§30. 3D Visualization of LHD Plasma with Dusts

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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. NIFS has developed new software, such as VFIVE, AVS for CAVE, a sonification system, and a reactor design aid tool.

As one of the scientific VR visualizations using CompleXcope system, we introduced a method to display both simulation results and experimental device data integrally in the VR world[2,3,4)]. We had succeeded in visualizing the data of HINT2 code[5,6)] by a visualization software *Virtual LHD*[7)], and in drawing punctures of sampled field lines on a Poincare section in VR space in order to characterize the structure of magnetic field. In this paper, we report the integrated scientific visualization of experimental observation data with simulation results and device data in the VR space.

The fast framing cameras installed in the Large Helical Device (LHD) observed the dust trajectories [8)]. By using the stereoscopic image data, the information of the dust trajectories was obtained as time-history data of three-dimensional positions. In the last fiscal year, we developed the interface function of reading the data and the visualization tool of the dust trajectories in the VR space for the software Virtual LHD. Since the dust position was visualized as a point by GL_POINTS, it was difficult to grasp the three-dimensional position relation. In this fiscal year, we adopt the point-sprite method to show the position. With point sprites it is possible to place a 2D textured image anywhere on the screen by drawing a single 3D point. This method enables the high-performance rendering of points. In the CAVE system, many particles can be displayed smoothly.

We figured out a way to distinguish among the dust particles and to clarify their transport direction in the visualization of the data of the multiple dust particle trajectories [9)]. The particle positions in one time-sequence data are connected by one line, and this line displays the particle trajectory. The different particles and trajectories are stained with different colors, respectively. The particle is painted with the mix colors which are generated from the color of the 2D textured image together with the color of the line by the OpenGL function, glTexEnvf, with the argument, GL MODULATE. However, the color of the first position is mixed with white color in order to recognize where the trajectory starts. From the first position of trajectory and the trajectory line, it is possible to recognize the transport direction of the dust particle.

Figure 1 shows one example of the visualization of the dust particle trajectories near the 3-O port of LHD. From the observation of the trajectories by using this VR system, it is confirmed clearly that 1) the observed dust particles are distributed in the periphery region, that 2) most dusts move along the magnetic-field line, but some particles move radially across the lines with sharply curved trajectories, and that 3) the transport direction varies from place to place. This system promoted the viewers' understanding.

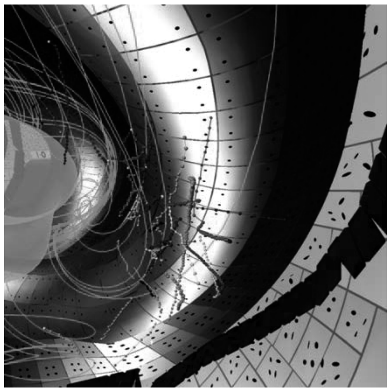

Fig. 1. Visualization of the dust particle trajectories near the 3-O port of LHD. The green line is a single magnetic-field line, the magenta surface is the isosurface of the plasma pressure. The line of sight is along the toroidal direction.

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

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