WAKE FIELDS IN PHOTONIC CRYSTAL ACCELERATOR STRUCTURES AND APPLICATION TO RF SOURCES

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Abstract

The RF properties of photonic crystals (PhCs) can be exploited to avoid the parasitic higher order modes (HOMs) that degrade beam quality in accelerator cavities and reduce efficiency and power in RF generators. Computer simulations show that long-range wake fields are significantly reduced in accelerator structures based on dielectric PhC cavities, which can be designed to trap only those modes within a narrow frequency range. A 2D PhC structure can be used to create a 3D accelerator cavity by using metal end-plates to confine the fields in the third dimension; however, even when the 2D photonic structure allows only a single mode, the 3D structure may trap HOMs, such as guided modes in the dielectric rods, that increase wake fields. For a 3D cavity based on a triangular lattice of dielectric rods, the rod positions can be optimized (breaking the lattice symmetry) to reduce radiation leakage using a fixed number of rods; moreover, the optimized structure has reduced wake fields. Using computer simulation, wake fields in pillbox, PhC, and optimized photonic cavities are calculated; a design for a klystron using the optimized photonic cavity structure is presented.

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