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Double pulse generator for discharge plasmas for particle accelerators

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The AWAKE experiment, running at CERN, investigates particle acceleration in plasma wakefield [1]. Since the current plasma source (10 m long and created in a rubidium vapour by laser field ionization [2]) is applicable only to a limited length, new scalable technologies are being developed, namely a helicon plasma source [3] and direct current gas discharges. The latter is a method that rapidly ignites the plasma and further heats it by applying a current between two electrodes immersed in the gas, inside a glass tube.

To produce the required plasma discharges, a high-power double pulse generator was designed and tested using a 5 m plasma cell setup [4]. The first pulse uses up to 120 kV to ignite the plasma into a relatively low current arc (10 A). The reduction in impedance allows the second pulse to increase the arc current up to 400 A using a lower voltage (up to 10 kV). This raises the ionisation fraction of the plasma to the AWAKE required density range [5]. The scalability is possible due to magnetic circuits (composed of common-mode chokes) that guarantee synchronization of discharges and current uniformity across multiple series tubes with shared electrodes.

In this presentation, I will describe the electrical components of the plasma source and the experimental results obtained from the double pulse generator and the current balancing magnetic circuit.

References

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