

Ultra-compact, cladding-free double hyperbolic waveguides with topologically protected boundary states

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15s-Summary

Question:

Photonic integrated circuits are useful, but waveguide capacity imposes a constraint on the integration density.

Task:

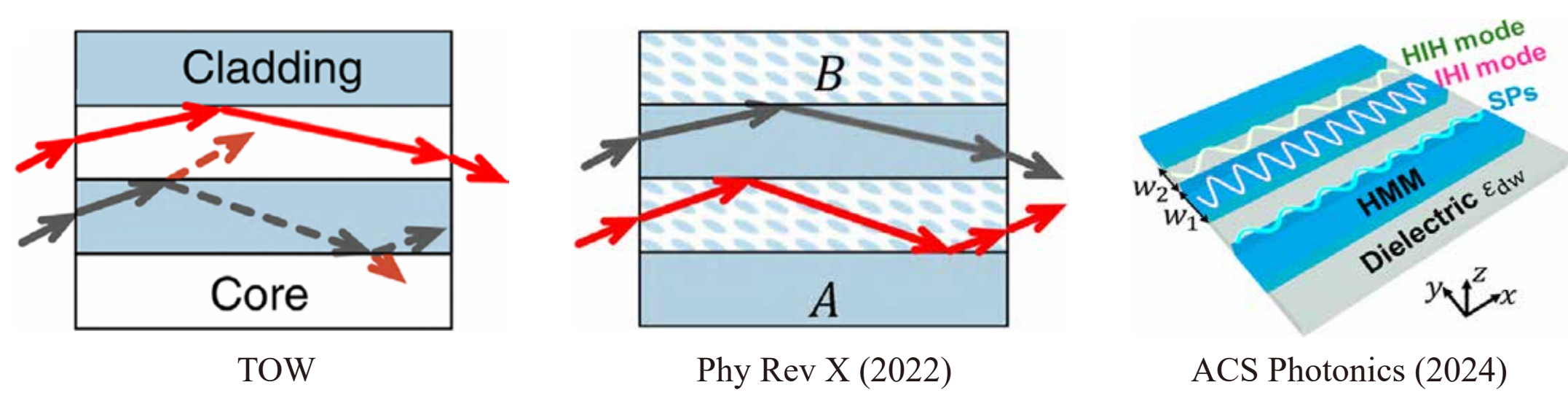
Find a strategy to further improve waveguide capacity.

Results:

- A cladding-free waveguide design using a double hyperbolic material (DHM) is proposed based on effective media theory.
- Microwave experiments were conducted to verify the existence of three kinds of independent waveguide modes for both polarizations.

