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Biased hairpin probes NICHOLAS BRAITHWAITE, FRED HAAS, JAFAR AL-KUZEE, The Open University — A hairpin probe is an open, quarter-wave transmission line. When immersed in a plasma its resonant frequency can directly and immediately provide a measure of local electron density, through the plasma's dielectric response. The sheath around the hairpin wires can be relatively large, either at low electron density or when deliberately baised to several times the mean electron energy. A model the hairpin resonance has been developed incorporating sheaths with positive and negative bias, including electron space charge in the former and taking account of the radial geometry. To date, in using the hairpin is has been presumed that its behaviour is well modelled without any independent test, though comparisons with Langmuir probes are certainly favourable. The variation of resonant frequency with bias is an important test of the hairpin concept. Calculations show that, as expected, negative bias lowers the resonant frequency monotonically. Positive bias shows a different trend with an initial sharp increase in resonant frequency at small bias settling into a weakly declining trend at larger bias. The latter behaviour is traced to radial convergence of electrons near the probe wires. Experimental results show similar trends with notable differences that highlight the shortcomings of the model.

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