



Mutual Interactions between the Mechanisms Maintenance Stability Internal Energy of the Open Thermodynamic Systems of “Alive Organisms” and Thermodynamic System of Atmosphere

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Abstract

The development of an organism from its birthday down to its death was elucidated via fluctuations entropy from organism's formation down to organism's death using Glansdorff-Prigogine theory. The stability Internal Energy and Internal Medium of organisms were presented by the stable biochemical and biophysical indices which are regulated as by three levels of regulation, as well as by cellular capacitors operations. Besides estimating the mutual influences mechanism stability of open non equilibrium non linear thermodynamic system of organisms and the mechanism stability thermodynamic system Atmosphere, the maintenance mechanisms stability Internal Energy of these thermodynamic systems were explained via use of famous Prigogine theorem and also Einstein formula. Also the mechanisms stability Internal Energy both an open thermodynamic systems organism and thermodynamic system Atmosphere induce balance catabolic exoergonic & anabolic endoergonic processes of these thermodynamic systems. Thus flows energy of both open thermodynamic systems organisms and thermodynamic system Atmosphere were shared into flows of catabolic exoergonic energy and anabolic endoergonic energy. Also it was proved that the flows of anabolic energy for exerting mechanism stability Internal Energy both Organisms and Atmosphere occur due to Life and Death of Organisms. Besides the flows of anabolic endoergonic energy were shared into flows of Plants anabolic energy, Animals anabolic energy and Human anabolic energy. Thus there was made the assumption that the flows Human anabolic energy between Human organisms and Atmosphere due to men's Life and Death can be identified as movements of human souls between Life and Death of organisms, *i.e.* immortality of human souls.

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Keywords

The First Law of Thermodynamics, Stability an Organism's Internal Energy, Stability Thermodynamic System Atmosphere, Stability an Open Thermodynamic System of an Organism, Prigogine Theorem, Glansdorff-Prigogine Theory

Subject Areas: Biophysics

1. Introduction

There are considered interactions between three thermodynamic systems: open non equilibrium non linear thermodynamic system of "organisms", thermodynamic system "Atmosphere-Planet the Earth", thermodynamic system "Universe-Galaxy". The interactions between these thermodynamic systems give opportunity to know about influences of these common mechanisms regulations on the mechanisms maintenance stability Internal Energy each of these thermodynamic systems. The explanation of mechanism maintenance stability Internal Energy of an open non equilibrium non linear thermodynamic system of an organism is determined by the famous Prigogine theorem which substantiates stability an organism's Internal Energy due to minimization gain of an entropy [1]-[3]. The thermodynamic system Atmosphere is described as the part of thermodynamic system of "Atmosphere-Planet the Earth". Besides the mechanism maintenance stability Internal Energy of thermodynamic system Atmosphere is presented as via exchanges Energy and Substances with open thermodynamic systems of "organisms" as well as via exchanges only Energy with thermodynamic system "Universe-Galaxy". Therefore the maintenance mechanism stability Internal Energy of thermodynamic system Atmosphere is determined by the Prigogine theorem with using Einstein formula, taking into account the exchanges energy with "organisms" and "Universe-Galaxy". Taking into account that the mechanisms stability Internal Energy both an open thermodynamic systems organism and thermodynamic system Atmosphere induce balance catabolic exoergonic & anabolic endoergonic processes, it was proved that the flows of anabolic energy for exerting mechanism stability Internal Energy both Organisms and Atmosphere occur due to Life and Death of Organisms. These data give possibility for making some important conclusions.

