

# **Research of an energy generation opportunity from environment heat on basis of synchronization and self-organizing laws in non-equilibrium systems**

**The head of scientists teams**

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Project Summary:

The purpose of offered research is the strict theoretical substantiation of non-equilibrium, phenomenological thermodynamics laws and development of new thermal technologies which will allow to effectively generate useful energy from an environment.

For the decision of problem the laws of synchronization and self-organizing will be applied, which are characteristic for discrete and chaotic (molecular and turbulent) systems.

The project will have the big scientific and practical interest as its results are directly connected to a problem of priority development of non - fuel energetics. The decision of given problem means not only the final decision of a problem of energy content. First of all, it is connected with prevention of increasing thermal disbalance and global warming on our planet.

Project Science and Technology Areas:

Primary: Physics

Secondary: Energetics.

Introduction:

What is the problem?

The catastrophes occurring recently in Japan have made it clear how huge is the danger connected to contemporary energetics. The leading countries of the world are seriously discussing the usage of nuclear energy. Moreover, taking the global warming into consideration, there is a special danger from using of any other types of fuel.

Under these circumstances, developing the non - fuel energy has become one of the burning problems of our society. Mankind should focused on safe, renewable energy sources (hydro energy, wind energy, sun energy etc) and using it efficiently. At the same time, the full decision of this problem includes in development of machines which will generate the useful energy from thermal energy of surrounding space (such as air and water). According to the second law of classical thermodynamics, development of such machines is out of question.

The majority of world large scientific centers make the contribution to development of modern energy industry that is based on the laws of equilibrium, phenomenological thermodynamics. Despite of it, today it is necessary to change a direction of its development.

1.12. Literature Search.

**The greatest scientists of the world from the very beginning have been rejecting the second law of thermodynamics.**

Against the second law in existing general formulation, as the first, Darwin has acted, having put forward widely known theory of evolution. In 1867 James Maxwell has offered the mental device, capable to divide heat and create non-equilibrium system, contrary to the second law. In the beginning of twentieth century, K. E. Tsiolkovsky, approving idea of " Eternal youth of the Universe ", has in detail proved limitation of the second law of thermodynamics and asserted an opportunity of use of accumulated in environment heat. Limitation of the second law is proved in the works of famous scientists *E. Haeckel*; *S. Arrhenius*, *L. Boltzmann*, *O. Lodge*. Против второго начала первым выступил Дарвин, выдвинув широко известную теорию эволюции. В 1867 году Джеймс Максвелл предложил мысленное устройство, способное разделять тепло, вопреки второму закону. В начале двадцатого столетия, К.Э. Циолковский, утверждая идею "вечной юности вселенной", подробно обосновал ограниченность второго закона термодинамики и утверждал возможность использования тепла окружающей среды. Об ограниченности второго закона утверждали в своих трудах Геккель, Аррениус, Больцман, Оливер Лодж..

In 1947 A.A. Gukhman has found out a mistake in the proof of Carnot theorem given by R.Klauzius [6].

The hypothesis of universe thermal death and principle of steady growth of entropy lose their bases at critical assessment of this parameter. The most critical estimations under the attitude of entropy are given in A.I. Veynik's researches [2].

The critical estimation of the second law is given in the works of winner of Onsager prize Miguel Ruby, which gives the analysis of lot of processes that contradicts to requirements of second law and a principle of steady growth of entropy [5].

Sense of entropy and the second beginning of thermodynamics are objects of sharp discussion. On the one hand, they correctly reflect a lot of physical phenomena, on the other hand, are unable to explain essence of many separate physical processes. They do not prove to be true by development of global processes in the Universe and are not stacked within the framework of fundamental principles of philosophical thinking

From the point of view of Philosophical judgment of problems which arise in connection with application of the second beginning of thermodynamics deserves attention the works [46,47,48], devoted to criticism of classical thermodynamics.

Fundamental results on issues of non-equilibrium thermodynamics are stated in works of the Belgian scientist, winner of Nobel Prize I. Prigogin [3,4].

The basic ideas in this direction are stated in the work of Ilya Prigogin and Isabella Stengers [3] in which the critical estimation of a science and philosophy of XIX and XX centuries is given. Problems and features of modern scientific thinking are considered. In works of these authors is shown that for natural processes are characteristic not only degradation of the order and aspiration to chaos, but also generation of the order from chaos and self-organizing of systems with more high level of disbalance. Hence it is proved, that the second law has no universal character.

