Nikolai Bogolubov (Jr) (V.A. Steklov Mathematical Institute of RAS, Moscow, Russia)
Anatoliy Prykarpatsky (Ivan Franko State Pedagogical University of Drohobych, Lviv region, Ukraine and AGH University of Science and Technology of Krakow, Poland)

The mathematical theory of the relativistic electrodynamical Lorentz force interaction

The report is devoted to the study of the vacuum structure, special relativity, electrodynamics of interacting charged point particles and the related quantum mechanical aspects.

The devised by Authors approach allowed to avoid the introduction of the well-known Lorentz transformations of the space-time reference systems with respect to which the relativistic action functional is invariant. It is stated that the Lorentz force in the relativistic electrodynamics $dp/dt := F = qE + qu \times B$, where $p \in \mathbb{E}^3$ is the particle momentum, describes, in reality, the no-backward interation between a charged point particle q and the external electromagnetic field. Define the following action functional $\delta S = 0, \qquad S := \int_{t_1}^{t_2}(-\bar{W}dt + q < A, dr >) := \int_{\tau_1}^{\tau_2}\mathcal{L}d\tau,$ where the Lagrangian function $\mathcal{L} := -\bar{W}(1+\dot{r}^2)^{1/2} + q < A, \dot{r} >$and $(\bar{W}, A) : M^4 \to \mathbb{R} \times \mathbb{E}^3$ is the corresponding vacuum field scalar potential, defined in the Minkovski space M^4. The following propositions, characterizing the general Lorentz force nature from the devised vacuum field theory approach, are stated.

Proposition. *The classical relativistic Lorentz force allows the least action formulation with respect to the rest reference system $\mathcal{K}_r$. Its electrodynamics is completely equivalent to the classical relativistic point particle electrodynamics. In the case when the mutual interation between a charged point particle q and the external electromagnetic field is taken into account, the classical Lorentz force expression should be modified as follows:* $dp/dt = qE + qu \times B - q\nabla < A, u >$.

The results obtained from the classical Lagrangian and Hamiltonian formalisms, shed a new light on the related physical backgrounds of the vacuum field theory approach to common studying electromagnetic and gravitational effects.

[1] Prykarpatsky A.K., Bogolubov N.N. (Jr.) and Taneri U. The vacuum structure, special relativity and quantum mechanics revisited: a field theory no-geometry approach. *Theoretical and mathematical physics,* Moscow, RAS, 2008 (in print) (arXiv lanl: 0807.3691v.8 [gr-gc] 24.08.2008 ;)Preprint ICTP, Trieste, IC/2008/051 (http://publications.ictp.it)

[2] Prykarpatsky A.K., Bogolubov N.N. (Jr.) and Taneri U. The Lagrangian and Hamiltonian formalisms for the classical relativistic electrodynamical models revisited. (arXiv:0810.3755v1 [gr-qc] 21 Oct 2008)