2. The Mechanism Maintenance Stability the Open Thermodynamic System of "Organisms"

A human organism, as well as other organisms, is the open non equilibrium non linear thermodynamic systems which are subjected to thermodynamic laws [1]. Considering first law of thermodynamics, the regulatory system of "organisms" for maintaining stability Internal Energy of the open thermodynamic systems of "organisms" operate via three levels of regulation: highest level regulation, high level regulation and low level regulation [2] [3] (**Figure 1**). According to first law of thermodynamics [$Q = \Delta U + W_{\text{int}} + W_{\text{ext}}$], Stationary State of an open non-equilibrium non-linear thermodynamic system of an able-bodied organism is characterized by stability of Internal Energy (ΔU) (stable temperature $36.0^{\circ}\text{C} - 36.9^{\circ}\text{C}$ by which all enzymes operate, stable index of $\text{pH} = 7.35$ in blood and in neurolymph etc.) [1] [4]-[7]. The mechanism stability of Internal Energy (ΔU) is maintained by Internal Works (W_{int}) and External Works (W_{ext}) of an organism. Internal Works (W_{int}) of an organism maintain stable Stationary State of an organism's Internal Energy and Internal Medium via biochemical and biophysical mechanisms of metabolism, mechanical mechanisms of common organism's activity, activity Heart with circulatory system, activity respiratory system and so on [1] [4]-[6]. External Works (W_{ext}) of an organism generate the Total Heat Energy (Q) which dissipates into Environment-Atmosphere as for maintenance stable an organism's temperature $36.0^{\circ}\text{C} - 36.9^{\circ}\text{C}$ by which all enzymes operate resisting Atmosphere influences as well as exchanging with Energy and Substances between Atmosphere and an organism for maintenance stability Internal Energy of Stationary State an open non-equilibrium non-linear thermodynamic system of an organism [1] [4]-[6]. Just stability Internal Energy displays balance anabolic endoergonic & catabolic exoergonic processes which maintenance is regulated by low level of regulatory mechanism [2] [3] [8] [9]. Low level regulation stability Internal Energy consists of "Equilibrium Constant of energy exchanges" and "Equilibrium Constant of metabolism" [1]-[3]. Low level regulation stability Internal Energy is subjected regulation by High level regulation

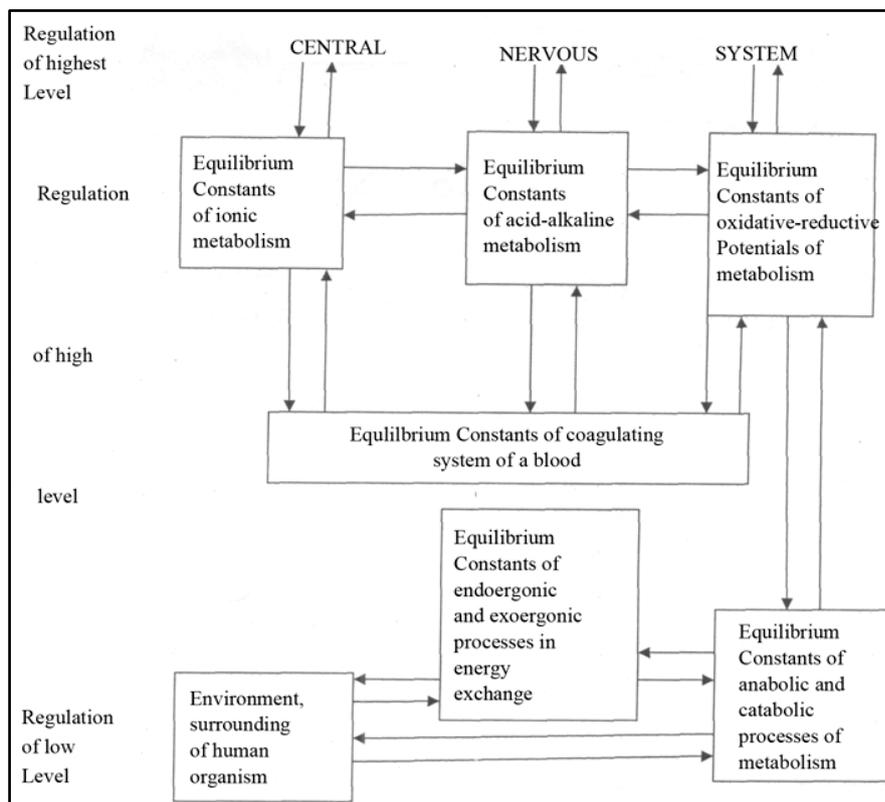


Figure 1. The mechanism maintenance stability Internal Energy and Internal Medium an organism. Footnotes: Metabolic and energy “equilibrium constants” regulate interactions of intracellular and extracellular chemical potentials ($\mu_{\text{int.}} \leftrightarrow \mu_{\text{ext.}}$) for maintenance stability of Internal Energy and Internal Medium an organism. The intracellular and extracellular chemical potentials ($\mu_{\text{int.}} \leftrightarrow \mu_{\text{ext.}}$) cause the formations of the positive/negative charges on internal and external membranes of cellular wall, promoting operation of remote cellular reactions via cellular capacitors operation.

