Instantaneous and scale-versatile gourdron theory: pair momentum equation, quasi-stability concept, and statistical indeterminacy revealing masses of elementary, bio-molecular, and cosmic particles

Ken Naitoh
Waseda University, 3-4-1 Ookubo, Shinjuku, Tokyo, 169-8555 Japan
k-naito@waseda.jp

Abstract. Flexible particles, including hadrons, atoms, hydrated biological molecules, cells, organs containing water, liquid fuel droplets in engines, and stars commonly break up after becoming a gourd shape rather than that of a string; this leads to cyto-fluid dynamics that can explain the proliferation, differentiation, and replication of biomolecules, onto-biology that clarifies the relationship between information, structure, and function, and the gourd theory that clarifies masses, including quark-leptons and Plank energy. The masses are related to the super-magic numbers, including the asymmetric silver ratio and symmetric yamato ratio, and reveal further mechanisms underlying symmetry breaking. This paper gives further theoretical basis and evidence, because the gourd theory reported previously is a little analogical and instinctive.

1. Introduction
Each of subatomic, biomolecular, and liquid fossil fuel particles, and stars in the cosmos is flexible and breaks up. [1-13] Although the nature is with this common feature, traditional particle models, Schroedinger equation, and Newton mechanics are useful only for narrow scales.

There are so many approaches, which try to find the universal theory describing temporal history of physical phenomena from subatomic to cosmic systems, i.e., four dimensional (unsteady three-dimensional) feature. [14]

However, one of our most important targets is to know the masses of various particles in the universe. It will not be necessary for predicting particle masses to know all the temporal developments before and after breakup of particles. Thus, we think about the most important timing at which masses are determined. The important timing is rate-determining step, just before breakup.

Let us think about the shape of particle just before breakup for various cases including subatomic, bio-molecular, and cosmic particles. The common shape will be like gourd, which has two sphere-like or spheroid-like particles connected.

Therefore, our previous models based on gourd shape assumption [1-13] show a large possibility describing the masses of various particles in the universe.

Cyto-fluid dynamic theory [1-4] proposed as the first stage of model clarifies a similarity underlying breakups of liquid droplets from millimeter to meter range, biological molecules hydrated, biological cells, and organs. An important feature is fusion of symmetric and asymmetric divisions, which are
related to the golden, silver, and yamato ratios. The theory is derived based on momentum conservation law and a new quasi-stability concept as weakest one, neighboring to absolute instability.

By including a new indeterminacy concept into the cyto-fluid dynamic theory, we proposed gourd theory. [5-13] The gourd theory clarifies the masses of subatomic particles including quarks, leptons, bosons, and hadrons. It is stressed that the gourd theory is based on the quasi-stability concept, whereas the traditional elementary particle theories are related to variation principle.

However, the indeterminacy concept included in the gourd theory was instinctive and qualitative. Thus, the present report gives a further theoretical explanation on the indeterminacy.

2. Cyto-fluid dynamic theory: based on pair momentum equation quasi-stability concept [1-4]

For collision and breakup during replication processes of biological molecules, we first define “parcel” as flexible lump which consists of a core molecule (such as nitrogenous base or amino acid) and water molecules hydrated to the core molecule, while “particle” implies the core molecule. For breakup phenomena of liquid droplets of water and fuel, “parcel” is identical to particle of liquid droplet. For cell division process, “parcel” includes nucleus as core and other biomolecules.

The following assumptions are also employed for deriving the model.

(1) Parcel with three-dimensional flexible axi-symmetric shapes such as spheroid- or circular-cone deformed in time,
(2) One-dimensional connection of two parcels along the axis in a free space.
(3) Unified form for various surface forces coming from coulomb force, surface tension, and gravity as the form of $1/r^m$, while $r$ is local curvature of parcel. (This assumption of force is effective, because we observe only the short timing around breakup as rate-determinant stage.)
(4) Potential flow [15, 16] inside the particles generated by high impact speeds of water molecules. (It is well known that the potential flow occurs for a condition of impulsive flow.)
(5) Particle size proportional to parcel size.

