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O3.101 Role of the radial electric field in Wendelstein 7-X

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The role of the radial electric field in high performance ion-root plasmas on Wendelstein 7-X (W7-X) is examined and compared with neoclassical predictions. In stellarator plasmas the neoclassical radial electric field (Er) is not intrinsically ambipolar, and is instead strongly tied to the plasma profiles. The properties of the Er profile strongly influence neoclassical transport of heat, particle and impurities.
Measurements of the core radial electric field (Er) have confirmed that ion-root conditions (negative Er in the plasma core) have been achieved in W7-X with highdensity plasmas, central ERCH heating and temperature equilibration (Te~Ti). This is an important achievement as these are precisely the plasmas conditions for which W7-X has been optimized. These measured Er profiles agree well with the neoclassical ambipolar Er predicted by the code SFINCS. This good agreement provides confidence in the validity of neoclassical calculations in high-density ionroot conditions, and enables initial studies on the role of neoclassical transport in the optimized high-density regime of W7-X. In addition, these results provide validation that turbulent particle fluxes are intrinsically ambipolar.
Experimental radial electric field profiles are inferred from the perpendicular
velocity (u perp), as measured by the XICS diagnostic, and available with a high time resolution of up to 10ms. These diagnostic measurements provide the detailed profile evolution of the radial electric field in response to changes to the plasma density and heating power. Profile measurements of electron temperature (Te), ion temperature (Ti) and electron density (ne) along with approximations for the average value of Zeff have been used as inputs to the SFINCS code to calculate the ambipolar Er profile along with neoclassical ion and electron heat flux profiles (Qi, Qe). Finally the total experimental energy input to the electrons and ions, from ECRH heating and collisional heat transfer, has been compared to the neoclassical heat fluxes to provide a first estimate for the fraction of transport that can be attributed to neoclassical processes in reactor relevant high-density ion-root conditions.

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