Chiral superfluorescence from perovskite superlattices at room-temperature

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Superfluorescence (SF) describes the enhanced radiation of coherent light from cooperatively coupled quantum emitters. While SF has been observed in several solid-state materials, the spontaneous generation of circularly polarized SF from chiral materials (chiral SF) has not been realized. Here, we report the first observation of chiral SF originating from edge states in large-area ($> 100\ \mu\text{m} \times 100\ \mu\text{m}$) vertically aligned quasi-2D chiral perovskite superlattices at room-temperature. Theoretical quantum optics calculations describe the transition from initially incoherent, unpolarized spontaneous emission to circularly polarized chiral SF, which changes sign depending on the handedness of the chiral material. Moreover, we show that both the intensity and degree of circular polarization of chiral SF can be modulated by a weak magnetic field. Our findings demonstrate an interplay between geometrical chirality and many-body quantum coherence, thereby revealing promising new directions for chirality-controlled quantum spin-optical applications at room-temperature. [1].

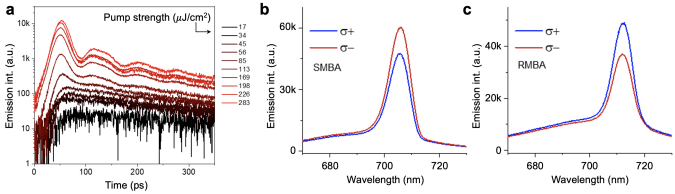

Fig. 1: Experimentally measured many-body chiral superradiance. (**a**) Time-resolved emission spectra for the SMBA perovskite exhibiting Burnham-Chiao ringing as a function of increasing pump laser strength. (**b**) Wavelength dependent emission spectra showing chiral superradiance in the SMBA perovskite at a pump laser strength of 196 μJ/cm^2. (**c**) Wavelength dependent emission spectra showing chiral superradiance in the RMBA perovskite at a pump laser strength of 184 μJ/cm^2. All spectra were recorded in the forward direction along the z-axis.

References

[1] Q Wei*, J.S. Peter*, H. Ren*, W. Wang, L. Zhou, Q. Liu, S. Ostermann, J. Yin, S. Cai S.F. Yelin, M. Li *Nature* (Under Review) (*Equal Contribution)

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