The most interesting to understand physical essence of self-organizing processes in system of physical bodies are the works on synchronization of dynamic systems [1].

Especial successes in the field of critical reassessments of the second law are achieved in researches in the field of molecular physics, the quantum mechanics, electromagnetism and nano-technology. It is possible to result a little bit hundred researches, from the given areas in which, theoretically and experimentally, obvious violation of the given law proves to be true. In this direction materials of the First International Conference on Quantum Limits to the Second Law, (American Institute of Physics, San Diego, California, 28-31 July 2002) deserves interest. Most interesting of them are [7-45].

In October, 2010 on the Internet the message that by the scientist at Tokyo university was experimentally proved validity of Maxwell's idea, was published.

In the field of phenomenological thermodynamics, similar results meet considerably seldom. In 2009-2011 the author of the given project published results of theoretical research in which, on the basis of methods of phenomenological, non-equilibrium thermodynamics and classical laws of the continuous environment, for the first time was shown, that

the marginal efficiency of heat and mechanical energy transformation is function of physical properties of working medium [49, 52, 53, 55, 56, 57].

It is shown, that there are such non-equilibrium thermodynamic cycles, with internal circulation of energy which efficiency, at the certain values of Prandtl number, is higher than Carnot limit [52, 55, 56, 57]. In such cycles cooling of a working body occurs during internal redistribution and circulation of heat that allows avoiding of losses.

In the publications [50, 51, 54, 57] by the project's author is proved that generation of turbulence in big scales streams, (in conditions of minimization of friction with external bodies), results in falling of entropy along an isolated stream that is obvious violation of the second law. Simultaneously, use of such process gives the possibility to carry out thermodynamic cycles which efficiency is higher than Carnot limit.

In author's researches is shown, that the second law and Carnot theory are fair only for equilibrium systems. At the same time the environmental world is non-equilibrium. Laws of synchronization and self-organizing which are characteristic for such systems not only break the second law of thermodynamics, but also gives the possibility of continuous generation of energy from an environment

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How are their results being applied?

The modern results of research in the field of molecular physics, quantum mechanics, electro magnetism, nano-technology, together with researches of self-organization of chaotic systems and problems of non-equilibrium thermodynamics prove words of *O. Lodge* which, in 1931, in the discussion, organized by the British association, on a theme "Evolution of the Universe ", has declared: "the final and inevitable increase of entropy up to a maximum is an idol, before which for philosophers is not necessary to bend the knees".

For today the principle of steady growth of entropy is not considered as universal and the given principle correctly expresses essence of processes only in specific case, when small-scale, isolated systems are considered, in which prevails dissipation, caused by friction with environmental bodies. Hence, the scientific methodology of modern

energetics, which denies an opportunity of generation of energy from heat of an environment, has lost the theoretical basis.

Despite of it, for today, such technologies and installations, which will allow making promotion to practical direction, are not developed yet. It is caused because in existing theoretical and experimental researches, basically, weak effects are fixed and the offered processes are complex. They do not allow compensating necessary losses and power charges. It is not possible to carry out effective processes practically.

Hence, in a basis of modern scientific thinking principles of classical, equilibrium thermodynamics of two-century prescription lay again. So, supporters of traditional energetics, on the one hand, concern critically to innovations in the given direction, but, on the other hand, realize that they conduct development of our society to a critical limit.

What are we going to do?

Taking into account the successes achieved in the field of non-equilibrium, phenomenological thermodynamics, in the project there is a plan to finish modern researches in the given direction up to the logical end - to develop such new technologies, which will allow extracting effectively energy from heat of an environment. In work, on the basis of fundamental theoretical research the final answer on question - whether the mankind is capable to generate the energy in the environment, where there is a temperature balance, without burning fuel and activation of nuclear energy-will be given

What is the objective?

Object of research are non-equilibrium and conditional - equilibrium thermodynamic systems (as a liquid or gas) in which gradients of thermodynamic parameters with any small size (but not equaled to zero) exist, if in them thermodynamic processes proceed. Hence, taking into account, that the continuous environment, in reality, always is discrete, even at presence of the minimal gradients, the object of research is considered as non-equilibrium for which processes of synchronization and self-organizing are characteristic.

