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Short_Oral_37: Inverse scattering based plasma density profilometry retrieval in front of ICRF Antennas

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A new profilometry diagnostic method is investigated in this work to measure the plasma electron density profile in front of the Ion Cyclotron Range of Frequencies (ICRF) antennas. As a reference scenario for our numerical study, the Divertor Tokamak Test (DTT [1]) ICRF antennas and plasma will be considered. Specifically, the profilometry needs to solve an inverse scattering problem, which is non-linear and ill-posed. In some recent papers [2-4], we performed plasma imaging profilometry in compact plasma reactors, such as the electron cyclotron ion sources (ECRIS), by means of electromagnetic inverse scattering techniques requiring only measurements of the reflection coefficient. In this paper, we would like to extend this method also to large-size (scale-length) fusion reactors by addressing the profilometry of DTT-like plasma, assuming a very high-frequency probing regime (~ 0.5 THz) for the accessibility of both O and X-modes in the DTT plasma (electron density up to 10^20 m−3 and magnetic field up to 9 T). To this aim, we adopt a ray-tracing technique for describing wave propagation and to determine the probing antenna configuration, with a proper formulation which allows to reconstruct the non-homogeneous plasma, approximated as an isotropic medium, due to the high probing frequency.

[1] R. Martone, R. Albanese, F. Crisanti, A. Pizzuto, P. Martin, "DTT Divertor Tokamak Test facility Interim Design Report, ENEA, April 2019 ("Green Book")" https://www.dtt-dms.enea.it/share/s/avvglhVQT2aSkSgV9vuEtw

[2] L. Di Donato, A. F. Morabito, G. Torrisi, T. Isernia and G. Sorbello, "Electromagnetic Inverse Profiling for Plasma Diagnostics via Sparse Recovery Approaches," in IEEE Transactions on Plasma Science, vol. 47, no. 4, pp. 1781-1787, April 2019, doi: 10.1109/TPS.2019.2902469.

[3] G. Torrisi et al "Electromagnetic inverse profiling for plasma diagnostics in compact microwave-based ion sources Journal of Instrumentation", Volume 14, September 201931 3rd European Conference on Plasma Diagnostics (ECPD2019)

[4] Di Donato, L.; Mascali, D.; Morabito, A.F.; Sorbello, G. "A Finite-Difference Approach for Plasma Microwave Imaging Profilometry". J. Imaging 2019, 5, 70. https://doi.org/10.3390/jimaging5080070

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