

Double pulse generator for AWAKE scalable discharge plasma source

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High-voltage pulsed discharges can produce suitable plasma for wakefield particle acceleration experiments, such as the AWAKE. Using two successive voltage pulses, the first for plasma ignition (up to 60kV of ignition voltage with around 20A of plasma current) followed by a second pulse (currents up to 600A) for plasma heating, it is possible, by taking advantage of the low impedance state created by the first pulse, to effectively obtain a highly reproducible plasma lasting tens of microseconds. Length scalability is achievable by adding multiple plasma modules in series (sharing electrodes), and by using a magnetic circuit for current balancing between the modules.

A discharge plasma source, based on this principle was installed in the AWAKE experiment producing over 21 thousand plasma discharges and tested with a double-plasma set-up (3.5 + 6.5m) using two pulse generators and a shared cathode. It was tested as well with different single plasma loads: three different gases (Ar, Xe, and He) and three different plasma lengths (3.5, 6.5 and 10m). The experiment resulted in promising reproducibility results: nanosecond jitter in the main heating pulse and around 1% current variation, crucial for the plasma required precision. Current balancing was possible even with asymmetric plasma lengths.

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