Core boron transport studies using CXRS at ASDEX Upgrade

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Impurities in fusion plasmas arise from many different sources including the erosion and sputtering of material from plasma facing components, the intentional injection of impurities for divertor cooling and core radiation control, and the production of helium from the fusion process itself. To achieve optimum fusion performance, future fusion reactors need to control the build up of both high- and low-Z impurities in the plasma core. Therefore, it is important to develop and validate our theoretical understanding of impurity transport in fusion plasmas. At ASDEX Upgrade (AUG), a novel method of studying the core boron transport has been developed and is being used to validate the theoretical understanding as well as the mechanisms behind low-Z impurity transport. This method utilizes the fact that a modulation of the power from the ion cyclotron resonance frequency (ICRF) antennae induces a modulation of the boron density, which can be measured with high spatial and temporal resolution by the charge exchange recombination spectroscopy (CXRS) diagnostics. From a time perturbed boron density signal the transport coefficients, D and v, can be separately determined with high radial resolution by solving an inverse problem, and this is in contrast to what is usually being done for low-Z impurities. This method, thus, combines the advantages of a transient transport analysis performed on modulated signals over many periods, as often applied for heat transport studies, with the high radial resolution enabled by the CXRS diagnostic. It has been applied to a wide variety of AUG H-mode plasmas, and from this, a database of core boron transport coefficients has been assembled. This database and how the transport coefficients depend on the local plasma parameters will be presented in this contribution as well as an in-depth comparison to theory. For the bulk of the database, there is a strong scaling of the transport coefficients with the electron cyclotron resonance heating (ECRH) power and consequently with T_e/T_i. Additionally, there is a quantitative agreement between the measured and the predicted theoretical diffusion coefficients. However, in all cases the convection is predicted to be more inward than is measured, resulting in an over-prediction of the peaking of the impurity density profiles. These results and explanations to the discrepancy will be presented in this contribution.