![Fig. 1 Two flexible parcels connected](image)

When there is no outer force to the two parcels connected, the time-dependent relation between dimensionless deformation rate $\gamma_k(=a_k/b_k [k = 1, 2])$ of each spheroid-like parcel and the size ratio of the two connecting parcels $\varepsilon = r_{si}/r_{sj} [i, j = 1, 2, i \neq j]$ with equivalent radius $r_{si} (= [a_i b_i^2]^{1/3})$ at equilibrium condition, i.e., the $\gamma_k - \varepsilon$ momentum equation, is described as

$$\frac{d^2 \gamma_i}{dt^2} = B_{ij}(\gamma_i)\left(\frac{d\gamma_j}{dt}\right)^3 + C_{ij}(\gamma_i)\gamma_i^{5/3} + (3-2i)E_{ij}(\gamma_i)\frac{d^2 \gamma_i}{dt^2}$$
\[ \frac{d^2\gamma_{Si}}{dt^2} = \frac{d^2\gamma_{Si}}{dt^2} e^{1+m} \]  

\[ \epsilon^{1+m} \frac{d^2\gamma_{Si}}{dt^2} - \frac{2}{3} \gamma_i^{-1/3} \frac{d^2\gamma_i}{dt^2} + \epsilon_{2-m} \frac{2}{9} \gamma_i^{-4/3} \left( \frac{d\gamma_i}{dt} \right)^2 \]

\[ + \left( \frac{d\gamma_i}{dt} + (3-2i) \frac{2}{3} \gamma_j^{-1/3} \frac{d^2\gamma_j}{dt^2} - (3-2i) \frac{2}{9} \gamma_j^{-4/3} \left( \frac{d\gamma_j}{dt} \right)^2 \right) = 0 \]  

where \( \gamma_{Si} = \frac{X_S}{r_{di}} \) denotes dimensionless contact position of two parcels, while being

\[ B_{ok} = \frac{1}{\gamma_k^2 - 2}, C_{ok} = \frac{3}{8} \frac{2\gamma_k^{2m} - \gamma_k^m}{\gamma_k^2 - 1/2}, E_{ok} = \frac{3}{\gamma_k^2 - 1/2}, \bar{r}_k = \sigma_k \bar{r}, \text{ and} \]

\[ \sigma_k^2 = \frac{8\sigma}{\rho \gamma_{rk}^{2+m}} [\text{for } k = 1, 2] \]

with \( \sigma, \rho, \text{ and } m \) denote surface force coefficient, parcel density, and a constant for extending surface force of the form of \( 1/r^m \) with local curvature \( r \), respectively. [Equation 1 is derived only under the assumptions above and by purely mathematical transformation. The long derivation of Eq. 1 is in Ref. 2 and has been confirmed by the referees.]

Equation 1a for \( i = 1 \) and 2 describes the momentum one for each individual parcel, while the third and fourth ones, Eqs. 1b and 1c are the definition of contact surface between two parcels and overall momentum conservation law for two parcels connected, respectively.

Eliminating \( \gamma_{Si} \) in Eqs. 1a-1c and taking the first order of approximation in the Taylor series for the equation result in Eq. 2.

\[ \frac{d^2y_i}{dt^2} = \left[ \left( \frac{dy_i}{dt} \right)^2 + 3(3-\epsilon^3)m y_i - 4\epsilon^{1+m} \left( \frac{dy_i}{dt} \right)^2 + 12\epsilon^{1+m} m y_j \right] / [3(\epsilon^3 + 1)] \]

where the deviation from a sphere is defined as \( \gamma_j \), which is equal to \( \gamma_i - 1 \). [See references 2 and 3 on the detail of derivation of Eqs. 1 and 2.]

Equation 2 shows that a symmetric ratio of 1.0 (\( \epsilon = 1 \)) makes the first term on the right-hand side of the equation zero, while an asymmetric ratio of 1.5 (\( \epsilon = 3 \)) makes the second term zero for each value of \( m \).

