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Plasma Diagnostics and Plasma Control with the Multipole Resonance Probe (MRP)

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Of the many diagnostic techniques available or proposed for low temperature plasmas, only a few are *industry compatible*. In order to be useful for supervision and control of technical plasma processes, a diagnostic must be (i) robust and stable, (ii) insensitive against perturbation by the process, (iii) itself not perturbing to the process, (iv) clearly and easily interpretable without the need of calibration, (v) compliant with the requirements of process integration and, last but not least, (vi) economical in terms of investment, footprint and maintenance. One very promising approach to industry compatible plasma diagnostics is plasma resonance spectroscopy, i.e. the attempt to exploit for diagnostics purposes the natural ability of plasmas to resonate on or near the electron plasma frequency ω_{pe}. This approach is particularly suited for depositing plasmas.
The purpose of this communication is to report progress on a particular realization of that concept, namely the multipole resonance probe (MRP). In the MRP, the excited resonances can be mathematically classified and the connection between the probe response and the desired electron density can be evaluated analytically, allowing for a transparent and calibration-free evaluation algorithm. The underlying theory will be presented, as well as the experimental characterization of a first prototype. Two further developments of the MRP will be discussed, namely that of a spatially resolved plasma diagnostics device and that of an in-situ monitor for the supervision and control of plasma processes.
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