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High-Power Testing of W-Band Accelerator Cavities

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We are developing high gradient linear accelerator technologies that operate at 100s of GHz and THz frequencies. Vacuum RF breakdown is one of the fundamental factors limiting high gradient performance of these linacs. Accordingly, a comprehensive study of RF breakdown physics in mm-wave accelerating structures is needed, which includes understanding of dependencies of the breakdown rate on electromagnetic, geometric, and material properties. In our previous work, we have tested beam-driven 100 GHz and 200 GHz metallic accelerating structures. In this work we report initial results of high power tests of a 110 GHz single-cell standing wave accelerating cavity powered by a 1 MW gyrotron. The RF power is coupled into the accelerating structure using a "Gaussian to TM01"mode converter. In order to characterize high gradient behavior of the cavity, including the rf breakdown probability, we have measured RF signals and field-emitted currents. The cavity is fed with 10 ns, 100s of kilowatt pulses. These short pulses were chopped from microsecond-long gyrotron pulses using a fast optical switch. At this power and pulse length the cavity's accelerating gradient reached up to 150 MV/m.

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