MAXWEL: FEM software module to compute EM fields within a magnetically confined fusion reactor

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The study of electromagnetic (EM) wave propagation in inhomogeneous, magnetically confined plasma is highly relevant to nuclear fusion, particularly for ion and electron heating. Evaluating whether an EM wave heats ions and electrons depends on its accessibility. This contribution presents the MAXWEL code, a finite element code designed to simulate EM wave propagation in inhomogeneous confined plasma. MAXWEL calculates EM fields in two-dimensional geometry by solving the Helmholtz equation in the frequency domain. The solver uses linear and quadratic elements, with dense meshes, to efficiently model domains with high precision. Various dielectric media and computational domains, including tokamaks, have been modelled and benchmarked, demonstrating reliability and robustness. Modelling plasma using the cold plasma permittivity tensor showed excellent agreement with the EM code ERMES [2]. Several plasma scenarios, including R and L cutoffs in tokamaks, have been analysed, showing good agreement with theoretical predictions. Future work will incorporate a hot permittivity tensor to account for wave and wave-particle resonances. This code contributes to ongoing efforts in reactor modelling using the ALYA [3] framework.

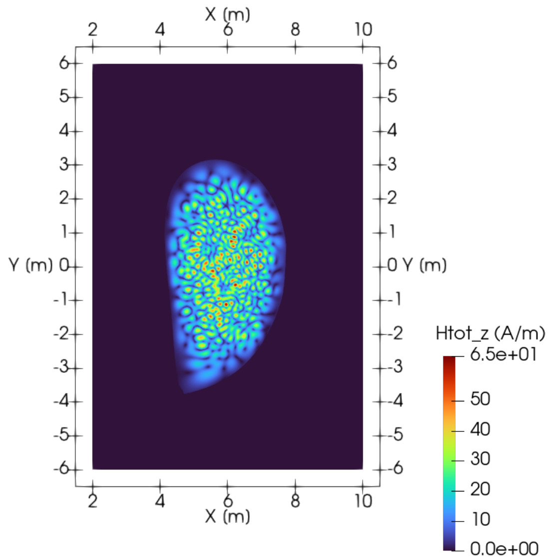

Figure 1: *MAXWEL simulated* H_z^{tot} *field amplitude for an ITER* 2^{nd} *tritium harmonic scenario* $(\omega = 2\omega_{cT})$ *as described in* [1].

References

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