

## §59. Planning of the All-Japan ST Research Program

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Based on the recommendation of the Fusion Research Working Group and the conclusions of the “Kyushu University Plasma Boundary Dynamics Experimental Device Review Committee”, spherical tokamak (ST) research in Japan was reorganized in 2005 as All-Japan ST Research Program supported by NIFS Bi-Directional Collaboration, and a new ST device QUEST was constructed at Kyushu University to fulfill one of the missions of this program, steady state operation. The formal establishment of the NIFS Bi-Directional Collaboration Research Promotion Expert Subcommittee for ST Research (ST Subcommittee) in November 2006 marked a great progress. The ST Subcommittee makes plans for activities in the entire field of ST research, coordinates collaborative efforts among different research groups, discusses any issues related to ST research, and reports to NIFS Bi-Directional Collaboration Committee as necessary. Since then, this Subcommittee has been working to establish the research plan of All-Japan ST Research Program and to coordinate its activities. The activities of the ST Subcommittee are published on the All-Japan ST Research Program website at NIFS, <http://www.nifs.ac.jp/kenkyo/icr/st.html>.

All-Japan ST Research Program promotes creative and innovative research at universities and other institutions. To maintain international competitiveness and to make significant contributions internationally, it is crucial to integrate all resources, including experimental research using existing devices in addition to the new ST, as well as theoretical and computational research. The purpose of this collaborative research is to plan and support the activities of All-Japan ST Research Program, making maximum utilization of NIFS Bi-Directional Collaboration, actively involving various ST research groups.

Two (Sixth and Seventh) meetings of the ST Subcommittee were held during FY2009. A key member of the All-Japan ST Research Program and the ST Subcommittee, Dr. Satoshi Nishio has passed away. He was a world leader in reactor design and was instrumental in promoting the low aspect ratio approach towards an economically competitive commercial fusion reactor. His membership in the ST Subcommittee was succeeded by Dr. Takahisa Ozeki of JAEA. The Sixth Meeting was held at Kyushu University on August 31, 2009. The Seventh Meeting was held at NIFS on March 17, 2010. Two new ST experiments QUEST (Kyushu Univ.) and UTST (Univ. Tokyo) have started operation since the establishment of All-Japan ST Research Program. It is timely to discuss a more concrete research strategy beyond the general goals

of “high beta” and “steady state”. It is also necessary to clarify the relationship of ST research with conventional tokamak (ITER and JT-60SA) and helical (LHD) research, as well as contribution to basic plasma physics research. The role of Japanese ST research was discussed in light of existing national ST programs NSTX (US) and MAST (UK). It was confirmed that Japan should contribute by innovative research (such as CS-less start-up, ultra-high beta ST formation by plasma merging, etc.) utilizing the versatility of university-scale experiments, and the extension of novel ideas in collaboration with NSTX and MAST. In order to accomplish these goals, active collaboration among research groups in Japan (including theory, modeling, and reactor design) is crucially important. However, inter-university collaborations are difficult to realize within the frameworks of presently available collaboration systems (with the exception of Kyushu Univ.). Therefore, improvements to allow more flexibility are necessary. It is particularly important to come up with a plan to succeed reactor design studies lead by Dr. Nishio up to now.

The ST Subcommittee has the function of coordinating contributions to the IEA Implementing Agreement from Japan. The Executive Committee for IEA IA was held in Madison, Wisconsin on October 22, during the International ST Workshop. Participants from Japan were Prof. A. Komori (via televideo) and Y. Takase (in person). Multilateral collaborations have become possible under this framework, and international collaborations are being strengthened as a result. The EBW plasma start-up experiment has started as the first trilateral (US-UK-JA) collaborative project under the IEA IA on ST. Japan leads the world in this research, and Japanese contribution is very important. A high-power (200 kW) long-pulse (0.3 s) 28 GHz gyrotron was transferred from ORNL to MAST. The first experiment using this gyrotron was performed in September 2009. H. Tanaka (Kyoto Univ.) and Y. Takase (Univ. Tokyo) participated in this experiment as Japanese representatives. Unfortunately, this experiment was plagued by arcing in the transmission line, preventing long-pulse full-power operation. However, important information on the ST configuration formation process was obtained by varying PF coil current and gas injection waveforms. This result was reported in the invited talk entitled “Electron Bernstein Wave Studies in MAST” by Vladimir Shevchenko at the 26<sup>th</sup> Annual Meeting of the Japan Society of Plasma Science and Nuclear Fusion Research, and active discussions followed. Experiments will continue at higher power and longer pulse length after repair of transmission components. The Japanese contribution will be coordinated by the ST Subcommittee. The results of these experiments have a large impact on the design of burning ST devices such as a volumetric neutron source and a commercial fusion reactor.

Up to now, collaboration with the US has been proposed and performed individually under the framework of the Japan-US Cooperation Program. It is important to strengthen activities under this program (with NSTX in particular). The ST Subcommittee will coordinate these activities as required.