

§7. Studies on History of Fusion Energy Conference and International Exchange of Nuclear Fusion Research in Japan

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We report the results of our research on history of nuclear fusion research carried out by the cooperative research “Archival Studies on History of IAEA Fusion Energy Conference”. These results were based on the historical documents that are kept in NIFS Fusion Science Archives and so on. In this fiscal year, we studied 1) History of Tihiro Ohkawa’s nuclear fusion research in 1960s; 2) Survey on the conference reports about Second Conference on Plasma Physics and Controlled Nuclear Fusion Research (the Culham Conference).

1. History of Tihiro Ohkawa’s nuclear fusion research in 1960s

Tihiro Ohkawa is the most famous one among Japanese nuclear fusion researchers. He graduated and got Doctor of Science from the University of Tokyo. After staying at CERN, Midwestern University and others, he moved to General Atomic (GA) and started multipole research with Donald W. Kerst in 1960.

At first, they made the linear octopole device to show that injection from coaxial plasma gun is available, because theory group of nuclear fusion research of GA opposed launching the multipole program. GA multipole group demonstrated that multipole was able to make the quiescent plasma and their experimental results were published in the *Physics Fluid* in 1963. In the meantime, Kerst transferred to the University of Wisconsin and started a multipole program in 1963. Therefore, Ohkawa became the director of multipole program (correctly, the head of experimental physics in the nuclear fusion research program) at GA. Then GA multipole group undertook to make a D.C. toroidal octopole device. In 1965, he demonstrated the effectiveness of average minimum B by the D.C. toroidal octopole experiment at the Second Conference on Plasma Physics and Controlled Nuclear Fusion Research. His result was called “the milestone of nuclear fusion research” by L.Spitzer Jr.(PPPL) in the summary talk of this conference. Thereafter, toroidal octopole has been converted to quadrupole configuration to compare the instabilities and the confinement time with toroidal octopole. The comparison between the configurations was presented at the Third

Conference on Plasma Physics and Controlled Nuclear Fusion Research in 1968 by Ohkawa, Masaji Yoshikawa and Arthur A. Schupp, Jr.

On the other hand, he had an influence on the line of nuclear fusion research in Japan. Shoichi Yoshikawa (PPPL) and Ohkawa (they were called “the brain drain of Japanese scientists” by Kodi Husimi et al.) advanced their opinions on the future plan for Japan (mainly the IPP Nagoya University) in 1967. Ohkawa advised that Japan would catch up with the world in nuclear fusion research if Japanese researcher started the plasma confinement research immediately. As the result of their advices Japan reached the turning point in its research. Thereafter, as often as he went back to Japan, Japanese fusion researchers invited comments from him.

2. Survey on the conference reports about Second Conference on Plasma Physics and Controlled Nuclear Fusion Research (the Culham Conference)

In 1965, the Second Conference on Plasma Physics and Controlled Nuclear Fusion Research was held in U.K.A.E.A. Culham Laboratory. Conference Reports or Trip Reports are available by participants from major countries. We investigated contents of conference reports of Japan, the USA and the UK.

Almost all Japanese participants: Shigeru Mori (JAERI), Shigeo Nagao (IPP) and Hiroshi Ito (Osaka Univ.) reported the result of GA toroidal octopole. However, they stated only that GA toroidal octopole accomplished the quiescent plasma and didn’t point out the effect of average minimum B on its realization.

Conference reports of the UK were found in U.K.A.E.A. Culham Laboratory reports. R.J.Bickerton and A.Gibson mentioned in each report that Cs plasma experiments of Wendelstein-I (Stellarator) and octopole in West Germany showed containment times ranging from 5 to 10 times the Bohm time. These results weren’t discussed in Japanese conference reports.

In the case of the USA, H. P. Furth (LRL) summarized the conference results as follows: (1) The open-ended systems didn’t rule out the possibility of nuclear fusion reactor but the possible forms have become increasingly restricted. (2) Toroidal confinement using shear-stabilization has been plagued by pumpout. (3) The addition of average min.B was favored in the U.S.A. and West Germany. In addition to the above, L.Spitzer Jr. who contributed his reports to *Physics Today* described as the milestone of nuclear fusion program not only average min.B by GA octopole but also min.B by Ioffe-bar in each country.

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