[“Equilibrium Constant of ionic metabolism”, “Equilibrium Constant of acid-alkaline metabolism”, “Equilibrium Constant of oxidative-reduction Potentials of metabolism” and “Equilibrium Constant of coagulating system of blood”] and Highest level regulation [Central Nervous System] providing some stable indices: 1) stable index of temperature $36.0^{\circ}\text{C} - 36.9^{\circ}\text{C}$ by which all enzymes operate; 2) stable index of $\text{pH} = 7.35$ in blood and in neurolymph; 3) stable index of osmotic pressure— 285 ± 5 mil-osm/kg H_2O , corresponding to 0.14 - 0.15 molar sodium chloride or the other univalent ions; 4) stable index of colloidal-oncotic pressure—18 - 25 mm Hg, corresponding to human serum albumin solution up to 300 grams per liter etc. [2] [3] [7] (Figure 1). Just “Equilibrium Constant of metabolism” and “Equilibrium Constant of energy exchanges” producing balance anabolic endoergonic & catabolic exoergonic processes result as in stable concentrations indices of all substances in blood and in neurolymph as well as stable data of biophysical indices, *i.e.* the stability of Internal Energy and Internal Medium of an organism [8]-[10]. Also the biophysical mechanism of cellular remote reactions due to cellular capacitors operations via resonance waves maintains stability Internal Energy both of an open thermodynamic system an organism and an organism’s cells [11] [12]. The mechanism of preservation stability Stationary State of an open thermodynamic system of an organism was substantiated by the famous Prigogine theorem [11].

Here is the theorem Prigogine:

[The symbols: Entropy-S; Stream of Substances-Js; Stream of Energy-Je; Force of Substances-Fs; Force of Energy-Fe; Phenomenological Streams of Substances and Energy-Zss and Zee]

$dS = J_s F_s + J_e F_e > 0$. Conjugated flows: $J_s = Z_{ss} F_s + Z_{se} F_e$ and $J_e = Z_{ee} F_e + Z_{es} F_s$.

$dS = (Z_{ss} F_s + Z_{se} F_e) F_s + (Z_{ee} F_e + Z_{es} F_s) F_e = Z_{ss} F_s^2 + Z_{se} F_s F_e + Z_{es} F_s F_e + Z_{ee} F_e^2 = Z_{ss} F_s^2 + 2Z_{se} F_s F_e +$

$Z_{eFe}^2 > 0$. Corresponding to the Onsager concept: $Z_{se} = Z_{es}$.

There are $Z_{ss} > 0$; $Z_{ee} > 0$; $Z_{se} > 0$.

Therefore we can conceive that there is no change flow of Substances in stationary state $J_s = 0$. Just after all, the concentrations of Substances in Internal Medium of an organism (in blood and in neurolymph) are constant, *i.e.* the quantity inflow of the Substances into Internal Medium of an organism is equal the quantity outflow of the Substances from Internal Medium of an organism. Hence there is the derivative dS from F_s , if it's $F_e = \text{const}$ (the constant production calories for maintenance temperature $36.0^\circ\text{C} - 37.5^\circ\text{C}$ by which all enzymes operate):

$$dS/dF_s = 2Z_{se}F_e + 2Z_{ss}F_s = 2(Z_{se}F_e + Z_{ss}F_s) = 2J_s = 0.$$

The second derivative (flexon) from S is peer: $d^2S/dF_s^2 = 2Z_{ss} > 0$

It corresponds to extreme point. It means that $dS \rightarrow \text{min}$.

So the minimization increment of dissipation energy via minimization of gain entropy proves the stability of the open non equilibrium thermodynamic system of an organism.

The mechanism stability of the development an open non linear non equilibrium thermodynamic system of an organism from its birth down to its death is substantiated by Glansdorff and Prigogine theory [9] [10] [13]. So an organism's metabolism develops via fluctuations positive and negative local production of an entropy [$\Delta_x\beta > 0$ and $\Delta_x\beta < 0$] from organism birth down to organism death, *i.e.* the ascending of the linear Stationary graph in the young age changes itself into horizontal flow graph in the middle age and then into descending graph in the old age (Figure 2). Also it is known, according to the Glansdorff and Prigogine theory [9] [10] [13], that the fluctuations of an entropy promote development an open non equilibrium thermodynamic system: the positive fluctuations local production of an entropy ($\Delta_x\beta > 0$) leads to the linear graph of normal Stationary State, the negative fluctuations of local production an entropy ($\Delta_x\beta < 0$) leads to non-linear Quasi-stationary pathologic State [9] [10] [13] (Figure 3).

