DEVELOPMENT OF A GENERIC MULTIPURPOSE

TOKAMAK PLASMA DISCHARGE FLIGHT SIMULATOR

<u>Ph. Moreau</u>[1], S. Bremond[1], N. Ravenel[1], S. Mannori[2], J.F. Artaud[1], P. Pastor[1], F. Saint-Laurent[1], Ph. Huynh[1], F. Imbeaux[1], B. Guillerminet[1], P. Bayetti[1]

[1] CEA, IRFM, F-13108 Saint-Paul-lez-Durance, France
[2] INRIA, Rocquencourt

Corresponding author: philippe.jacques.moreau@cea.fr

The optimisation of present tokamak plasma experiments and the preparation of ITER operation highlight the needs of new plasma discharge simulation tools: the access to high performance relies more and more on advanced control schemes, such as MHD modes or plasma profiles control that are to be designed by extensive simulations before experiment; the machine protection issues, that are becoming crucial with water-cooled and/or metallic wall devices, require a very careful off line and online check of the plasma discharge behaviour. Experimental time and cost saving call for a more systematic and more extended pre-pulse validation of the plasma discharges settings and real-time data processing codes. These needs will definitely be essential for the operation of ITER.

In order to fulfil all these needs, the development of a generic multipurpose tokamak plasma discharges flight simulator has been started. It is generic in the sense that it makes use of the tokamak engineering and plasma physics data standardisation defined under the European Integrated Tokamak Modelling Task Force (ITM-TF) [1], and thus may be applied to whatever tokamak facility, as soon as its specific features are provided (e.g. poloidal field coils system, vacuum vessel geometry, heating systems, etc.). It is multipurpose in the sense that it allows both stand alone tokamak discharges simulation in a "full simulation" mode but also several "hardware in the loop" modes where a more or less extended part of the real tokamak Plasma Control System (PCS) is included. These last modes, which are of course partially depending on the PCS technology particular to a given facility, have been developed on Tore Supra, as a test case.

The simulation platform is based on the Kepler open source software used by the ITM-TF, where tokamak engineering and plasma models are provided or can be easily added. This simulation platform has been successfully coupled to the Scicos open source control toolbox for the feedback control design tasks.

The paper will report on the present status of the project, reviewing in particular the architecture of this generic multipurpose tokamak plasma discharge flight simulator, with the different software/hardware interfaces. Test cases both in the "full simulation" and "hardware in the loop" modes will be presented.

[1] A. Becoulet, Comput. Phys. Commun. 177 (2007)