Dynamics by the ECT - Summary

Version-2024.10

Summary from "Novel Dynamics by the Energy Circulation Theory"
https://mitiempo-ect.main.jp/NovelDynamics.pdf
Books on ECT: https://mitiempo-ect.main.jp/books.html

Mass in the **standard physics**:

Not clearly defined. Accepted as a fundamental property.

$$\mathbf{F} = m\boldsymbol{\alpha}\,, \qquad \boldsymbol{\alpha} = \frac{d\mathbf{v}}{dt} = \frac{d^2\mathbf{x}}{dt^2}$$

$$\mathbf{F} = -G\frac{m_1 m_2}{d^2}\mathbf{e_d}$$

$$E = mc^2$$

Mass in the **ECT**:

Intrinsic energy has the nature of mass.

$$E = M_1 {V_1}^2 = M_2 {V_2}^2 = mc^2 \ \ (M \text{ varies by } V)$$

"**mass**" in narrow sense is **defined** as

intrinsic energies moving at the light speed c (common velocity)

< Cosmic energy >

- **Space energy** (energy of the vacuum space)

  - Symmetric part, spreading evenly in 3D surface of 4D sphere.

  Spacia: space energy in the unit 4D space with radius μ_0
  coupled conjugate pair of energy circulations

$$E_\mu \psi_\mu = E_\mu \mu_0 \big(\exp(i\omega_0 t) + \exp(-i\omega_0 t)\big) , \qquad \exp(i\omega_0 t) = \cos\omega_0 t + i\sin\omega_0 t$$

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

- **Apparent energy** (our observable energy)

  - Asymmetric part of cosmic energy
  - Additional circulation of a component circulation of a spacia
  - Can be regarded as a vibration of the space energy (medium).
  - Energy circulation by $(n)\omega_0$ with μ_0 → **quantized** within a spacia

  Elementary single circulation (smallest quantized circulation):

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

< Types of particles >

Energy circulation

- Keeps a constant radius depending on its energy quantity.
- Can be static to the space energy.
- Interacts with other ones by the fundamental force, attractive or repulsive.

*The "**particle**" is defined as an **energy circulation**.*

Elementary circulations:

- Single circulation: S (space-space dimensions), iS (hidden-space)
- Double circulation: D (space-space), iD (hidden-space)
- Excited circulation: $D^{\#}$, $iD^{\#}$ $(\omega = 2\omega_0)$, $D^{\#\#}$, $iD^{\#\#}$ $(\omega = 3\omega_0)$

Quantum particles:

- Composition of elementary circulations in one spacia
- Energy can be expressed by $E = m{\mu_0}^2{\omega_0}^2 = mc^2$

Other components:

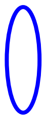
- Elementary charge pair eCP (prolonged iS)
- Hemi-circulations: H (neutrino), iH_+(plus part of eCP) iH_-(minus part)

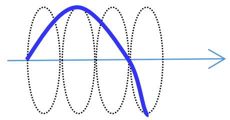
< Linear motion of particle – helical expression >

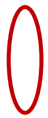
Stationary or moving particle of a total energy E:

1) Stationary

2) Moving at v to the space energy







Movement of m

Movement of M

$E = mc^2$ $\qquad E = m(v^2 + {C_r}^2)$ $\qquad E = M{C_r}^2$

In the **stationary** frame $\qquad$ In the **co-moving** frame

	1) Stationary	2) Moving (stationary frame)	2) Moving (co-moving frame)
Intrinsic energy (IE):	m	m	M
Velocity of IE:	c	c	C_r
Circulating velocity:	$c = \mu_0\omega_0$	C_r	C_r

$${C_r}^2 = c^2 - v^2\,, \qquad M = \frac{m}{1 - v^2/c^2}$$

Total energy: $E = E_c + E_L$, **Circular energy**: $E_c = m{C_r}^2$, **Linear energy**: $E_L = mv^2$

< Equation of motion >

Newtonian equation of motion is valid at the **initial speed = 0** either in **stationary** frame or **moving** frame.

Acceleration in the stationary frame:

$$\alpha = \frac{dv}{dt}$$

Acceleration in a moving frame at v_1 to the space energy:

$$V = v - v_1$$

$$\frac{dV}{dt} = \frac{d(v - v_1)}{dt} = \frac{dv}{dt} = \alpha$$

For any value of v_1, the acceleration is the same in the two frames.

