IFERC Newsletter

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Status of CSC activity

Highlights of CSC activity

The objectives of IFERC in BA Phase II are to support ITER, JT-60SA and IFMIF/EVEDA and to consolidate the know-how for the development of future fusion reactors (DEMO). In line with the objectives, F4E together with EUROfusion, and QST continuously promote simulations in IFERC-CSC. CSC activity in 2022 includes:

- The sharing of experience and best practices in the design and operation of HPC centres for fusion users and in the usage of such centres by fusion users (EUROfusion and QST).
- The organization and monitoring of the provision of computer resources to IFERC (EUROfusion and QST) with the support of the joint allocation committee (JAC) for their allocation and the assessment of the results.
- The support for fusion research projects including the supply of high-level support for the usage of Marconi100 (EUROfusion), the supply of support to high priority simulation activities (QST), and the organization of workshops to share important outcomes of these projects.
- The analysis and planning of high priority simulation activities in order to identify important issues not sufficiently addressed by existing projects and, in this case, to make proposal in order to improve the situation (QST).

From the beginning of the BA Phase II (April 2020), half of the total resources of the high-performance supercomputer JFRS-1 in Rokkasho is provided by QST as a JA host contribution for BA simulation projects. In addition, a portion of Marconi 100 (equivalent of 10 nodes of GPU accelerator) is provided to JA users as EU voluntary contribution. The IFERC HPC follow-up working group monitors the CSC activity including the usage of the resources and the allocation of resources performed by the JAC, which also evaluates the results.

In order to support ITER project in the framework of IFERC-CSC, collaborative work has been performed in two high priority areas: uncontrolled disruption studies (Modelling of disruptions in ITER) and edge/SOL /divertor simulations (ITER edge/SOL/divertor plasma simulations). ITER unmitigated disruptions of the type “asymmetric hot vertical displacement events (VDEs)” are simulated with the 3D MHD code JOREK, in order to assess the maximum horizontal forces that are expected to act on the ITER vacuum vessel. Two phases can be distinguished during these events: the loss of thermal energy (Thermal-Quench, TQ) and the consequent loss of magnetic energy (the Current-Quench, CQ). The simulations performed have resulted in the first estimations of the TQ properties during asymmetric hot VDEs in ITER. Scans of the re-scaling factor show that the ITER TQ duration in these events is expected to take more than 10 ms (Fig-1), which is significantly longer than expected from experimental extrapolations (1-3 ms). This result is convenient for mitigation procedures.

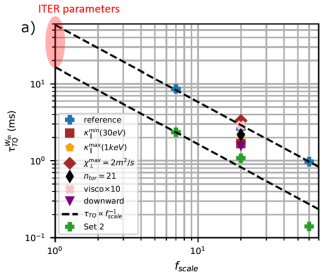

Fig-1: TQ time as a function of the re-scaling factor

Another ITER relevant result comes from a JFRS-1 project where the MEGA code is used for transport simulations of fast and slow alpha particles during a sawtooth crash in JET geometry, focusing on the He ash removal problem. The results demonstrate energy-selective transport of He ash and confinement of fast alphas in sawtooth crashes under certain conditions. The evolution of isotropic distributions of alphas as passive tracer particles is shown in Fig-2. This demonstrates how a benign sawtooth crash starting from q0 ~ 1 can expel He ash (< few 100 keV) while retaining fast alphas (> 1 MeV).

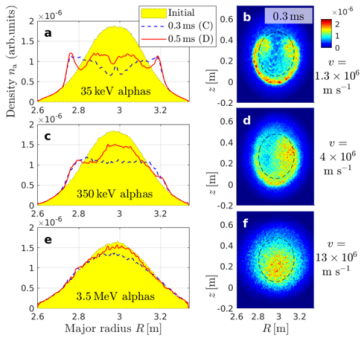

Fig-2: Alpha particle density profile with different energy [Adopted from Nat. Comm. 13 (2022) 3141]

(CSC TCs)