

## §9. Plans and Preparations for Bolometer Measurements on LHD

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This report details research activity during the 1996 fiscal year in preparation for bolometer measurements on the Large Helical Device (LHD) at the National Institute for Fusion Science (NIFS). These activities consisted array design, detector acquisition, testing and calibration and design of a new concept, IR imaging bolometer.

Array design has concentrated on Port 6.5-L which will be used during the first two LHD experimental cycles for bolometer array measurements (see Figure 1). During the First Cycle a 20 channel array will be used to measure the radiation from the core and divertor regions. This will be supplemented in the Second Cycle with a 12 channel array at port 6.5-L that views the lower outboard divertor exclusively. By comparing the signals from these two arrays we should be able to infer how much of the radiation is coming from the lower outboard divertor compared to the rest of the plasma cross section and also be able to compare radiation from the inboard and outboard divertors. In addition to these arrays, bolometers with a wide viewing angle for estimating the total radiated power will be mounted at two ports in the first cycle and two additional ports in the second cycle.

A total of 16 channels of metal film bolometers have been calibrated and tested on the bolometer test stand. A four channel head was mounted on CHS and used to investigate the effectiveness of wire mesh in blocking unabsorbed microwaves which can produce spurious signals on the bolometer sensors. The 50 mesh per inch, 20 micron diameter wire mesh was effective in blocking 70% of the 53 GHz signal and 60% of the 106 GHz signal. When an additional mesh was added at a separation of 1.4 mm ( $\lambda/4$  for 53 GHz and  $\lambda/2$  for 106 GHz) the 53 GHz signal was reduced by more than a factor of 10 and the 106 GHz signal was reduced by an

additional 60% compared to the single mesh case. This strong attenuation at a spacing of  $\lambda/4$  is attributed to the destructive interference of the microwaves which occurs at this spacing.

Comparison of the signal from the metal film bolometer with that from an existing pyroelectric detector on CHS showed good agreement in measuring the total radiated power from a plasma heated by NBI and ECH. A difference of 25% in the amplitude of the signals is attributed to the rough calibration of the pyroelectric detectors.

Design of a Infrared Imaging Bolometer has been completed and construction has begun of a prototype device which will be tested on CHS during the summer of 1997. This concept offers the advantage a two-dimensional image of the plasma radiation by using an IR camera to measure the temperature change of a 2 dimensional array of metal foils which are exposed to plasma radiation through a pinhole.

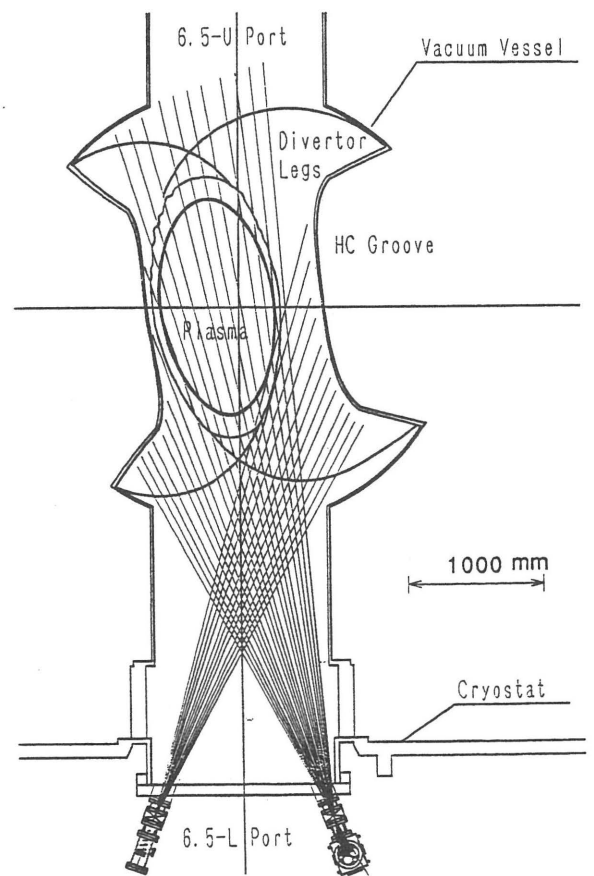


Fig. 1. Poloidal cross section of LHD showing the bolometer sight lines for arrays at Port 6.5-L.