## A monolayer transition metal dichalcogenide as a

**topological excitonic insulator**

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Abstract

Fifty years ago a few outstanding physicists, including Leonid Keldysh and Walter Kohn, put forward a heretic paradigm of a strongly correlated insulator: If a narrow-gap semiconductor failed to fully screen its intrinsic charge carriers, then excitons---electron-hole pairs bound together by Coulomb attraction---would spontaneously form. So far, the observation of this phase has been elusive. The crux of the matter is the trade-off between competing effects in the semiconductor: as the size of the energy gap decreases, favouring spontaneous exciton generation, the screening of the electron-hole interaction increases, suppressing the exciton binding energy.

Very recently, novel low-dimensional systems seem to renew the promise of the excitonic insulator, as they combine optimal band structures, poor screening, truly long-ranged interactions, and giant excitonic effects. In this talk I will discuss our theoretical predictions, based on the combination of first-principles and model approaches, concerning monolayer MoS2 in the T' phase [1]. Monolayer transition metal dichalcogenides in the T’-phase promise to realize the quantum spin Hall (QSH) effect at room temperature [2], here we show that the binding energy of electron-hole pairs is larger than the gap itself. Importantly, we show that in this system topological and excitonic order cooperatively enhance the bulk gap by breaking the crystal inversion symmetry. A moderate biaxial strain applied to the system leads to two additional excitonic phases, different in their topological character but both ferroelectric as an effect of electron-electron interactions.

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**References:**

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