OBSERVATION OF THE OPTICAL SPIN HALL EFFECT IN PHOTONIC GRAPHENE

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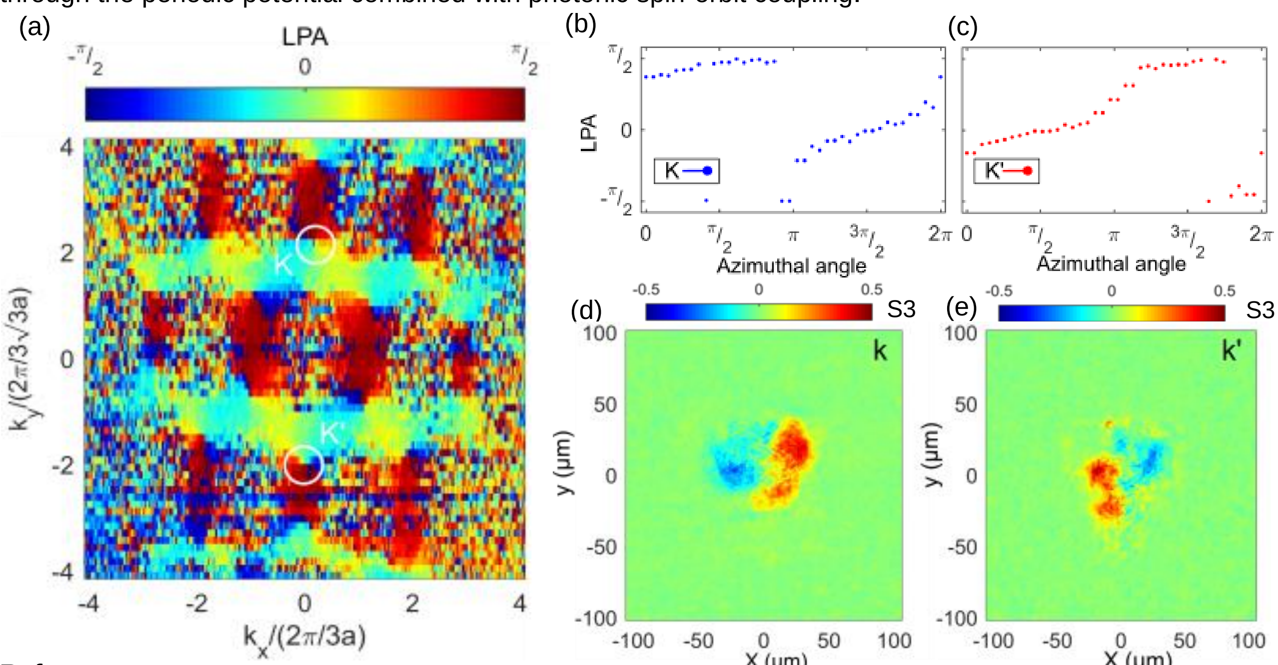
Exciton-polariton (polariton) gases confined in lattice potentials have emerged as an attractive candidate for emulating nonlinear lattice Hamiltonians, where 2D arrays of micropillars whose photonic energy bands have strong analogy with the electronic energy bands of real world 2D (or quasi-2D) materials. Results such as the demonstration of Dirac cones [1] and more recently a topological insulator [2], have only furthered research into this ever growing field of research.

The spin hall effect is the spin current generated from the interplay between spin-orbit coupling and the TE-TM modes in a photonic system. We report on the experimental observation of the optical spin Hall effect in a patterned microcavity with a honeycomb lattice geometry, so-called photonic graphene. TE-TM splitting native to microcavities, which acts as an effective magnetic field with a double azimuthal winding, in the neighborhood of the dirac point energies K-K' point is transformed into a Dresselhaus-type field with a single winding around these points, figure 1a ,b, c. This reduced symmetry is revealed in the optical spin hall effect pattern, figure 1d, e. The precession of the pseudospin of a resonantly injected photonic wave packet, which leads to the formation of the two spin domains, confirming the artificial gauge field created through the periodic potential combined with photonic spin-orbit coupling.



References

[1] ***Direct Observation of Dirac Cones and a Flatband in a honeycomb Lattice for polaritons. T.Jacqmin, I. Carusotto, I. Sagnes, M. Abbarchi, D. D. Solnyshkov, G. Malpuech, E. Galopin, A. Lemaître, J. Bloch, and A. Amo, Physical Review Letters, 2014, 112, 11.***

[2] Exciton-polariton topological insulator. S. Klembt, T. H. Harder, O. A. Egorov, K. Winkler, R. Ge, M. A. Bandres, M. Emmerling, L. Worschech, T. C. H. Liew, M. Segev, C. Schneider & S. Höfling, Nature, 2018, 562, 552-556.