As we define a system as being quasi-stable when only one term on the right-hand side of the differential equation system governing the phenomenon is zero [1-13], the system of two connected parcels shown above is relatively quasi-stable when the size ratio of connected parcels takes the values of \( \epsilon = 1 \) or \( \epsilon = 3 \).

Let us look at biological systems containing water flows. We can classify the five bases of adenines (A), guanines (G), cytosines (C), thymines (T), and uracils (U) into two groups: purines and pyrimidines. Purines, i.e., A and G, have a relatively large size, while pyrimidines, i.e., C, T, and U, are small. This grouping specifically refers to the asymmetric size ratio of purines and pyrimidines of around 1.50 in their hydrogen bonds within DNA and RNA, i.e., that of the Watson-Crick type, although a symmetric size ratio of 1.00 is often observed in RNA. (Fig.2a) These ratios correspond to
the quasi-stable ones derived from Eq. 2. Symmetric and asymmetric size ratios are also observed at the cell level of microorganisms such as yeast. (Fig. 2b)

A neutron impacting uranium 235 produces smaller child atoms that often have an asymmetric weight ratio of about 2:3 between the golden and silver ratios. [17] In contrast, varying the impact speed of neutrons results in a nearly symmetric division of uranium 235, which has the yamato ratio of 1:1. (Fig. 2c.)

The concept of quasi-stability is necessary for living beings because stronger stability cannot bring variations, i.e., adaption to environmental change and evolution. This quasi-stability is also possible for nonliving systems such as atoms because atomic systems such as uranium 235 also vary over time.

It is stressed that the quasi-stable ratios of $1: \sqrt[n]{n}$ for $n=1$ and 3 appear for each $m$. (See Eq. 2)

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**a.** Asymmetric and symmetric base pairs in DNA and RNA

**b.** Asymmetric and symmetric pairs of Yeast cells

**c.** Asymmetric and symmetric breakups of uranium 235 obtained by varying impact speeds of neutron

Let us consider the reason why the energy conservation law and variation principle such as the Bohr model and some extensions [14] do not explain the fusion of symmetry of 1:1 and asymmetry of
around 2:3 in size and density (number density). The reason is that previous models based on energy conservation have tended to eliminate the relative motion between parcels, whereas the momentum conservation in Eqs. 1 and 2 models all of the relative motion between two parcels, nonlinear convections inside the parcels, interfacial forces at the parcel surfaces, and collisions with smaller molecules.

When we set $m = 1$, the second term in the Taylor series results in a quasi-stable ratio of about 1.27, the third term in ratios of about 3.58 and 1.35, the fourth term in ratios of about 2.47 and 1.39, the fifth term in ratios of about 2.1, and 1.4, the sixth term in a ratio of about 1.41, and the seventh in ratios of about 1.79 and 1.42. [6-13] Thus, these ratios over 2:3 reveal the molecular weights of the twenty types of amino acids of a threefold variations between 240 of cysteine as the maximum and 75 of glycine as the minimum. The halo structures such as H10 and M32 have number ratios of neutrons and protons of about 1:3.5. The higher-order analysis for $m = 1$ clarifies the ratios over 2:3 in several systems. [6-13]

3. Four types of indeterminacy

Basically, there are two types of theoretical indeterminacies, i.e., those appearing in quantum mechanics related to Kennard’s consideration [18] and those in statistical mechanics related to the Liouville equation [19]. The discontinuity of particles in nature essentially leads to statistical indeterminacy for several stages of phenomena from subatomic to cosmic, whereas very small particles such as electron particles described by the Schrodinger and Klein-Gordon equations [20] have the other type of indeterminacy indicated by quantum mechanics (quantum indeterminacy).

