Abstract Submitted
for the MAR15 Meeting of
The American Physical Society

Highly Anisotropic and Robust Excitons in Monolayer Black Phosphorus XIAOMU WANG, Yale Univ, AARON M. JONES, KYLE L. SEYLER, Univ of Washington, VY TRAN, Washington University, YICHEN JIA, Yale Univ, HUAN ZHAO, HAN WANG, Univ of Southern California, LI YANG, Washington University, XIAODONG XU, Univ of Washington, FENGNIAN XIA, Yale Univ — Recently, black phosphorus emerged as a promising new 2D material due to its widely tunable and direct bandgap, high carrier mobility and remarkable in-plane anisotropic electrical, optical and phonon properties. However, current progress is primarily limited to its thin-film form, and its unique properties at the truly 2D quantum confinement have yet to be demonstrated. Here, we reveal highly anisotropic and tightly bound excitons in monolayer black phosphorus using polarization-resolved photoluminescence measurements at room temperature. We show that regardless of the excitation laser polarization, the emitted light from the monolayer is linearly polarized along the light effective mass direction and centers around 1.3 eV, a clear signature of emission from highly anisotropic bright excitons. In addition, photoluminescence excitation spectroscopy suggests a quasiparticle bandgap of 2.2 eV, from which we estimate an exciton binding energy of around 0.9 eV, consistent with theoretical results based on first-principles. The experimental observation of highly anisotropic, bright excitons with exceedingly large binding energy not only opens avenues for the future explorations of many-electron effects in this unusual 2D material, but also suggests a promising future in optoelectronic devices such as on-chip infrared light sources.

Xiaomu Wang
Yale University

Date submitted: 12 Nov 2014 Electronic form version 1.4