Intrinsic spin orbit torque in antiferromagnets with weak ferromagnetic order

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We report a property of antiferromagnet(AFM)-generated spin-orbit torque(SOT) which is absent in its ferromagnetic counterpart. AFM consists of at least two sublattice magnetizations. For instance, in case of AFM with two sublattcie magnetizations, says, $\mathbf{M}_A$ and $\mathbf{M}_B$, there are two independent degrees of freedom, which are Néel order $\mathbf{n}=(\mathbf{M}_A-\mathbf{M}_B)/2$ and ferromagnetic order $\mathbf{m}=(\mathbf{M}_A+\mathbf{M}_B)/2$, unlike FMs with only one degree of freedom. Although **m** vanishes in equilibrium, two sublattice magnetizations become noncollinear to each other during the AFM magnetization dynamics[1] and the resulting non-vanishing **m** may endow AFM with qualitatively different properties from FMs[2]. Earlier theoretical calculations[3, 4] of SOT in AFM ignore the **m** degree of freedom. Here we show that the **m** degree of freedom can qualitatively modify properties of SOT in pure AFMs.

References

[1] A. C. Swaving and R. A. Duine, Phys. Rev. B **83**, 054428 (2011)
[2] A. V. Kimel, et. al., Nat. Phys. **5**, 727 (2009)
[3] J. Železný, et. al., Phys. Rev. Lett. **113**, 157201 (2014)
[4] P. Wadley, et. al., Science **351**, 587 (2016)