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Development of the Plasma Impedance Prediction Model in Radio Frequency Negative Ion Sources

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A new linear accelerator Linac4 is under development at CERN as a part of the upgrade of their accelerator chain. A radio frequency (RF) driven type negative hydrogen (H^-) source is used as an injector of Linac4. The Linac4 H^- source must deliver 40-50mA, 45 keV H^- beam. The power transfer efficiency between the RF generator and the ion source plasma is one of the important parameters that determines the extracted H^- beam current. In order to achieve efficient power supply, it is required to match the impedance between the RF-system and plasma loading. In the previous study [1], it has been shown that the frequency tuning during the plasma pulse is useful to cope with the variation of the load impedance.

Aiming to investigate the optimum frequency tuning, we have developed a plasma impedance prediction model. The model consists of mainly two parts: 1) the global particle/energy balance of plasma, and 2) the equivalent circuit model of the RF plasma and surrounding antenna [2, 3]. The characteristics of the load can be calculated in the time domain by using this model.

We have calculated the optimum frequency tuning during the plasma pulse using the model described above. The results indicate that the amount of the power supplied to the plasma increases by a few tens percent by tuning the frequency adequately. The calculated optimum waveform of the frequency agrees qualitatively with the frequency waveform used for the experiments at CERN [4]. The model developed in the present study is useful to investigate the optimization of power supply by the dynamic frequency tuning and can also be used for the analysis of other inductively coupled plasma (ICP) reactors.

References

[1] M. M. Paoluzzi, et. al., AIP Conf. Proc. **1390**, 265 (2011).

[2] Pascal Chabert and Nicholas Braithwaite, "Physics of Radio Frequency Plasmas", Cambridge Univesity Press, New York, (2011).

[3] Kenjiro Nishida, et. al., Rev. Sci. Instrum. **87**, 02B117 (2014).

[4] K. Nishida, et. al., "Experimental Investigation of Plasma Impedance in Linac4 H^- Source"(in press).

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