BAYESIAN ESTIMATION OF Z_{eff} IN THE TEXTOR TOKAMAK FROM VISIBLE BREMSSTRAHLUNG AND CXRS MEASUREMENTS

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Abstract

In a tokamak plasma a local measurement of impurity concentration, often characterized by the ion effective charge Z_{eff}, is of great importance with a view to impurity transport studies [1]. Several diagnostic methods exist for the determination of Z_{eff}, each with its specific weaknesses. Here we consider the derivation of Z_{eff} from bremsstrahlung measurements in the visible [2] and from a weighted summation of individual impurity densities, calculated from charge exchange recombination radiation (CXRS) intensities [3]. There is generally no good agreement between the results from both methods, in particular towards the plasma edge, owing to several uncertainties in both the measurement of all required plasma parameters and in the employed theoretical models. This is a long-standing and unresolved problem in fusion plasma physics.

In a first approach towards an improved estimation of Z_{eff}, we combine in a single model the measurement of visible bremsstrahlung emissivities and—carbon being the dominant impurity in most TEXTOR discharges—the carbon density obtained from CXRS measurements based on the C VI transition $8 \rightarrow 7$ in the visible. Both the central Z_{eff} and the central electron density are estimated from the two data sets. The estimated electron density can be compared with the results of diagnostics dedicated to density measurement, thus giving an idea of the quality of the estimation. We conclude by discussing the possibility of the estimation of the edge Z_{eff}.

References

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