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Plasma Outages in Pulsed, High-Power RF Hydrogen Ion Sources
MARTIN STOCKLI, BAOXI HAN, SYD MURRAY, TERRY PENNISI, CHIP PILLER, MANUEL SANTANA, ROBERT WELTON, Oak Ridge National Laboratory — Pulsed, high-power RF ion sources are needed to produce copious amounts of negative H- ions for high-power accelerators with charge-changing injection schemes. When increasing the RF power, the plasma inductance changes the RF resonance, which drifts away from the low-power resonance. When the RF circuit is tuned to maximize the (pulsed) plasma power, the (off- resonance) power at the beginning of the pulse is reduced. If the induced electric fields fall below the breakdown strength of the hydrogen gas, the plasma fails to develop. This can be avoided with a compromise tune and/or by increasing the inductance of the resonant circuit. However, the breakdown strength of the hydrogen gas increases with time due to the gradual decrease of the electron-rich plasma impurities, which causes plasma outages after weeks of reliable operation. In this paper we discuss the success of different mitigations that were tested and implemented to overcome this fundamental problem of pulsed, high-power RF hydrogen ion sources.

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