OPTIMIZATION OF A TRUNCATED PHOTONIC CRYSTAL CAVITY FOR PARTICLE ACCELERATION

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Abstract

Through computer simulation, a 2D photonic crystal (PhC) cavity formed from a truncated triangular lattice of dielectric rods is optimized to confine a single accelerating mode efficiently. Photonic crystals have the ability to reflect radiation within only certain frequency ranges, called bandgaps; the bandgaps are determined by the geometry and material of the PhC and so are tunable. For truncated PhCs, reflection is incomplete. Therefore, the confinement of bandgap frequencies to a cavity within a truncated PhC is weakened by the severity of the truncation. For a cavity made of 18 dielectric rods in a truncated triangular lattice arrangement, the desired accelerating cavity mode is weakly confined. Adjusting the positions and sizes of the dielectric rods away from the best lattice configuration within an optimization procedure gives unintuitive structures, ultimately increasing the confinement of the accelerating mode by a factor of 100. Confinement of higher-order modes is also dramatically reduced by the optimization. Similar increases in confinement of the fundamental accelerating mode are found for a 24-rod structure.

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