WF-Note-231
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High Gradient Wakefield Experiment on 1" Standing Wave DLA Structure

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Introduction: in this article, we present the results of our recent high gradient wakefield experiment carried on AWA facility on January, 2006. The experiment is motivated by achieving the highest electric field that the DLA structure can handle without breakdown. Our previous similar experiment has reached a gradient of 23 MV/m by passing 40nC charge through [1]. Currently, our laser system can launch more power, then, it provides a chance to test the up-limitation of the gradient inside the DLA structure. The tested device is a short standing wave DLA structure consisted of two cutoff copper ends and a short dielectric loaded waveguide. The loaded cordiate tube has dimensions: inner radius of ceramic tube a=5mm, outer radius b=7.49mm, length *l*=23mm. The dielectric constant is 4.8. The synchronized mode for this structure is designed to be TM013 mode at frequency of 11.4GHz. An E-field probe is located at 6.1mm away from the upstream end of the ceramic tube. The setup to measure the wakefield signal can refer WF-230.

Highest charge experiment: The highest charge we passed through the structure is around 80nC (2.6V peak value of ICT2 signal, with calibration of 32.5mV/nC). Figure 1 shows the wakefield signal captured in the digital scope. This is down-converted signal with local oscillation of 9 GHz. So, the measured TM013 mode is 14.1GHz (5.1+9GHz), which agrees very well with the simulation. The 12.3GHz and 13GHz signals are some dipole modes excited by off-center beam.

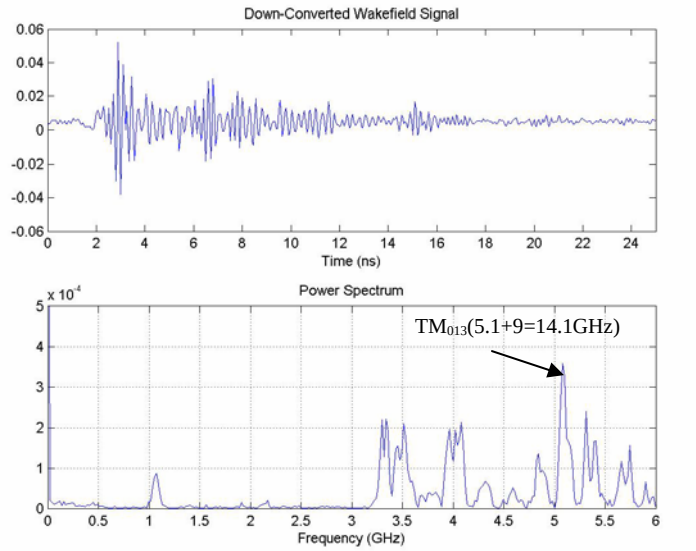


Figure 1 down-converted wakefield signal when 80nC charge passing through.

Discussion*:* Based on the simulation, 80nC charge can generate 45MV/m gradient inside the dielectric tube. This doubled the electric field presented in ref[1], plus, we also did

not observe any breakdown signature. However, during the experiment, we found the wakefield signal appeared two or three pulses occasionally. At some cases, the amplitude of the second pulse even larger than the first one (shown in Figure 2 (b)). By tracing back, we found it is caused by the multiple pulsed laser, shown in Figure 2(a). The reason of the multiple pulsed laser is still under investigation. Back to Figure 1, we also can see the signature of three pulses although it is not very significant. That means the highest gradient inside dielectric tube must be less than 45MV/m. We will continue this experiment in near future when the laser problem solved.

