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Nanooptics with van der Waals Materials

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Highly anisotropic crystals have recently attracted considerable attention due to their ability to support polaritons with a variety of unique properties, such as hyperbolic dispersion, negative phase velocity, or extreme confinement. In particular, the biaxial van der Waals semiconductor α-phase molybdenum trioxide (α-MoO3) has received much attention [1] due to its ability to support in-plane hyperbolic phonon polaritons (PhPs) —infrared (IR) light coupled to lattice vibrations in polar materials— with ultra-low losses, offering an unprecedented platform for controlling the flow of energy at the nanoscale. In this talk, we will show experimental demonstrations of the unique behaviour of PhPs in these crystals, including the visualization of anomalous cases of the fundamental optical phenomena of refraction [2] and reflection, and the exotic phenomenon of canalization, in which PhPs propagate along a single direction with ultralow losses [3].

[1] W. Ma et al., Nature 562, 557 (2018).
[2] G. Álvarez-Pérez et al., Adv. Mater. 32, 1908176 (2020).
[3] J. Duan et al., Nature Communications, 12, 1, 1-8 (2021).
[4] J. Duan et al., Nano Letters, 20, 7, 5323-5329 (2020).