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Real-time diagnostic for charging and damage of dielectrics

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The research will be presented that was aimed to address issues of analysis and mitigation of high repetition rate effects in Dielectric Wakefield Accelerators, and more specifically, to study charging rate and charge distribution in a thin walled dielectric wakefield accelerator from a passing charge bunch and the physics of conductivity and discharge phenomena in dielectric. The issue is the role played by the beam halo and intense wakefields in charging of the dielectric, possibly leading to undesired deflection of charge bunches and degradation of the dielectric material. During initial stage of development, microwave apparatus was built and signal processing was developed for observing time-dependent charging of dielectric surfaces and/or plasmas located on or near the inner surface of a thin-wall hollow dielectric tube. Three frequencies were employed to improve the data handling rate and the signal-to-noise. The test and performance results for a plasma test case will be presented; the performance of the test unit showed capability to detect small changes ~ 0.1% of a dielectric constant, which would correspond to the scraping-off of only 0.3 nC to the walls of the dielectric liner inside the cavity from the passing charge bunch.

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