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Investigation of magnetic proximity effects in SU/FMI/SE heterostructures

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Topological states, potentially leading to the formation of Majorana fermions, have been predicted to emerge in heterostructures of an s-wave superconductor (SU) and a semiconductor (SE) with large spin orbit coupling and split band structure [1]. Incorporation of ferromagnetic materials, such as ferromagnetic insulators (FMI), into the het-erostructures constitutes a promising route for providing the Zeeman energy necessary for splitting the SE bands [2]. The initial step towards development of an intrinsically topological trilayer structure is to ensure the adequate strength of magnetic proximity effects at different combinations of FMI/SE and FMI/SU interfaces [3]. We use polarized neutron reflectometry to quantify the extent of the magnetic proximity at the FMI/SU and FMI/SE interfaces, which is crucial for entering the topological phase. We will pre-sent detailed depth resolved structural and magnetic profiles of different MBE grown heterostructures, e.g. InAs/EuS/InAs/Pb, InAs/Pb/EuS/Pb, and InAs/EuS/Pb. The data will be compared to structural and magnetic response information obtained from Scanning Tunneling Electron Microscopy (STEM) and SQUID VSM measurements. The understanding of these interfaces will help in the optimization of the final device structure.

References:
1. Lutchyn, R. M., et. al., PRL, 7, 105 (2010)
2. Escribano, S. D., et. al., NPJ QM, 7, 81 (2022)
3. Liu, Yu, et. al., ACS N. Lett., 1, 20 (2019)

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