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Excitons as massless and massive Dirac particles in monolayer transition metal dichalcogenides[1] HONGYI YU, Department of Physics and Center of Theoretical and Computational Physics, The University of Hong Kong, Hong Kong, China, GUIBIN LIU, School of Physics, Beijing Institute of Technology, Beijing 100081, China, XIAODONG XU, Department of Physics, University of Washington, Seattle, Washington, USA, WANG YAO, Department of Physics and Center of Theoretical and Computational Physics, The University of Hong Kong, Hong Kong, China — In monolayer transition metal dichalcogenides, tightly bound excitons can form at +-K valleys, where optical generation of excitonic valley polarization and coherence can be realized through a polarization selection rule. Here, we show that the the electron-hole Coulomb exchange leads to the strong coupling between the valley pseudospin of bright exciton and its motion. In the light cone, the exciton dispersion exhibits a massless Dirac cone with chirality index I=2. Moderate tensile strain provides a powerful approach to tune the exciton dispersion. When the exciton binds an electron to form a negatively charged trion, the exchange interaction with the excess electron opens up a gap and the trion behaves as a massive Dirac particle. With the optical addressability at specifiable momentum and energy, excitons in monolayer transition metal dichalcogenides may provide unique opportunities to study Dirac particles.

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Hongyi Yu
Department of Physics and Center of Theoretical and
Computational Physics, The University of Hong Kong

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