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Spin-Mechanical Inertia in Antiferromagnet[1] RAN CHENG, XIAOCHUAN WU, DI XIAO, Carnegie Mellon University — Interplay between spin dynamics and mechanical motions is responsible for numerous striking phenomena, which has shaped a rapidly expanding field known as spin-mechanics. The guiding principle of this field has been the conservation of angular momentum that involves both quantum spins and classical mechanical rotations. However, in an antiferromagnet, the macroscopic magnetization vanishes while the order parameter (Néel order) does not carry an angular momentum. It is therefore not clear whether the order parameter dynamics has any mechanical consequence as its ferromagnetic counterparts. Here we demonstrate that the Néel order dynamics affects the mechanical motion of a rigid body by modifying its inertia tensor in the presence of strong magnetocrystalline anisotropy. This effect depends on temperature when magnon excitations are considered. Such a spin-mechanical inertia can produce measurable consequences at nanometer scales. Our discovery establishes spin-mechanical inertia as an essential ingredient to properly describe spin-mechanical effects in AFs, which supplements the known governing physics from angular momentum conservation.

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