

To 190 years of the Wave of Translation and 50 years of the Davydov's soliton: Soliton dynamics in an oscillating magnetic field.

Tuesday, 24 September 2024 12:30 (20 minutes)

In this talk some less known facts of the discovery of the Wave of Translation will be discussed. A brief review of the advancement of the theory of Davydov's solitons will be given. New results on the study of the dynamics of the Davydov's soliton [1] in an external oscillating in time magnetic field [2,3] will be reported. It is shown that in the magnetic field, perpendicular to the molecular chain axis, soliton wave function is a superposition of the electron plane wave in the plane perpendicular to the molecular chain, and longitudinal component of the wave function which satisfies the modified Nonlinear Schroedinger equation which is solved using the perturbation method based on the inverse scattering transform. It is shown that soliton width and amplitude are constant, while its velocity and phase are oscillating in time functions with the frequency of the main harmonic determined by the magnetic field frequency. Account of the energy dissipation results in bounding soliton velocity from above due to the balance of the energy gain from the magnetic field, and its loss because of the radiation of linear sound waves and energy dissipation. Soliton radiation due to time-depending velocity is calculated and shown to be the most intensive at the resonant frequency of the magnetic field. It is concluded that such complex impact of time-depending magnetic fields on charge transport, provided by solitons, can affect functioning of the devices based on low-dimensional molecular systems. These results suggest the physical mechanism of the resonant therapeutic effects of oscillating magnetic fields as the resonant impact of the magnetic field on the charge transport processes provided by solitons in the redox processes [4,5].

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- [1] A.S. Davydov, N.I. Kislukha. Solitary excitons in one-dimensional molecular chains. Phys. Stat. Sol. B (1973) **5** 465. <https://doi.org/10.1002/pssb.2220590212>
- [2] L. Brizhik. Davydov's soliton in an external alternating magnetic field. arXiv:2402.09172v1 [cond-mat.soft] 14 Feb 2024.
- [3] L. Brizhik. Dynamics of the Davydov's soliton in external oscillating magnetic field (Submitted to Chaos, Solitons and Fractals, 2024).
- [4] L. Brizhik, E. Fermi, B. Zavan. Working principle of magnetic resonance therapy. <http://arxiv.org/abs/1509.04475>
- [5] Electric, Magnetic, and Electromagnetic Fields in Biology and Medicine: From Mechanisms to Biomedical Applications: 2nd Edition. Bioengineering, Special Issue. (2024), **11**.

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