Performance tests of the ASDEX Upgrade

Imaging Motional Stark Effect diagnostic (IMSE)

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Coherence imaging has been proposed[1] as a new method to measure two dimensional images of Motional-Stark Effect (MSE) polarised neutral beam emission in Tokamak plasmas.

Modelling shows that the quantity of measurements and their 2D nature opens the possibility of accurate 2D plasma current tomography in Tokamaks. Early results from Textor[1] showed promise and systems have now been successfully implemented at K-STAR[2] and ASDEX Upgrade.

Prior to installation, the ASDEX Upgrade IMSE system was subjected to a series of tests to demonstrate the concept, quantitatively assess its capability and choose optimum operating parameters. During these, several unanticipated effects were discovered, identified and mitigated.

A controlled recreation of the MSE polarised spectrum is produced using a set of light-sources, filters and polarisers and used to illuminate the IMSE diagnostic. First, the spectral-coherence concept is demonstrated by confirming that the system can measure the polarisation angle despite zero net polarisation over the filter passband. Several advantages over conventional MSE systems are demonstrated, such as insensitivity to wide-band and/or unpolarised background light, high spatial resolution and independence of spectrum details. Measurement of polarisation ellipticity from Stark-Zeeman coupling is also possible and the accuracy of this is assessed.

A variety of designs and operating modes have been proposed for coherence imaging polarimeters. Each is tested here and the achieved accuracy and relative benefits compared in order to determine the optimum for plasma measurements on ASDEX Upgrade. Finally, the accuracy of the primary quantity of interest - the polarisation angle - is demonstrated to below the required ±0.2° over the expected operating range.

Results from the first plasma measurements will be presented at main EPS conference 2013.

References