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Analytical and Numerical Characterization of a One and Two-Dimensional Plasma Photonic Crystal with Smooth Variations in Density[1] W. R. THOMAS, U. SHUMLAK, University of Washington — Plasma photonic crystals (PPCs) have the potential to significantly expand the capabilities of current microwave filtering and switching technologies by providing high speed (μs) control of energy band-gap/pass characteristics in the GHz through low THz range. Furthermore, plasma-based devices can be used in higher power applications than their solid-state counterparts without experiencing significant changes in function or incurring damage. The majority of numerical and theoretical investigations into PPCs are based on metallic PC theory, and make the simplifying assumption of uniform density plasmas. In practice, most methods of generating repeatable, controllable plasmas have density gradients arising either from diffusion or wall effects. In this investigation we use an analytically derived dispersion relation and a multi-fluid plasma model, implemented in the WARPXM computational framework, on a plasma with both one and two-dimensional density variations. The two methods are used to understand the relationship between important dimensionless parameters (a lattice normalized plasma frequency, density variation amplitude, and the peak normalized density gradient) and electromagnetic wave dispersion characteristics.

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