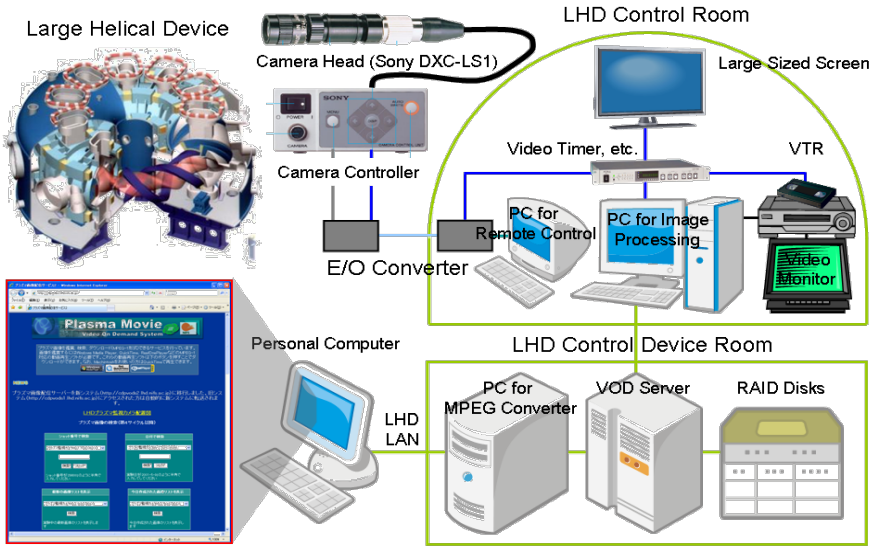
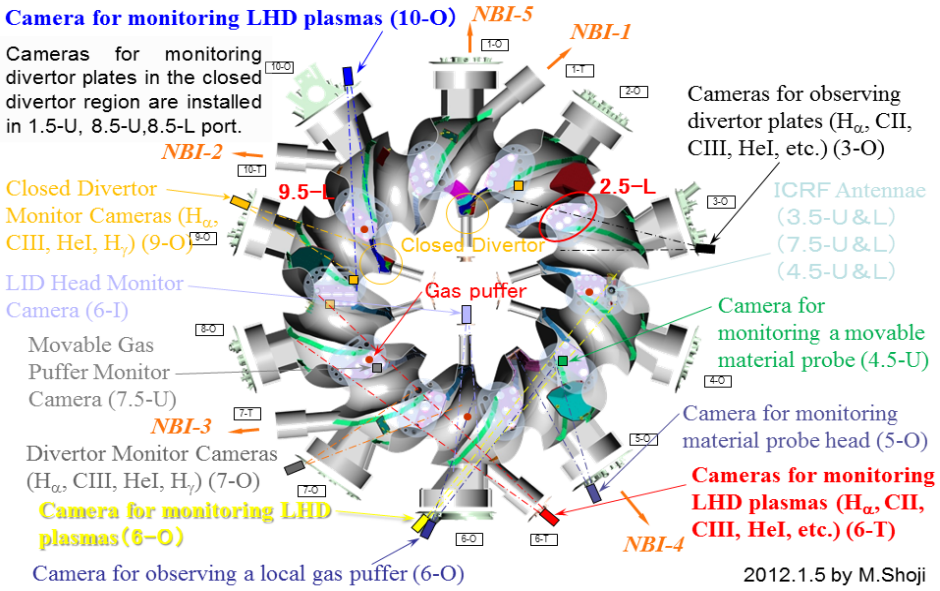
1	Name of diagnostics	Plasma monitor camera
2	Responsible person	Mamoru SHOJI
3	Specification (measured physical object, accuracy, space&time resolution, etc.)	The plasma monitor cameras have been routinely monitored visible images of the plasma from various optical ports. The system is composed of CCD camera heads, camera controllers, electrical/optical media converters, optical fibers, personal computers (PC) for acquiring image data with a MPEG converter, PCs for remote control, a trigger system, video tape recorders, a digital video recorder, TV monitors, a Video On Demand (VOD) server with RAID disks and a network attached storage (NAS). Some CCD cameras with interference filters (for Hydrogen, helium, carbon and oxygen etc.) measure images of visible emission by impurities and neutral particles in the LHD plasmas. The cameras also observe plasma-wall interactions on the vacuum vessel, divertor plates, ICRF antennae, etc. This system has been used for safe operation of plasma discharge experiments and for monitoring plasmas for wall conditioning and boronization, etc. The real-time video signals transmitted from the camera are displayed in the TV monitor and large sized screen in the LHD control room. Slow-motion images are replayed after every plasma shots (normally every 3 minutes) on the large sized screen by specified PCs for this purpose. The images are captured as colored 8-bit resolution by the MPEG converter. The sampling time of the captured images can be flexibly changed in the range from 25μs to 8.53s. The captured rate is 30 frame/s for the MPEG converter and 60 frames/s for the video recorder. The system can obtain time-integrated images up to 8.53s by changing the sampling time. In this case, the cameras output images every 8.53s. The acquired data via the converter are compressed and stored as an MPEG-1 formatted video (352×240 pixels). We can look the videos by accessing to the VOD server (http://cdpvods2.lhd.nifs.ac.jp).
4	Drawing of device/facility	
5	Arrangement (installation port, position, field of vision,	Tangential viewing CCD cameras are installed in 6-T, 6-O and 10-O ports for monitoring LHD plasmas. Five cameras are set in 3-O port for observing the lower divertor structure near 2.5-L port and the plasma-wall interactions on the divertor plates. Some of the cameras have interference filters at the front of the

	direction, etc.)	lens to get the profile of visible emission by impurities and neutral particles. Tangentially viewing cameras with interference filters are installed in 6-T port for observing the emission profile by impurities and neutral particles in the plasma periphery and for monitoring emission of carbon released from a movable limiter. Emission profile by neutral gas introduced from a local gas puffer installed at the lower saddle point of the helical coil can (5.5-L) is monitored with four cameras with interference filters in 6-O port. Three cameras with interference filters (H_α, HeI, H_γ or CIII) are installed in 7-O port for measuring neutral particle and impurity emission profile in an open divertor region from the outboard side. For monitoring the neutral particle and impurity transport in the closed divertor region, four cameras are set in 9-O port. One of the cameras observes plain image of the plasmas. The other three cameras with interference filter measure neutral and impurity line emission near the divertor region. Some cameras for monitoring a movable gas puffer, a movable material probe, a local island divertor head, divertor plates in the closed divertor region and retractable mirrors for charge exchange recombination spectroscopic measurement are installed in other LHD vacuum ports. To monitor the head of the movable material probe from an outboard side, a camera is installed in 5-O port. It has been routinely used for safe plasma discharge operation in electric bias experiments.
6	Arrangement plot (relation to port, structure, etc.)	
7	Operational requirement	Stray magnetic fields in special magnetic configurations influence camera controllers and the remote control system. Abnormal electric current shutdown in super-conducting magnetic coils often perturbs the camera's performance.
8	Plan for the next step	In near future, some cameras will be installed in outer port in order to monitor closed divertor components. Use of high-speed cameras in 6-T, 10-O and 3-O port with a stereoscopic optics are planned for detailed fluctuation measurement in the plasma periphery, the temporal behavior of a rotational radiation belt and TESPEL ablation cloud, etc.
9	Remarks	The CCD camera head will have to be frequently replaced in the experimental campaign for deuterium plasma discharges, because neutron fluxes degrade and damage the CCD chip in the camera heads.