

# Propagation of exciton-polaritons in monolayer

## semiconductor coupled to at- $\Gamma$ bound state in the continuum

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ITMO UNIVERSITY

Optical BIC

Strong coupling

Propagation length

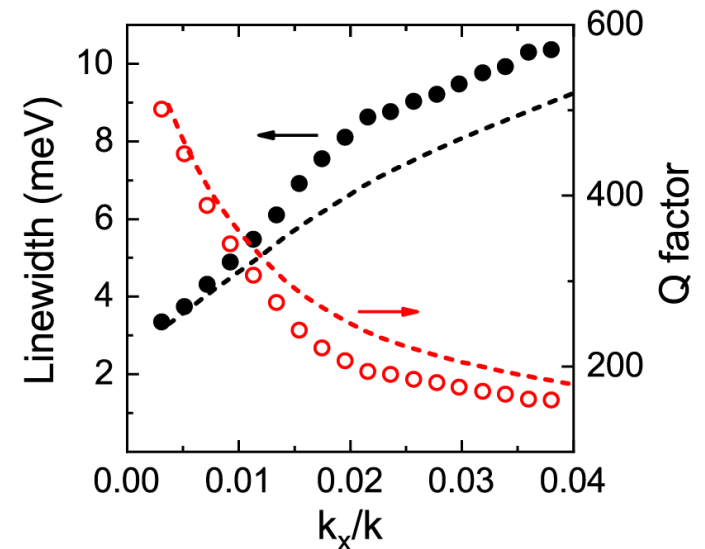
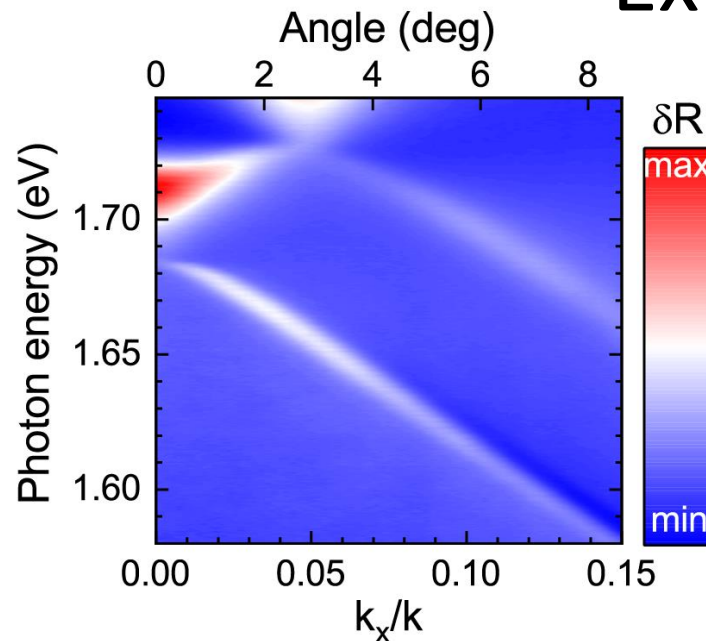
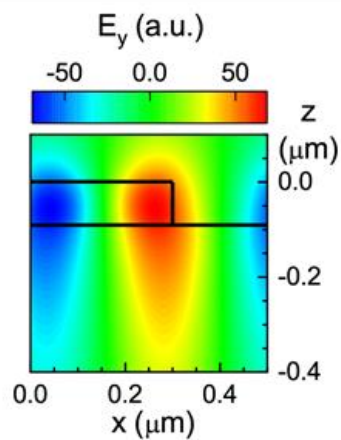
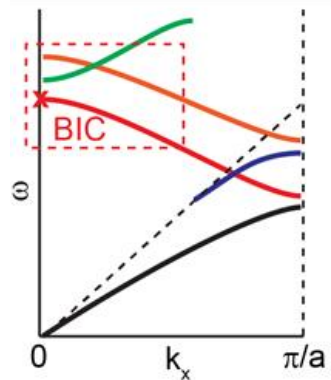
Polaritons propagation

Summary

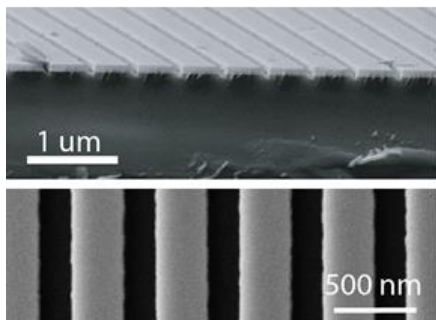
Band structure

E-field

### Experiment



SEM



Optical bound states in the continuum (BICs) provide a way to engineer resonant response in planar photonic structures with ultimately high-quality factors.

Join the poster session to discuss our recent results on the first experimental observation of **topological polaritonic edge states** in a hybrid TMD/metasurface system.

