§28. Integrated Scientific Visualization of Simulation and Device Data in Virtual Reality System

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In 1997, the National Institute for Fusion Science (NIFS), Japan, installed the CompleXcope virtual-reality (VR) System based on CAVE system [1] as an instrument for scientifically analyzing simulation results (Fig.1).

NIFS has developed new softwares including VFIVE, AVS for CAVE, a sonification system, and a reactor design aid tool. Through the use of these new tools, CompleXcope was adapted for scientific investigations, such as analysis of magnetohydrodynamics (MHD) simulation results for MHD dynamo and spherical tokamak, analysis of molecular dynamics simulation results for chemical sputtering of plasma particle on a diverter, and analysis of particle simulation for magnetic reconnection.

Fig. 1: CAVE system.

As one of scientific VR visualizations using CompleXcope system, we construct a method to display both simulation results and experimental device data integrally in the VR world [2,3].

In this paper, we succeeded in visualizing the data of HINT2 code [4,5] by a visualization software "Virtual LHD" [6] through the interface program for the simulation results. While the HINT code uses the relation between Cartesian coordinates and the rotating helical coordinates, the HINT2 code uses the relation of the cylindrical coordinates with the rotating helical coordinates. By visualizing HINT2 data in the VR space, it became possible to show and analyze the equilibrium plasma (isosurface of plasma pressure, magnetic field line, and drift particle orbit) in the practical magnetic configuration in the experimental device with the realistic description.

In the HINT code, each coil is assumed to be a filament outside the computation box. On the other hand, in the HINT2 code, the coil currents exist in the computation region, and it becomes much easier to use the code in practical applications for evaluation of equilibria of actual non-axisymmetric configurations. Since the HINT2 code can treat consistently the net toroidal current effects (Ohmic and Neoclassical) and the full torus configuration with the coil currents in the computation region [5], it will be possible to display the magnetic islands and stochastic regions in the periphery and divertor region when the data including the divertor region are loaded. In that situation, if we put the starting point of magnetic-field streamline or the initial position of particle near the divertor plate or the vessel wall as shown in Fig. 2, we can calculate the streamline or the particle orbits which hit the divertor plate or the wall by the time-reversal integration of equations. It will be possible to find the origin of the magnetic field and particles which strike the plate and the wall in the plasma core, periphery, or stochastic region.

VR technology is powerful equipment for analyzing simulation data and developing experimental devices. We believe that the buildup in this paper will boost up the research of the plasma physics and fusion plasmas.

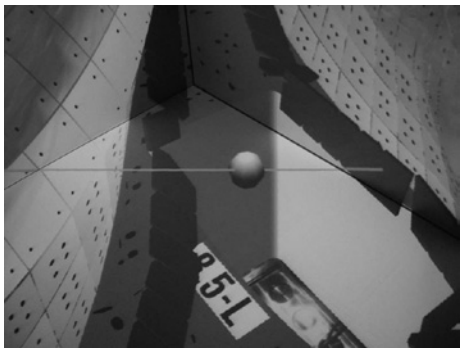

Fig. 2:

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