

HTPD 2018



Contribution ID : 24

Type : not specified

## 10.9 Conceptual Design of a Heavy Ion Beam Probe Diagnostic for W7-X

Wednesday, 18 April 2018 10:30 (120)

A Heavy Ion Beam Probe (HIBP) diagnostic on the Wendelstein 7-X (W7 X) superconducting stellarator will provide a unique ability to advance understanding of neoclassical and turbulent particle and energy transport. We present results of beam simulations which show that measurement signal levels, calculated using neoclassical density and temperature profiles with central densities up to  $10^{20} \text{ m}^{-3}$ , will enable study in the eight W7-X reference magnetic configurations of the equilibrium plasma potential and  $E_r$  at all radii, and ion-scale fluctuations of  $n_e$  and potential in the outer plasma region. Elements of the diagnostic design include (1) a beam of thallium or cesium ions having a maximum energy of 2 MeV; (2) injection and detection of the beam through previously allocated ports; (3) a toroidal magnetic field in the + direction of W7-X; and (4) location of all HIBP system components outside of the W7 X cryostat. These design parameters can be realized using the accelerator and energy analyzer of the TEXT-U 2 MeV HIBP (which is now in Greifswald), and beam steering systems having smaller electrodes and electric fields (but higher voltages) than those of the TEXT-U diagnostic. This work is supported by US DoE Award DE-SC0013918.

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Session Classification : Session #10, Wednesday Morning Poster Session