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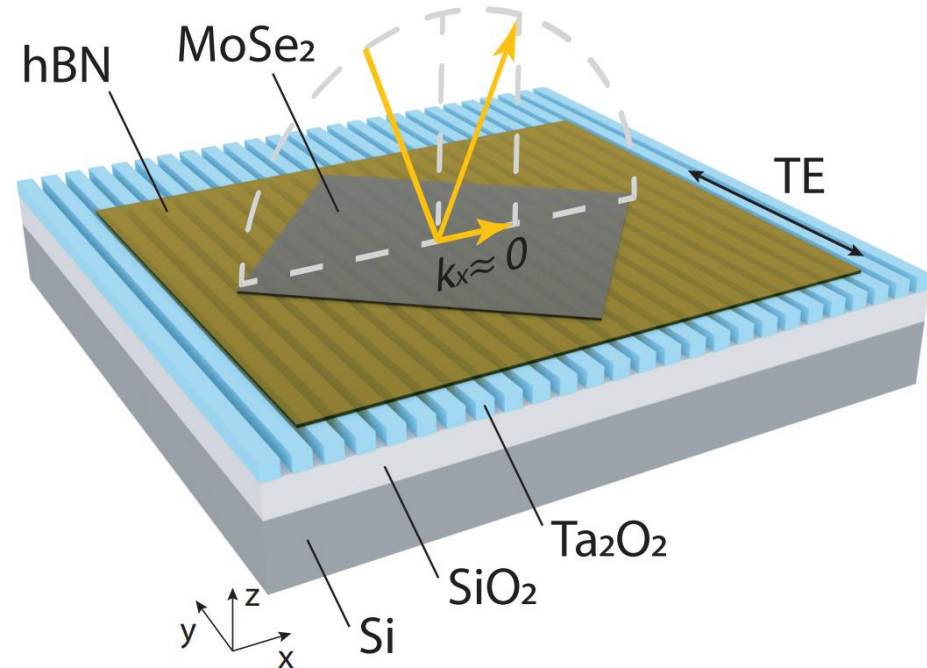
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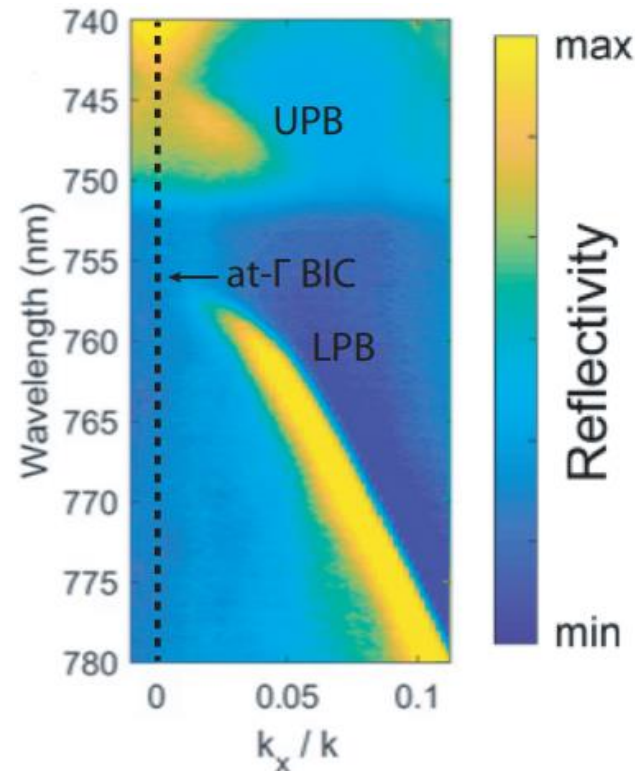
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Summary



Schematic of a hybrid  
1L MoSe<sub>2</sub>/hBN/PCS structure



Angle-resolved reflectance spectra of  
the hybrid sample, showing the upper  
and lower polariton branches

We realize the strong coupling regime of an at- $\Gamma$  BIC in a photonic crystal slab (PCS) with excitons in a monolayer transition metal dichalcogenide (TMD) in fully planar configuration.

