§43. Construction and Development of Long Term Sustained Spherical Tokamak "QUEST" in Kyushu University

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Long term sustainment and steady state operation (SSO) is one of the most critical issues for realization of the future fusion reactor. The analysis and understanding of the plasma-wall interaction (PWI) is the quite important issue from the viewpoint of density control for SSO, since a wall plays significant roles both as the particle sink and source. In TRIAM-1M, the ultra-long discharge with the duration of 5 h 16 min has been achieved using a local movable limiter with large cooling capability, and the extensive studies especially on PWI have been carried out.

In order to extend and develop the experimental results and knowledge by TRIAM-1M, a new project of long term sustained spherical tokamak "QUEST" has been proposed, and the device construction has been carried out as the three years plan (FY2005-2007). The device has been completed at the end of FY2007, that is, at the end of March, 2008, as shown in Fig.1.

Main objectives of the project are to investigate the following issues:

i) Development of current start-up and long-term current driving in an ST.

ii) Integrated studies of plasma performance and PWI in long term sustained ST with the advanced active wall-temperature control and a divertor system with intensive pumping.

iii) Studies on comprehensive understanding of toroidal plasmas.

The device parameters are decided to be as a major radius of R = 0.68 m, a minor radius of a = 0.40 m (the aspect ratio R/a = 1.70), and a magnetic field strength of B = 0.25 T (M_{max} = 0.5 T) in order to carry out the issues above. A plasma current of 20 kA with the density of several x 10^{18} m^{-3} at the present heating power level, and 100 kA at the level of 1 MW are expected to be obtained in the quasi-steady state operation.

The main parameters of the device are listed in Table I. The device check on vacuum, the connection of power sources and radio-frequency sources have been carried out.

Period	1st	2nd (CW)	2nd (Pulsed)	Final
Major R (m)	0.68			0.64
Minor a (m)	0.40			0.36
Aspect Ratio	1.70			1.78
Radius of V.V.(m)	1.4			
Height of V.V.(m)	2.8			
BT(T)	0.25	0.25	0.5	0.25
IP(MA)	～0.02	0.1	0.3	0.5
Pin(MW)	0.45	1	3	3
k	1.6	1.6	1.6	2.5
d	0.4	0.4	0.4	0.7

Table I The main parameters of QUEST.

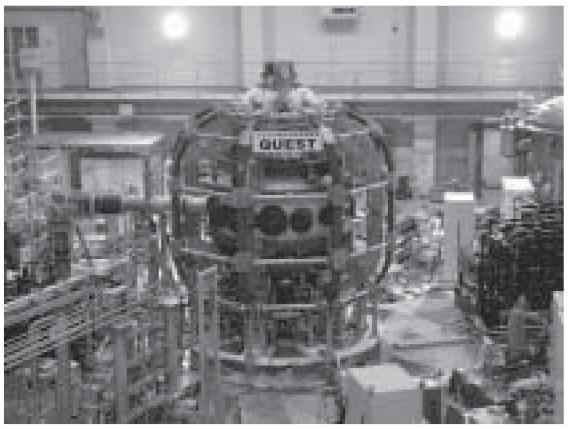

Fig.1 The new device : "Long term sustained spherical tokamak QUEST" in Kyushu University.