Synthetic spin–orbit coupling in perovskite microcavities: Polariton spin Hall effect and *Zitterbewegung* at room temperature

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Exciton polaritons are spinor light-matter quasiparticles, which combine the photon spin as well as applied field sensitivity of excitons, providing a versatile platform for spin-based applied applications. However, the generation and manipulation of pure polariton currents under ambient conditions remains challenging. To overcome this obstacle, we introduce liquid crystals into perovskite microcavities to induce synthetic Rashba-Dresselhaus (RD) spin-orbit coupling. This strategy has achieved a robust polariton spin Hall effect in the RD regime at room temperature, where spin-polarized polaritons with a high chirality of 0.88 spread over 45 μm while remaining spatially separated.[1] Furthermore, we modulate RD regime by tuning the energy splitting via external electric fields, enabling the demonstration of polariton *Zitterbewegung*, where polariton fluid trembles perpendicular to its flow with interlocked spin features.[2] By controlling the energy gaps, we observe the continuous transition of polariton *Zitterbewegung* from relativistic (small gaps) to non-relativistic (large gaps) regimes. Our findings not only deepen the understanding of spin-dependent quantum physics, but also pave the way for using exciton polaritons in novel spin-optoelectronic applications including spin lasers, filters and logic gates.

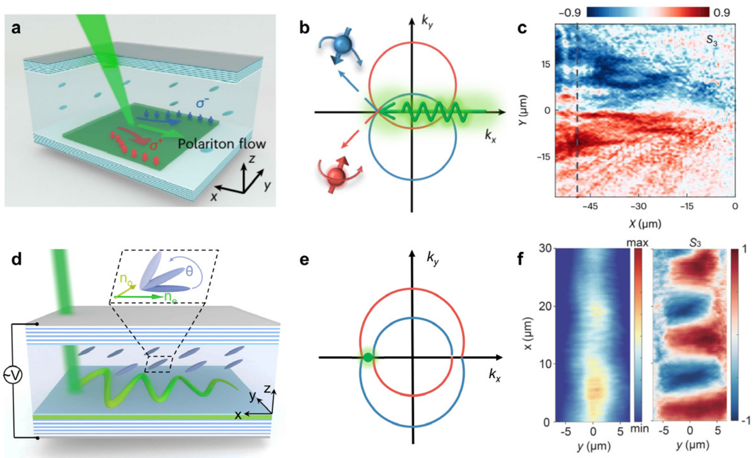

Figure 1: Polariton spin Hall effect (a-c) and *zitterbewegung* (d-f)

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References

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