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A Compact Faraday Cup for Nanosecond-Pulse Runaway Electron Beams

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Runaway electron beams play the dominant role in the process of nanosecond pulse discharges, which cannot be fully explained by traditional discharge theories and attracted continuous attentions. In this paper, a new collection device for runaway electrons in nanosecond pulse discharges based on faraday cup was investigated. A VPG-30-200 pulse generator was used to excite discharges and generate runaway electrons with a pulse width of 3˜5 ns, a rise time of 1˜2 ns and an amplitude of up to 200 kV. The measurement system consisted of metal anode, electron collector, sample resistance and signal leading body. The receiving part of electron collector device made of graphite had the shape of cup, with the diameter of 55 mm and a depth of 10 mm. The fast electrons with high energy were gathered and the induced voltage was connected to the oscilloscope through the sample resistances, consisting of ten 50Ω parallel non-inductive resistances. The experimental results showed that the runaway electron beams could be well measured by the faraday cup. The typical waveform of runaway electron beam had the amplitude of 10 mA, a rise time of 400 ps and a pulse width of 3 ns when the applied voltage was 110 kV in atmospheric pressure air. Furthermore, experimental results with pulse sequences proved that both the voltage waveform and electron beams were stable.

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