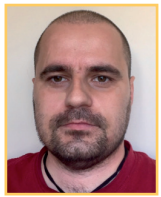
PHD GRANT



Very low temperature and high magnetic field Faraday force magnetometer for frustrated magnets

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LABORATORY : NEEL

The objective of this work was to develop a Faraday magnetometer to measure absolute values of magnetization at very low temperatures (40 mK) and high magnetic fields (16 T) with a high sensitivity (10^{-5} emu). The challenge was to push the boundaries of the existing magnetometers to complete the Grenoble instruments in very low temperature magnetometry, needed in numerous studies in condensed matter physics. My thesis has implied experimental developments in several technological fields: i) cryogenics, with the building and optimization of a ^{3}He-^{4}He dilution refrigerator to reach very low temperatures, ii) electronics, with the development of a cold amplifier needed to reach a high sensitivity, iii) microfabrication, iv) the optimized design required to make the magnetometer operational (Fig.1).

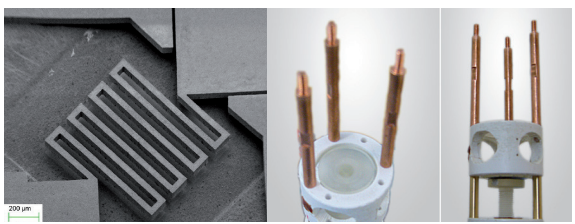

Fig. 1: Capacitive sensors: left: zoom of a silicon spring of the MEMS sensor. right: «macroscopic» sample holder, fabricated with a 3D printer.

In parallel, I focused on the experimental study of classical and quantum frustrated magnets [1,2]. We completed the H-T phase diagram of the puzzling spin-liquid compound $Gd_3Ga_5O_{12}$ [3]. Through the first very low temperature study on the isomorphous compound $Gd_3Al_5O_{12}$ [4], and contrary to theoretical predictions, we proved that this phase diagram is robust. We put into evidence the convergence of all observed phases to a unique point in both samples.

OUTCOMES

[1] Antiferroquadrupolar correlations in the quantum spin ice candidate $Pr_2Zr_2O_7$, Phys. Rev. B 94, 165153 (2016).

[2] Fluctuations and All-In–All-Out Ordering in Dipole-Octupole $Nd_2Zr_2O_7$, Phys. Rev. Lett. 115, 197202 (2015).

[3] Updating the phase diagram of the achetypal frustrated magnet GdGaO, Phy. Rev. B 91, 014419 (2015).

[4] Absence of magnetic ordering and field-induced phase diagram in the Gadollinium aluminum garnet, Phy. Rev. B 96, 220413 (2017)

Oral Presentations: ICM 2015, Barcelona, Spain. SFP 2013, Marseille, France , 2013.

Main collaboration: P.P. Deen, ESS, Lund, Sweden