§7. LHD Bolometer Diagnostic Development at NIFS

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This report details research activity during the 1995 fiscal year directed towards the development of a steady-state bolometer diagnostic for use on the Large Helical Device (LHD) at the National Institute for Fusion Science (NIFS). These activities consisted of port and array design, sample detector acquisition and testing and new concept development.

Ports and arrays were designed in order to fulfill the overall objectives of the LHD Bolometer program to provide local and global time and space resolved measurements of the the total radiated power from core and divertor plasmas. This consideration lead to the design of ports for divertor plasma bolometric measurement (6 ports), two dimensional core plasma bolometric measurement (6 ports), one dimensional plasma bolometric measurement (2 ports) and global plasma bolometric measurements (8 ports). Based on a preliminary array design, a flange size of 152 mm was considered adequate for the planned arrays. An example of a two- dimensional view of the LHD plasma achieved with a semi-tangential plane of view is shown in Figure 1.

Detector acquisition and testing activities consist of detector acquisition, test equipment acquisition and detector testing and calibration. Samples of various types of detectors including pyroelectric, metal foil and photodiode bolometers have been acquired for testing and evaluation. Using a newly constructed vacuum chamber the sensitivity and time response of ASDEX type metal foil bolometers have been tested in vacuum and atmosphere using a HeNe laser and the power pulse method. Both methods show good agreement with each other and give a sensitivity of 9.5 V/W in vacuum and 5 V/W in atmosphere. The corresponding noise equivalent power is 2 x 10^{-6} W/cm^2. This is 50 times smaller than the expected radiation to be seen by a bolometer behind the designed pinhole array configuration from a 3 MW (steady-state case) fully radiating plasma in LHD.

Preparations have begun to use two ports on CHS for bolometer system testing and for measurement of the radial profile of the power radiated by the CHS plasma. Gate valves were mounted and hardware for mounting detectors was designed and fabricated.

Preliminary work in the design of an IR imaging bolometer for LHD has been carried out. This new concept has the advantages of two-dimensional data, no electrical wire feeds and long-pulse operation. Ongoing work involves thermal modeling of the segmented foil detection array leading to the construction and testing of prototypes on CHS and LHD.

In conclusion, preliminary work has been carried out in the development of a bolometer diagnostic system for LHD during the 1995 fiscal year. These activities have included port and array design, sample detector acquisition and testing and new concept development.

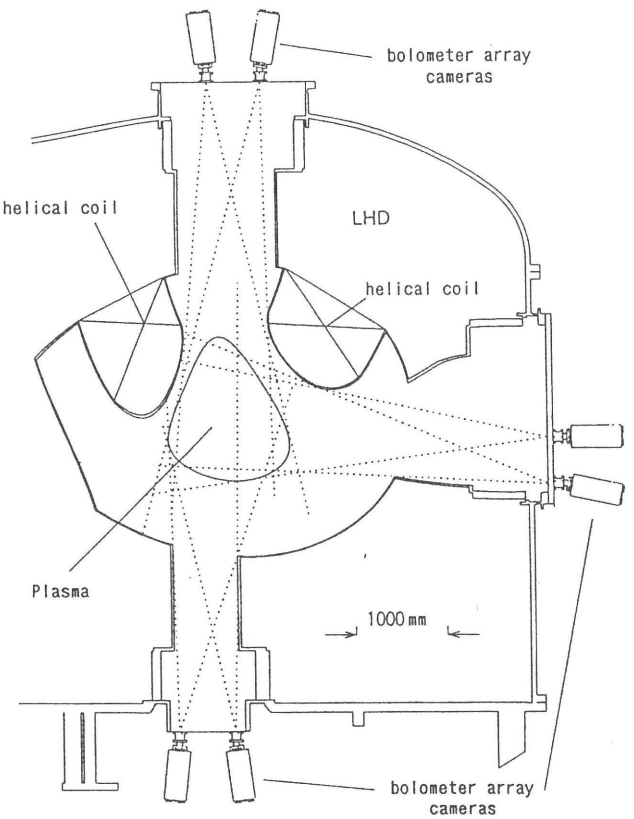

Fig. 1. Semi-tangential cross-section of LHD showing sight lines(dotted) for a two-dimensional view of the plasma by bolometer arrays.