Affect the **same force** at $v = 0$ and at $v = v_1$:

Force at $v = 0$: $F = m\alpha_0$

Force at $v = v_1$, $V = 0$: $\boxed{F = M\alpha_{v_1}}$

Acceleration at $v = v_1$, $V = 0$:

$$F = M\alpha_{v_1}\,, \qquad M = \frac{m}{1 - {v_1}^2/c^2}$$

$$F = \frac{m}{1 - {v_1}^2/c^2}\alpha_{v_1}$$

This is valid for any value of v_1 for v.

Equation of Motion: $$F = \frac{m}{1 - v^2/c^2}\alpha$$

Two types of interpretation of the equation:

In **stationary** frame: Acceleration is multiplied by the **acceleration factor** $\boldsymbol{f_a}$.

$$F = m\alpha\,, \qquad \alpha = \alpha_0 f_a = \alpha_0\left(1 - \frac{v^2}{c^2}\right)$$

In **co-moving** frame: **Intrinsic energy** $\boldsymbol{M}$ varies by v.

$$F = M\alpha\,, \qquad M = \frac{m}{1 - v^2/c^2} = \frac{m}{f_a}$$

< Potential energy, Kinetic energy, Rest energy >

Kinetic energy and potential energy of a particle set off as the sum is zero.

$$E = mc^2 = mc^2 + E_k + E_p \,, \qquad E_k = -E_p$$

Definition of **potential energy** in general, set as $E_p(\infty) := 0$:

$$E_p(x) \equiv \int_{\infty}^{x} \big(-F(x)\big) dx$$

More general definition: set $E_p(x_0) := U_0$ as the reference at $x = x_0$

$$E_p(x) \equiv \int_{x_0}^{x} \big(-F(x)\big) dx + U_0$$

Kinetic energy: $v = 0$ at $x = 0$ then accelerated to $v = v$ at $x = x$

$$E_k = -\big(E_p(x) - E_p(0)\big) = \int_0^x F(x) dx$$

$$E_k = \int_0^x \frac{m}{1 - v^2/c^2} \alpha dx = m \int_0^x \left(1 - \frac{v^2}{c^2}\right)^{-1} \frac{dv}{dt} dx = m \int_0^v \left(1 - \frac{v^2}{c^2}\right)^{-1} v dv$$

$$T \equiv 1 - \frac{v^2}{c^2} \,, \qquad \frac{dT}{dv} = -\frac{2v}{c^2}$$

$$m\int T^{-1}\,v\,\frac{c^2}{-2v}\,dT = -\frac{mc^2}{2}\int T^{-1}\,dT = -\frac{mc^2}{2}\log T + C$$

$$\boxed{E_k = -\frac{mc^2}{2}\log\left(1-\frac{v^2}{c^2}\right)}$$

By Taylor's expansion:

$$E_k = \frac{1}{2}mv^2\left(1+\frac{1}{2}\frac{v^2}{c^2}+\frac{1}{3}\frac{v^4}{c^4}+\frac{1}{4}\frac{v^6}{c^6}+\cdots\right)$$

$$\lim_{v\to c} E_k = \infty$$

Definition of **rest energy**: Total energy minus Kinetic energy

$$E_r(x) \equiv E - E_k(x)$$

Potential energy is **incorporated** in **rest energy**.

$$E = E_r(x) + E_k(x)$$

$$E = mc^2 + E_p(x) + E_k(x)$$

$$E_r(x) = mc^2 + E_p(x)$$

< Free motion >

If accelerated by **receiving a force**, does the total energy change or not?

Answer: No, the **total energy** is **invariant**.

Take the case: A static ball is hit by the counterpart, and accelerated to v.

(1) At $t < 0$, it is static at $x = 0$.

(2) In $0 \leq x \leq \Delta x$, it attaches to the counterpart, and is accelerated to v.

(3) In $x > \Delta x$, it moves alone at the constant velocity v.

Potential energy can exist only in the region where a force acts.

(1)(3): No force acts. Potential energy does not exist.

(2): The ball receives F from the counterpart, shows the **potential energy**:

$$E_p(x) = \int_0^x \big(-F(x)\big)dx \quad \big(0 \leq x \leq \Delta x\,,\ E_p(0) := 0\big)$$

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

Total energy: $E(x) = mc^2 + E_k(x) + E_p(x) = mc^2$ (no change)

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

The counterpart receives the force $-F$ form the ball.

	Receiving force	Kinetic energy	Potential energy
Ball (object):	F	increase	decrease
Counterpart:	$-F$	decrease	increase

(3): No force, no potential energy

$E_r(x)$ and $E_k(x)$ get **constant** as $E_r(\Delta x)$ and $E_k(\Delta x)$.

The ball is in a **free motion**, which is a wider concept than **free fall**.

