

## ***Supplementary Information***

# **Direct Observation of Degenerate Two-Photon Absorption and Its Saturation of WS<sub>2</sub> and MoS<sub>2</sub> Monolayer and Few-Layer Films**

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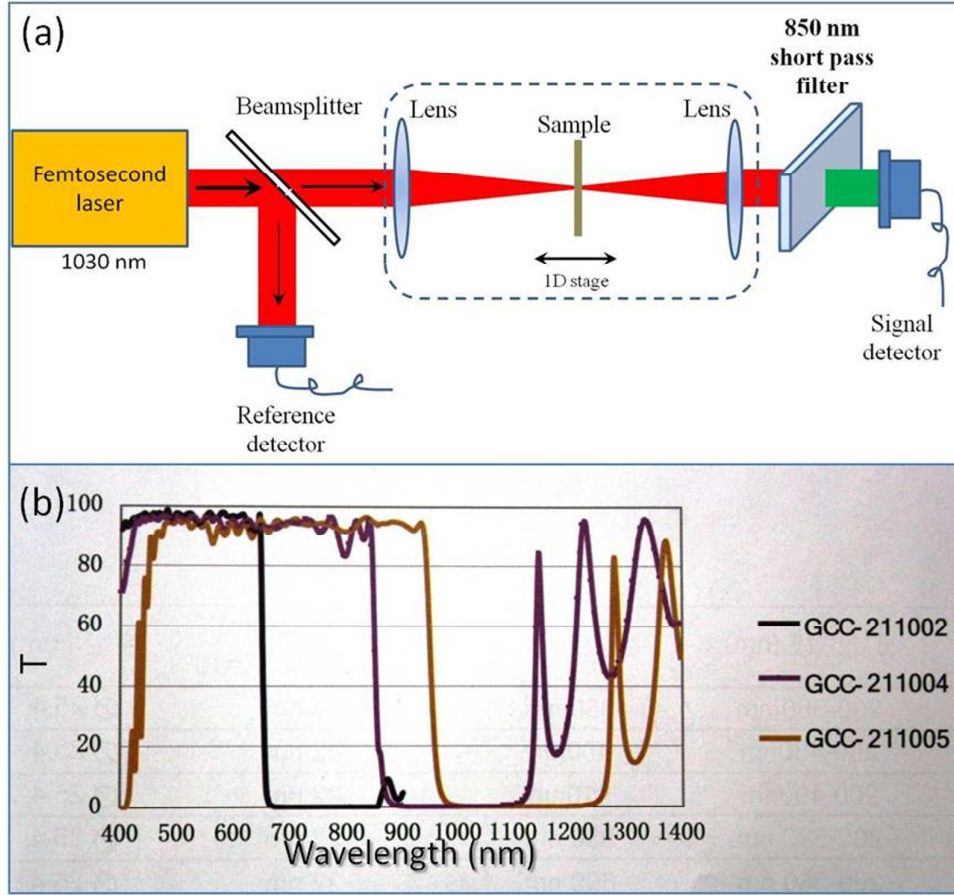


Figure S1. (a) The Z-scan setup for measuring SHG signal (with a 850 nm short pass filter in front of the signal detector), (b) the transmission of the 850 nm short pass filter (Type: GCC-211004)

In order to figure out the pure SHG signal from the transmitted beam, we placed an 850 nm short pass filter to block the fundamental frequency beam (1030 nm) in front of the signal detector. The setup is shown in Fig. 2(a). We have measured plenty of points on each sample and the results are almost the same. Our results show that all Z-scan curves of 1~3L, 18~20L and 39~41L WS<sub>2</sub> are almost flat (Blue squares in Fig. 3), indicating that the SHG effect is negligible compared to TPA effect. The results are in agreement with the calculated SHG conversion efficiency ( $\sim 10^{-5}$ ) based on the results of C. Janisch *et al.*[Sci. Rep., 4, 5530, 2014]. Therefore, the above estimation and our experiment results show that SHG effect can be neglected and Eq. (1) in the manuscript is valid for the 2D WS<sub>2</sub> and MoS<sub>2</sub> films.

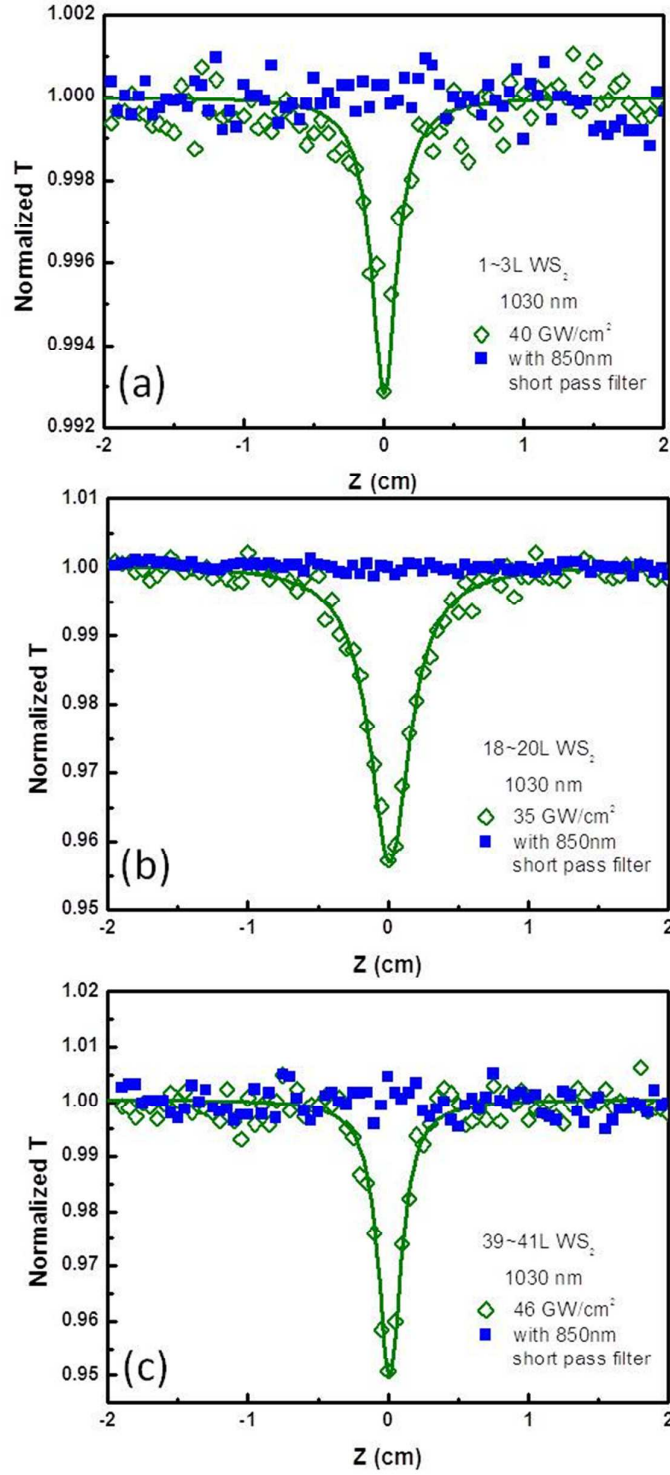


Figure S2. The Z-scan data of (a) 1~3L WS<sub>2</sub>, (b) 18~20L WS<sub>2</sub>, (c) 39~41L WS<sub>2</sub> with/without an 850 nm short pass filter.