Spin transport and superconductivity in half-metallic nanowires and junctions

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Propositions

accompanying the dissertation

SPIN TRANSPORT AND SUPERCONDUCTIVITY IN HALF-METALLIC NANOWIRES AND JUNCTIONS

by

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1. The present theoretical models fail to predict the correct threshold for current-induced domain wall motion in half-metallic ferromagnets. (*Chapter 3 of this thesis*)

2. Due to their higher resistivity, oxide ferromagnets are more efficient in injecting spins in a normal metal than conventional ferromagnets, which typically have lower resistivity. (*Chapter 4 of this thesis*)

3. The intrinsic magnetic inhomogeneity in the top layer of LSMO is the key to generating long-range triplets. (*Chapter 5 of this thesis*)

4. Half-metallic LSMO has clear advantages over its counterpart, CrO_2, for hosting long-range triplet supercurrents. (*Chapter 6 of this thesis*)

5. When lowering the temperature in half-metallic Josephson junctions, the lack of experimental evidence for a critical current maximum, followed by a decrease, remains an unresolved problem for the physics of the long-range triplet proximity effect. (*M. Eschrig, et al., Nat. Phys. 4, 138-143 (2008)*)

6. Magnetic domain walls cannot account for the generation of long-range triplets in YBCO/LSMO junctions reported by D. Sanchez-Manzano, *et al.*, in *Nat. Mater. 21, 188–194 (2022).*

7. Strain engineering is a powerful tool for creating diverse magnetic textures in epitaxially-grown ferromagnetic films. (*Y. Zhang, et al., Phys. Rev. Lett., 127, 117204 (2021)*)

8. Whether spin-triplet Cooper pairs can induce spin-transfer torque remains a central problem, which needs to be addressed. (*J. Linder, et al., Nat. Phys. 11, 307–315 (2015)*)

9. The solution to the experimental challenges involved in device fabrication lies in allocating sufficient time and patience.