3. Interactions between an Open Non Equilibrium Non Linear Thermodynamic System of "Organisms", Thermodynamic Systems of "Atmosphere" into Thermodynamic System of "Atmosphere-Planet the Earth" and Thermodynamic System "Universe-Galaxy"

The activity of three thermodynamic systems are investigated including thermodynamic system "alive organisms", thermodynamic system Atmosphere into thermodynamic system "Atmosphere-the Planet of Earth" and thermodynamic system "Universe-Galaxy". There are the arrangement of all these systems one inside the other, *i.e.* such embedding of these systems: 1) Inside of the system "Universe-Galaxy" is the system "Atmosphere-the Planet of Earth"; 2) Inside of thermodynamic system "Atmosphere-the Planet of Earth" is the open non equilibrium non linear thermodynamic systems of "alive organisms". An environment of the open thermodynamic

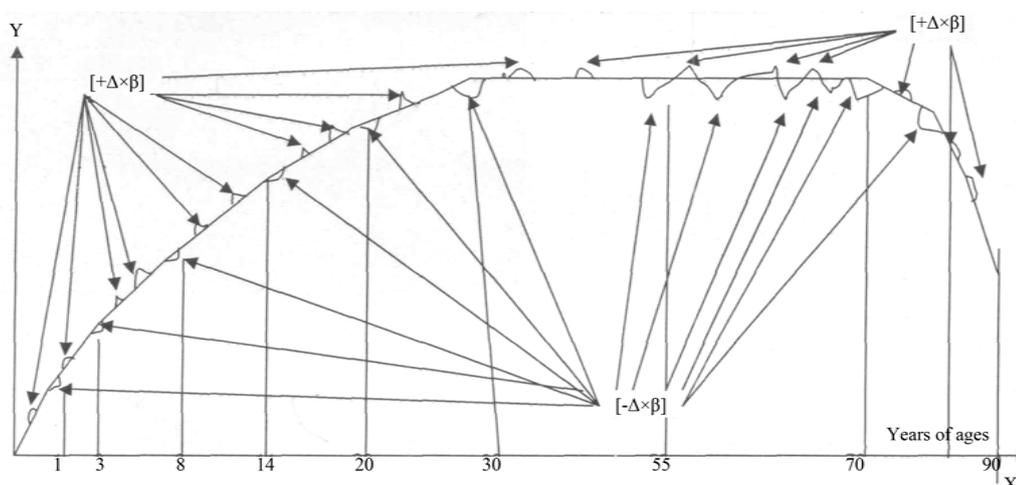


Figure 2. The changes of metabolism during a life of an organism. The organism's age: from 0 till 3 years-babyhood; from 3 till 14 years-young age; from 14 till 20-juvenile age; from 20 till 30 years-middle age; from 30 till 55 years-full age; from 55 till 70 years-elderly age; after 70 years-old age.

