DEPARTMENT OF PHYSICS

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TPSC SEMINAR NOTICE

SPEAKER: Dr. Gorky Shaw
Last position: Marie Curie BeIPD-COFUND Postdoctoral fellow
University of Liège, Belgium

TITLE: Imaging magnetic structures: from micro-flux sources to manipulated vortex matter

DATE & DAY: 1 May 2018 Tuesday

VENUE: Seminar Hall

TIME: 4.00 P.M.

Abstract **Extended abstract attached**

About the Speaker

Dr. Shaw joined the M.Sc.-Ph.D. (dual degree) program in the department of Physics at IIT Kanpur in 2005 and received the Ph.D. degree in 2013. He worked with Prof. Satyajit Banerjee on the investigation of static and driven phases of vortex matter in superconductors with intrinsic and nanopatterned pins, primarily using magneto-optical imaging (MOI) and transport measurements. Part of the research work was carried out at Tata Institute of Fundamental Research (**TIFR**), Mumbai, with Prof. Arun Grover.

During 2012-2015, Dr. Shaw was a CNRS fellow at Institut Néel, Grenoble, France. He worked with Dr. Klaus Hasselbach and Dr. Nora Dempsey on the development of scanning Hall probe microscopy (SHPM) for quantitative study of stray magnetic fields produced by high performance micro-magnets developed for applications in biology and medicine. In 2015, Dr. Shaw joined University of Liège, Belgium, as a Marie Curie BeIPD-COFUND post-doctoral fellow. Till 2017, Dr. Shaw worked there with Prof. Alejandro V. Silhanek on quantitative MOI investigation of vortex matter in heterostructures of superconductors and patterned micro-magnets.

.All interested are cordially invited to attend.

Chairperson

SPEAKER: Dr. Dr. Gorky Shaw

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University of Liège, Belgium

TITLE: Imaging magnetic structures: from micro-flux sources to manipulated vortex matter

Abstract: Quantitative local magnetic characterization is important from the point of view of both fundamental studies and technological applications in various fields such as superconductivity, magnetic manipulation and sensing, and spintronics. Several phenomena in superconductors, such as thermomagnetic flux avalanches and melting of vortex matter, have been revealed and understood using local magnetic imaging techniques. On the other hand, there is a growing interest in application of high-performance micro-magnets in several fields, such as bio-medical studies, micro-electromechanical systems, etc. There is an increasing need for careful magnetic characterization of these devices. Scanning Hall probe microscopy (SHPM) [1] is a popular non-invasive local magnetic characterization technique as it enables direct high resolution quantitative mapping of magnetic field. Another technique, magneto-optical imaging (MOI) [2] stands out as it offers short acquisition time and the ability to map field profiles over large surfaces, with fair spatial and magnetic field resolution.
In the present talk, first, a scanning Hall probe microscope developed at Institut Néel, Grenoble, for characterization of micro-magnet devices in ambient conditions, will be introduced [3]. A variety of samples, from micro-magnet arrays of hard and soft magnetic materials (NdFeB, Co, etc.), to bulk magnets, are being studied using this microscope. Among these, permanent micro-magnet structures prepared using thermomagnetic patterning (TMP) [4] present an interesting and so far, unexplored option for controlled artificial pinning in a superconductor. Results from a detailed quantitative MOI study of superconductor/ferromagnet hybrid structures, including Nb deposited on top of thermomagnetically patterned NdFeB will be discussed [5,6]. Further, a reconfigurable metastable dilute vortex state inside an area patterned with an array of blind micro holes using focused ion beam (FIB) in a BSCCO single crystal, revealed using MOI, will be discussed [7,8]. Finally, apart from these imaging studies, evidence of a new non-equilibrium driven jammed vortex state in NbS_2, uncovered by measuring the velocity time series response of a vortex state to a continuous drive applied via transport current, will also be presented [9].

References:

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3. G. Shaw *et al*, Rev. Sci. Instrum. **87**, 113702 (2016).
4. F. Dumas-Bouchiat *et al*, Appl. Phys. Lett. **96**, 102511 (2010).
5. G. Shaw, J. Brisbois, *et al*, Rev. Sci. Instrum. **89**, 023705 (2018).
6. J. Brisbois, …, G. Shaw *et al*, Scientific Reports **6**, 27159 (2016).
7. G. Shaw *et al*, Supercond. Sci. Technol. **25**, 095016 (2012).
8. G. Shaw *et al*, Supercond. Sci. Technol. **29**, 065021 (2016).
9. G. Shaw *et al*, Phys. Rev. B **85**, 174517 (2012).