

## §22. Summary of Heliotron Non-neutral Plasma Experiments and Study on Image Charge Probe for Measuring Confinement Time

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**PURPOSE OF RESEARCH:** It is theoretically predicted that the confinement time of helical pure electron plasmas could be very long if the electron plasma obeys the empirical scaling law for the ion root of helical neutral plasmas. To test it experimentally, a passive method to measure the plasma charge confined in helical magnetic surfaces needs to be developed. Therefore, we have developed a new wall probe for experiments on Heliotron J.

**CIRCUITS AND CURRENT STATUS:** One of key techniques to diagnose the dynamics of non-neutral plasma is to measure the image charge that is inductively induced on the inner surface of either a cylindrical or a segmented electrode within which the non-neutral plasma is confined. In this study, we have developed a new circuit to measure the image charge. The specific features of the circuit are as follows. It is basically a current amplifier; nonetheless it can

be connected to electrodes even biased to finite voltages. Figure 1 shows the circuit diagram we have designed. To reduce errors due to the bias current of OP amps, the circuit is equipped with precise OP amps. Also, to maintain good frequency characteristic, low impedances are used to especially circuit lines in which the image charge flows.

At present, we have finished constructing the circuit and started to examine the circuit performance in a linear machine where non-neutral plasmas can be produced. Insufficiently, the circuit is so far suffered from large inductive noise. In fact, in preliminary experiments performed in Kyoto Inst. Tech., the value of S/N ratio is less than unity. To fix the noise problem, several conventional methods such as filters and double-shielded cables are applied to the circuit.

**HARDWARES:** The rest equipment is ready for the next experiments. Regarding the wall probe, we have designed a wall-shaped electrode. This electrode will be mounted at the edge of a long barrel that is made of stainless 304. And then, the barrel will be inserted into the vacuum vessel. To precisely move the barrel in a straight line, we put a couple of safety guides in the barrel. As for the flange that is set on the #11.5 port on the vacuum vessel of Heliotron J, we have finished improving the attachment used for our electron gun. By this work, the gun would be successfully relocated from the #3.5 port to the #11.5 port of Heliotron J.

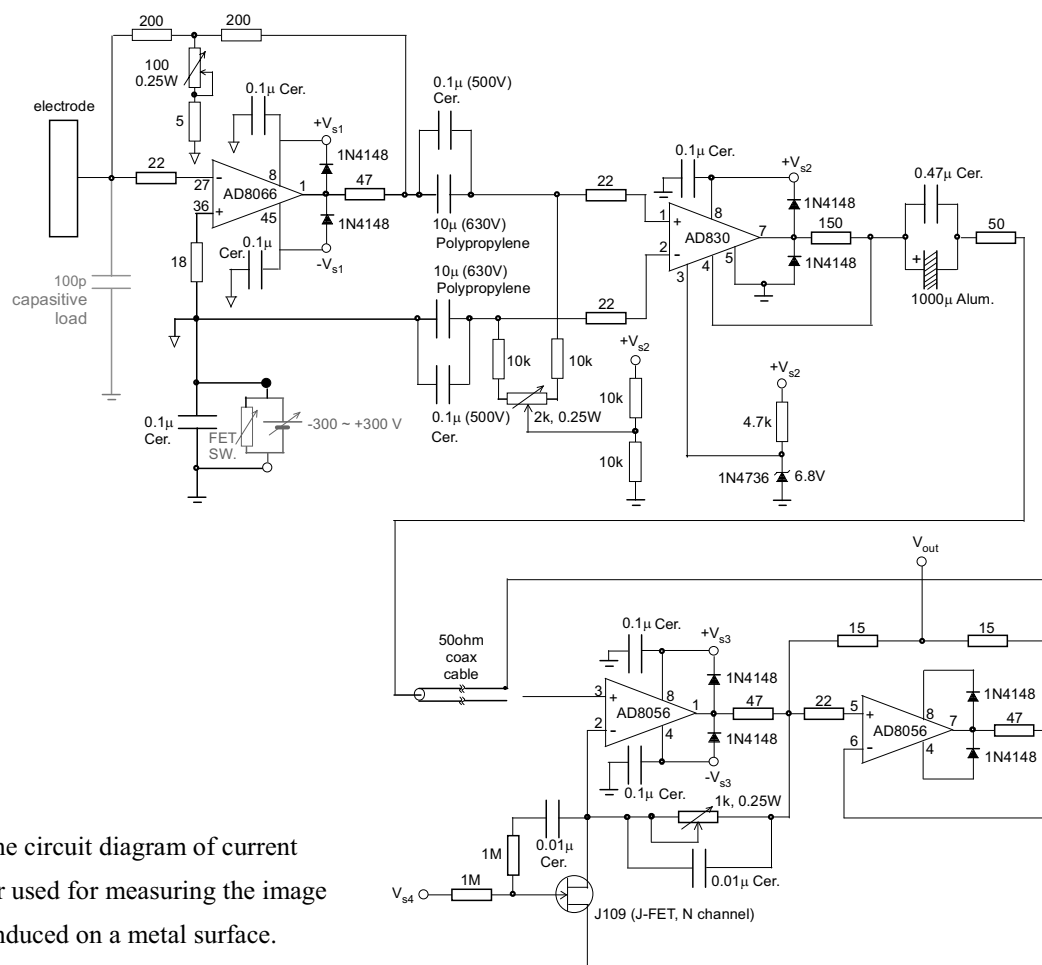


Fig. 1 The circuit diagram of current amplifier used for measuring the image charge induced on a metal surface.