ELPH seminar

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日時：令和 2年 1月 29日（水） 16時 0分 ～
場所：電子光理学研究センター 三神峯ホール

Nuclear Fusion of Hydrogen Isotopes Induced by the Localized Anharmonic Vibrations

Energy localization in bulk hydrides of Pd and Ni crystals manifest itself as Localized Anharmonic Vibrations (LAVs), in which large amplitude atomic motion may result in time-periodic driving of adjacent potential wells occupied by hydrogen ions (protons or deuterons) [1]. This driving has been shown to result in the increase of amplitude and energy of zero-point vibrations (ZPVs) and in broadening of the wave packet [2]. Numerical solution of Schrodinger equation for a particle in a non-stationary double well potential, which is driven time-periodically, shows that the rate of tunnelling of the particle through the potential barrier separating the wells is drastically enhanced by the driving with a resonant frequency ranging from w_0 to $2w_0$, where w_0 is the eigenfrequency of the potential well [3]. Based on that, we demonstrate a drastic increase of the D-D or D-H fusion rate with increasing number of modulation periods evaluated in the framework of Schwinger model [4], which takes into account suppression of the Coulomb barrier due to ZPVs, which is further enhanced by the time-periodic driving in DBs. The resulting macroscopic fusion rate is determined by the concentration and lifetime of DBs, which should be sufficiently large to provide observable fusion rates.

Experimental verification of the proposed model is discussed.

[1] V.I. Dubinko, D.V. Laptev, D. Terentyev, S. V. Dmitriev, K. Irwin, Assessment of discrete breathers in the metallic hydrides. Comput. Mater. Science 158 (2019) 389
[2] V. I. Dubinko, D. V. Laptev, Chemical and nuclear catalysis driven by localized anharmonic vibrations. Lett. on Materials 6 (2016) 16
[3] V. Dubinko, D. Laptev, K. Irwin, Catalytic mechanism of LENR in quasicrystals based on localized anharmonic vibrations and phasons, J. Condensed Matter Nucl. Sci. 24 (2017) 1.
[4] J. Schwinger, Nuclear Energy in an Atomic Lattice I. Z. Phys. D 15 (1990) 221.