6 - 28 First Principle Test of DWA at IMP

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The experiment study of DWA as an electron diode was under test at IMP. The laser triggered switches, including semiconductor and spark gap switch, are tested. It is found that the semiconductor switch is not satisfied for the stacked pulse forming lines, and much more effort need to do, and the spark gap switch is satisfied and used in the experiment. The voltage stack efficiency of the four layers stacked Blumlein lines is about 60% to 70% with laser triggered gas filled spark gap switches. Furthermore, a short DWA as a diode is under test. The pulse voltage achieved by four stacked Blumlein pulse forming lines used for extracting and accelerating the electron. With 23 kV 5 ns pulse voltage, the beam current is about 320 mA measured by FCT. The principle test of DWA is well achieved.

When the laser intensity of a femtosecond laser is high enough, plasma can be created that spans the complete distance between the spark gap switch electrodes. The gas-filled spark gap is then closed on a femtosecond time scale, similar to photoconductive switching of a semiconductor switch. Stochastic breakdown processes, such as avalanche and streamer formation that causes the breakdown in laser triggered spark gaps, are passed over, which results in faster rise time and less jitter[1]. Here the illuminating region is both the electrode and the gap.

The first beam test of DWA is as a diode, shown in Fig. 1. The DWA can accelerate any kinds of charged particles. Electrons were chosen for initial operation in the short-pulse DWA because their small mass allowed them to gain energy from the 5-ns accelerating pulse without the need for injection at high energy[2]. The four layers Blumlein lines switch simultaneously by laser triggered spark gap switches. The output lines connected to the cathode and anode grid electrode. After the beam tube, a solenoid is used for transversely focus the beam. A fast current transformer (FCT) is used for diagnostic and a faraday cup is used as a beam damp. The beam tube is formed by a silicon glass tube, of which the inner radius is 2 cm and the out radius is 3 cm.

The laser triggered spark gap switches with gas filled box can provide high output voltage of the stacked Blumlein lines. With 0.2 MPa, the charging voltage is about 8.6 kV, and the output voltage is about 20～25 kV. The electron gun is heated by 10 V～12 A current source. When the solenoid current is 0.6～0.7 A, the beam current is the largest. The beam current is measured by the FCT and the cathode and anode voltage is measured by the high voltage probe TeKP6015A. When the solenoid current is 0.6 A, the beam current peak is about 320 mA, shown in Fig. 2.

Fig. 1 The beam test platform of DWA as a diode.

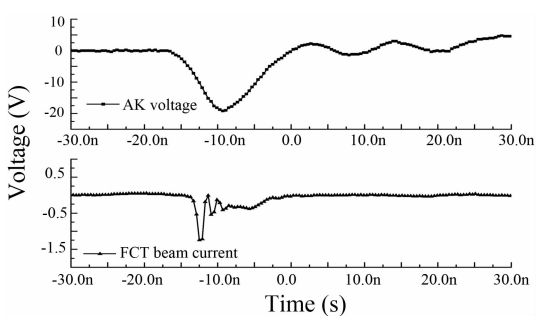

Fig. 2 The AK voltage waveform and beam current waveform.

The key technology and the assembling technology of DWA are under development in IMP and the DWA as an electron diode is under test. The demands of switch and pulse forming lines for DWA are studied by experiment. The principle test of DWA is well achieved. With these tests, combine with new materials, the better DWA can be achieved easier. The experiment platform is used to try the new materials for DWA. It is expected that the real DWA and the high accelerating gradient can be achieved with better and more suitable material.

References

[1] G. J. H. Brussaard, J. Hendriks, Applied Physics Letters, 86(2005)081503.
[2] J. R. Harris, B. Hickman, R. Anaya, et al., IEEE Transactions on Plasma Science, 37, 6(2009)1069.