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Precursors and triggering mechanisms of granular avalanches

Delannay Renaud
Université de Rennes 1, France

Exploration of the dynamical response of an inclined granular packing brings information which may be helpful for the prediction of the occurrence of the avalanche. During inclination, small rearrangements implying only a few grains are first detected. Their size increases with the inclination angle. At some stage, large amplitude and quasi periodical events are observed . These events, called precursors, consist of collective motions of grains. Experiments showed that the precursors are bulk phenomena and allowed to interpret these events as reorganizations of the weak-contact sub network occurring in the packing. Besides optical imaging techniques which give access to grain motion and rearrangements during the tilting, acoustic methods can be experimentally used to detect precursors and to probe internal rearrangements in the bulk of the granular layer. Because part of the acoustic wave energy transports through the contact network and the elastic beads of the medium, the probing methods based on the monitoring of acoustic signatures are sensitive to changes in the elastic properties of the granular layer. The acoustic probing methods can be divided in two groups, the passive methods where acoustic sensors are used to listen to the sounds emitted by the destabilized layer itself and the active methods where an acoustic signal with desired properties is generated and detected by transducers in the medium. Systematic experiments of granular layer destabilization for various granular media and external conditions are compared and allow better understanding of the mechanisms responsible for the appearance, periodicity and intensity of precursors.

renaud.delannay@univ-rennes1.fr

Spin manipulation at the interface of a topological insulator/GaAs heterostructure

Dongxia Qu
Lawrence Livermore National Laboratory, USA

Spin generation, manipulation, and detection are foundations for spin physics and spintronics. One primary goal of spintronics is to discover materials and devices, which enable efficient electrical control of spins. The emerging field of topological insulators provides intriguing opportunities for spin generation and manipulation, owing to their strong spin-orbit character. Here we report that spins can be driven from a topological insulator thin film into an adjacent non-magnetic semiconductor at room temperature. At the interface between a topological insulator and GaAs heterostructure, a photo-induced spin current flows across the interface and induces an electrical current via the inverse spin Hall effect, which converts the spin current into a charge current. We find that the magnitude and direction of the helicity-dependent photocurrent can be controlled by gate-voltage, indicative of electric tuning of the spin configuration. Our results suggest that topological insulator heterostructures may eventually allow electric fields to manipulate the spin degree of freedom in a non-magnetic semiconductor, a new mechanism that can be used to create innovative optoelectronic and spintronic devices.

qu2@llnl.gov

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