Development of Fibre Optics Current Sensor synthetic diagnostic for ITER

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The Fibre Optic Current Sensor (FOCS) is a diagnostic system, to be installed on ITER as a part of Diagnostic upgrades beyond the 2016 Baseline and to be enabled for PFPO-1. In the present-day magnetic fusion devices, tokamaks, including the biggest European machines JET and Tore-Supra (in the framework of the WEST project) the plasma current measurements rely on the inductive type sensors: Rogowski coils, saddle lops, etc. Coil based sensors provide a signal which is proportional to the time derivative of the magnetic flux through the sensor loop. In case of a nearly stationary operation the magnetic flux is also nearly constant and the useful signal is close to zero. To obtain accurate data in case of a long plasma discharge with weakly changing current sophisticated integration-based signal processing is required. This situation may result in non-linear drifting of the signal. Moreover, in case of burning plasma experiments, like ITER, the presence of strong nuclear radiation fields should result in a high level of parasitic currents in electromagnetic sensors and may generate a significant error of the plasma current estimation. To mitigate the risk of the measurement drift of the inductive sensors, FOCS was proposed as a back-up option.
Important knowledge on using FOCS for plasma current measurements is already available thanks to FOCS implementation at JET. However, the operation conditions of ITER FOCS will be different from that at JET. In this regards, it is important to develop a FOCS model relevant for ITER environment in order to predict the measurement performance of the diagnostics and to support both ITER plasma operation and research activities. In the presentation we will describe development of the FOCS synthetic diagnostics which will be a part of the ITER Integrated Modelling & Analysis Suite (IMAS). The model takes into account constrains related with the ITER implementation. The physical background of simulation approach based on the Jones matrix formalism will be outlined and results of the FOCS operation simulation for several scenarios will be presented. The simulations show that the stability of the optical link between the sensing fibre placed on the vacuum vessel and the data acquisition hardware is important to satisfy the measurement accuracy requirements.

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