Nanometre-resolution three-dimensional tomographic and vectorial near-field imaging in dielectric optical resonators

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All-dielectric optical nano-resonators, exhibiting exotic near-field distributions upon excitations, have emerged as low-loss, versatile and highly adaptable components in nanophotonic structures for manipulating electromagnetic waves and enhancing light-matter interactions. However, achieving experimental full three-dimensional characterization of near-fields within dielectric nano-resonators poses significant challenges. Here, we develop a novel technique using high-order sideband generation to image near-field wave patterns inside dielectric optical nano-resonators. By exploiting the phase-sensitivity of various harmonic orders that enables the detection of near-field distributions at distinct depths, we achieve three-dimensional tomographic and near-field imaging with nanometer resolution inside a micrometer-thick silicon anapole resonator. Furthermore, our method offers high-contrast polarization sensitivity and phase-resolving capability, providing comprehensive vectorial near-field information. Our approach can potentially be applied to diverse dielectric metamaterials, and becomes a valuable tool for comprehensive characterization of near-field wave phenomena within dielectric materials.

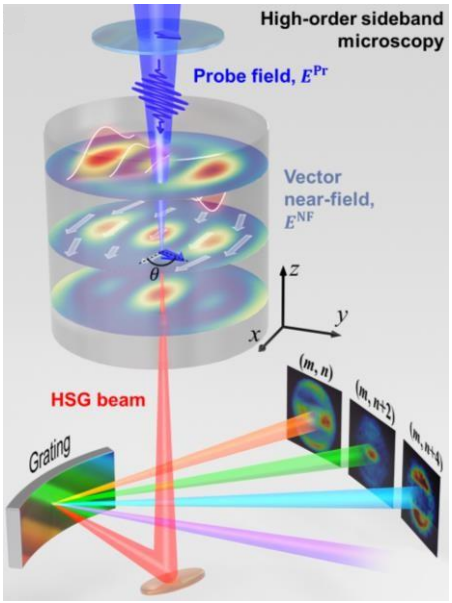

Fig. 1 Schematics of the proposed near-field detection technique

References

1. Bingbing Zhu, et al., **Nature Nanotechnology** DOI:https://doi.org/10.1038/s41565-025-01873-9