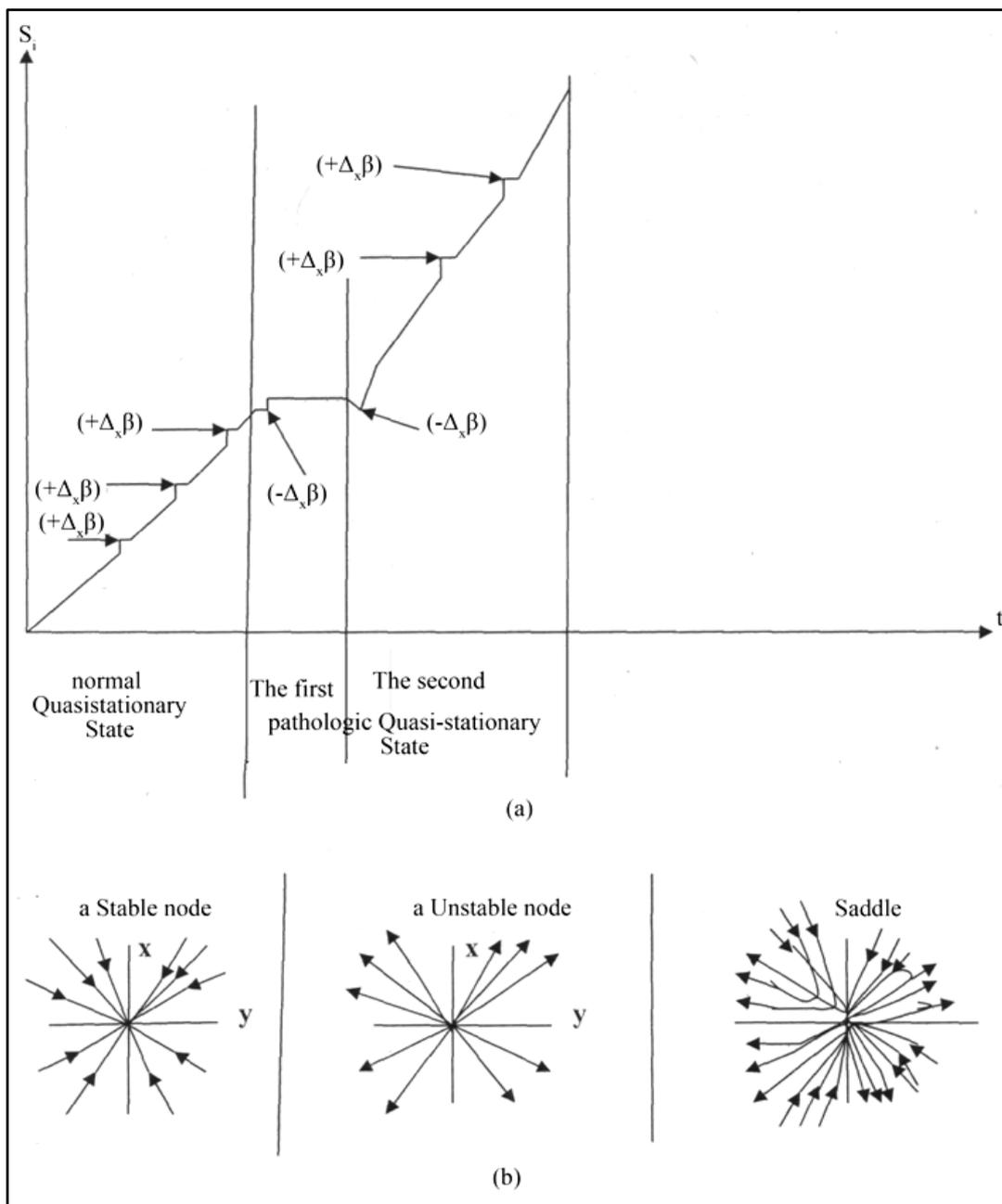


Figure 3. Change fluctuations of an entropy at transition from normal quasi-stationary state into pathologic quasi-stationary state.

system of “organisms” is the thermodynamic system of “Atmosphere-the Planet of Earth” [10]. Thermodynamic system “Atmosphere”, as the main aerial part of the thermodynamic system of “Atmosphere-the Planet of Earth”, has such steady parameters: 20% of Oxygen; 70% of Azote; Pressure (density) – $P = 101,325 \text{ Pa}$, that is the equivalent to $760 \text{ mmHg} \pm 15 \text{ mmhg}$; Humidity from 30% to 70% of [water in air]; Temperature in air from -50°C (223°K) to $+35^\circ\text{C}$ (308°K) [average temperature 20°C (293°K) - 25°C (298°K)] etc. [14]. On the one hand, thermodynamic system “Atmosphere” exchanges Energy and Substances with the open thermodynamic systems of “organisms” as environment, exhibiting property open thermodynamic system. On the other hand, thermodynamic system “Atmosphere” exchanges only Energy with the system “Universe-Galaxy”, exhibiting property closed thermodynamic system. Therefore the stability Internal Energy of thermodynamic system “At-

mosphere—the Planet of Earth” is explained via Prigogine theorem by using Einstein formula $E = mc^2$ or $E/c^2 = m$ [The symbols: E—Energy, m—mass of Substance, c—speed of light, T—temperature, S—entropy, H—enthalpy, Q—heat energy] [15]-[18].

