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Tunable unidirectional reflection in cold atoms based on spatial Kramers-Kronig modulation

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Abstract

We propose a scheme for realizing spatial Kramers-Kronig (KK) relation of probe susceptibility in a cold atomic sample driven by a linearly modulated control field. The sample is found to exhibit broken, transitional, and unbroken regimes, where the non-Hermitian KK relation is well satisfied, foreshortened, and fully destroyed in order. The unbroken and transitional regimes are of special interest because they allow unidirectional reflection at one and both sample ends, respectively. Bragg scattering can also be incorporated into spatial KK relation to largely enhance the nonzero reflectivity, leading thus to a high forward-backward reflectivity contrast.