§23. 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 aids 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.

Recently, Shoji et al. installed stereoscopic fast framing cameras in the Large Helical Device (LHD) in order to observe three-dimensional trajectories of dusts[8]. By using the stereoscopic image data, the information of the dust trajectories are obtained as time-history data of three-dimensional positions. 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. Figures 1, 2 and 3 show VR visualizations of dust trajectories by new Virtual LHD with the LHD vessel. The experimentally observed positions of dusts are presented as red balls, and the trajectories are shown as red lines. In Fig. 1, we can see the trajectories from the outer port of LHD vessel. Figure 2 shows the same as Fig.1 but inside view of LHD vessel. In these figures, isosurface of plasma pressure (deep red) is also shown simultaneously. Figure 3 presents the dust trajectories with a single magnetic field line (green).

In the observations, the typical dusts were transported along the magnetic field lines, but some dusts moved radially across the magnetic field lines with sharply curved trajectories[8]. In order to understand the physics of the behaviors of the dusts, Shoji et al. performed the simulation of the transport of test spherical dust particles with the background plasma parameter profiles calculated by a three-dimensional edge plasma code. However, it is difficult to grasp the relationship between the trajectories and three-dimensional plasma flow pattern on the two-dimensional display, because they are projected on the two-dimensional space and the information of depth is lost. By using the integrated VR visualization with the plasma flow simulation, it is expected that we understand more about three-dimensional behaviors of the dusts.

Fig.1. VR visualization of dust trajectories (red balls and lines) with the isosurface of plasma pressure (deep red) from the outer port of LHD.

Fig.2. The same as Fig.1 but inside view of LHD vessel.

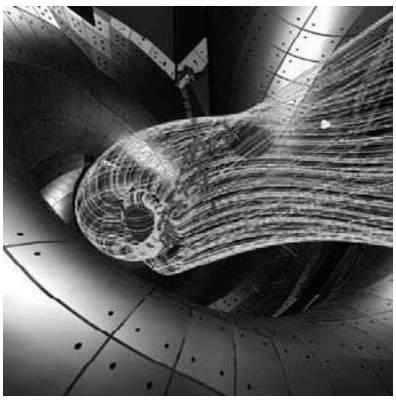

Fig.3. The same as Fig. 2 but with single magnetic field line.

1) Cruz-Neira, C. et al.: Proc. SIG-GRAPH'93. (1993) 135.
2) Miyachi, H. et al.: IEEE Comp. Soc., (2005) 530.
3) Ohtani, H. et al.: PFR **6** (2011) 2406027.
4) Ohtani, H. et al.: IEEE Trans. Plasma Sci. **39** (2011) 2472.
5) Hayashi, H. et al.: Contrib. Plasma Phys. **42** (2002) 309.
6) Suzuki, Y. et al.: Nucl. Fusion **46** (2006) L19.
7) Kageyama, A. et al.: Proc. ICNSP, (1998) 138.
8) Shoji, M. et al.: PSI 2014.