Colloquium

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Optical tuning of electronic valleys

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Coherent light-matter interaction can be used to manipulate the energy levels of atoms, molecules and solids. Here, I will discuss how we used light to break apart two electronic states in energy in the thinnest-ever semiconducting crystals, monolayer semiconducting transition-metal dichalcogenides (TMDs). The recently discovered monolayer TMDs are 2D crystalline semiconductors with unique spin-valley properties. They have a pair of valleys that, by time-reversal symmetry, are energetically degenerate. Lifting the valley degeneracy in these materials is of great interest because it would allow for valley specific band engineering and offer additional control in valleytronic applications. In this talk, I will show that off resonant, circularly polarized light can be used to lift the valley degeneracy by means of the optical Stark effect. At small detuning, we find that this effect is capable of raising the exciton level in monolayer TMD WS2 by as much as 18 meV in a controllable valley-selective manner. At large detuning, we observe an additional contribution from Bloch-Siegert shift, which we can disentangle entirely from the optical Stark shift, because the two effects are found to obey opposite selection rules at different valleys. These findings represent the first observation of Bloch-Siegert shift in solids.

Monday, October 9, 2017 at 3:00pm
SERC, Room 116
Refreshments served at 2:45pm