Floquet Engineering in Valleytronic Materials

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Résumé

Light-driven control of quantum materials opens powerful routes to creating nonequilibrium states of matter. Floquet engineering, based on the coherent dressing of solids by time-periodic electromagnetic fields, enables the tailored manipulation of electronic structure through the amplitude, frequency, and polarization of light.

Valleytronics exploits momentum-space energy extrema as a novel degree of freedom for information processing, with symmetry-driven optical selection rules allowing valley-selective excitation.

In this talk, I unite Floquet engineering and valleytronics by extending symmetry-guided selection rules to hybrid light–matter states. I first demonstrate valley-polarized Floquet–Bloch states in 2H-WSe_2 induced by below-bandgap circularly polarized driving. I then establish group-IV transition-metal monochalcogenides (here SnSe and SnS) as a new valleytronic platform, revealing ultrafast highly anisotropic valley polarization dynamics and polarization-controlled manipulation of Floquet–Bloch wavefunction symmetry.

These results are enabled by a newly developed time- and polarization-resolved extreme-ultraviolet momentum microscope at CELIA (Bordeaux).