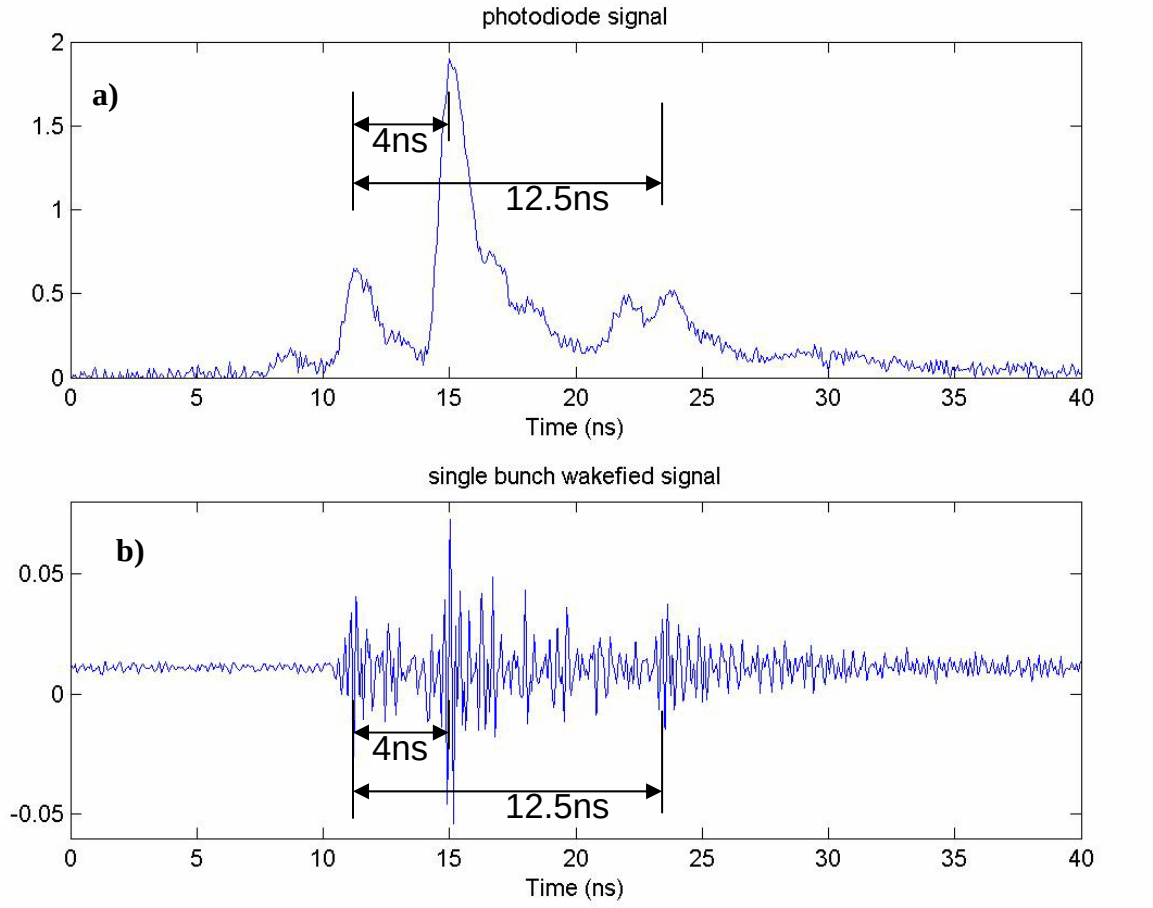
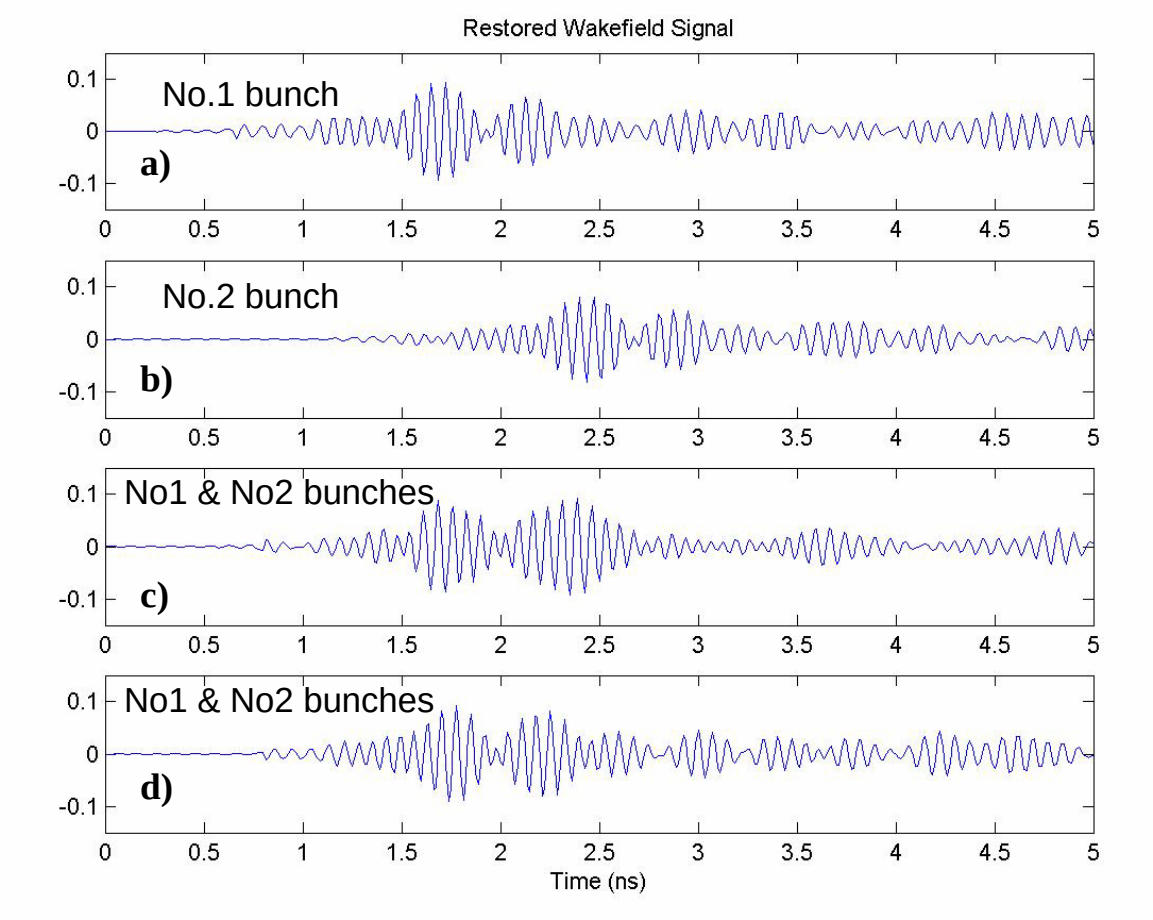


Figure 2 a) multiple pulsed laser; b) multiple pulsed wakefield signal;

Two-bunch experiment: We finished the bunch train experiment in this 2-week-run. Two electron bunches with around 10nC charge each are steeled into the tube with time interval of one rf cycle of 1.3GHz. We did observed some signature of the wakefield signal superposition when varying the time interval between two bunches, however, it is not very significant like traveling wave signal (refer WF-230). Figure (3a) and (3b) show the wakefield signal generated by two bunch (No.1 and No.2) alone; (3c) and (3d) show the signals when launching two bunch together but with different time interval, in which (3c) shows signal addition and (3d) shows subtraction.

2-bunch experiment



Reference:
[1] M. Conde, Proc. Of PAC 2005, pp1485-1487