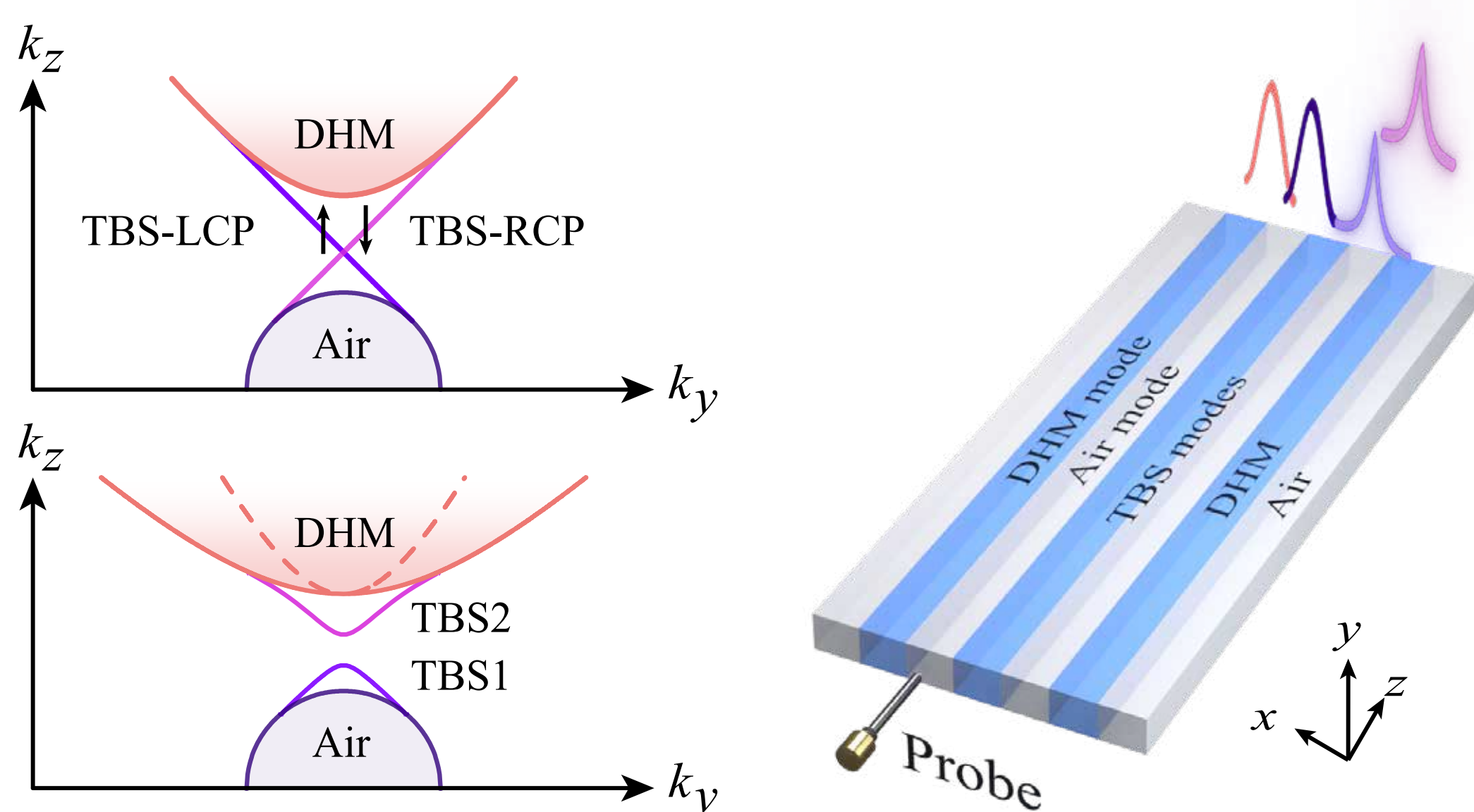
Introduction

Previous waveguides



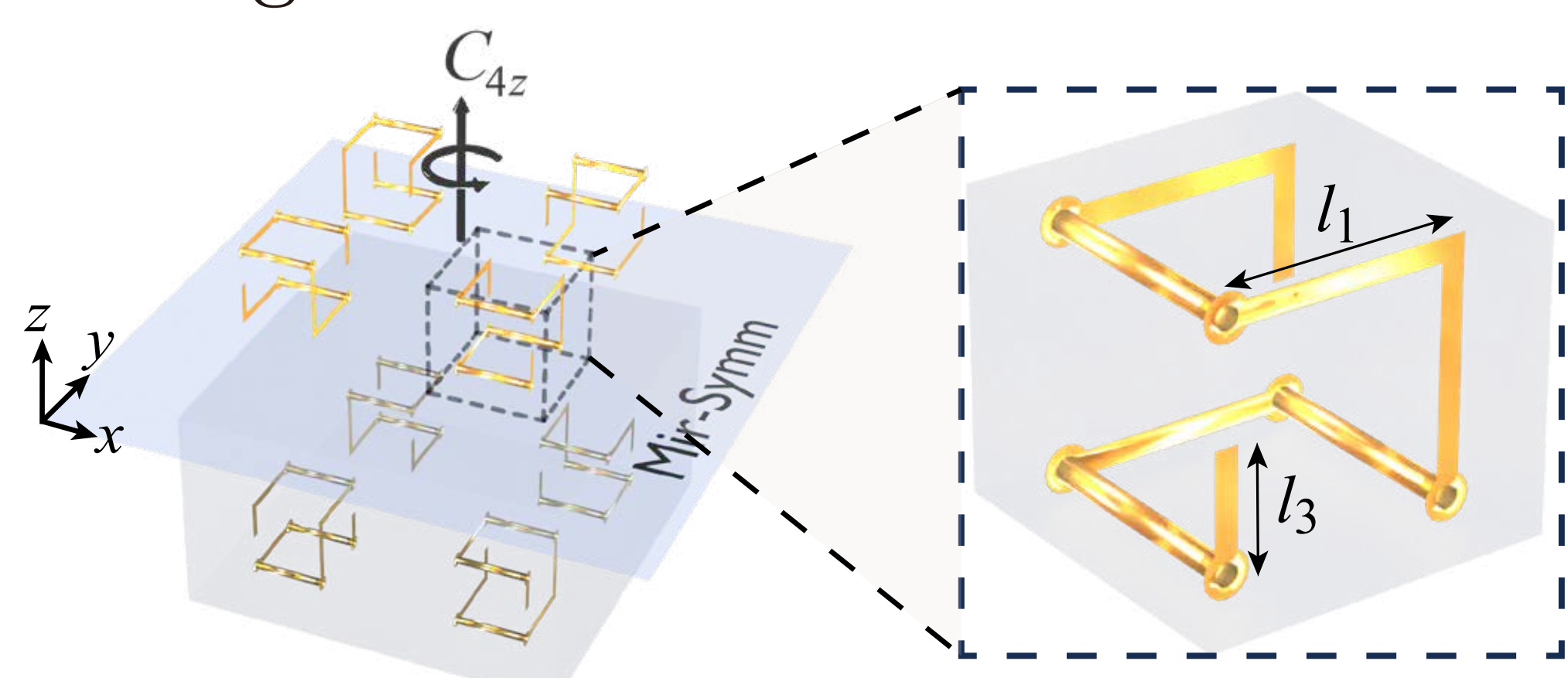
- Traditional optical waveguides (TOW): the cladding layers are wasted.
- Cladding-free waveguides: only bulk channels are utilized.
- TM polarization cladding-free hyperbolic waveguides: work only for TM polarization.