An important point is that the level of statistical indeterminacy, i.e., degree of variation, varies according to the window scales used for averaging (stochastic determinism window) and the number of particles involved. Statistical mechanics based on the Liouville and Boltzmann equations [19] tells us that a very large window for averaging the aggregation of a huge number of particles results in deterministic continuum mechanics, whereas a small window for a small number of particles leads to a stochastic differential equation. When a small window is used for averaging, physical quantities such as mass, size, and velocity are defined with indeterminacy, i.e., vagueness. (Fig. 3)

Baryons and mesons are constructed of only three and two quarks, respectively. There are only two electrons inside the smallest orbit around a He atom having only a few baryons. The number of carbon, oxygen, and nitrogen particles inside a nitrogenous base is not enough for a continuum, even if the nitrogenous base is hydrated, because of the order of ten or one hundred. These small numbers of particles will lead to statistical indeterminacy in the governing equations, even in cases where the indeterminacy in quantum mechanics does not work. On the other hand, a biological cell or a liquid droplet of over one millimeter in size includes a lot of molecular particles that result in deterministic governing equations. Theoretical model considering this statistical indeterminacy, i.e., an approach lying between the Langevin and Boltzmann equations, revealed even the 100-year mystery in the transition to turbulence in closed pipes. [21]

Third indeterminacy is Heidelberg’s one, which is related to observation.

We proposed the forth indeterminacy, which appears only for two connected particles (parcels) shown in the above section. An important point is that, when the statistical indeterminacy appears for small number of sub-particles in a parcel and for small window of averaging, the contact-surface position, i.e., relative distance and relative velocity between particles, also becomes indeterminant, i.e., vague.
4. Gourd theory [5-13]
Equation 1 shown in the cyto-fluid dynamic theory is extended with the following assumptions (1) and (2) related to the indeterminacies on statistical mechanics and contact surface position depicted in Section 3 and also the other ones of (3) and (4).

(1) Stochastic random disturbance due to stochastic indeterminacy is included in momentum equations.
(2) Relative distance and relative velocity between two parcels connected are also indeterminant.
(3) Potential flow inside the particles because of high impact speeds of subatomic particles,
(4) Unified form for various surface forces coming from, strong- and weak- nucleic forces, coulomb force, surface tension, and gravity as the form of $1/r^m$, while $r$ is local curvature of parcel.

The $\gamma_k - \varepsilon$ equation of Eqs. 1a-1c is extended as

$$\frac{d^2\gamma_k}{dt^2} = B_0(\gamma_i)(\frac{d\gamma_i}{dt})^2 + C_0(\gamma_i)\gamma_i^{\frac{5}{3}} + (3 - 2i)E_0(\gamma_i)\frac{d^2\gamma_k}{dt^2} + \delta_{si}$$

$$[(i=1 \text{ and } j=2) \text{ or } (i=2 \text{ and } j=1)] \quad (3a)$$

$$\frac{d^2\gamma_{Si}}{dt^2} = \frac{d^2\gamma_{Si}}{dt^2} e^{1+2(m-\Delta m)} + \delta_{st-e}$$

$$[(i=2 \text{ and } j=1) \text{ or } (i=1 \text{ and } j=2)] \quad (3b)$$

$$e^{2-(m-\Delta m)}\frac{d^2\gamma_{Si}}{dt^2} - e^{2-(m-\Delta m)}\frac{2}{3}\gamma_i^{1/3}\frac{d^2\gamma_i}{dt^2} + e^{2-(m+\Delta m)}\frac{2}{9}\gamma_i^{4/3}(\frac{d\gamma_i}{dt})^2$$

$$+ \left[\frac{d\gamma_{Si}}{dt} + (3 - 2i)\frac{2}{3}\gamma_j^{1/3}\frac{d^2\gamma_j}{dt^2} - (3 - 2i)\frac{2}{9}\gamma_j^{4/3}(\frac{d\gamma_j}{dt})^2\right] = \delta_{st-on} \quad (3c)$$

with $\sigma, \rho, m, \text{ and } \delta_{st}$ denote surface force coefficient, parcel density, a constant for extending surface
force of the form of $1/r^m$ with local curvature $r$, and indeterminacy of density and velocity due to less sub-particles inside each individual parcel, respectively, while $\Delta m$ and $\Delta m^*$ denote indeterminacy of the contact position of two parcels and relative velocity between two parcels connected, respectively. After eliminating $\gamma_{si}$ in Eqs. 3a-3c and when $\Delta m = \Delta m^* = \lambda (1 - m)$ and $\lambda = 1/2$ are assumed, Eqs. 3a-3c result in Eq. 4.

