

# NUMERICAL SIMULATIONS FOR SPINTRONIC EFFECTS IN JOSEPHSON NANOJUNCTIONS

## Project Scope:

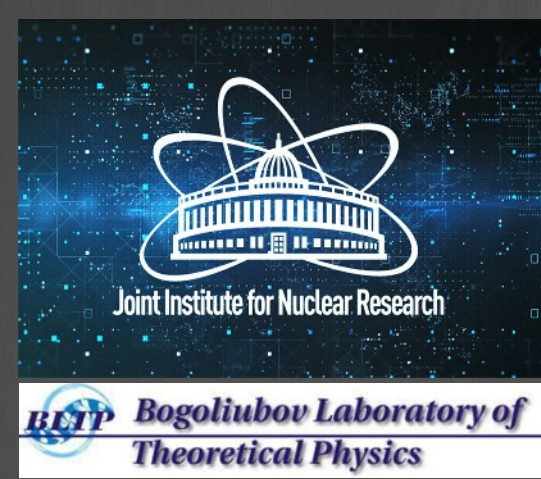
The possibility to manipulate the magnetic properties by Josephson current attracts much attention nowadays. In the present project, we plan to do a detailed investigation of different types of ferromagnet Josephson nanojunctions. We will investigate the generation of magnetic precession by Josephson current at different values of bias current and the effect of external radiation on the character of precession. Different computer programs will be developed for modeling different types of interactions between magnetic moment and Josephson current.

## Required Skills:

- Basic knowledge of superconductivity, and magnetism.
- C++ programming.
- Students with Python and COMSOL Multiphysics knowledge may have the additional tasks.

## Recommended literature:

- B.D. Josephson. *Physics letters*, 1(7):251–253, 1962.
- A. Buzdin *Phys. Rev. Lett.* 101, 107005 (2008).
- Yu. M. Shukrinov, *et al.*, *Appl. Phys. Lett.*, 110(18):182407, (2017).
- S.A. Abdelmoneim, *et al.*, arXiv:2201.04524 (2022).



*Dr. M. Nashaat*

(Theoretical Condensed  
Matter Physics)

Bogoliubov Laboratory of  
Theoretical Physics

Email: [majednas@theor.jinr.ru](mailto:majednas@theor.jinr.ru)

## TRAINING TASKS & ACQUIRED SKILLS

- Be familiar to Josephson junction and how to simulate its phase dynamics.
- Modeling of phase dynamics and current voltage characteristics of Josephson junctions with spintronics effects.
- Study the manipulation of magnetic moment in superconductor Josephson junction coupled to ferromagnet.
- Since nanomagnetic systems have many applications in spintronic logic devices, and memory devices. We devote part of the practice to use micromagnetic simulation tools to study magnetization phenomena on the intermediate scale between the quantum mechanical scale of individual atoms and the macroscale.