Thus the solar energy is braked, corresponding to formula- $[E/c^2]$, and is transformed into Substances- $[E/c^2 = m]$, e.g. as Monoatomic oxygen radicals ($O\cdot$), Ozone (O_3), hydroxyl radical ($OH\cdot$), chlorine radicals ($Cl\cdot$), hypochloryl radical ($ClO\cdot$) etc., as well as main stable concentrations of molecules—20% oxygen molecule (O_2) and 70% azote molecule (N_2) [15] [16].

Besides corresponding to second law thermodynamics [$TdS = Q$ or $TdS = H$ or $TdS = E$ (thermal energy)], braked solar energy [TdS/c^2] is dissipated into thermal energy [TdS] transforming into Substances [m] in “Atmosphere—the Planet of Earth”- $[TdS/c^2 = m$ or $Q/c^2 = m]$. Transformed Substances by solar energy are as the light flying reactive nonorganic radicals or ionized Substances, which induce both anabolic and catabolic reactions, as well as the light flying neutral nonorganic Substances [O_2 and N_2] [17] [18]. The heavy non-flying molecules and compound Substances [carbon (C), silicon (Si) and the others] are formed in a great depth of “the Planet of Earth” due to huge pressure in a great depth. Therefore the mechanism stability Internal Energy of thermodynamic system “Atmosphere—the Planet of Earth” causing the stable concentration 20% oxygen (O_2) and 70% azote (N_2) in thermodynamic system Atmosphere should be considered choosing main stable flying Substances [oxygen (O_2) and azote (N_2)] separately.

Thus the mechanism maintenance stability Internal Energy in thermodynamic system Atmosphere is explained by use Prigogine theorem, considering the flows Energy and Substances between Atmosphere and an organism as environment [11] (see above), that cause stable concentrations such Substances as 20% oxygen (O_2) and 70% azote (N_2) in thermodynamic system Atmosphere. Just this mechanism maintenance stability Internal Energy results in the stable balance anabolic endoergonic & catabolic exoergonic processes in thermodynamic system Atmosphere, as well as the stable Internal Energy of the other thermodynamic systems [2]-[4]. Therefore the flows of the Substances oxygen (O_2) between Atmosphere and an organism as environment are linked with flows of catabolic exoergonic Energy. An oxygen (O_2) inflows into an organism from Atmosphere, and an organism produce carbon dioxide (CO_2). This carbon dioxide (CO_2) is consumed by Wood’s Trees and some other Plants which produce again oxygen (O_2), flowing back from an organism to Atmosphere. Thus it occurs the oxygen (O_2) cycle due to flows of the oxygen (O_2) between Atmosphere and an organism, as environment. Also thermodynamic system Atmosphere is supported by solar energy activity producing oxygen (O_2) via thermodynamic system “Universe-Galaxy” into Atmosphere. However the flows of only catabolic exoergonic energy are insufficient for maintenance stability of Internal Energy in Atmosphere via creating balance anabolic endoergonic & catabolic exoergonic processes. Just the stable concentration of 70% azote (N_2) in thermodynamic system Atmosphere is the outcome of flows anabolic endoergonic energy [14] [15]. These exchanges anabolic endoergonic energy occur between thermodynamic system Atmosphere and the open thermodynamic systems of “organisms”/Plants, Animals and Men/owing to Life and Death of these organisms. Just the anabolic endoergonic energy together with catabolic endoergonic energy creates balance anabolic endoergonic & catabolic exoergonic processes in alive organisms [8] [9]. When the organisms die, the catabolic exoergonic oxidized energy remains in body of dead organism causing decomposition dead body of men and corpse of animals or plants, as well as remained exoergonic oxidized energy in Atmosphere. Anabolic endoergonic energy operates in the anabolic biosynthetic processes of alive organisms’ cells presenting molecules containing azote [Proteins, DNA, RNA etc.] [8] [9]. Just the maintenance stable concentration of 70% azote in Atmosphere is induced by the flows of the anabolic endoergonic energy as to Atmosphere after the death of organisms as well as the back into alive organisms.

