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Plasma density determination from surface-wave transmission spectra SEBASTIEN DINE, JEAN-PAUL BOOTH, GARRETT CURLEY, CORMAC CORR, JACQUES JOLLY, JEAN GUILLON, LPTP, Ecole Polytechnique — We have developed a new plasma density measurement technique based on the transmission spectra of surface waves (SW) propagating along a plasma-sheath boundary. Simple theory indicates that the lowest frequency at which SWs can propagate is equal to $1/\sqrt{2}$ of the plasma frequency, allowing the plasma density to be determined. Our probe (Plasma Transmission Probe or PTP) consists of emitting and receiving antennas joined by a dielectric cylinder, all immersed in the plasma. A sheath forms around this device, creating a cylindrical wave-guide between the antennas along the sheath-plasma interface. The transmission spectrum was measured with a network analyser. Experimental spectra were measured in CCP discharges in argon (40-750 mTorr) and in an ICP, and are compared to the results of an axisymmetric finite element model. The densities determined by this method were found to be lower by a factor 0.5-0.6 compared to those obtained with Langmuir and hairpin probes. We attribute this to the density gradient in the pre-sheath around the PTP, which determines the sheath-edge density. The PTP is promising for the measurement of low densities ($< 10^{10}$ cm^{-3}) at relatively high gas pressure (> 0.5 Torr).

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