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Geometry and magnetic-state induced phenomena in S/F nanohybrids: unusual flux pinning effects and bistable superconductivity[1]

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Superconducting/Ferromagnetic (S/F) hybrids exhibit a plethora of induced effects and novel physical properties, due to the interplay between the competing S and F orders. We will show a few examples of those, in a series of experiments on a simple hybrid system: a S thin film with an array of F nanodots. Changing the array geometry, the nanodots size or their magnetic-state allows to investigate a large variety of physical phenomena. We will focus on two of them: flux pinning effects and stray-magnetic-field induced manipulation of superconductivity. We will firstly consider *geometry* induced effects; in particular, we will compare the pinning properties of periodic, quasiperiodic, and fractal arrays [1]. Secondly, we will discuss the effects induced by particular nanodot magnetic-states. We will show experiments on the interaction between flux quanta and nanodot magnetic vortices, which can be used to obtain switchable flux pinning potentials [2]. Finally, we will describe an experiment in which the magnetic reversal events of the nanodot magnetic vortices are imprinted into the transport properties of a superconducting thin film [3]. This yields a very unusual hysteretic magnetoresistance. This effect is induced by the stray magnetic fields from the nanodots, which drive the superconducting-to-normal transition of the hybrid depending on the magnetic history.

[1] J.E. Villegas *et al.*, Phys. Rev. Lett. 97, 027002 (2006).
[2] J.E. Villegas *et al.,* Phys. Rev. B 77**,** 134510 (2008).
[3] J.E. Villegas *et al.*, Phys. Rev. Lett. 99, 227001 (2007).

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