Spin-Orbit Torque in Antiferromagnets

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Antiferromagnets are common in nature and just like ferromagnets possess a long-range magnetic order. They have found little practical application so far, but were recently proposed as possible future materials for spintronics. They have some advantages over ferromagnets, in particular ultrafast magnetization dynamics and wide range of materials available, including many semiconductors. One of the key problems for application of antiferromagnets in spintronics remains manipulation of the spin-axis. While several methods exist, there is no practical, electrical method available. Here, we present calculations which show that due to relativistic effects, electrical current can trigger ultrafast switching in bulk antiferromagnets. The effect is analogous to the spin-orbit torque in ferromagnets. The switching is possible because the current creates a field opposite on the two magnetic sublattices. We discuss the symmetry of the torques, especially the necessary conditions for their existence. Electrical switching of antiferromagnet using this method was recently observed experimentally.