Abstract Submitted
for the GEC09 Meeting of
The American Physical Society

High accuracy identification of microwave hairpin resonances MARK BOWDEN, VLADIMIR SAMARA, NICHOLAS BRAITHWAITE, The Open University — The quarter-wave hairpin resonator is a useful density diagnostic in low pressure plasmas. Among its advantages are the immediacy and potential accuracy of the determination of electron density by a microwave frequency measurement. One difficulty in making high precision measurements has been the identification of the precise resonant frequency because of the shape of the resonance and the background signal on which it is superimposed. In a development of the hairpin method the mean potential of the hairpin is directly modulated at a few kHz while a separate, inductively coupled microwave signal is swept through the range of resonance. When immersed in a plasma the low frequency modulation perturbs the electron density in the immediate vicinity of the hairpin, impressing a modulation on the resonant frequency. At resonance there is a sharp phase change in the modulated microwave reflection (referenced to the modulation input). This aids identification of the resonance since all other structure in the microwave signal reflected from the hairpin is unaffected. This provides a simple determination of the resonance that can be readily implemented in software for automated measurements, with time resolution restricted only by the modulation period. The method has been demonstrated in a GEC reference cell with pulsed and steady CCP excitation at 13.56 MHz.

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Date submitted: 12 Jun 2009 Electronic form version 1.4