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High transformer ratio of multi-channel dielectric wakefield structures and real-time diagnostic for charging and damage of dielectrics

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Dielectric wake field (DWA) accelerator concepts are receiving attention of late, on account of their promising performance, mechanical simplicity, and anticipated low cost. Interest in DWA physics directed toward an advanced high-gradient accelerator has been enhanced by a finding that some dielectrics can withstand very high fields (> 1 GV/m) for the short times during the passage of charged bunches along dielectric-lined channels. In a two-channel structure, a drive bunch train propagates in a first channel, and in the second adjacent channel where a high gradient wakefield develops, a witness bunch is accelerated. Compared with single-channel DWA's, a two-beam accelerator delivers higher transformer ratios, and thereby reduces the number of drive beam sections needed to achieve a given final test beam energy. An overview of multi-channel DWA structures will be given, with an emphasis on two-channel structures, presenting their advantages and drawbacks, and potential impact on the field. Studies that were aimed 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 materials useful for such accelerator applications will also be briefly presented.

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