Journal of Physics: Conference Series **668** (2016) 012109 doi:10.1088/1742-6596/668/1/012109

From lepton protoplasm to the genesis of hadrons

S. M. Eliseev[1] **and O. S. Kosmachev**[2]

Joint Institute for Nuclear Research, 141980, Moscow region, Dubna, Russia

E-mail: [1]`selis@theor.jinr.ru`, [2]`kos@theor.jinr.ru`

Abstract. Theory of matter under extreme conditions opens a new stage in particle physics. It is necessary here to combine Dirac's elementary particle physics with Prigogine's dynamics of nonequilibrium systems. In the article we discuss the problem of the hierarchy of complexity. What can be considered as the lowest level of the organization of extreme matter on the basis of which the self-organization of the complex form occur?

New physics appears if and only if we change the assumptions or if they are complemented by original assumptions of related disciplines under the condition of the synthesis of these disciplines. In other cases we have **news** of the known physics.

The theory of matter under extreme conditions is the beginning of the formation kinetics of elementary particles. In this theory merging of **Dirac's physics** of elementary particles with **Prigogine's dynamics** of nonequilibrium systems is necessary. Full wording and subsequent design of this conceptual program represent extraordinary difficulties as they affect the foundations of modern physics of the microworld. One of the initial problems of the program is the problem of **the hierarchy of complexity**. What can be considered simple on the basis of which the self-organization of complex occurs?

The exclusive role of leptons is associated with their participation in most cases of nuclear and subnuclear processes. In addition, they are the final products of the decays of all hadrons. In recent years we have achieved a holistic description of the **lepton sector** [1-2]. Based on five assumptions a complete and closed set of lepton equations was obtained. They describe the massive and massless, charged and neutral, and stable and unstable leptons in a free state. The presence of individual structure of each lepton equation is established. Assumptions are necessary and sufficient conditions based on which Dirac received his fundamental equation (1928). Next, Pauli got the equation for the two-component neutrino (1932) using the Dirac's algorithm, and Majorana derived the equation for massive neutrinos (1937). Each of these lepton equations is determined by its own group. Groups are not isomorphic and differ in their structure. Just the structure is the carrier of individual characteristics of each lepton equation and, as a consequence, the properties of leptons. So the structure is an invariant feature that distinguishes one lepton equation from another. Given these circumstances, one can speak about the differences in the structures of the leptons themselves or their characteristics and thereby about guarantees of existence of their own quantum numbers. The presence of these structures is simply a mathematical fact. It was found that in the lepton sector relativism (or rather all four connected components of the Lorentz group) is the original structure-forming factor.

The decays of **tau leptons** are of particular interest for the studied range of problems [3-5]. They can decay directly into leptons and hadrons with further disintegration of the latter again into leptons. Therefore, stability of the end products of decay of hadrons to leptons proves that

Journal of Physics: Conference Series **668** (2016) 012109 doi:10.1088/1742-6596/668/1/012109

the structure lepton is simpler than the structure of hadrons. On the other hand, it is easy to verify that stable leptons do not contain substructures of the type of quarks. Therefore, the fact of the decay of Tau leptons directly into hadrons is obvious evidence of the possibility to describe **hadrons and quarks in terms of the same components like leptons**. In general, the decay of unstable particles from a free state (i.e. in a vacuum) with the release of energy can be considered as the process opposite to the synthesis (self-organization) not in a vacuum but in an environment where processes of energy dissipation are possible. The environment, which is equally suitable for the genesis of leptons and hadrons, is the **lepton protoplasm** [1-2].

We have the answer to the question of the total lepton number of equations that are valid in the framework of five assumptions (see [1-2]). From here, together with a detailed description of the structure of each lepton equation, it was found that in the lepton sector there is an **analogue of confinement**. From this it follows that in the structures of the unstable leptons there appear maximal invariant substructures that do not exist in a free state. They satisfy the requirement to be wave processes in free states, but they do not contain necessary elements for the formation of the current probability conservation. This situation may be a prelude to a non-standard description of confinement of quarks without unnecessary suppositions.

Theory of matter under extreme conditions should be a testing ground for building and validating new physics. Here physics faces the most important task: how, starting from something simple, to recreate all that was accumulated by particle physics during the time of its existence. The amazing diversity of the final particles in a single act of collision of heavy ions does not give reasons to assume that private methods to explain the birth of those or other particles will create understanding of the problem. It is a natural situation when a realistic unification of strong and electroweak interactions will require the description of quarks and leptons in a unified and strictly relativistic basis, because there is no alternative for the description of mutual transitions binding energy and matter. In this case, the lepton sector is the most adequate starting point for advancing in this direction.

From the standpoint of extreme matter one can take a fresh look at famous models or phenomenona. Here is the blurring of the notion of the on-mass surface as well as of the concept of structure that separates particles into the fermions with their spin structure and bosons with their vector structure. Therefore, the achievements of supersymmetry can be claimed in the analysis of numerous transitions during highly non-equilibrium phase in heavy ion collisions.

References

[1] Kosmachev O S 2015 Quartet of tau-leptos and possibility of their oscillations *Proc. of Science* PoS ISHEPPXXII (2015) 030

[2] Kosmachev O S 2012 The simplest and universal constituents for description of leptons and hadrons *Phys. Atom. Nucl.* **75** 885

[3] Sudhir Kumar Gupta et al. 2012 Tau lepton charge asymmetry and new physics at the LHC Phys.Rev. D **86** 119901

[4] Aaltonen T et al. 2013 Search for Supersymmetry with Like-Sign Lepton-Tau Events at CDF *Phys. Rev. Lett.* **110** 201802

[5] Chatrchyan C et al. (CMS Collaboration) 2013 Search for physics beyond the standard model in events with tau leptons in pp collisions at sqrt(s) = 7 TeV *Eur. Phys. J.* C **73** 2493