$$\frac{d^2}{dt^2} \gamma_i = \{ m_{ij} \left( \frac{d}{dt} \gamma_i \right)^2 + m_{ij} \left( \frac{d}{dt} \gamma_j \right)^2 + m_{ij} \gamma_i^{\frac{5}{3}} m_{ij} \gamma_j^{\frac{2}{3}} \} \text{Det} + \delta_{ij}$$

[for $i, j \in \Omega, (i = 1 \text{ and } j = 2) \text{ or } (i = 2 \text{ and } j = 1), i \neq j$] 

with

$$m_{ij} = \left[ \left( -\varepsilon - \varepsilon^4 + \frac{2}{3} \varepsilon E_0 \gamma_j^{-1/3} \right) B_{ij} + \frac{2}{9} \varepsilon^4 - 2 \Delta m E_0 \gamma_i^{-4/3} \right]$$

$$m_{ij} = \left[ \frac{2}{3} \varepsilon^2 + m - \Delta m E_0 \gamma_j^{-1/3} B_{ij} - \frac{2}{9} \varepsilon^2 + m - \Delta m E_0 \gamma_j^{-4/3} \right]$$

$$m_{ij} = \left( -\varepsilon - \varepsilon^4 + \frac{2}{3} \varepsilon E_0 \gamma_j^{-1/3} \right) C_{ij}$$

$$m_{ij} = \frac{2}{3} \varepsilon^2 + m - \Delta m E_0 \gamma_j^{-1/3} C_{ij}$$

$$\text{Det} = -\varepsilon - \varepsilon^4 + \frac{2}{3} \varepsilon^2 E_0 \gamma_j^{-1/3} + \frac{2}{3} \varepsilon E_0 \gamma_j^{-1/3}, B_{ok} = \frac{1}{3} \gamma_k^{2} - \gamma_k^{1/2}, \gamma_k^{1/2}$$

$$C_{ok} = \frac{3}{8} \gamma_k^{2/3} - 1/\gamma_k^{1/2}, \gamma_k^{1/2} = \frac{3}{8} \gamma_k^{2/3} - 1/\gamma_k^{1/2}$$

It is stressed that this system is not the simple two-body problem of a rigid body because of the flexible nonlinear deformations of the parcels.

Equation 4 is derived only under the assumptions above and by purely mathematical transformation. The long derivation of Eq. 4 is in Ref. 2 and has been confirmed by the referees, although only the stochastic terms including $\delta_{ij}$ are not in Ref. 2.

Moreover, we will consider a higher order of the Taylor series, for Eq. 4. For various values of $m$, the $q$-th order of the Taylor series for parcel 1 results in

$$\frac{d^2}{dt^2} \gamma_1 = \sum_{q=1}^{\infty} a_q(\varepsilon, m) y_1^{q-1} \frac{d^{q+1}}{d t^{q+1}} + \sum_{q=1}^{\infty} b_q(\varepsilon, m) y_1^{q+1} + \sum_{q=1}^{\infty} c_q(\varepsilon, m) y_1^{q+1} \frac{d^{q+1}}{d t^{q+1}} + \sum_{q=1}^{\infty} d_q(\varepsilon, m) y_1^{q+1} + \delta_{ij}$$

where the last term on the right-hand side $\delta_{ij}$ is the stochastic one due to random fluctuation, while

$a_q(\varepsilon, m), b_q(\varepsilon, m), c_q(\varepsilon, m), \text{and } d_q(\varepsilon, m)$ are four coefficients related to the size ratio $\varepsilon$ and $m$. [8]

