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Spin transfer torques in antiferromagnets and magnetic semiconductors

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Spin transfer torques (STT) in ferromagnetic metals can be understood in terms of conservation of total spin, allowing a simple evaluation and interpretation of these torques in terms of spin currents. STTs also occur in antiferromagnets, which have no net spin and different symmetries than ferromagnets, resulting in qualitatively different torques. We consider a structure with a compensated antiferromagnetic layer and a ferromagnetic layer. We find a STT on both layers, which vanishes when the layers' order parameters are either collinear or perpendicular. This torque can drive the magnetization of a thin film ferromagnet to be perpendicular to the easy plane. In dilute magnetic semiconductors, strong spin orbit coupling in the semiconductor host implies that spin is not even approximately conserved, requiring modifications of the microscopic calculation of the STT. We describe these modifications and present results from first principles calculations of STT in GaMnAs.