Copropagating Edge States Produced by the interaction between Electrons and Chiral Phonons in Two-Dimensional Materials [1]

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Unlike the chirality of electrons, the intrinsic chirality of phonons has only surfaced in recent years [2, 3]. Here, we report on the effects of the interaction between electrons and chiral phonons in two-dimensional materials by using a non-perturbative and non-adiabatic Fock space solution. We show that chiral phonons introduce inelastic *Umklapp* processes resulting in a valley-selective pseudogap (as shown in Fig. 1), bridged by copropagating edge states that coexist with a continuum. Transport simulations further reveal the robustness of the edge states. Our results hint on the possibility of having a metal embedded with hybrid electron-phonon states of matter.

References

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[3] H. Zhu, J. Yi, M.-Y. Li, J. Xiao, L. Zhang, C.-W. Yang, R. A. Kaindl, L.-J. Li, Y. Wang, and X. Zhang Science, **359** (2018) 579

Figures

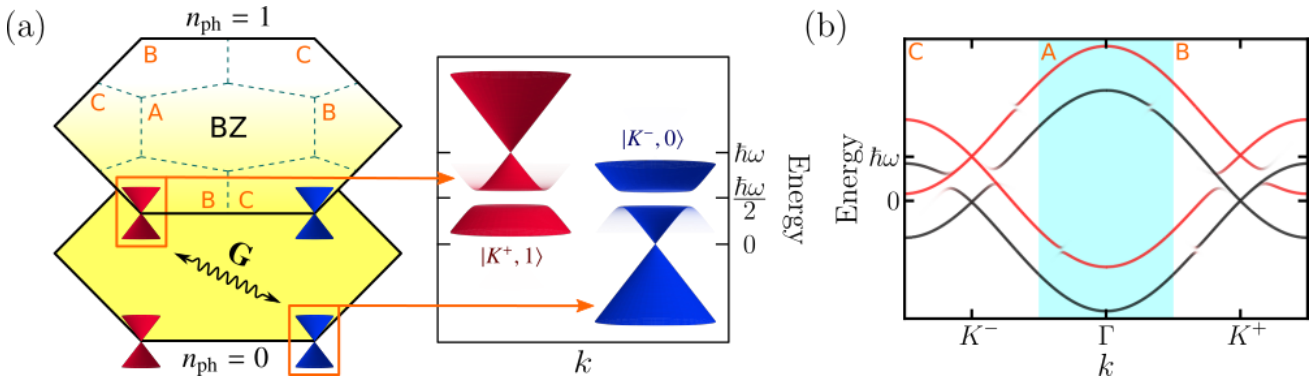

Figure 1: We consider the interaction between electrons and a single chiral phonon mode of frequency ω, and momentum ***G*** corresponding to valley K⁺. Considering the phonon Fock space, the system can be viewed as a semi-infinite series of pure electronic replicas centred at energies $\hbar\omega n_{ph}$, with n_{ph} the phonon population. Electron-phonon interactions generate transitions between momentum ***k*** in replica n_{ph}=0 and ***k*** - ***G*** in replica n_{ph}=2, opening a valley-selective pseudogap. A scheme of the mechanism is shown in panel (a), while the bulk band structure of the system is shown in panel (b), truncated to n_{ph}=1, 2.