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Development of High-Density Plasma Photonic Crystals Using High-Power Lasers[1] ROBERTO COLON QUINONES, BENJAMIN WANG, ANDREA LUCCA FABRIS, MARK CAPPELLI, Stanford University — A plasma photonic crystal (PPC) is an array of plasma structures that interacts with electromagnetic (EM) waves in ways not possible with natural materials. 2D PPCs can be used for generating a band gap, which is a range of wave frequencies in which no waves are transmitted through the structure. Such gap forms when an EM wave travels through a 2D PPC with spacing equal to half the wavelength of the wave and plasma frequency (ω_p) on the order of the frequency of the wave. Until recently, research on PPCs has been limited to $\omega_p < 30\ GHz$, which is equivalent to a plasma density of $n_e < 10^{13}\ cm^{-3}$. Over the last year, PPCs of $n_e > 10^{15}\ cm^{-3}$ have been generated at Stanford through the use of high-power lasers. The PPCs are generated by expanding the laser beam from a Q-switched Nd:YAG laser through a Galilean beam expander and subsequently focusing the beam through an optical micro-lens array. The intense photoionization of air that occurs at the focus of the individual lenses leads to the formation of a 2D array of very dense plasma spots. Photomultiplier measurements show a plasma lifetime of ~150 ns during which the plasma array functions as a PPC, representing a first step towards advancing the field forward into the low THz regime.

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