Our results



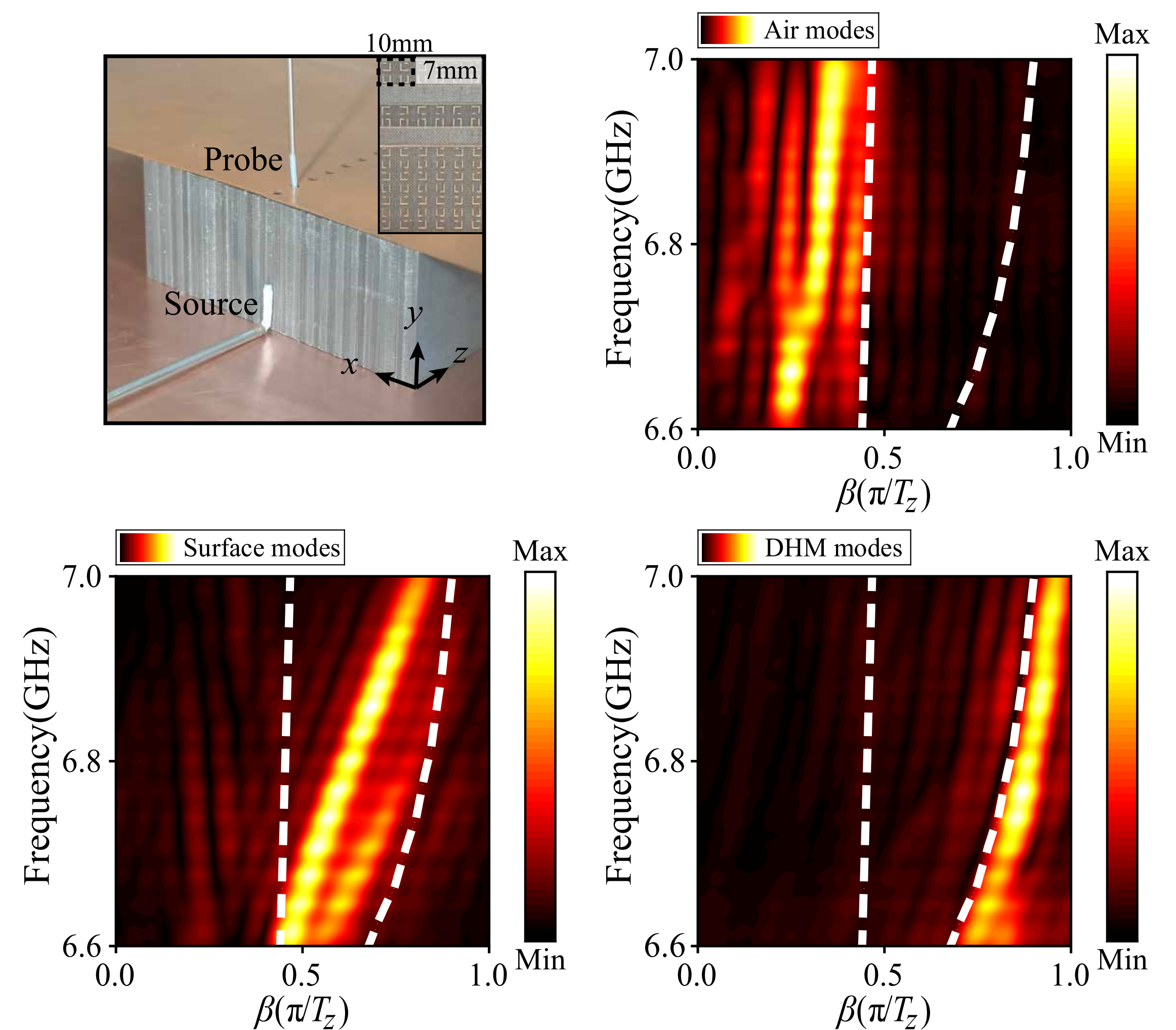
- Cladding-free hyperbolic waveguides supporting bulk and surface channels with unmatched propagation constants for both polarizations.

