13th International Stellarator Workshop

Radial Electric Field Modification by Perpendicular Neutral Beam Injection in the Stellarator W7-AS

J. Baldzuhn, A. Werner

Max-Planck Institut fuer Plasmaphysik, EURATOM Ass., 85748 Garching, Germany

The radial electric field E_r is of crucial importance for the confinement in stellarators. Typically, high values of E_r are accompanied by improved confinement, both for particles and energy. Two stable roots for E_r are expected from the ambipolarity contraint for the neoclassical particle fluxes: the positive electron-root and the negative ion-root. In the stellarator W7-AS, both roots could be confirmed experimentally by Charge Exchange Recombination Spectroscopy. Those results will be summarized briefly. The electron-root could be achieved by on-axis Electron Cyclotron Resonance Heating, driving a non-ambipolar suprathermal electron flux, resulting in a strongly reduced central electron heat conductivity.
It is planned to enhance the negative ion-root in the gradient region by the recently installed Radial Neutral Beam Injector RNBI, which will be described briefly. In preparation for these experiments, the expected temporal change of E_r by RNBI is calculated numerically to figure out in advance, which type of discharge is most appropriate for a modification of E_r, and provides thus the optimum basis for an improvement of the global confinement.
In a first step, the birth profile of the fast ions is calculated by a Monte-Carlo algorithm. Then the ions are followed along their orbits including slowing-down until deposition occurs, either as lost ions outside the plasma or until they disappear in the thermal bulk. Thus, the radial fast ion flux profile is obtained. From these ion fluxes, the temporal change $\Delta E_r / \Delta t$ is evaluated for a variety of magnetic configurations and plasma parameters.
It is found that the value of $\Delta E_r / \Delta t$ depends only weakly on the plasma density and temperature. The power of the auxiliary heating devices also plays only a minor role. However, much higher $\Delta E_r / \Delta t$ can be obtained by an increasing the accelerating voltage in the RNBI device. But technical limits restrict this to values < 60 kV. Most promising is the modification of the magnetic field configuration. Injection into a magnetic field minimum causes enhanced ripple trapped fast ion losses with maximum values for $\Delta E_r / \Delta t$, promising a maximum improvement of the global confinement properties of the discharges.

Topic no.: 2
Poster preferred.
e-mail: baldzuhn@ipp.mpg.de