

# Modelling the phase dynamics of long superconductor-ferromagnet-superconductor $\varphi_0$ Josephson junction

*Monday 28 October 2024 15:35 (15 minutes)*

We consider the phase dynamics in long superconductor-ferromagnet-superconductor  $\varphi_0$  Josephson junction described by the modified sine-Gordon equation. In such a junction the Josephson phase and magnetic moment are coupled due to spin-orbit coupling. This allows the manipulation of magnetic properties by Josephson current and vice versa. We investigate the effect of the spin-orbit coupling, Josephson to magnetic energy ratio, and Gilbert damping on the presence of the fluxon states. Also, the magnetic moment dynamics on the fluxon steps are demonstrated. The obtained results can find applications in the field of superconducting spintronics and quantum computing. The calculations were performed on the HybriLIT cluster.

**Acknowledgement:** The work was carried out with the financial support of Project No. 22-71-10022 of Russian Science Foundation (RSF). Yu. M. Shukrinov and M. Nashaat acknowledge the financial support from collaborative project ASRT, Egypt –JINR, Russia.

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**Session Classification:** Mathematical Modelling and Computational Physics

**Track Classification:** Mathematical Modeling and Computational Physics