Department of Materials Science and Engineering Seminar Series 2026

Nanomechanical properties of magnetic 2D materials

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Date and time: 25th November 2026 (Wednesday) 09:00am

Venue: S9, Level 9 Conference Room

Abstract

Two-dimensional van der Waals magnets tie their magnetic order closely to the crystal lattice. A membrane made from such a material shifts its resonance frequency whenever its magnetic state changes, which makes suspended nanomechanical resonators unusually sensitive to magnetism in flakes far too small, too insulating or too air-sensitive for standard magnetometry. The difficulty is that this sensitivity arrives as a single mechanical signal in which several magnetic and thermal effects are combined, so magnetic properties have to be disentangled from the mechanical response rather than measured independently of it. This thesis develops suspended magnetic membranes into instruments that measure magnetic properties directly. A theoretical framework relates the resonance to strain, thermal properties and magnetic ordering, and a polymer-free fabrication method suspends clean heterostructures of air-sensitive crystals. On this basis, four magnetic properties are measured mechanically: the resonance amplitude follows the magnetisation, separating it from magnetostriction within a single measurement; field sweeps along different crystal directions probe the anisotropy of an individual flake; cooling in a weak field sets distinct domain configurations that the oscillating membrane tells apart and saturation erases; and in a spin glass the same readout follows slow, history-dependent relaxation as it unfolds. The outcome is a platform on which a single suspended flake gives access to several distinct magnetic properties. The methods developed here are intended both for characterising newly discovered magnetic two-dimensional materials and for designing magnetic nanoelectromechanical devices from materials whose magnetic response is already known.

Biography

Timofei Savilov graduated from Lyceum “Second School” in Moscow and received his Bachelor’s degree in Applied Mathematics and Physics from the Moscow Institute of Physics and Technology (MIPT) in 2022, where his thesis was devoted to molecular dynamics simulations of ion diffusion in zirconium dioxide. The same year he moved to Singapore to pursue a Ph.D. at the Institute for Functional Intelligent Materials (I-FIM), National University of Singapore (NUS), under the supervision of Prof. Sir Konstantin S. Novoselov. His research focuses on nanomechanics of two-dimensional magnetic materials and the development of nanoelectromechanical devices based on them.

Please join us!

HOST: Asst Prof Zhong Peichen