INTERNSHIP PROPOSAL

Laboratory name: Unité Mixte CNRS/Thales
CNRS identification code: UMR 137
Internship director'surname: Frank Mizrahi / Julie Grollier
e-mail: frank.mizrahi@cnrs-thales.fr ; Julie.grollier@cnrs-thales.fr
Web page: https://www.neurophysics.cnrs-thales.fr/
Internship location: Thales Research & Technology, 1 avenue Agustin Fresnel, Palaiseau

Thesis possibility after internship: YES
Funding: YES/ If YES, which type of funding: EU project

Neural networks using the dynamics of magnetic tunnel junctions

Running and training artificial neural networks on conventional computers consumes a large amount of energy. Our team studies how to build novel hardware for artificial intelligence, that physically implements neural networks using spintronic nanodevices [1].
In particular, we leverage the high-speed dynamics of magnetic tunnel junctions to implement the key operations of neural networks.

The objectives of the internship are:
• Characterizing magnetic tunnel junctions and demonstrating basic operations (neuron, synapse).
• Physically connecting a few devices to build a neural network and perform a small computing task.
• Using numerical simulations, performing learning and computing on a larger neural network. Studying how the dynamics of the nano-devices impacts learning.

This internship requires to be interested in learning new concepts and tools from both physics and machine learning.

[1] Ross, A., Leroux, N., De Riz, A. et al. Multilayer spintronic neural networks with radiofrequency connections. Nat. Nanotechnol. (2023). https://doi.org/10.1038/s41565-023-01452-w

Techniques/methods in use:
• Electrical and magnetic characterization (DC, RF and time-resolved measurements)
• Neural network simulations (using Pytorch)
Applicant skills: Measurements, Coding. Interdisciplinary mindset.
Industrial partnership: Yes (Thales Research & Technology)

Please, indicate which speciality(ies) seem(s) to be more adapted to the subject:

Condensed Matter Physics: YES Soft Matter and Biological Physics: YES
Quantum Physics: YES Theoretical Physics: YES