Poster-1-14

Unusual magnetoresistance response in van der Waals antiferromagnetic semiconductor $CrPS_4$ vertical transport

Xiaohanwen Lin,[1,2] Fan Wu,[1,2] Ignacio Gutiérrez-Lezama,[1,2] Nicolas Ubrig,[1,2] and Alberto Morpurgo[1,2]

[1] *Department of Quantum Matter Physics, University of Geneva, 24 Quai Ernest Ansermet, CH-1211 Geneva, Switzerland*

[2] *Department of Applied Physics, University of Geneva, 24 Quai Ernest Ansermet, CH-1211 Geneva, Switzerland*

Vertical transport through antiferromagnetic multilayer devices has been intensively investigated, and negative magnetoresistance due to injection-limited tunneling processes has been found in all cases. Here, antiferromagnetic semiconductor $CrPS_4$, in which transport is not injection-limited but space charge-limited, is investigated. The I-V characteristics of our devices exhibit a trap-limited regime -with a small current that increases rapidly with increasing bias and a trap-free regime, with a current that depends quadratically on the applied bias (and transport mediated by states in the conduction band). In the trap-limited regime, we observe a very large and positive magnetoresistance when the magnetic field B is well below the spin-flip transition. We attribute the phenomenon to the response of the wavefunction of localized states to the applied magnetic field. Specifically, the wavefunction is squeezed as B is increased, resulting in an exponential decrease of the overlap of the wavefunction of impurity states in layers with the same spin (the next-next layers, at small B). Finally, in the trap-dominated regime, we observe large magnetoresistance oscillations, whose origin remains to be explained in detail. Our experiments reveal a transport regime that had not so far been observed in 2-dimensional magnetic semiconductors.