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High Power Microwave Gas Breakdown Experiments at 110 GHz[1] ALAN COOK, MARTIN GOYCOOLEA, MICHAEL SHAPIRO, RICHARD TEMKIN, Plasma Science and Fusion Center, MIT — We report the results of measurements of breakdown in gases induced by megawatt-level W-band radiation, covering the pressure range 5 - 760 Torr. A microwave beam, generated by a 1.5 MW, 110 GHz gyrotron with a 3-microsecond pulse duration, is focused by a lens into a pressurized chamber at a peak intensity of 5 MW/cm^2. Breakdown takes place in the volume of gas, without any field-enhancing objects to initiate the discharge. Data is taken in air and argon. Breakdown threshold data is seen to follow a Paschen-type curve of E vs. p, similar to DC breakdown, having a minimum threshold level at a pressure of about 40 Torr in air and 80 Torr in argon. The spatial structure of the breakdown plasma changes from a diffuse, uniform discharge at low pressure to a periodic array of quarter-wavelength-spaced filaments at high pressure. The transition in observed structure coincides with the measured transition between the low-pressure, diffusion-controlled and the high-pressure, collisional breakdown regimes.

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