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2D and 3D modelling of JT-60SA for disruptions and plasma start-up

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The JT-60SA is a superconducting tokamak device being built as a joint international project between Japan and Europe in the frame of the broader Approach agreement. One of the main goals of JT-60SA is to study practical and reliable plasma control schemes in view of the power plant. Plasma electromagnetic modelling is one of the essential tools for plasma operation in a fusion device and they require detailed models for ensuring an accurate preparation of the magnetic controllers. To achieve this goal, suitable models are needed at different level of details. 2D plasma nonlinear equilibrium codes are used to develop the operational scenarios and to perform breakdown studies. Furthermore, three-dimensional modelling permits the assessment of 3D vessel structures on the plasma behaviour, e.g. during disruptions, as well as to study non-axisymmetric plasma instabilities. On the other hand, engineering-oriented models are essential for the commissioning of the magnetic diagnostics, and the design of control algorithms.
In this context, a set of alternative modelling tools based on the CREATE 2D equilibrium codes have been developed as additional benchmark for magnetic modelling. These tools have been exploited to perform breakdown studies and to design a preliminary functional architecture of the plasma magnetic control system. Furthermore, several studies of the impact of three-dimensional structures on plasma evolution have been carried out, ranging from pure electromagnetic analysis of the magnetic field produced by the non-axisymmetric coils, to nonlinear evolution of n=0 instabilities.
In this paper, we report on the activities that have been carried out exploiting the CREATE modeling tools. In particular, 2D modelling has been exploited to study the magnetic configurations for the EC assisted breakdown, while 3D tools have been used to evaluate the effect of three-dimensional structures on evolutionary equilibrium of axisymmetric plasmas.

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Primary author: Prof. DE TOMMASI, Gianmaria (Università degli Studi di Napoli Federico II)

Presenter: Prof. DE TOMMASI, Gianmaria (Università degli Studi di Napoli Federico II)

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