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 and identifying the mechanisms setting the low-Z impurity transport. This method utilizes the fact that a modulation of the power from the ion cyclotron resonance frequency (ICRF) antennas induces a modulation of the edge boron density, which then propagates into the plasma core and can be measured with high spatial and temporal resolution by the charge exchange recombination spectroscopy (CXRS) diagnostics. From the time dependent boron density signal the transport coefficients, that is the diffusivity D and drift velocity v, can be separately determined with high radial resolution over the entire minor radius. This method 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 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 with T_e/T_i. Additionally, there is quantitative agreement between the measured and the predicted theoretical diffusion coefficients, supporting the theoretical result that diffusion coefficients can be of the same size as the heat conductivities and increase with increasing electron cyclotron heating fraction in NBI heated plasmas. 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 boron density profiles. These results and a discussion of the observed discrepancies will be presented in this contribution.