol{\Delta p_\beta}$:

$$\Delta F = K_f \frac{\Delta p_\alpha \Delta p_\beta}{d^2} \sin\frac{\theta}{2} \sin\frac{-\theta}{2} = -K_f \frac{\Delta p_\alpha \Delta p_\beta}{4{\mu_0}^2}$$

Component in the space direction X:

$$\Delta F_x = \Delta F \cos\gamma = \Delta F \sin\frac{\alpha+\beta}{2} = \Delta F\left(\sin\frac{\alpha}{2}\cos\frac{\beta}{2} + \cos\frac{\alpha}{2}\sin\frac{\beta}{2}\right)$$



$\#1{:}\quad \alpha$

$\#2{:}\quad \beta$

$\#3{:}\quad \theta = \beta - \alpha$

$\#4{:}\quad \theta/2$

$\#5{:}\quad -\theta/2$

$\#6{:}\quad \gamma$

$$\gamma = \frac{\pi}{2} - \frac{\theta}{2} - \alpha = \frac{\pi}{2} - \frac{\alpha+\beta}{2}$$

$$d = 2\mu_0 \sin\frac{\theta}{2}$$

Force in X on $\mathbf{\Delta p_\alpha}$ from the entire momentum $\mathbf{p_\pi}$ in the half circle $\pi/2 \leq \beta \leq 3\pi/2$:

$$p_h \equiv p_\pi = \Delta p_\beta \int_{\pi/2}^{3\pi/2} d\beta = \Delta p_\beta \pi\,, \qquad \Delta p_\beta = p_h/\pi$$

$$F_x(\alpha) = \int_{\pi/2}^{3\pi/2} \Delta F_x \partial\beta = \int_{\pi/2}^{3\pi/2} \Delta F \left(\sin\frac{\alpha}{2}\cos\frac{\beta}{2} + \cos\frac{\alpha}{2}\sin\frac{\beta}{2}\right) \partial\beta$$

$$= -K_f \frac{\Delta p_\alpha}{4{\mu_0}^2} \frac{p_h}{\pi} 2\sqrt{2}\cos\frac{\alpha}{2}$$

Force in X between two half-circle momentums, $\mathbf{p_0}$ and $\mathbf{p_\pi}$:

$$F_x = \int_{-\pi/2}^{\pi/2} F_x(\alpha)\partial\alpha = -K_f \frac{2\sqrt{2}}{4{\mu_0}^2} \frac{{p_h}^2}{\pi^2} \int_{-\pi/2}^{\pi/2} \cos\frac{\alpha}{2}\partial\alpha$$

$$= -\frac{8}{\pi^2} K_f \frac{{p_h}^2}{(2\mu_0)^2}$$

< Gravitational force within an elementary single circulation >

g-circulation of an elementary single circulation:

$$E_5 = m_5 {\mu_0}^2 {\omega_0}^2 = m_5 c^2 \,, \qquad m_5 = \frac{m_0}{kc^2}$$

Half-circle momentum of g-circulation:

$$p_h = \frac{m_5 c}{2} = \frac{m_0}{2kc}$$

Gravitational force between two half-circle momentums:

$$F_x = -\frac{8}{\pi^2} K_f \frac{(m_5 c/2)^2}{(2\mu_0)^2} = -\frac{8}{\pi^2 k^2 c^2} K_f \frac{(m_0/2)^2}{(2\mu_0)^2}$$

$$= -G \frac{(m_0/2)^2}{(2\mu_0)^2} \equiv F_g$$

$$G \equiv \frac{8}{\pi^2 k^2 c^2} K_f \,, \qquad k \equiv \frac{m_s + m_{od}}{m_s} > 1$$

Gravitational constant G is derived.

Electric force between 2 halves of iS:

$$F_e = -\frac{8}{\pi^2} K_f \frac{(m_0 c/2)^2}{(2\mu_0)^2} = -K_e \frac{e^2}{(2\mu_0)^2}$$

$$K_e \equiv \frac{8}{\pi^2} K_f \,, \qquad e \equiv \frac{1}{2} m_0 c$$

Comparison of **gravitational force** and **electric force** within the same iS.

$$F_g = -\frac{8}{\pi^2 k^2 c^2} K_f \frac{(m_0/2)^2}{(2\mu_0)^2} \,, \qquad F_e = -\frac{8}{\pi^2} K_f \frac{(m_0 c/2)^2}{(2\mu_0)^2}$$

$$G = \frac{K_e}{k^2 c^2} \,, \qquad k = (m_s + m_{od})/m_s > 1$$

$$F_g = \frac{F_e}{k^2 c^4} = \frac{F_e}{k^2 \times 8.1 \times 10^{33}} \approx F_e \times 10^{-34}$$

< Gravitational force between two static quantum particles >

All intrinsic energies are connected each other by a series of g-circulations in X_5-X, defined as **g-chain**.