Free motion: free acceleration by a force **without change** in **total energy**

Two ways of expressing a particle energy:

By **helical expression**: $E = E_c + E_L = mC_r{}^2 + mv^2 = mc^2$

By **rest** & **kinetic energies**: $E = E_r + E_k = \left(mc^2 + E_p\right) + E_k = mc^2$

< Static particle under receiving a force >

Distance x: from the counterpart affecting the force (e.g. from the center of earth)
It moves from x_1 under receiving F, remaining stationary: Potential energy alters.

$$E(\infty) = mc^2$$

$$E(x_1) = mc^2 + E_p(x_1) = m_1c^2$$

$$E(x_1 + \Delta x) = E(x_1) + \int_{x_1}^{x_1+\Delta x} \big(-F(x)\big)\, dx = m_1c^2 + \Delta E_p$$

$$E(x_1 + \Delta x) = mc^2 + E_p(x_1 + \Delta x) = (m_1 + \Delta m)c^2$$

Gravitational potential energy on the **earth**: r: distance, M: mass of earth

$$E(r) = m(r)c^2$$

$$U(r) = \int_{\infty}^{r} \big(-F(r)\big)\, dr = \int_{\infty}^{r} G\frac{Mm(r)}{r^2}\, dr$$

$$E(r) = mc^2 + U(r_0) + U(r) - U(r_0) = m(r_0)c^2 + \Delta U(r - r_0)$$

$$\Delta U(r - r_0) = \int_{r_0}^{r} G\frac{Mm(r)}{r^2}\, dr \approx GMm(r_0)\left(\frac{1}{r_o} - \frac{1}{r}\right)$$

$E(r)$ is approximated as

$$E(r) \approx m(r_0)c^2 + GMm(r_0)\left(\frac{1}{r_o} - \frac{1}{r}\right)$$

Take the see level as r_0.

$$r = r_0 + h \ \ (h\text{: height}), \quad g = GM/r_0 \ \ \text{(gravitational acceleration)}$$

$$E(r) \approx m(r_0)c^2 + GMm(r_0)\left(\frac{1}{r_o} - \frac{1}{r_0 + h}\right) \approx m(r_0)c^2 + m(r_0)gh$$

Atomic clock in a satellite:

- The **total energy** of an atom is larger at a higher altitude than the ground level due to the **increase** of the **potential energy**.
- A **radiation frequency** of the atom at a higher altitude increases at the **same ratio** as that of the total energy.
- An **atomic clock** needs the adjustment of its clock frequency for one second by the altitude of its location.

Ref) Interpretation by the **general relativity**:

The change of clock frequency comes from the difference of the **gravitational redshift** by the height. They claim that the **time** at a higher altitude passes **faster** than that at a lower altitude **subject to the rest mass kept invariant**.

< Charge for the gravitational force >

Charge for the fundamental force: Orthogonal component of momentum

$$_{\mathbf{r}}\mathbf{p} = p \sin\theta \, \mathbf{e_r} \quad (\mathbf{e_r}\text{: orthogonal to distance direction})$$

Charge for the **gravitational force**:

- Amount of component energy for motion of the intrinsic energy in orthogonal directions to the force (distance), defined as the "**orthogonal energy**" $\boldsymbol{E_{ort}}$
- Static particle: Circular energy acts as orthogonal energy, equal to rest energy and total energy

$$E_{ort} = E_c = E_r = E$$

Gravitational force of a particle of mass m moving at v with a static huge mass M:

$$\textbf{Gravitational force:} \quad F = -G\frac{Mm_{ort}}{d^2}, \qquad m_{ort} = \frac{E_{ort}}{c^2}$$

(1) For force in the same direction as its motion:

$$E_{ort} = E_c = m{C_r}^2 = m(c^2 - v^2), \qquad m_{ort} = m\left(1 - \frac{v^2}{c^2}\right)$$

(2) For force orthogonal to its motion:

$$E_{ort} = E = mc^2, \qquad m_{ort} = m$$

Gravitational lensing

Orthogonal energy of light:

In the propagation direction:

$$E_{ort} = E_c = m_\gamma(c^2 - c^2) = 0\,, \qquad m_{ort} = 0$$

In an orthogonal direction:

$$E_{ort} = E_L = m_\gamma c^2\,, \qquad m_{ort} = m_\gamma$$

Gravitational force does not work on light in its propagation direction, but does act in an orthogonal direction. The situation is same for the fundamental force.

Light **cannot** be accelerated in **magnitude** of its **speed**,
but **can be bent** in its direction by a force.