Afterwords

This CT workshop has a long history supported by activities of each member group and cooperation between groups. The TCS group at the University of Washington is studying FRC plasmas, especially with translation along with the FIX group at Osaka University and the NUCTE group in Nihon University. On RMF current drive theory, the TCS group is working with Drs. Ohnishi and Ishida. On the self-organization and minimum energy state, Dr. Steinhauer is working with Dr. Geren and Dr. Ishida. Dr. Kondoh is also working in this field. Self organization of FRC plasmas was first addressed by Dr. Ono in Tokyo University. Theoretical study on the tilt stability is pursued by Dr. Belova and other researchers referred by her, Dr. Steinhauer, Dr. Ishida and his co-workers and a group in the National Institute for Fusion Study in Nagoya. Studies related to merging spheromacs are carried out by the TS group in Tokyo University and The SSX group in the Swarthmore University. Theoretical studies on transport and electromagnetic wave propagation are carried out by the group in the Gunma University. The spheromak group in the Himeji Institute of Technology is cooperating with the Lawrence Livermore National Laboratory. Some examples of cooperation and/or interplay between some groups are shown below.

The technology of translation, which was started in Russia, began to take a confinement-oriented track at the Los Alamos National Laboratory, and encouraging results were obtained in Osaka. Now, the Osaka and Washington groups are adopting complementary approaches using Neutral Beam Injection and Rotating Magnetic Field current drive, respectively. It is hoped that these two techniques can be combined in future. Both techniques use translation in order to decrease the plasma density. On the FIX (FRC Injection Experiment) Apparatus in Osaka, the bias magnetic field B_w was decreased to obtain an FRC plasma with larger separatrix radius r_s and therefore, longer confinement time. In the process, it was found that there was a threshold value of B_w below which the confinement became poor. The FIX group suspected that interaction of the overly swollen plasma at the reflection phase might cause confinement degradation, but definite evidence was not forthcoming. In this workshop, however, the TCS group in Washington presented definite evidence linking increased impurity radiation and confinement degradation. They have also shown that the trapped magnetic flux inferred from diamagnetic signal is consistent with the one calculated from measured magnetic field profile. This measurement was done with internal magnetic probes carefully designed to minimize perturbation to the plasma. The importance of the removal of the radial wobble instability is also shown to allow correct measurement. The TCS group has shown that lower translational energy is desirable for better confinement. The proposal by the group of Nihon University to reduce the translational energy using passive liners may help to improve confinement. A 2-D MHD simulation which is capable of dealing with the translation with super sonic velocity will also be useful to design the translation experiment.

On the TCS experiment, RMF did not penetrate fully into the plasma but penetrated only to the magnetic axis. Intensive theoretical work was also done by the group to interprete the result. On the other hand, Dr. Ohnishi showed that the equation to govern the penetration has two roots---shallow and deep penetration---and by appropriate choice of parameters and the initial condition, deep penetration can be realized.

Though the following example is not related to cooperation between groups, it should be mentioned. The TS-4 experiment showed preliminary results that the parameter window in which merged spheromaks with opposite polarity can relax into an FRC becomes narrower when the s value increases or the plasma becomes less kinetic.

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