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Fundamental relationship of cosmology and particle physics

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Modern cosmology is based on the inflationary models with baryosynthesis and dark matter/energy. These cornerstones of the structure and evolution of the universe are well supported by the observational data of the precision cosmology but find no physical basis in the known physics. Such basis appears in physics beyond the standard model of elementary particles. The hope that supersymmetric extension of the standard model can not only provide physical grounds for the modern cosmology but also can find experimental verification at the Large Hadron Collider (LHC) is not supported by the negative results of searches for supersymmetric particles at the LHC. The simplest solution for dark matter candidates in the form of weakly interacting massive particles (WIMPs) in spite of its miraculous possibility to explain cosmological dark matter also doesn't find support in experimental searches for dark matter. It makes us to extend the field of research of new physics, on which modern cosmology can be based. In many cases such extensions are related to super high energy physics, which cannot be studied directly in the experiments at modern and even planned particle accelerators. Cosmoparticle physics studying fundamental relationship of cosmology and particle physics in the proper combination of its indirect physical, astrophysical and cosmological signatures can offer the solution to approach the true physics, on which true cosmological structure and evolution is based. The methods of cosmoparticle physics and examples of probes for various predictions of new physics are discussed.

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Parametrically controlled film flow disintegration in metallurgy and material science

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Parametrically excited oscillations and new parametric effects were revealed for the important engineering and technological applications. Scientific novelty of this work is in a development of the theory and applications of parametric excitation and suppression of oscillations on the boundaries of continua of three tasks' classes: flat and radial spreading film flows of viscous incompressible liquids; surfaces of phase transition from a liquid state into a solid one, etc. The external actions considered were: alternating electromagnetic, vibration, acoustic and thermal fields. The three new phenomena of the controlled parametric film flow decay were discovered and studied: electromagnetic controlled resonance film flow decay, soliton-like vibration film flow decay and vibration shock-wave film flow decay. The shock wave regime was got by nearly ten times higher the vibration Euler number than for the soliton-like regime. The phenomena were first theoretically predicted and then experimentally investigated. Based on these new phenomena, the prospective dispersing and granulation machines were invented, developed and tested for some metals. The new phenomena allowed building the devices by the controlled film flow decay for obtaining the particles of the given size and form. Specific cooling and solidification methods and devices have been developed. Theoretical results allowed patenting and constructing the new granulation machines for production of the metal granules with cooling rate up to 104 K/s. The unique granules were used to produce the new specific materials with strong properties, e.g. so-called amorphous materials and materials with complex structure.

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