- Rabi splitting  $\sim 27$  meV
- Coupling strength  $\sim 14$

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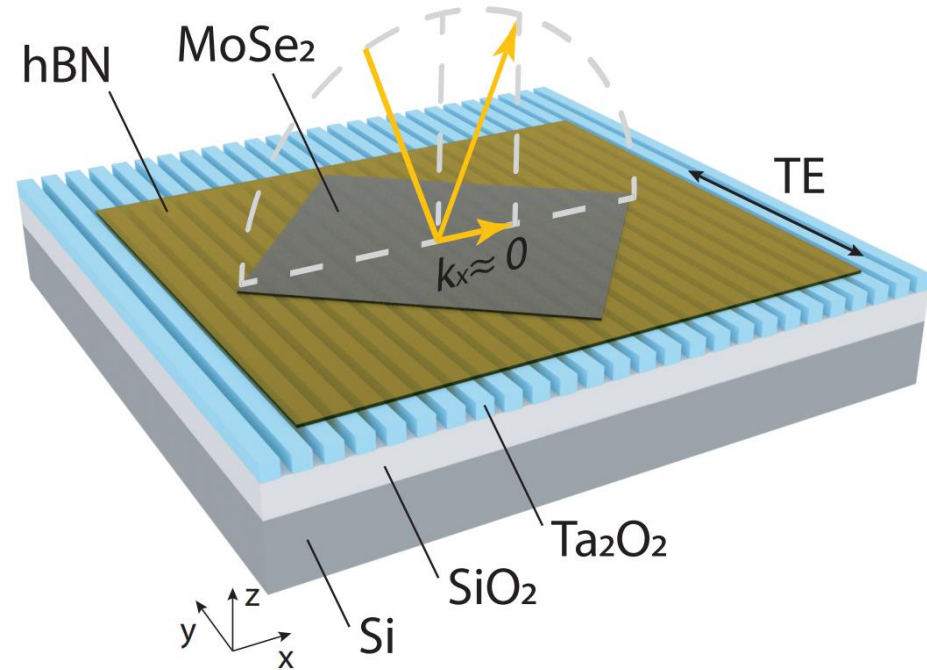
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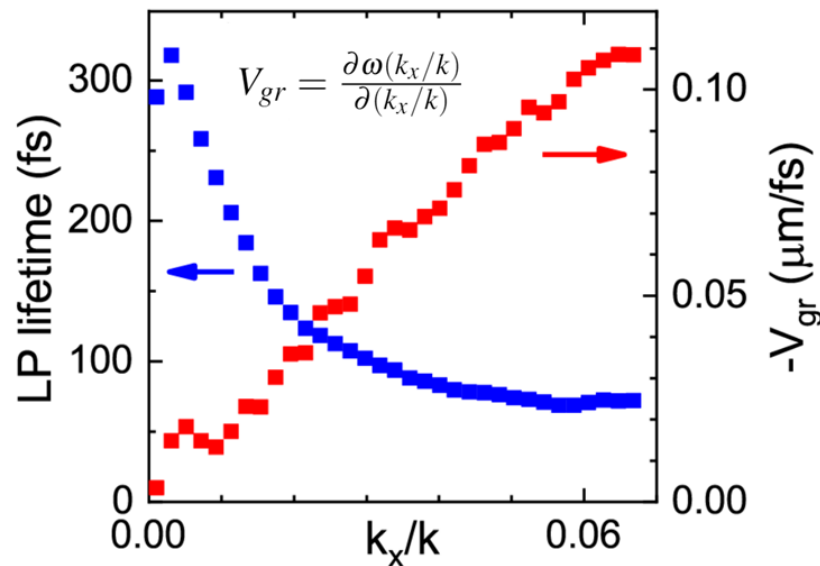
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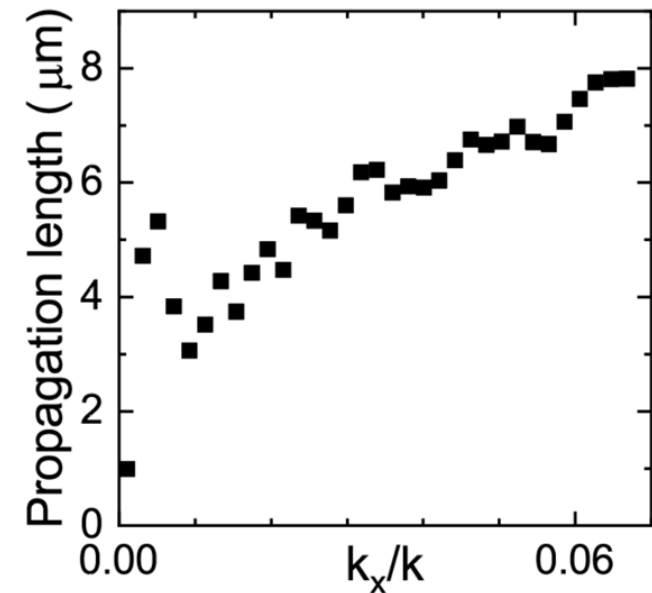
Summary



Schematic of a hybrid  
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Lifetime (blue) and group velocity (red)  
extracted from the measured lower  
polariton branch dispersion



Propagation length extracted for  
the lower polariton branch.

