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## Circular Dichroic Photoluminescence from Multilayer WS<sub>2</sub>

We have observed strong circular dichroic photoluminescence from exfoliated multilayer WS<sub>2</sub> crystals containing up to 5 layers. The degree of valley polarization was shown to increase with number of layers, peaking near 0.9 for 4-layered crystals. At present, it is thought that valley-spin polarization in transition metal dichalcogenide (TMDC) monolayers arises from a straightforward consideration of spatial inversion asymmetry in the crystal unit cell. Natural bilayers have this inversion symmetry restored, so it is expected that signatures of valley-spin polarization – including circular dichroic photoluminescence – vanish for crystals containing an even number of layers. Our observations corroborate well with recent reports [1, 2], and suggest that some new and interesting physics might be required to better understand WS<sub>2</sub>. From a technological perspective, this also makes WS<sub>2</sub> particularly interesting since one does not strictly require the monolayer limit to exploit valley properties.

### References

- [1] Bairen Zhu, Hualing Zeng, Junfeng Dai, Zhirui Gong, Xiaodong Cui, Proceedings of the National Academy of Sciences 111 (2014) 11606
- [2] Pramoda K. Nayak, Fan-Cheng Lin, Chao-Hui Yeh, Jer-Shing Huang, Po-Wen Chiu, Nanoscale 8 (2016) 6035