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JT-60SA Status and advances towards the initial operational phases

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JT-60SA is a fully superconducting tokamak device jointly designed, built, and exploited by Japan and Europe under the Broader Approach Satellite Tokamak Programme, and under the Japanese national Programme [1]. JT-60SA is the largest tokamak ever built before ITER and it can provide essential information for risk mitigation towards the D-T operation in ITER but as well explore new routes for the optimization of the DEMO design.

In particular, JT-60SA will expand the physics domain from current tokamaks towards plasmas at higher beta, in the presence of electron heating provided by high-energy fast ions, with low collisionality and in stationary conditions lasting for several current diffusion times [2]. Regarding disruptions suppression and mitigation techniques, JT-60SA provides a unique testbed that considerably expands previous studies in JET to higher thermal and magnetic energy plasma conditions.

The recently appointed experiment team is in charge of the preparation of the JT-60SA experimental programme and it has undertaken a predict-first activity in view of a better preparation of the initial JT-60SA experimental campaigns.

The accessibility to the main expected scenarios, baseline, hybrid and high-beta steady-state has been analyzed with integrated modelling tools and sensitivity analyses to the plasma actuators have been carried out. The potential destabilization of Alfvén modes by the negative ion beam injection has been studied showing that such modes can be actively expected. From the heat transport point of view, gyrokinetic simulations show that in the high beta plasmas Kinetic Ballooning Modes (KBM) can be expected, which indicates a new paradigm of transport dominated by electromagnetic fluctuations. An important activity has been carried out towards the design of detailed plasma control schemes prepared to be used in high beta with high triangularity plasmas, a domain which is particularly challenging and important for ITER and DEMO.

Finally, the analyses of the data obtained during the first operation, expected in 2023, and during which the first plasma will be obtained, provides a first chance to compare with the predict first activity recently carried out in support of this initial operation.

[1] H. Shirai IAEA-FEC, London, October, 2023
[2] M Yoshida et al 2022 Plasma Phys. Control. Fusion 64 054004