

§18. Gas Analysis of Vacuum Chambers of the LHD

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1. Introduction

LHD has two vacuum chambers, plasma vacuum chamber and cryostat vacuum chamber. The plasma vacuum chamber contains mostly stainless steel, but the cryostat chamber contains stainless steel, Multi Layer Insulator (MLI), Glass Fiber Reinforced Plastic (GFRP), and Carbon Fiber Reinforced Plastic (CFRP). The purposes of the MLI, the GFRP and the CFRP are thermal and electric isolation, and they are source of outgassing. A required value of a pressure of the cryostat chamber for thermal isolation is 2×10^{-2} Pa. When the pressure become lower than the required pressure, cooling down of coils is start, then outgassing rate is expected to be suppressed as the temperature goes down.

2. Apparatus

Two quadruple mass spectrometers are installed on the plasma vacuum chamber pumping duct and the cryostat pumping duct. A valve is installed between the duct and the mass spectrometer. A small turbo molecular pump is also installed near the each mass spectrometer. To adjust a conductance using the valve, the mass spectrometers become operational, even if the pressures of the plasma vacuum chamber and cryostat are still high.

3. Pumping of the cryostat

Pumping of the cryostat started on 2 Feb '98. After fixing leakage, the last pumping started on 13 Feb. Then cooling of coils started on 23, Feb '98.

Fig 1 shows time evolutions of several gas pressures in the cryostat and temperatures of the coolant

of the helical coil On 1 Mar, the temperature of the coolant become about 220K, and the pressure of water suddenly dropped. On 14 Mar, the temperature of the coolant became about 70K, the pressure of nitrogen and oxygen suddenly dropped. These phenomena coincide with expectations.

4. Pumping of the plasma vacuum chamber

Pumping of the plasma vacuum vessel started on 30 Jan. After fixing leakage, the last pumping started on 6 Feb. Finally, the partial gas pressures reached 9.0×10^{-10} Torr(H_2), 6.9×10^{-10} Torr(H_2O), 2.5×10^{-10} Torr(N_2/CO), and 3.0×10^{-11} Torr(O_2) on 23 Mar.

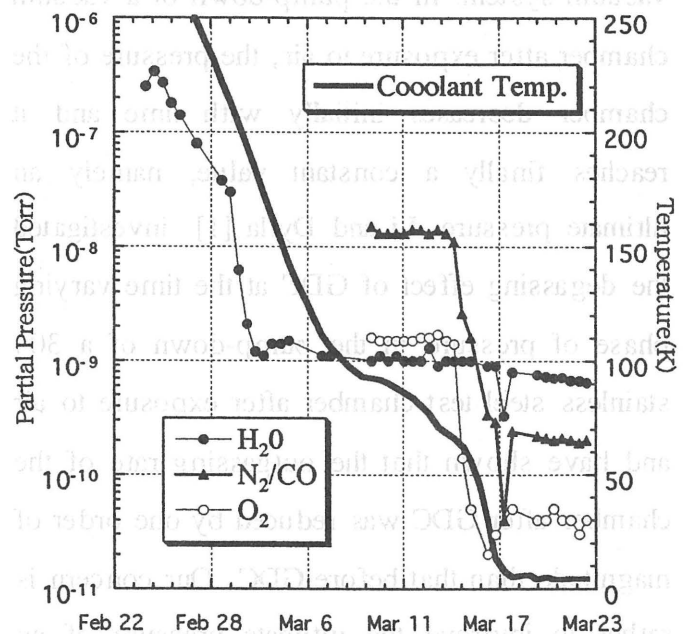


Fig.1 Partial pressures of the cryostat and temperature of the coolant of the helical coil