Measurement of core plasma temperature and rotation on W7-X made available by the x-ray imaging crystal spectrometer (XICS)

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A new x-ray imaging crystal spectrometer diagnostic (XICS) is currently being built for installation on W7-X. This diagnostic will contribute to the study of ion and electron thermal transport and the evolution of the radial electric field by providing high resolution temperature and rotation measurements under many plasma conditions, including ECH heated plasmas. Installation is expected before the first experimental campaign (OP1.1), making an important set of measurements available for the first W7-X plasmas. The XICS diagnostic will provide profiles of the ion-temperature (T_i), electron-temperature (T_e), poloidal flow velocity (V_p) and impurity ion density for the Ar^{16+}, Ar^{17+} and Fe^{24+} charge states. This system will have a maximum time resolution of 5ms, a spatial resolution of 2cm, and spatial coverage from the core to a normalized minor radius of ρ ~ 0.8. The XICS diagnostic relies on impurity emission from highly charged impurity ions, and is designed to measure emission from both injected argon and intrinsic iron. A one dimensional image of line integrated emission spectra is recorded, and tomographic inversion using a known plasma equilibrium is used to infer the local plasma parameters from the line integrated data. The detailed layout and expected performance of the diagnostic will be presented along with a discussion of spectral analysis and tomographic inversion techniques. The W7-X XICS diagnostic design is similar to the XICS installation on the Large Helical Device (LHD)[1], and a presentation of recent results from the LHD system will be presented to demonstrate the diagnostic capabilities.

References: