Electromagnetically Induced Transparency in Second-Harmonic Generation from Monolayer WSe_2

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Electromagnetically induced transparency (EIT) occurs in atomic systems and shows versatile applications in slow-light generation, gain without inversion and optical quantum-information processing [1, 2]. As illustrated in Figure 1, we demonstrate a cavity-free, atomic-like EIT effect in single-layer crystals of WSe_2, probed by exploiting the intrinsic second-harmonic generation (SHG) arising from the breaking of inversion symmetry [3]. Under conditions of double resonance of the driving and radiated field with the fundamental transitions, the SHG spectrum bifurcates. The feature follows a pump-wavelength-dependent spectral anticrossing given in Figure 2, accurately described by a ladder-type three-level model. Crucially, the SHG power-law exponent diverges from the canonical value of 2 to follow a Fano-like dispersion with wavelength. This signature of quantum interference is retained at room temperature, opening up opportunities in solid-state quantum nonlinear optics for optical mixing and gain without inversion.

References

[1] M. D. Lukin and A. Imamoğlu, Nature, 413 (2001) 273-276.
[2] M. Fleischhauer, A. Imamoğlu and J. P. Marangos, Rev. Mod. Phys. 77 (2005) 633-673.
[3] K.-Q. Lin, S. Bange and J. M. Lupton, Nat. Phys. DOI: 10.1038/s41567-018-0384-5 (2019).

Figures

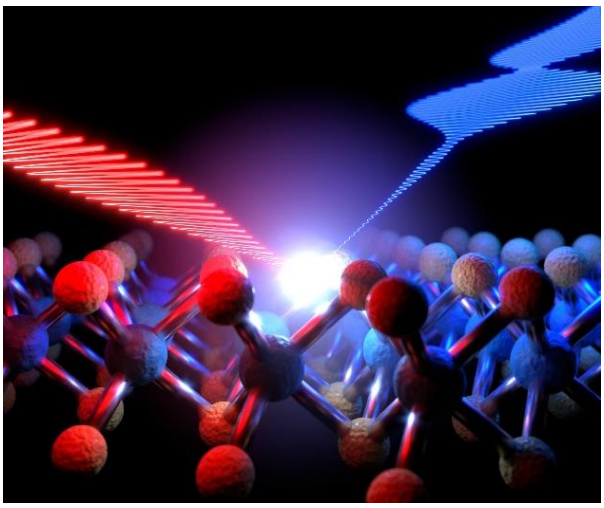

Figure 1: Artistic illustration of the EIT effect in single-layer crystals of WSe2, driven by femtosecond pulsed laser.

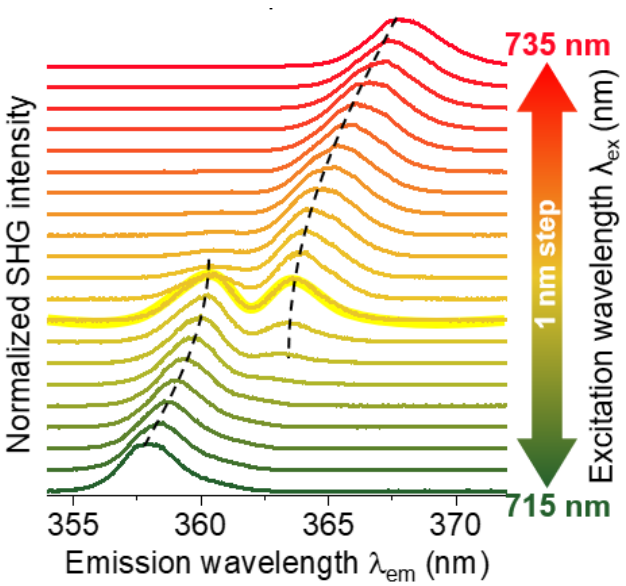

Figure 2: Dependence of the normalized SHG spectrum on pump wavelength in experiment, revealing anticrossing behaviour of the SHG peaks.