

# Time resolved measurements of hydrogen ion energy distributions in a pulsed 2.45 GHz microwave plasma

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## Abstract-

A plasma diagnostic study of the Ion Energy Distribution Functions (IEDFs) of  $H^+$ ,  $H_2^+$ , and  $H_3^+$  ions in a 2.45 GHz hydrogen plasma reactor called TIPS is presented. The measurements are conducted by using a Plasma Ion Mass Spectrometer with an energy sector and a quadrupole detector from HIDEN Analytical Limited in order to select an ion species and to measure its energy distribution. The reactor is operated in the pulsed mode at 100 Hz with a duty cycle of 10% (1 ms pulse width). The IEDFs of  $H^+$ ,  $H_2^+$ , and  $H_3^+$  are obtained each 5  $\mu$ s with 1  $\mu$ s time resolution throughout the entire pulse. The temporal evolution of the plasma potential and ion temperature of  $H^+$  is derived from the data. It is shown that the plasma potential is within the range of 15–20 V, while the ion temperature reaches values of 0.25–1 eV during the pulse and exhibits a fast transient peak when the microwave radiation is switched off. Finally, the ion temperatures are used to predict the transverse thermal emittance of a proton beam extracted from 2.45 GHz microwave discharges.

## Index Terms-

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