Abstract Submitted
for the MAR13 Meeting of
The American Physical Society

Spinful Majorana fermions and magnetoelectricity in junctions of semiconductor / superconductor heterostructures[1] PANAGIOTIS KOTETES, ALEXANDER SHNIRMAN, GERD SCHOEN, Karlsruhe Institute of Technology — Recently, the interest in topological quantum computing has grown due to the appearance of promising platforms for realizing Majorana fermions. The most prominent proposal involves a 1D semiconducting quantum wire in proximity to a bulk s-wave superconductor, where in addition a Zeeman field is applied. Here we investigate the Josephson effect in TNT and NTN junctions, consisting of topological (T) and non-topological (N) phases of semiconductor-superconductor 1D heterostructures in the presence of a Zeeman field [1]. A key feature of our setup is that, in addition to the variation of the phase of the superconducting order parameter, we allow the orientation of the magnetic field to change along the junction. We find a novel magnetic contribution to the Majorana Josephson coupling that permits the Josephson current to be tuned by changing the orientation of the magnetic field along the junction. We also predict that a spin current can be generated and additionally controlled by a finite superconducting phase difference. This new type of coupling not only constitutes a unique fingerprint of Majorana fermions but also provides an alternative pathway for manipulating and braiding topological qubits.

[1] P. Kotetes, A. Shnirman, G. Schön, arXiv:1207.2691.

[1]We acknowledge funding from the EU projects NanoCTM, SOLID and GEOMDISS.

Panagiotis Kotetes
Karlsruhe Institute of Technology

Date submitted: 11 Nov 2012 Electronic form version 1.4