



INDIAN INSTITUTE OF TECHNOLOGY GUWAHATI
SHORT ABSTRACT OF THESIS

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Thesis Title: Quasi-BIC Resonance Modes in Metasurface: Excitation and Applications at Near-Infrared and Terahertz Frequencies

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SHORT ABSTRACT

Bound States in the Continuum (BICs) are states that remain perfectly localized despite lying in the continuum, with ideal BICs possessing an infinite Q factor. However, real scenarios exhibit quasi-BIC modes, observed as Fano resonances with high but finite Q factors. This thesis investigates symmetry-protected quasi-BIC modes in metasurfaces for terahertz (THz) and near-infrared (NIR) applications.

In the NIR C-band (1535–1565 nm), an ultra-narrowband pass filter and a high Figure of Merit dual-parametric (temperature and refractive index) sensor were demonstrated using an all-dielectric metasurface, minimizing ohmic losses. Multipolar decomposition theory was used to analyze the excited modes.

For the THz region, we explored selective symmetry-breaking in metallic metasurfaces, strategically altering a ring-shaped metamolecule to reduce radiation density and enhance the Q factor. Additionally, lattice perturbation was investigated as an alternative quasi-BIC excitation method, leveraging band folding for stable resonance frequencies and tunable Q factors.

This work advances quasi-BIC resonance modes in metasurfaces, offering novel approaches for high-Q photonic devices with applications in filtering, sensing, and nonlinear optics.