Interaction between magnetism and superconductivity in La$_{0.7}$Ca$_{0.3}$MnO$_3$/YBa$_2$Cu$_3$O$_{7-\delta}$ multilayers

T. HU, H. XIAO, C. C. AL-MASAN, Department of Physics, Kent State University, Kent, OH, 44242, USA, C. VISANI, Z. SEFRIOUI, J. SANTAMARIA, GFMC, Departamento Física Aplicada III, Universidad Complutense de Madrid, 28040 Madrid, Spain — Angular and field dependent magnetoresistance measurements were performed on La$_{0.7}$Ca$_{0.3}$MnO$_3$/YBa$_2$Cu$_3$O$_{7-\delta}$ (LCMO/YBCO) heterostructures below and above the superconducting transition temperature $T_c \approx 28$ K of the YBCO layer, in order to address the origin of the long range proximity effect found in these heterostructures. The proximity-induced conductance in the LCMO layer at $T < T_c$ increases significantly with decreasing temperature $T$. These magnetoresistance measurements show that the dissipation mechanism in the LCMO layer of thickness $\xi_F$ at $T < T_c$ is due to flux vortices that have fully spin polarizes quasiparticles in the vortex core. This clearly shows that triplet superconducting pairs penetrate into the ferromagnetic LCMO layer. An estimate of $\xi_F \approx 4.7$ nm at 10 K is in excellent agreement with a previously reported value and further shows the consistency of the present analysis.

$^1$This research was supported by the National Science Foundation under Grant No. DMR-0705959 at KSU, MCYT MAT 2005-06024 at U. Complutense de Madrid.