§84. Magnetic Measurement and Plasma Control of Long Discharge in QUEST

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For fusion, measurement of magnetic field and flux play very important role in reconstruction and control of plasma boundary and position. Magnetic sensors with heat and radiation resistance are necessary for future DEMO and reactor. In order to meet these requirements, for instance, a magnetic probe with a coil winded mineral insulation (MI) cable has been developed. However, it is known that this type of sensor with the more turn number has the worse frequency response. Therefore, the magnetic sensor shown in Fig. 1 is improved in JAEA based on one with tungsten metalized ceramic plate co-developed by Dr. Takahashi, NIFS and Kyocera. The original magnetic sensor, called AT (advanced technology) probe, has six channels consist of three axial probe for low and high frequency. Therefore, the coupling area, which is product of cross-section and the turn number, of the original AT probe is relatively small, for instance, it is about one tenth of that of the magnetic sensor (TC probe) for plasma equilibrium and control in JT-60U. Large coupling area decreases the problem of noise and drift of integration in the long discharge, therefore, that of the new AT probe is increased by decreasing the channel from six to three and increasing the size. On the other hand, importance of MI cable will increase in future as the signal wire with heat and radiation resistance in the vacuum vessel. However, connection of MI cable is difficult and complex, which lead to the cost escalation of the production and installation and reliability degradation. Therefore, JAEA newly developed the connector for MI cable as shown in Fig. 2. The ends of the MI cable are shielded by airtight ceramic terminal inside the plug of the connector, therefore we do not have to pay attention to the slow leak and degradation of the withstand voltage. The new AT probe is designed to directly connect to MI cable with the connector. A severe test of the magnetic sensor can be done with the long and relatively low plasma current discharge in QUEST. Therefore, we installed new AT probe in QUEST. Original AT probes and the probes made of winded MI cable had been also installed and comparison between them is possible. We also installed TC probe for comparison.

The integrated signal from magnetic sensors, new AT probe, two original AT probes and TC probe in QUEST long discharge are shown in Fig.3. New AT probe and TC probe are installed at same poloidal position. The signals of them are comparable and the lines are almost perfectly overlapped each other. The noises of them are much smaller than those of signals from original AT probes. The new TC probe with single sheath is installed in QUEST whereas the original TC probe shown in Fig. 3 has double sheath. The new AT probe with multi pin feedthrough is also installed in order to compare with one already installed with BNC type feedthrough.

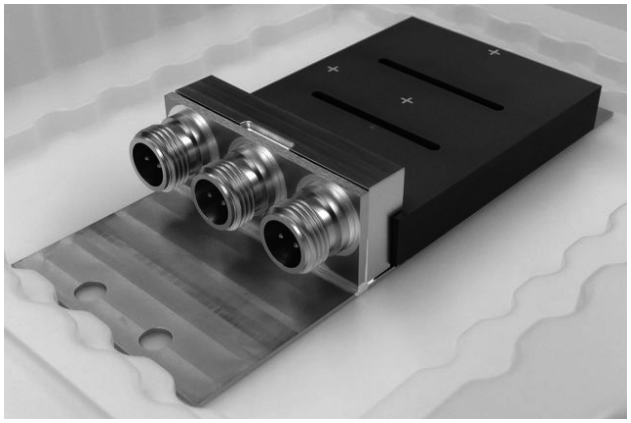

Fig. 1. A photo of a new AT probe.

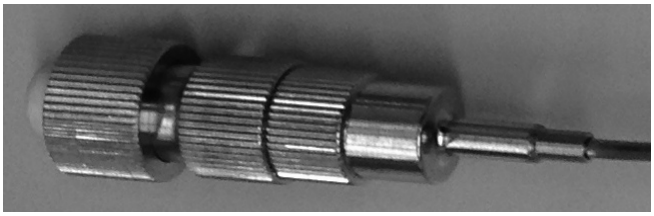

Fig. 2. A photo of a newly developed connector for Mineral insulation cable.

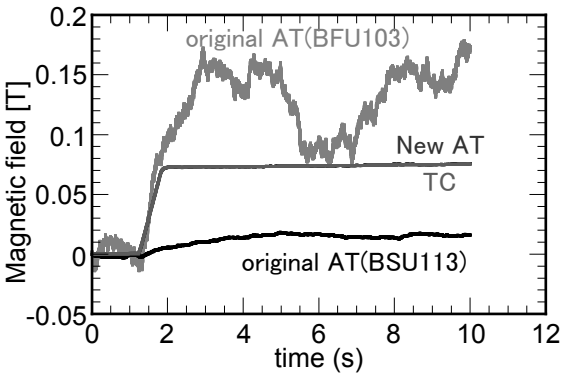

Fig. 3. The integrated signal from magnetic sensors, new AT probe, two original AT probes and TC probe in QUEST long discharge.