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Development of Design Technique for Vacuum Insulation in Large Size Multi-Aperture Multi-Grid Accelerator for Nuclear Fusion

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Optimization techniques of the vacuum insulation design have been developed in order to realize a reliable voltage holding capability of multi-aperture multi-grid (MAMuG) accelerators for giant negative ion sources for nuclear fusion. In this method, the nested multilayer configuration of each acceleration stage in the MAMuG accelerator can be uniquely designed to satisfy the target voltage within given boundary conditions. The evaluation of the voltage holding capabilities of each acceleration stages were based on the past experimental results of the area effect and the multi-aperture effect on the voltage holding capability [1]. Moreover, total voltage holding capability of multi-stage was estimated by taking the multi-stage effect into account, which was experimentally obtained in this time. In this experiment, the multi-stage effect appeared as the superposition of breakdown probabilities in each acceleration stage, which suggested that multi-stage effect can be considered as the voltage holding capability of the single acceleration gap having the total area and aperture. The analysis on the MAMuG accelerator for JT-60SA agreed with the past gap-scan experiments with an accuracy of less than 10% variation.

References

A. Kojima, M. Hanada, A. Hilmi et. al., Rev. Sci. Instrum. 83, 02B117 (2012).