Physics applications of ion-cyclotron heating on Wendelstein 7-X

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An Ion-Cyclotron Resonance Heating (ICRH) system is in construction for the stellarator Wendelstein 7-X. The primary role of this heating system is to generate a population of fast ion with a large velocity component perpendicular to the main magnetic field. Such a fast particle population will allow a critical test for the confinement of fast ions in the optimized magnetic configuration of W7-X. Other applications are plasma startup and wall conditioning. Details of the physics applications and the status of the construction of the ICRH system will be explained.

Physics Applications of ICRH on W7-X

A crucial test to prove that a stellarator device can be used as a reactor is to demonstrate that fast alpha particles from the D-T fusion reaction are well confined. To mimick alphas in W7-X, fast particles (H,D/^{4}He ,^{3}He) need to be generated with energies up to ~100 keV. This is a challenging task, but can be accomplished making use e.g. of the recently demonstrated and very efficient 3-ion ICRH scheme to accelerate thermal ^{3}He [1] or injected fast ions [2] from the neutral beam injection system with acceleration voltages of ~ 50kV. To this end an ICRH system will be installed in W7-X using the former TEXTOR RF generators, with a frequency range 25-38MHz.. Ion cyclotron wall conditioning and plasma startup are additional applications of the ICRH system on W7-X. The very interesting physics of the 3-ion scheme and of fast ion confinement in a stellarator will be explained and a brief overview of the status of the construction of the ICRH will be shown.

References

[1] Ye.O.Kazakov, J.Ongena, Nature Physics, **13**, 973–978 (2017)
[2] J.Ongena, Ye.O.Kazakov, EPJ Web of Conferences **157**, 02006 (2017)