

§5. Archival Studies on Devices of Fusion Science

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The research for the peaceful use of thermonuclear energy has been progressed through an iterative process including the experimental evidence of physics principle and the improvement of experimental apparatus. To analyze and investigate the progress process of the research and development on the basis of evolution of the experimental devices for fusion research gives useful knowledge and suggestions for a course of research and development on future big scientific projects such as nuclear fusion. The studies of experimental devices, including the idea with their evolution, will help us to find the way to resolve technical difficulties and scientific problems on the research.

The main objective of this research is to collect and arrange the documents/materials on the devices of fusion research, which were built and used from the early stage in the fusion research to the recent fruitful stage. Another objective is to provide the collection as materials available to historians as well as scientific researchers.

Activities in this fiscal year

We have historically reviewed the experimental devices in the dawn of fusion research in Japan (1945 to 1965) by referring to proceedings of meeting of relevant academic societies, scientific journals and committee reports.

In Japan, discussions and thoughts on the use of nuclear fusion energy began after the second Geneva Conference in 1958. The pioneering experimental works started in Osaka University and in Electro Technical Laboratory.

Until 1957 when experimental studies of gaseous discharge related to pinch had been reported in the gas discharge session in the meeting of Physical Society of Japan, gas discharge physics still had been an active field of study both in universities and in industrial laboratories, and there had been no presentations related to nuclear fusion. Since 1958 when fusion researches were declassified, activities of fusion research were increased in Universities, and the presentations of gas discharges and plasma studies related to fusion had increasingly appeared.

By the early 1959, the experimental works on the three confinements: pinch, mirror and stellarator concepts, which had been pursued in the world, had been carried out in universities and institutes in Japan. Works on the pinch concept had been carried out 1) at Osaka University, at The Institute of Physical and Chemical Research, and at Tokyo Institute of Technology for linear pinch, 2) at Nagoya University and at Mitsubishi Atomic Power Industries for torus, and 3) at Electro Technical Laboratory for torus and Scylla. The Stellarator approach had been pursued 1) at Kyoto University for Heliotron, 2) at Toshiba Research and Development Center and at Tokyo University for Scallop and 3) at Tokyo University for figure-8. The magnetic mirror concept was developed 1) at Nihon University and at Toshiba Research and Development Center with compression, 2) at Hitachi Central Research Laboratory with Ion cyclotron heating, 3) at Osaka University for DCX, 4) at Tohoku University with magnetohydrodynamic wave heating, and 5) at Nagoya University for fundamental confinement study. Although these researches followed the experiments that had already carried out in the world, and aimed at confirming the results of them and improving their performance, they developed their apparatus on the basis of their own idea individually.

In several years from 1957, most of the fundamental plasma physics researches moved to the studies on the magnetized plasma from on the plasma without magnetic field. Then the experimental apparatus had evolved from the small glass discharge tube to the vacuum chamber assembled with the electrodes, the window for diagnostic and the magnetic coils.

Around the beginning of 1960, the necessity of better understandings of plasma in magnetic field had been realized because a number of difficulties had appeared in early stage experiments, and the researches for fusion tended toward fundamental plasma studies by using good qualities plasma and precise diagnostics. Such a thought led to the foundation of Institute of Plasma Physics, Nagoya University in which physics oriented researches were prior to others. Q.P. Project and Test Plasma Program had started as the first experimental program in the Institute for high temperature plasma research and for fundamental plasma study, respectively.

Present status to collect documents and future plan

In this fiscal year, some documents of the mirror machine in University of Tsukuba, GAMMA, have been collected by the collaboration with University of Tsukuba.

We are going to continue to review the evolution of the devices for fusion research in Japan and to collection the documents of them, especially the materials of the torus devices.

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