

# Peculiarities of the mutual influence of superconductivity and magnetism in Josephson structures with ferromagnet

Yu. M. Shukrinov<sup>1,2</sup>

<sup>1</sup>JINR, Dubna, Russia

<sup>2</sup>Dubna University, Dubna, Russia

Corresponding Author: Yu. M. Shukrinov

Email: shukrinv@theor.jinr.ru

---

The short review on the effects of mutual influence of superconductivity and magnetism in the Josephson  $\varphi_0$  junction with a direct coupling of the Josephson phase and magnetization is presented [1]. The interesting prospects in the field of superconducting spintronics, in particular, based on the reversal of the magnetic moment by a superconducting current, the manifestation of the Kapitza pendulum features by the  $\varphi_0$  junction are discussed [2]. The results of studies of the dynamics and current-voltage characteristics (CVC) of the junction under the action of external electromagnetic radiation are presented [3-5]. A new element in the consideration of this problem is the inclusion of the magnetic component of the radiation, which leads to the emergence of new synchronization mechanisms and corresponding steps on the CVC. We discuss the resonant control of magnetization in a shunted  $\varphi_0$  junction with LC circuit, the locking, hysteresis, and chaotic features [6-8]. The combination of Josephson and Kittel ferromagnetic resonances in the  $\varphi_0$  junction with different types of synchronization, clearly expressed in the dynamics and in the CVC, makes the physics of this system very interesting and opens up a number of new applications.

## References:

[1] A. Buzdin, *Phys. Rev. Lett.* **101**, 107005 (2008).

[2] Yu. M. Shukrinov, *Physics Uspekhi* **65**, 317 (2022).

[3] S. A. Abdelmoneim, Yu. M. Shukrinov, K. V. Kulikov, ElSamman, and M. Nashaat, *Phys. Rev. B* **106**, 014505 (2022).

[4] Yu. M. Shukrinov, E. Kovalenko, J. Tekic, K. Kulikov, and M. Nashaat, *Phys. Rev. B* **109**, 024511 (2024).

[5] M. Nashaat M., E. Kovalenko, and Yu. M. Shukrinov, *Phys. Rev. B* **110**, 024510 (2024).

[6] A. A. Mazanik, A. E. Botha, I. R. Rahmonov, and Yu. M. Shukrinov, *Phys. Rev. Applied* **22**, 014062 (2024).

[7] I. R. Rahmonov, Yu. M. Shukrinov, O. A. Kibardina, S. A. Abdelmoneim, *Cond-mat. arXiv:2411.6037* (accepted for APL, 2025).

[8] M. Sameh, Yu. M. Shukrinov, A. Y. Ellithi, Th. M. El-Sherbini, and M. Nashaat, *J. Phys.: Cond. Mat.* **37**, 235803, (2025).