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Reflections on Electric Probes

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One of the more immediate temptations for an experimental plasma physicist is to insert some kind of refractory, conducting material into a plasma, as a simple means of probing its charge composition. Irvine Langmuir tried it in the 1920s and was one of the first to develop an electrical probe method in his early work on electrical discharge plasmas. There are now numerous variations on the theme including planar, cylindrical and spherical geometry with single, double and triple probes. There are also probes that resonate, propagate and reciprocate. Some probes are electrostatic and others are electromagnetic; some are effectively wireless; most absorb but some emit. All types can be used in steady and transient plasmas, while special schemes have been devised for RF plasmas, using passive and active compensation. Magnetised plasmas pose further challenges. Each configuration is accompanied by assumptions that constrain both their applicability and the analytical methods that translate the measured currents and voltages variously into charge densities, space potentials, particle fluxes, energy distributions and measures of collisionality. This talk will take a broad look at the options and opportunities for electric probes, principally in the environment of non-equilibrium plasma.