Then, the theory having only one arbitrary constant $m$, i.e., Eqs. 3-5, lead to the various and discrete quasi-stable ratios, which reveal the masses of subatomic particles such as hadrons, quarks, leptons, bosons including Higgs-like one, and Plank mass [6-13], whereas the traditional standard theory based on mathematics includes many parameters, which should be determined by experiments.
Figure 4a for $m=1.03$ shows the prediction of some bosons and plank mass, with the corresponding experimental and other theoretical ones, while Fig. 4b for $m=1.03$ also includes photon, because photon has a very small mass at quantum entangle, i.e., during interaction of two particles. Thus, the theory proposed predicts both the masses of W-, Z-, and Higgs-like bosons close between 80 and 130 GeV/c$^2$ and photon $< 10^{-25}$ GeV/c$^2$. It is also stressed that theoretical mass ratios for $m = 1.03$ may also predict plank mass and are close to the prediction due to the SUSY-GUT theory [14]. This result may lead to a breakthrough for solving the mysterious hierarchy problem [14] in elementary particle physics. Optimizations of $m$ and $\lambda$ will bring better agreement with prediction and experiment. The present theory also prognosticates a new particle between 10 TeV and 1,000 TeV, which will be indicated by the other theoretical studies. 

As the present paper considers only the short interval around breakup, the Einstein’s relativity effect will be small. Even if the relativity effect on light speed appears, the mass ratio of two parcels connected will not be changed very much, because the effect works on both.

Fig. 4 Prediction of masses for bosons. (We assume that photon during interaction of quantum entanglement or single $\approx 10^{-28}$ GeV/c$^2$ and plank mass $\approx 10^{+19}$ GeV/c$^2$)

5. Further theoretical analysis on validity of indeterminacy $\Delta m^*$ in gourd theory

Let us think about the indeterminacy of contact surface and of relative velocity in Eq. 3c, which is described with quantities of $\Delta m$ and $\Delta m^*$ further. Question is the reason why $\Delta m$ has a negative effect
for $m$ in the terms of acceleration $\frac{d^2 \gamma_i}{dt^2}$ and $\frac{d^2 \gamma'_i}{dt^2}$, while $\delta m^*$ is positive in the term of momentum energy $\left(\frac{d \gamma'_i}{dt}\right)^2$.

An important point is that $\left(\frac{d \gamma'_i}{dt}\right)^2$ is nonlinear, while $\frac{d^2 \gamma_i}{dt^2}$ and $\frac{d^2 \gamma'_i}{dt^2}$ are linear. Thus, when $\gamma \rightarrow \gamma + \gamma'$ with the indeterminacy $\gamma'$, the third term on the left hand side of Eq. 3c becomes $\left(\frac{d \gamma'_i}{dt}\right)^2 \rightarrow \left(\frac{d \gamma'_i}{dt}\right)^2 + 2 \left(\frac{d \gamma'_i}{dt}\right) \left(\frac{d \gamma'_i}{dt}\right) + \left(\frac{d \gamma'_i}{dt}\right)^2$. Then, as value $\gamma'$ is often comparable to $\gamma$, two terms of $2 \left(\frac{d \gamma'_i}{dt}\right) \left(\frac{d \gamma'_i}{dt}\right) + \left(\frac{d \gamma'_i}{dt}\right)^2$ cannot be eliminated.

For thinking about $2 \left(\frac{d \gamma'_i}{dt}\right) \left(\frac{d \gamma'_i}{dt}\right)$ further, we can see Fig. 5 demonstrating small oscillation of parcel pair, while indeterminant (fluctuation) velocities are defined as those observed from the contact surface. Figure 5 demonstrates two types of situations of two parcels: tearing and oncoming. When two parcels tear, indeterminant velocity of $\left(\frac{d \gamma'_i}{dt}\right)$ can relatively take larger values, because of less collisions between smaller particles inside a parcel. However, while two parcels come near, the indeterminant velocity is small on average during a certain time, because more collisions result in plus and minus values of velocity. Therefore, this leads to the fact that parcel shape cannot be a little left-right symmetric, as observed in megascopic liquid droplet. This is apparent because left- and right-boundary surface conditions of each parcel among two ones connected are not identical. [Fluctuations of gravity center and particle surface cannot be left-right symmetric due to existence of the other particle connecting on one side.] Therefore, we use $\Delta m^*$ for this nonlinear term of momentum energy, which differs from $\Delta m$ of the linear term. It is also emphasized that this is not dissipation in continuum mechanics, because of fluctuation-dissipation theorem.