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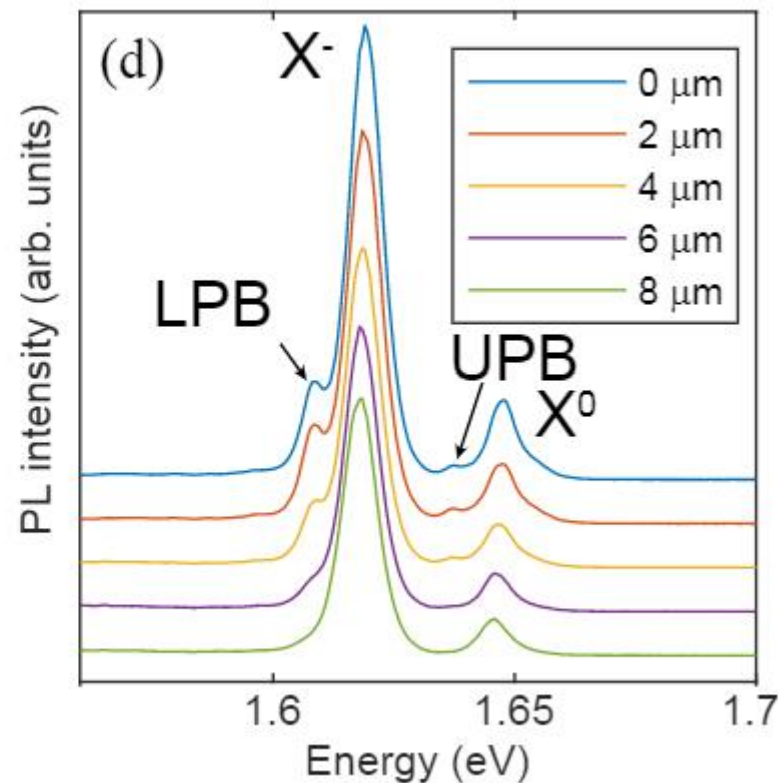
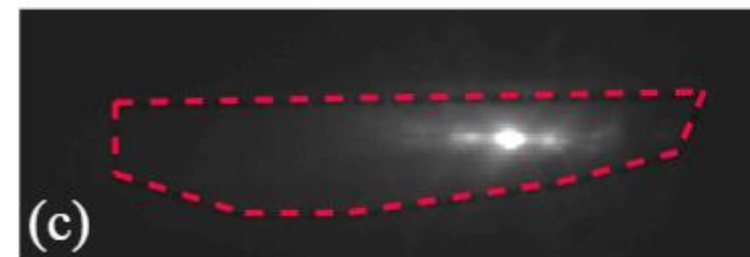
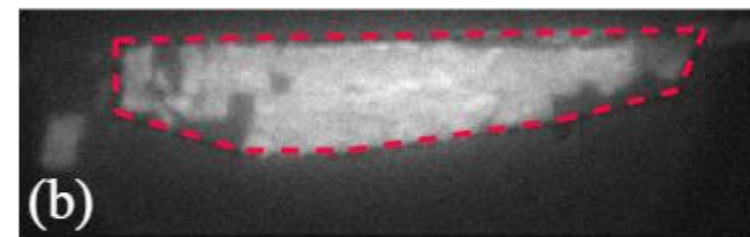
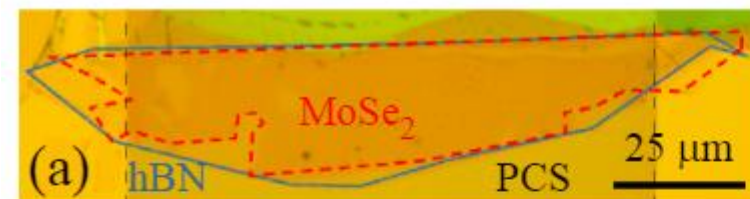
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(a) Optical microscopy image (reflected light) of the fabricated sample. (b) PL image of the sample: the bright area corresponds to the region of MoSe<sub>2</sub> monolayer. (c) Real-space PL image of the propagating modes, obtained under local non-resonant excitation. The pump wavelength in (b) and (c) is 633 nm. (d) Spatial evolution of the PL spectra depending on the distance between collection and excitation points.

Propagation length of exciton-polaritons is equal to 10 μm.



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We have studied lifetime and propagation properties of exciton-polaritons enabled by the strong coupling of an at- $\Gamma$  optical bound state in the continuum in a photonic crystal slab with an excitonic transition a monolayer 2D semiconductor MoSe<sub>2</sub>. With the in-plane Bloch wavevector approaching  $\Gamma$ -point of the Brillouin zone, both the polariton linewidth and group velocity decrease simultaneously resulting in extended (over 300 fs) exciton-photon interaction at sub-10-micron spatial scale. This opens the potential for the use of ultracompact on-chip TMD-based polaritonic systems employing bound states in the continuum for sensing, lasing, and nonlinear optics.

