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NEXT (Numerical EXperiment Tokamak) project and future prospect of burning plasma simulation

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The NEXT (Numerical EXperiment of Tokamak) project is directed at understanding the complex properties of fusion plasmas and predicting the physical processes in the next generation of tokamaks, such as JT-60SA, ITER (International Thermonuclear Experimental Reactor) and DEMO using recently advanced computer resources. To achieve our project, we are developing numerical simulation codes which are applicable for prediction of properties of the core plasma and the divertor plasma on equal footing. This project was initiated at 1996 and has been continued up to now. There was a turning point. From January 2012, IFERC-CSC (International Fusion Energy Research Center – Computer Simulation Center) HELIOS supercomputer [1] started the operation under ITER BA (Broader Approach) between Japan and EU. The 5 years operation has successfully completed at December, 2016. In this period, the multi-scale simulation research on Tokamak plasmas confinement has been propelled to contribute to an early realization of DEMO reactor. From June 2018, the new supercomputer JFRS-1 (Japan Fusion Reactor Simulator – 1) will start the operation which is the largest supercomputer dedicated for the magnetic fusion research purpose [2]. Using the new supercomputer, we will explore the mutual interaction between core transport and PWI (plasma wall interaction) which is a crucial issue for self-ignition in ITER plasmas. The multi-physics simulation technique will be developed as well.

Figure 1 shows the schematic view of multi-scale nature of fusion plasmas [3]

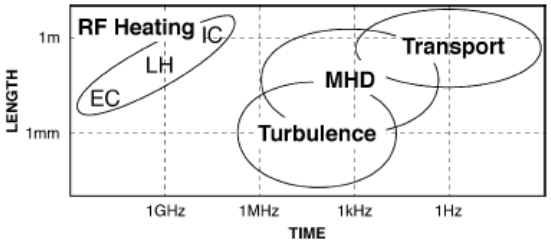

Fig.1 The range of time and spatial scales of the phenomena in fusion plasmas cited from Ref.[3].

The multi-phase simulation method is developed to treat the multi-scale interaction in fusion plasmas [4] as well as the direct simulation method [5] using the super computer such as Kei [6] and Helios.

The multi-physics simulation in fusion plasmas is important topic for the prediction of burning plasmas. It is reported that C and W wall drastically change the characteristic of core confinement [7]. It is an urgent task to understand the mutual interaction between core confinement and PWI, the integrated simulation technique will be developed to tackle this problem[8].

References

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It will appear in the top 500 list of June 2018.
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