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Plasma Commissioning in a High Power External Antenna RF-driven Volume-type H- Ion Source

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A high power, high duty cycle, negative hydrogen ion source is in development at ISIS. It will operate in pure volume-production mode and is driven by a $6\frac{1}{2}$ -turn solenoid antenna mounted external to the plasma chamber. A solid-state amplifier with a maximum output of 100 kW in 50 Hz, 1 ms pulses delivers RF power to the antenna via an impedance-matching network. The amplifier has a relatively wide bandwidth, able to deliver full power from 1.8-4.0 MHz. This flexibility allowed straightforward commissioning of the matching network into an inductively-coupled plasma. Striking of the pulsed plasma is facilitated by a compact microwave ignition cavity requiring only 10 W of power at 2.45 GHz to deliver 1 mA seed pulses of electrons. Experiments have shown that it is vital to encapsulate the RF antenna properly to mitigate high voltage sparking. In addition, the location of the antenna relative to the ion source's permanent magnets has a critical effect on the ease of plasma ignition.

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