Thus the mechanism maintenance stability Internal Energy of both the open non equilibrium non linear thermodynamic systems of “organisms” and thermodynamic system Atmosphere is explained by Prigogine theorem via the flows of Streams Energy and Substances between the open non equilibrium non linear thermodynamic systems of “organisms” and thermodynamic system Atmosphere forth and back, causing balance catabolic exoergonic & anabolic endoergonic processes in both these systems.

However it should be distinguished different kinds of anabolic endoergonic energy in Plants, Animals and Men which maintains stability Internal Energy of these organisms causing balance catabolic exoergonic & anabolic endoergonic processes.

The Plants anabolic endoergonic energy operate via use Substances of inorganic molecules converting them into Substances of organic molecules causing balance catabolic exoergonic & anabolic endoergonic processes in Plants due to stable Internal Energy in Plants via streams Energy and Substances. Such vegetable anabolic en-

doergonic energy in plants promote only processes growth of Plants' organisms.

Both Animals anabolic endoergonic energy and Human anabolic endoergonic energy operate via use as vegetable organic Substances as well as animal organic Substances which were subjected to oxidation into CO₂ and H₂O by catabolic exoergonic oxidative processes causing balance catabolic exoergonic & anabolic endoergonic processes as in Animals as well as in Men. However it should share different kinds Animals anabolic endoergonic energy and Human anabolic endoergonic energy:

Animals anabolic endoergonic energy promote, besides growth of organisms, also movement activity, organs of sight activity, organs of hearing activity, some memory and some understanding, *i.e.* physiologic functions.

Human anabolic endoergonic energy promote, besides all physiologic functions of animals, also good memory and good understanding, capability to thought, abstract thinking, dream, fantasy, improvisation, conscious love and so on, *i.e.* mental functions.

Thus the exchanges anabolic endoergonic energy between thermodynamic systems Organisms and Atmosphere due to Life and Death of organisms exert mechanisms maintenance stability Internal Energy and Internal Medium as in Atmosphere as well as in alive organisms. Such movements of anabolic endoergonic energy between Life and Death of human organisms can be identified with movements of human souls between Life and Death of organisms, *i.e.* immortality of human souls.

4. Discussion

The significance of the study interactions between three thermodynamic systems/open non equilibrium non linear thermodynamic system of "organisms", thermodynamic system "Atmosphere-Planet the Earth", thermodynamic system "Universe-Galaxy"/is that it reveals supplementary mechanisms maintenance stability Internal Energy and Internal Medium as open thermodynamic system of a human organism via interaction it with Environment how thermodynamic system Atmosphere as well as thermodynamic system Atmosphere via interactions with Environment how open thermodynamic system of human and other organisms. Also the study interactions between these three thermodynamic systems leading to stability their Internal Energy substantiates the exchanges anabolic endoergonic energy between thermodynamic systems Organisms and Atmosphere due to Life and Death of organisms as the necessary links of the mechanism maintenance stability Internal Energy of Atmosphere, that gives opportunity to make assumption possible immortality of human souls.

5. Conclusions

- 1) The mechanism maintenance stability Internal Energy of an open thermodynamic system human organism, as well as other organisms, occurs due to exchanges Energy and Substances between an organism and Environment according Prigogine theorem.
- 2) The stability Internal Energy and Internal Medium of a human organism results in the stable biochemical and biophysical indices which are regulated as by three levels of regulation, as well as by cellular capacitors operations.
- 3) There was explained stability Internal Energy of open thermodynamic system Atmosphere using Prigogine theorem and Einstein formula.
- 4) The stability Internal Energy as an open thermodynamic systems organism as well as thermodynamic system Atmosphere induces balance catabolic exoergonic & anabolic endoergonic processes.
- 5) The flows of Energy for mechanisms formation balance catabolic exoergonic & anabolic endoergonic processes in open thermodynamic systems organisms and thermodynamic system Atmosphere were shared into flows of catabolic exoergonic energy and anabolic endoergonic energy.
- 6) The flows of anabolic endoergonic energy were shared into flows of Plants anabolic energy, Animals anabolic energy and Human anabolic energy.
- 7) There was proved that flows of anabolic energy for causing stability Internal Energy both Organisms and Atmosphere occur due to Life and Death of Organisms.
- 8) There was made the assumption that the flows Human anabolic energy between Human organisms and Atmosphere due to men's Life and Death can be identified with movements of human souls between Life and Death of organisms, *i.e.* immortality of human souls.

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