太赫兹超表面中的混合连续域束缚态

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更高的品质因数 (Q) 意味着更长的光子寿命，这会极大增加光与物质相互作用的时间。高品质因数谐振腔可以有效地束缚光从而增强光与物质的相互作用，这对激光器、滤波器、谐波产生和传感器等应用具有重要意义。

南方科技大学丛龙庆教授团队提出了一种通过广义途径来提高对称保护型 BIC 品质因数和鲁棒性的方法。该方法与常规通过均匀破坏谐振器的对称性 (U-qBIC) 来获取准 BIC 的方法不同，通过在晶格层面上选择性地打破谐振器对称性，从而降低整个阵列的辐射强度，提升阵列的品质因数。该思路适用于任何对称保护的 BIC，对微结构几何尺寸和能带结构没有任何约束，因此是一种更广泛适用的机制。

根据定性和定量分析，这种混合 BIC 晶格可实现比常规晶格高出 14.6 倍以上的品质因数。通过提升 Q 与 k 之间的比例系数，提升混合 BIC 谐振品质因数对失序等扰动的鲁棒性，从而能够有效降低实际器件中品质因数的恶化，这为获得高品质因数提供了一个有效途径。通过对晶格倒易空间分析，这种混合 BIC 晶格同时将均匀 BIC 晶格的 X 点、Y 点和 M 点的本征态折叠到 Γ 点，从而可以在远场辐射中观察到多个 Fano 共振峰。

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Hybrid bound states in the continuum in terahertz metasurfaces

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The quality factor (Q) is a critical parameter that characterizes the strength of light-matter interactions. Cavities with higher quality factors can efficiently confine light and thus enhance light-matter interactions.

Recently, Longqing Cong's group at Southern University of Science and Technology (SUSTech) proposed a more generalized approach to improve the overall quality factors and robustness of symmetry-protected BIC. Unlike the conventional approach of achieving quasi-BIC by breaking symmetry of resonators uniformly in the entire lattice of metamaterials, they selectively maintain the local C_2 symmetry of the entire lattice so that radiative loss could be decreased and the quality factor of the array is improved. This is a generalized method that could be extended to any symmetry-protected BIC without requirements of accurate geometric design or band selectivity. According to qualitative and quantitative analysis, the hybrid BIC lattice can achieve a quality factor more than 14.6 times higher than that of the conventional lattice. By increasing the proportional coefficient between Q and k, the quality factor robustness of the hybrid BIC metasurfaces against disorders and other disturbances is improved, thereby effectively reducing the deterioration of the quality factor in actual devices. This provides a more generalized and simple approach to achieving a high-quality factor.

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