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**Formation of regular filamentary plasma arrays generated by a 1.5 MW, 110 GHz gyrotron**[1] Y. HIDAKA, E.M. CHOI, I. MASTOVSKY, M.A. SHAPIRO, J.R. SIRIGIRI, R.J. TEMKIN, Plasma Science and Fusion Center, Massachusetts Institute of Technology — We report the achievement of self-initiated breakdown of a volume of air at atmospheric pressure with a focused Gaussian beam generated by a pulsed gyrotron. The relevant parameters of the beam are the frequency of 110 GHz, pulse length of 3 microseconds, maximum peak power of 1.5 MW, and peak power density of 2.5 MW/cm$^2$. Regular two-dimensional arrays of plasma filaments, similar to those observed in our previous experiments on air breakdown at the surfaces of dielectric windows, were also present in the open-shutter images of volume breakdown. Patterns observed in volume breakdown allowed us to deduce that the formation of the array can be explained as a progressive development of each filament due to diffraction from each existing filament resulting in field enhancement approximately a quarter wavelength upstream of the filament. Electromagnetic wave simulations strongly corroborate this explanation. Further breakdown experiments will be also conducted in different pressures and gases in the near future.

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