LABORATORY OF PHYSICS OF
NANOSTRUCTURED MATERIALS

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Imprinting superconducting vortex footsteps in a magnetic layer

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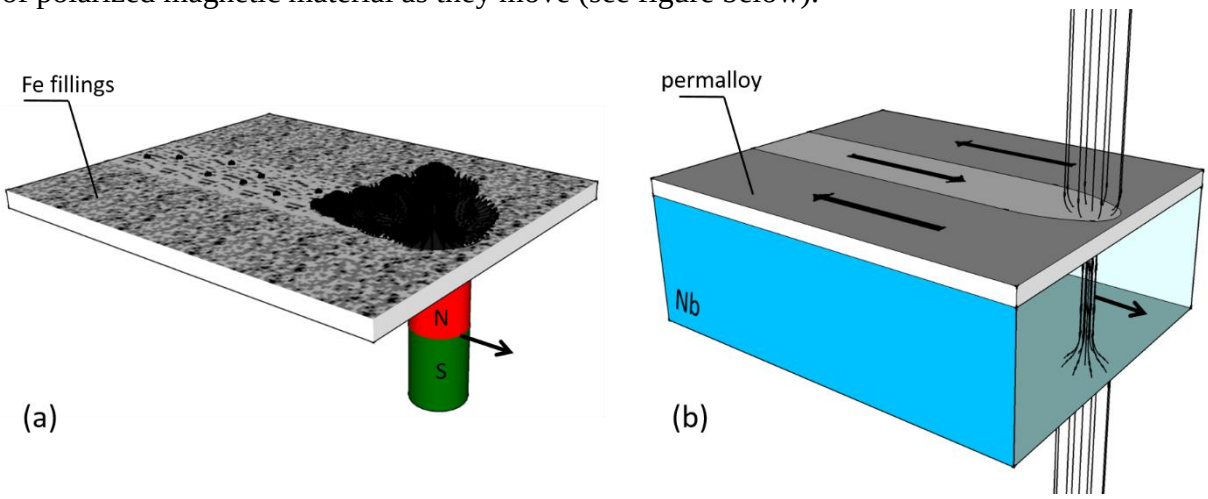
Local polarization of a magnetic material has become a well-known and widely used method for storing information. Numerous applications of our daily life such as credit cards, computer hard drives, and the popular magnetic drawing board toy, rely on this principle. In practice, two basic ingredients are required: a ferromagnetic material with finite remanent moment and a localized source of magnetic field. Interestingly, quantum units of magnetic flux, also called fluxons, are readily available in type-II superconductors and generate a magnetic field confined at the submicron scale. Therefore, if a magnetic layer is deposited on top of the superconductor, we could envisage the possibility to use these fluxons as tiny magnetic scribers, leaving a trail of polarized magnetic material as they move (see figure below).



In this communication, we present compelling experimental evidence showing that the above described principle can be applied for imprinting the trajectory of fluxons travelling in a superconducting film (Nb), into a soft magnetic layer of permalloy (Py). We were able to record the flux distributions into the Py layer at cryogenic temperatures and observe them ex-situ at room temperature, well above the critical temperature of the superconducting state. Furthermore, the magnetic layer provides an additional damping mechanism slowing down the magnetic flux avalanches bursting into the Nb and thus protecting the superconducting film. The undeniable appeal of the proposed technique lies in its simplicity and the possibility to explore high T_c superconductors. This work might therefore trigger further experimental and theoretical pursuit to discover new magnetic compounds optimizing the resolution of the technique down to single vortex imprints.