§1. Analysis on the Winding Motions of the LHD Coils by Correlation of AE and Balance-voltage Signals

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We have been investigating the amount of mechanical disturbances occurred in the LHD coils and are conducting research to explore more stable operation for the excitation [1]. In particular, the amount of disturbances on the innermost helical coil blocks (H-I) has been observed with intensive care. In FY2009; we investigated the difference in the amount of mechanical disturbances by changing the excitation methods of the LHD coils using AE signals [2]. From this investigation, we confirmed the validity of the method in the standard excitation. In FY2010, the same characteristics were investigated using the balance voltage signals. At this time, the signals were confirmed to contain a lot of components other than mechanical disturbances. Therefore, we created the software to remove these unwanted signals and to speed up the data analysis [3]. And in FY2011, we examined the effect of the noise component superimposed on the balance voltage signals when the Neutral Beam Injection (NBI) was operated. In addition, we improved the program so that it can calculate independently the amount of mechanical disturbances occurring in the two helical coils, i.e., H-1 and H-2. The results of these studies are described as follows.

The signal superimposed on the balance voltage at the timing of NBI operation was an impulse-like signal in the level of ~10 mV, and its interval was observed at ~180 s. The total number was 18 times in one hour excitation. Figure 1 shows the histogram of the mechanical disturbances observed in the H-I coil block. This result shows that the NBI signals do not significantly affect the evaluation of mechanical disturbances. In this case, we performed two kinds of eliminating methods for the NBI signals. The first one is to subtract the NBI signal superimposed on the balance-voltage signal. In order to perform this, we prepare a NBI signal as the reference before the excitation. Whereas the second one removes all the signals at the corresponding timings of the NBI operations.

Figure 2 shows the histogram of the mechanical disturbances that occurred in each coil of the H-1 and H-2. From these characteristics, the disturbance signals of <5 mV was almost the same amount mostly for the H-1 and H-2. However, it turned out that the signals >5 mV were observed only in the H-1. In contrast, when we analyze the data acquired in 2008, the result of the mechanical disturbances was almost the same for both H-1 and H-2. This result indicates that there might be some different trends occurring in the mechanical properties in the two coils, which should be carefully monitored in the LHD operations.

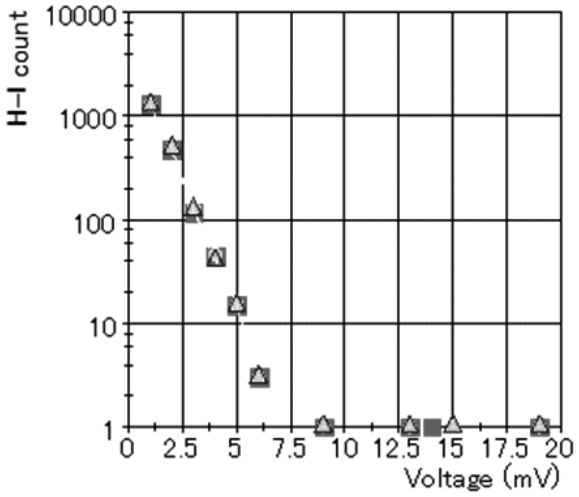

Fig.1 Histogram of the balance voltage signals observed for the LHD helical coils when the NBI was operated, where ■ shows the case including the NBI-induced signals and △ shows the case after removing them.

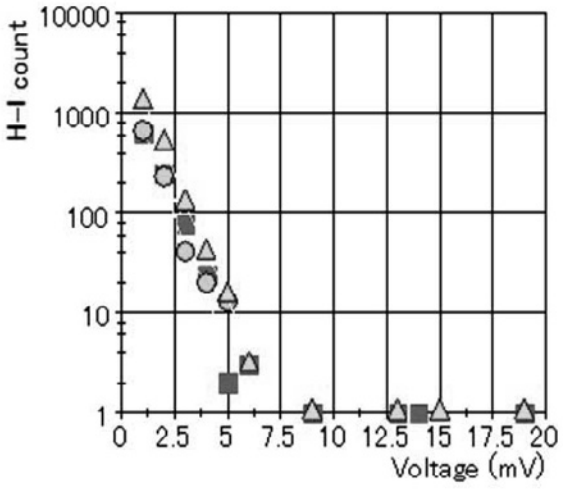

Fig.2 Comparison of mechanical disturbance signals on the LHD H-I blocks （■ : H-1, ○ : H-2, △ : Both H-1and H-2）

1) Ishigohka, T. et al., Ann. Rep. NIFS (2008-2009) 81.
2) Ninomiya, A. et al., Ann. Rep. NIFS (2009-2010) 94.
3) Ninomiya, A. et al.: Ann. Rep. NIFS (2010-2011) 103.