Advances in the physics studies for the JT-60SA tokamak exploitation and research plan

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JT-60SA is a large fully superconducting new tokamak device being built jointly by Europe and Japan, and due to start operation in 2020 [1]. In this prospect, a broad set of preparation activities [2] has been carried out for years, involving the elaboration of the JT-60SA Research Plan [3], and is now focusing on the forthcoming experiments. The physics results obtained are not only relevant to the future JT-60SA experiments, but often constitute original contributions to plasma physics and fusion research. In particular, results have been obtained and research is further progressing on the following subjects:

- test and selection of models for transport, pedestal, H&CD, combined into integrated modelling simulations, and validated on JET and JT-60U selected sets of discharges [4-6]
- gyrokinetic modelling of impact of fast ions and electromagnetic effects on turbulent transport in high-beta regimes
- non-linear studies of ELM stability with the JOREK code
- core/SOL/divertor and impurity seeding simulations for C and W PFC configurations
- non-linear 3D kinetic modelling of RWM and their control
- MHD instabilities associated with fast ion distributions produced by NBI
- experimental validation of wall conditioning methods by EC waves
- advanced modelling of EC-assisted breakdown and magnetic control
- first results of a new simulator combining plasma model and free-boundary equilibria.

An overview of the main results achieved by these studies will be presented. The highlights of the scientific programme that will be carried out, as described in the final version of the Research Plan, will be discussed, with particular focus on the first experimental campaigns.

[1] H. Shirai et al., Nucl. Fusion **57** (2017) 102002.

[2] G. Giruzzi et al., Nucl. Fusion **57** (2017) 085001.

[3] JT-60SA Research Plan - Version 4.0, Sept. 2018, http://www.jt60sa.org/pdfs/JT-60SA_Res_Plan.pdf

[4] J. Garcia et al., Nucl. Fusion **54** (2014) 093010.

[5] N. Hayashi et al., Nucl. Fusion **57** (2017) 126037.

[6] L. Garzotti et al., Nucl. Fusion **58** (2018) 026029.