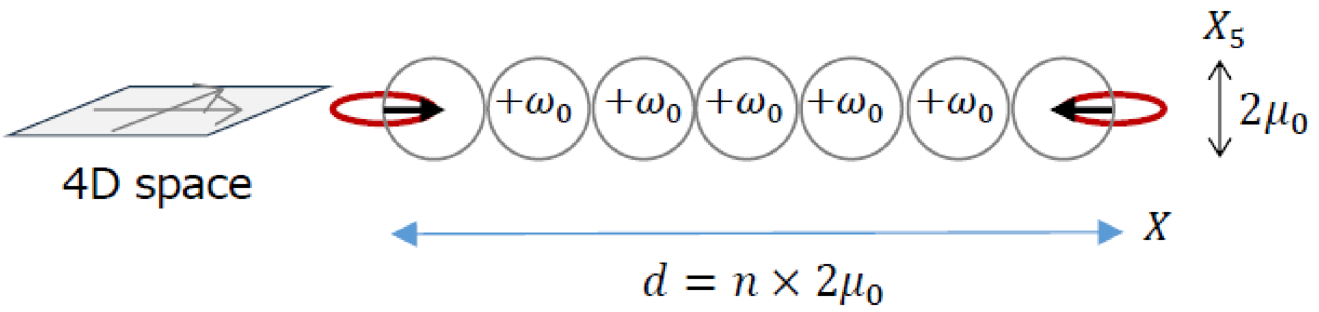
Quantum particle of $E = mc^2$:

$$m_5 = \frac{m}{k^2 c^2}$$

Gravitational force within a quantum particle:

$$F_g = -G\frac{(m/2)^2}{(2\mu_0)^2}$$

Gravitational force between **two** quantum particles:



Case of $n = 1$ (two particles adjacent – one g-circulation):

$$m_5(n=1) = \frac{2m}{k^2c^2} = 2m_5\,, \qquad E_5(n=1) = 2m_5c^2$$

$$F_g = -G\frac{m^2}{(2\mu_0)^2}$$

Case of $n \gg 1$ (atomic scale distance $n > 10^4$):

In general, **potential energy** can be defined as

$$U(x) \equiv \int_{x_0}^{x} \big(-F(x)\big)dx + U(x_0)$$

Gravitational potential energy:

Let the energy of a g-circulation for $n = 1$ be $U_g(2\mu_0)$.

$$U_g(x) \equiv \int_{2\mu_0}^{x} \Big(-F_g(x)\Big)\,dx + U_g(2\mu_0)$$

$$U_g(2\mu_0) \equiv 2m_5c^2$$

Practical distances greater than atomic size: We can treat $U_g(x)$ as a **constant**.

$$U_g(x) \approx U_g(\infty) \equiv U_g$$

Between 2 particles, the g-chain consists of n g-circulations.

Energy of g-chain $= U_g$, Energy of one g-circulation $= U_g/n$

$E_5(n) = 2m_5c^2/n$ (in each g-circulation)

Force on one particle: intra-circulation force on the half-circle of **one** g-circulation.

$$F_g(x) = -G\frac{(m/n)^2}{(2\mu_0)^2} = -G\frac{m^2}{(n \times 2\mu_0)^2} = -G\frac{m^2}{x^2}$$

Gravitational force is **inversely proportional** to the **square** of the **distance**.

Only **attractive** since it is an **intra-circulation force**.

Between **any two static quantum particles** (masses m_1 and m_2) :

$$\mathbf{F_g}(x) = -G\frac{m_1m_2}{x^2}\mathbf{e_d}$$

Gravitational force on a particle from a **cluster of particles**:

Sum of vectors of individual forces

< Gravitational force under the free motion >

Free motion is defined as:

that an object is **freely accelerated** by receiving a force.

The **total energy** does **not change**.

Potential energy: Let us define as

$$E_p(x) \equiv \int_{\infty}^{x} \big(-F(x)\big)dx \ , \qquad E_p(\infty) \equiv 0 \text{ (reference)}$$

For gravitational, magnetic, and inter-circulation forces.

(For electric force, we use a different reference at $x = 2\mu_0$.)

The reference of gravitational potential energy is changed to $E_p(\infty) \equiv 0$.

Kinetic energy: $E_k(x) = -E_p(x)$

Rest energy: $E_r(x) \equiv E_t(x) - E_k(x) = mc^2 + E_p(x)$

Total energy: $E_t(x) = E_r(x) + E_k(x) = mc^2$

The potential energy is incorporated in the rest energy.

< **Helical expression** >

Liner energy: $E_L(x) = mv^2$

Circular energy: $E_c(x) = m{C_r}^2 = m(c^2 - v^2)$

Total energy: $E_t(x) = E_c(x) + E_L(x) = mc^2$

By receiving a force, the linear velocity v is accelerated.

General formula for the **gravitational force**:

The charge for the fundamental force is the orthogonal momentum.

$${}_r p = p \sin\theta$$

3D charge for the gravitational force is the **orthogonal mass**.

$${}_r m = {}_r E/c^2 = m(1 - v^2/c^2)$$

$$\mathbf{F_g}(x) = -G \frac{{}_r m_1 \, {}_r m_2}{x^2} \mathbf{e_d}$$

Light: $v = c,\ {}_r m = 0$ in propagating direction (light speed does not change)

$v = 0,\ {}_r m = \frac{E_{(\gamma)}}{c^2} = \frac{m_0}{2} \frac{\omega^2}{{\omega_0}^2}$ in orthogonal direction (propagation bends)