**Design and commissioning of the new Imaging Motional Stark Effect diagnostic at ASDEX Upgrade**

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Motional Stark Effect (MSE) diagnostics are one of the main diagnostics capable of providing information on the current distribution in magnetically confined fusion plasmas. However, they are typically very difficult to calibrate and to maintain due to the complexity of the systems. Imaging MSE (IMSE), on the other hand, offers several advantages over the classical approach [1-3].

Like classical MSE diagnostics, IMSE systems also utilise the Stark-split D-alpha light from neutral beams injected into fusion plasmas. However, once collected the light is lead through a series of birefringent (Savart) and displacer plates, a delay plate and finally a polariser before being imaged onto a CCD chip, forming an interference pattern. While conventional MSE systems typically filter out the $\pi$- or $\sigma$-lines of the Stark spectrum, the IMSE diagnostics utilises all lines. The inclusion of the delay plate in the setup enables the two components to be added constructively in the interference pattern, maximising the signal intensity. From the interference pattern it is possible to obtain a 2-D image of the polarisation angle, which allows for a tomographic reconstruction of the plasma current. Moreover, the 2-D image simplifies the identification of reflections and provides inherent position calibration as the vessel components on the image can easily be compared to the CAD model of the machine.

A prototype of the new diagnostic was successfully tested at ASDEX Upgrade in 2014, motivating a permanent IMSE system, which was installed for the 2015 experimental campaign. The new system has a specially designed set of optics that maximises the collected light throughput while enabling three neutral beam sources to be viewed simultaneously. The design of the new diagnostic and the effectiveness of the new calibration techniques will be shown. Moreover, initial measurements including a comparison to the results from the conventional MSE system will be presented.

**References**