

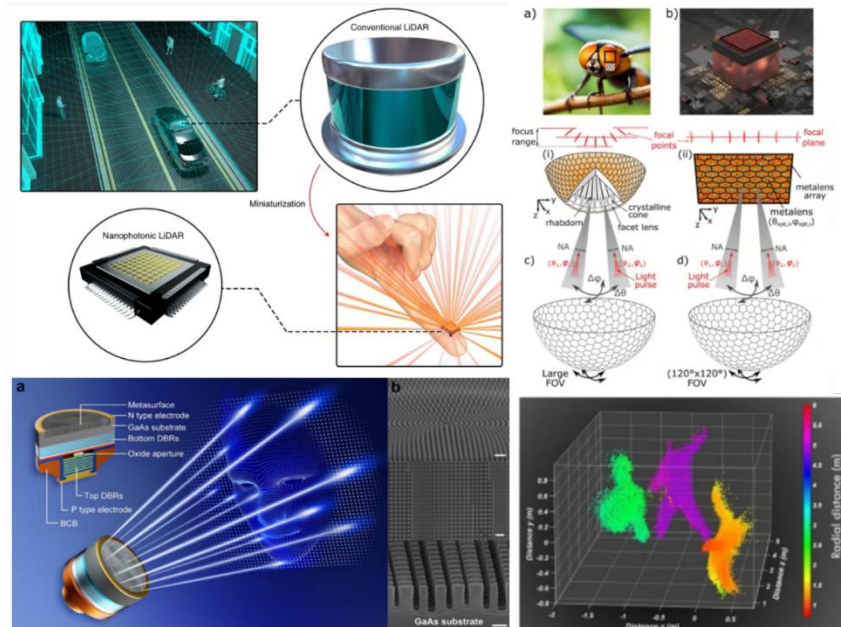


Metasurface Physics and System Integration

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In this seminar, I will present the design methodology of Metasurfaces, including our latest results on non-Hermitian metasurface physics [1]. We will introduce the concept of scattering complex singularities and discuss leveraging their position in the complex frequency plane for wavefront shaping.

We then will introduce new meta-systems, namely a chip-scale directional laser emission for arbitrary wavefront engineering and spin-controlled laser emission [2], and a kHz frame rate Metasurface-LiDAR for 3D imaging [3]. New imaging capabilities provided by 3D LiDAR metasystem can be attained using Metasurfaces, including high frame rate beam switching and imaging, high field of view, and the simultaneous acquisition of multiple fields of view, in particular 3D insect-inspired directional imaging[4]. We will conclude the presentation by discussing how to achieve reconfigurable liquid-crystal metasurfaces and how these new functionalities could potentially push the frontiers of optoelectronic systems beyond conventional devices.

- [1] *Science*, 373, 1133-1137 (2021); *Laser & Photonics Reviews* 2200976 (2023); *Optica* 10(10) 1287-1294 (2023), *Nature commun* 15 (1), 232 (2024) ; *Nature commun* (2025 in press)
- [2] *Nat. Nanotechnol.* 15, 125–130 (2020); *Nat Commun* 13, 7795 (2022).
- [3] *Nat Commun* 13, 5724 (2022); *Advanced Photonics*, 5, 046005 (2023).
- [4] *npj Nanophotonics* 1 (1), 18 (2024)