The special attention is given to questions of non-equilibrium processes under influence of the human factor. The object of research chooses such processes in which the conscious subject creates special conditions for synchronization and organization of the order that results in generation of large-scale movement from small-scale thermal and chaotic turbulent movement.

#### 1.14. Expected Significance

What is new?

By the author of the project, on the base of methods of phenomenological thermodynamics and the mechanics of the continuous environment, for the first time is shown, that, in conditions of presence of thermal and mechanical non-equilibrium (presence of temperature and pressure gradients), occurrence of internal streams of heat and mechanical energy, allows to organize cyclic processes with circulation of energy. Such processes provide cooling of working body, at temperature, lower than ambient temperature, without transfer of energy to environmental space. Hence, it is possible to avoid necessary losses, characteristic for equilibrium thermodynamic cycles. It is shown, that at internal circulation, energy can be accumulated both in a stream of heat, and in mechanical energy of vortical or turbulent movement. Thus, in any case, accumulation of energy results in effect of cooling without external influence and to falling of isolated working body entropy. The marked phenomena give the possibility to explain violation of the second law and occurrence of an opportunity of useful energy generation. Basic circuits for such non-equilibrium thermodynamic cycles are developed.

#### 1.15. Organization, Qualification and Staffing

Who are we?

The participants of project are leading scientists of Georgian Technical University and Kutaisi National University. On this subject the participants have many scientific publications. The problem was discussed in many conferences and seminars.

The participants of the project on the part of Kutaisi National University are experts in the field of thermodynamics, theory of heat and mass transfer.

#### 1.16. Expected results

What will be done in the framework of this project?

Theoretical substantiation of energy generation opportunity in conditionally equilibrium environment. The technological process of energy reception from environment.

. What is next?

Successful end of theoretical research and development of new technologies becomes the accelerator of works in a direction of development of new thermal engines and thermal pumps. Simultaneously gets an urgency an intensification of works for development of partitions with unilateral conductivity of fast molecules (Thermal ratchets).

### 1.17. Scope of activities

The analysis of the second law from the point of view of phenomenological thermodynamics and molecular physics - demonstration of a difference of approaches and the contradiction of results.

The analysis of two opposite scripts of development of natural processes and classification of physical phenomenon in which obvious violation of the second law is observed.

Research of influence of the human factor on development of natural processes. (The order, resistance of physical bodies and the person, as the conscious subject of a nature).

Research of influence of physical properties of bodies on a marginal efficiency of thermal processes. A marginal efficiency of transformation of energy - function of physical properties.

Research of essence of synchronization and self-organizing processes as theoretical basis of energy generation from the chaotic environment.

Research of distinctive features of non-equilibrium processes. Circulating processes of synchronous character - an opportunity of reception of paradoxical decision from the point of view of equilibrium thermodynamics.

Research of features of dynamic systems synchronization, studying of physical essence of self-organizing of large movements and generation of mechanical energy from chaos.

Research of movement synchronization problem in volume of a liquid and gas at a minimum level of non-equilibrium - infringement of laws of equilibrium thermodynamics and the mechanics of the continuous environment.

Studying features of Bénar-Rayleigh instability on the basis of laws of synchronization of molecular movement at average and high levels of non-equilibrium.

Research of issues of Bénar type instability in motionless gas - local and integrated criteria of instability.

The analysis of physical essence of occurrence of cyclones, as result of processes of Bénar-Rayleigh instability. Origin, development and stability of cyclones as consequence of synchronization of atmosphere turbulence.

Research of methodological questions of entropy analysis.  $T-s$  the diagram and friction. The conflict of laws for open thermodynamic cycles.

Research of features of construction  $T-s$  diagrams at currents in small scales channels. Friction and apparent effect of heating.

Research of features of construction  $T-s$  diagrams at currents in channels of the big scales. Turbulence and apparent effect of cooling of a stream.

The analysis of the reasons of organic laws conflict occurrence in the closed systems - the adiabatic piston.

Difference between physical origins of rectilinear and relative movement energy. Thermal and mechanical invariants of averaged movements. Internal energy, as the basic energy source for vortical and turbulent movement.

The integrated equation of conservation of energy and connection of kinetic energy with entropy

The differential equations of preservation and connection of kinetic energy of turbulence with entropy.

Thermodynamic cycles with generation and dissipation of the big scales turbulence during permanent increase of pressure with the subsequent adiabatic expansion for development of energy due to cooling the working body which have been thrown out in environmental space.