§1. Development of VFIVE, an Interactive Visualization Software for CAVE VR System

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We have been developing VFIVE, an interactive visualization software for the CAVE VR system, in order to cope with recent large and complex simulation results. In this fiscal year, we have implemented mainly two projects; improvement of the function of ion trajectory tracer in time-varying electromagnetic field and development of Mobile-VFIVE, VFIVE for personal computer, as a supporting tool of VFIVE.

Improvement of Ion Trajectory Tracer

Particle kinetic effect originated from ions' complex thermal motion called meandering motion is considered to play an important role in collisionless magnetic reconnection in high temperature plasmas. We use VFIVE to analyze ions' trajectories in a time-varying electromagnetic field effectively in CAVE's 3D virtual space because the ion's motion is three-dimensional and complex.

In the last fiscal year, we incorporated a function for tracing ion trajectory in a time-varying electromagnetic field into VFIVE. By this function, user can place initial points of ion trajectories intuitively using the wand where he wants and observes the trajectories in the CAVE's virtual space [1]. To calculate them, Newton-Lorentz equations are solved. If other visualization methods are used, user can observe the other physical quantities changing in time.

In this fiscal year, to obtain more accurate trajectories of ions in a time-varying electromagnetic field, we have improved this function so that VFIVE uses linearly interpolated electromagnetic field in the time direction when solving Newton-Lorentz equations. Currently we are examining ions' trajectories by using this function (Fig.1).

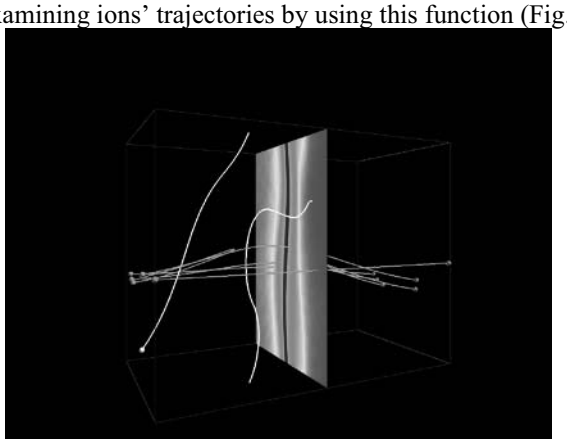

Fig.1 One snapshot of CAVE visualization of ion time-tracing trajectory (white lines), magnetic fields lines (blue lines) and reconnection component of magnetic field (yz-plane).

Development of Mobile-VFIVE

We have developed Mobile-VFIVE, VFIVE for personal computers (PCs), and actually it runs even on laptop PCs. The source code of this software is written in the Java programming language and JOGL (Java's OpenGL) using that of the basic version of VFIVE, so that this software does not depend on OS and so on. Mobile-VFIVE has all the visualization methods of basic version of VFIVE such as particle tracer, arrows, isosurface and volume rendering. Since the user interface is implemented by Swing, a Java's library for graphical user interface (GUI), user can easily change the visualization parameters such as isosurface level (see Fig.2).

We have incorporated a new function of writing down visualization parameters in text files and reading them into both Mobile-VFIVE and VFIVE. Via those text files, VFIVE and Mobile-VFIVE are connected. For example, the visualized object such as isosurface displayed in the CAVE's virtual space can be displayed in PC's display and vice versa. By this development more effective analysis of simulation data is expected.

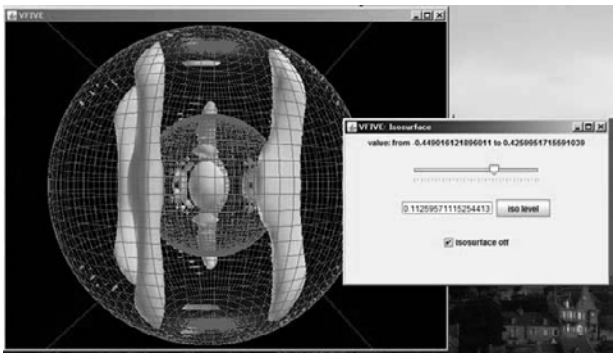

Fig. 2. Mobile-VFIVE's main window and GUI for changing isosurface level. Isosurface level can be changed by the slider or inputting a value directly.

1) Ohtani, H. et al.: Plasma and Fusion Research **5** (2010) S2109.
2) Ohtani, H. et al.:"Application of Virtual Reality Technology to Research of Plasma Physics and Fusion Plasmas", 52th Annual Meeting of the APS Division of Plasma Physics, Nov. 8-12, 2010, Hyatt Regency Chicago (Chicago, IL, USA)