Design

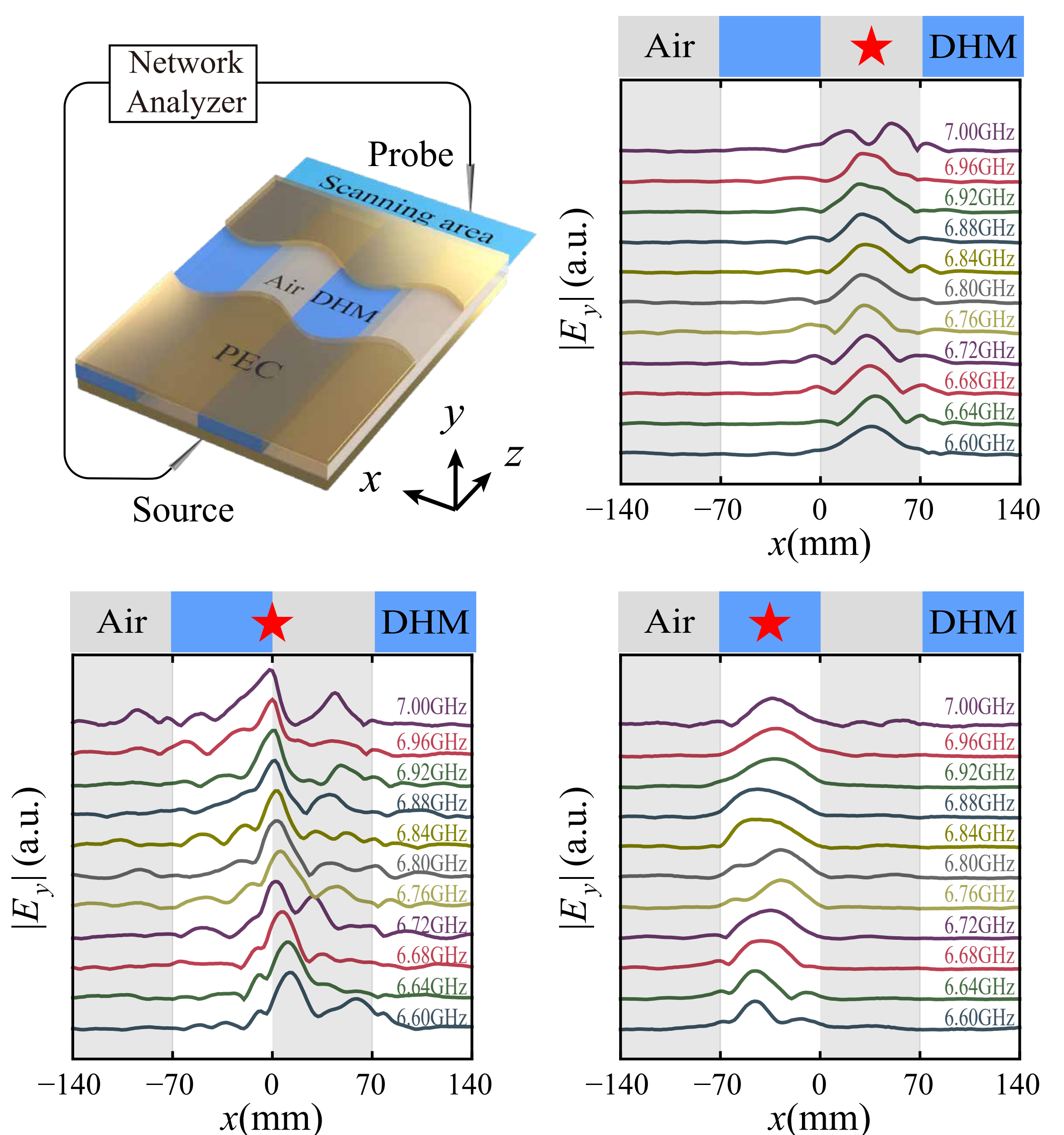


- Unit cell: C_4 and mirror symmetries.
- Double hyperbolic dispersion: p_z and m_z .

Experiment



- The separation of the bands into three regions along the propagation direction is observed.



- The confinement of signals proves the feasibility to transmit signals independently in three kinds of channels.

References

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- [4] Guo, Q. H. et al., Phys. Rev. Lett. 119, 213901 (2017).