

Scientific Visualization of Fusion Plasma and Plasma Physics by Virtual Reality System

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Since virtual reality (VR) technology can analyze complex structures in a really three-dimensional space with a deep absorption into the VR world by the scientific visualization technology, it is a powerful and useful tool in an analysis of simulation data and development of experimental devices. National Institute for Fusion Science (NIFS), Japan installed VR System “CompleXcope” based on CAVE system [1] in 1997 as a scientific analysis instrument for the simulation results. The system produces a stereo, immersive and interactive view. In this paper, we report an integrated scientific visualization of plasma simulation data and experimental device data in one VR world [2,3], and scientific visualization research of magnetic reconnection [4-7].

In the integrated visualization, an isosurface of plasma pressure, a stream line of a magnetic-field line and trajectories of drift particles calculated from the MHD equilibrium simulation data [8] are interactively visualized in the Large Helical Device (LHD) vessel data with an objective description (that is, a realistic device mechanical vessel) in the VR space. You can interactively change an isosurface level, initial positions of drift particles, and a starting point of the magnetic-field line. From this success, a lot of attractive possibilities have opened up for intuitively understanding the physics of plasma, for aiding in the design and arrangement of the devices, and for confirming the field of vision from the observation port in VR space.

In the scientific visualization research, we investigate particle trajectories in time-varying electromagnetic fields obtained by simulation of magnetic reconnection in the VR system, in order to know the role of the particle kinetic effects in breaking the frozen-in condition and exciting collisionless magnetic reconnection. From this research, we found that ions are accelerated toward the downstream region in the time-varying fields around the reconnection region.

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