Contribution ID: **2989** Type: **not specified**

O3.105 Plasma performance in high-density and high-confinement regimes in Wendelstein 7-X

Wednesday, 10 July 2019 12:40 (15 minutes)

See the full abstract here http://ocs.ciemat.es/EPS2019ABS/pdf/O3.105.pdf

High-density operation is an attractive target for a fusion reactor, as it raises the fusion power output. Stellarators are especially suitable for such a regime, because they are not restricted by the disruptive density limit and because their energy confinement is roughly proportional to the square root of the density. The collisional coupling between ions and electrons is also improved, which is important for the dominant electron heating either by fusion alpha-particles or by ECRH. In addition, divertor detachment can be realized at sufficiently high densities, and, thus, the integrated operation with high power output and tolerable exhaust seems possible. In the last divertor campaign, OP1.2b, the operational space of the large optimized stellarator Wendelstein 7-X was expanded to relevant high densities. We present experimental results and transport analysis of three typical scenarios in the density range 0.8 x 10^20 - 2 x 10^20 m^-3 with closely equilibrated electron and ion temperatures: ECRH heated plasmas with edge gas fuelling, predominantly NBI heated plasmas and discharges with central pellet fuelling. Gas fuelled discharges with ECRH heating are characterized by flat density profiles, ion temperatures limited to values below about 2 keV and the energy confinement time close to the ISS04 scaling. NBI heated plasmas exhibit a pronounced density peaking and a particle barrier at the half radius, where the density peaking can be controlled by addition of a low fraction of ECRH heating. In pellet fuelled discharges, transient phases with improved energy confinement, ion temperatures as high as 3.5 keV and strong temperature gradients are observed. These phases demonstrate the highest stored plasma energy and the highest ion temperatures observed in W7-X so far. The significant improvement in the plasma performance seems to be related to strongly peaked density profiles. Also, in the last two scenarios a consistent reduction of broadband density fluctuations is found. Power balance is used to quantify energy losses in the neoclassical and turbulent channels, and to understand the influence of profile shaping on the transport and on the achievable plasma parameters.

pppo

Presenter: BOZHENKOV, S. (EPS 2019)

Session Classification: MCF

Track Classification: MCF