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**Classical Forces in Aharonov-Bohm Effects** SCOT MCGREGOR, ADAM CAPREZ, HERMAN BATELAAN, University of Nebraska-Lincoln, RYAN HOTOVY, Texas A&M — Our recent experimental and theoretical work will be reported on Aharonov-Bohm type effects [1]. This includes the experimental demonstration that the Matteucci-Pozzi phase shift is a result of a classical force [2], in contradiction to earlier claims that it is a Type-II Aharonov-Bohm effect [3]. This result is part of a larger discussion that is centered around a classical paradox. Aharonov and Rohrlich point out that this paradox is “... crucial for clarifying the entirely *quantum* interactions of ‘fluxons’ and charges [4].” Surprisingly, the Lorentz force acting on an infinite solenoid in the presence of an approaching charge is neglected [4]. Inclusion of the Lorentz force, along with the electromagnetic field momentum, leads to conservation of momentum. This motivates further investigation of the dual of the Aharonov-Bohm effect in which a neutral magnetic moment passes a charged wire. The question of sorting out which phase shifts are accompanied by classical force and which ones are not is still a topic of much debate and we report on our efforts to settle the argument.

[1] Batelaan H and Tonomura A 2009 *Phys. Today* **62** 38–43

[2] Shawn A Hilbert *et al* 2011 *New J. Phys.* **13** 093025

[3] Matteucci G and Pozzi G 1985 *Phys. Rev. Lett.* **54** 2469

[4] Aharonov Y and Rohrlich D 2005 *Quantum Paradoxes: Quantum Theory for the Perplexed* (Weinheim: Wiley)

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