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Coherent and dissipative coupling in ferro- and antiferromagnetic dynamics

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Abstract
The dynamics of a heterostructure composed of antiferromagnetic and ferromagnetic layers, separated by a metalic layer, has been investigated. By adjusting the applied magnetic field so that the frequency of one of the antiferromagnetic modes lies in the frequency range of the ferromagnetic layer, coherent coupling can be achieved due to interlayer exchange interaction. Moreover, the magnetization dynamics within the magnetic layers induce spin pumping into the metal, generating a spin accumulation in the metallic layer. The spin accumulation generates a spin transfer current from the metal to the magnetic layers, which can result in dissipative coupling between the dynamics of the antiferromagnetic and ferromagnetic layers. This coupling manifests as level attraction in the system's eigenmodes. The indirect coupling between the dynamics of the magnetic layers can be either coherent or dissipative, depending on the thickness of the metallic layer; for thin metallic layers, where interlayer exchange interaction is dominate, coherent coupling emerges, whereas in thick layers, where exchange interaction is negligible, dissipative coupling prevails.

Keywords: coherent and dissipitive coupling, ferromagnetic, antiferromagnetic, spin-pumping and spin-transfer

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