9th International Workshop on 2D Materials

Title of the Presentation: Unconventional excitonic states in layered SiP_2

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Short Biography:

Prof. Tang got the Ph.D degree from the Department of Physics in Tsinghua University, Beijing China in 2015. After that, he worked as a post-doctor researcher in Prof. Shou-Cheng Zhang's group in Stanford University, USA until 2017. From 2017 to 2020, he worked as a post-doctor in Prof. Angel Rubio's group in Max-Planck Institute for Structure and Dynamic of Matter (MPSD) in Hamburg, Germany. In 2018, he won the Marie-Currie Fellowship. Since 2020, he is the Professor in the School of Material Science and Engineering in Beihang University, Beijing China. Prof. Tang's research focuses on the topological materials and light-matter interaction by using ab initio methods.

Abstract:

Many-body interactions between quasiparticles (electrons, excitons and phonons) have led to the emergence of new complex correlated states and are at the core of condensed matter physics and material science. In low-dimensional materials, unique electronic properties for these correlated states could significantly affect their optical properties. In this talk, we systemically demonstrate an unconventional excitonic state and its bound phonon sideband in layered silicon diphosphide (SiP2), in which the bound electron-hole pair is composed of electrons confined within one-dimensional phosphorus–phosphorus chains and holes extended in two-dimensional SiP2 layers. The excitonic state and the emergent phonon sideband show linear dichroism and large energy redshifts with increasing temperature. Within the GW plus Bethe–Salpeter equation calculations and solving the generalized Holstein model non-perturbatively, we confirm that the observed sideband feature results from the correlated interaction between excitons and optical phonons. Furthermore, we show the excitonic states could be tuned via layer stacking in SiP2.

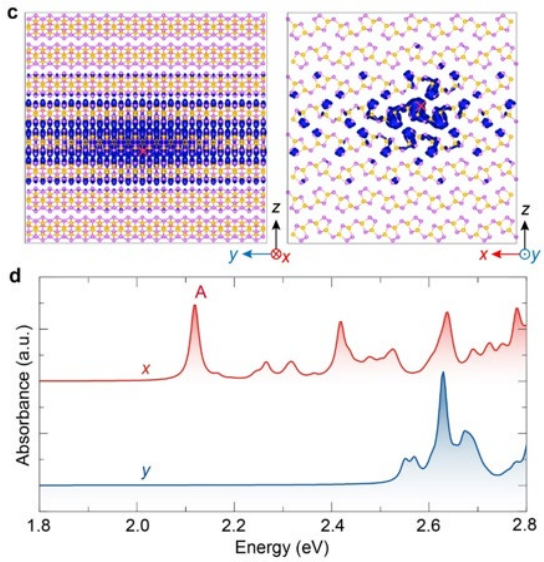

Fig. 1. Exciton's wavefunctions and absorptions in SiP2.