Next, let us think about the sign of $\Delta m$. The condition of $m \geq 1.0$ evident in our previous researches [1-13] leads to $\Delta m \leq 0$. This indeterminacy corresponds to larger size ratio of $\mathcal{E}$, which is possible because ragged parcel shape due to indeterminacy permits connection at longer distance.

Let us think about the two limits of $m=1$ and $m=\infty$. When $m = 1$, $\Delta m = \Delta m^* = \lambda (1 - m)$ results in $\Delta m = \Delta m^* = 0$, whereas $m = \infty$ leads to $\Delta m/m = \Delta m^*/m = -\lambda$. This implies that $\Delta m$ and $\Delta m^*$ are finite. This may explain the mysterious feature that, as $m$ becomes larger than 2.0, quasi-stable ratios are again close to those for $m=1$ shown in references [6-13].

6. Conclusion and further possibility
The present theory may also lead to that for ultimate particle such as prion. As the first step, we can conclude that the number of prions in a quark or lepton will be decided by values of $\Delta m/m$ and $\Delta m^*/m$. If $m$ for breakup of a quark and lepton is less than 1.03, the number of sub-particles (prions) may be large because of smaller values of $\Delta m/m$ and $\Delta m^*/m$. 


Fig. 5 Two types of patterns of indeterminant velocities.

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References
[1] Naitoh K 1999 Oil & Gas Science and Technology 54 205.
[2] Naitoh K 2001 Japan Journal of Industrial and Applied Mathematics 18-1 75.
[3] Naitoh K 2006 Gene Engine and Machine Engine, Springer-Japan, Tokyo. 1-251.
[4] Naitoh K 2008 Artificial Life and Robotics 13 10-17.
[5] Naitoh K 2010 Artificial Life and Robotics 15 117.
[6] Naitoh K 2011. Quasi-stability theory: explaining the inevitability of the Magic numbers at various stages from subatomic to biological, Proc. of 15th Nordic and Baltic Conf. on Biomedical Engineering and Biophysics, IFMBE proceedings 34, Denmark. pp.211-214.
[7] Naitoh K 2011. The inevitability of biological molecules connected by covalent and hydrogen bonds. Proc. of European IFMBE Conference, IFMBE Proceedings 37, Pp. 251-254.
[8] Naitoh K 2012 Spatiotemporal structure: common to subatomic systems, biological processes, and economic cycles. J. of Physics, C. S. 344.
[9] Naitoh K 2012. Quasi-stability, Proceedings of 17th International Conference on Cold Fusion.
[10] Naitoh K 2012. Quasi-stability, Soryushiron Kenkyu YITP-W-11-25, pp.276-294.
[11] Naitoh K 2012. Hyper-gourd theory. Artificial Life and Robotics. Vol.17, pp.275-286.
[12] Naitoh K, 2013. Gourd theory: rather than string and hyper-symmetry theories, Proceedings of JSST2013 International Conference on Simulation Technology, Tokyo.
Appendices

A: Inevitability of chromosomes and proteins

Equations 1 and 3 may also reveal the masses for human chromosomes and proteins. (Fig. A1 and A2)

Fig. A1 Masses of human chromosomes and the corresponding predictions
Fig. A2 Masses of proteins and the corresponding predictions

B. Inevitability of two $m$ for small scales
For small subatomic particles, the prediction is possible if two values of $m$ are simultaneously used. For example, we employ $m = 1$ and 2 for hadrons, whereas $m = 1.1$ and 1.2 for leptons. [8-13] There are some possibilities for explaining the inevitability of these two.

1. Strong and weak forces: Strong, weak, electric, and gravity forces work hadrons, while electric and weak forces work quarks, leptons, and bosons. [14]
2. Two terms inside nucleic force
3. Exponential function of distance for one term in nucleic force
4. Attractive and repulsive forces
5. Stabilization and un-stabilization forces in fluid mechanics
6. Spherical- and string- like shapes of particles inside a parcel