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Numerical Optimization of Electromagnet Current Distribution in Superconducting Linear Acceleration System

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The enhancement of the acceleration performance of a superconducting linear acceleration (SLA) system to inject the pellet container to supply fuel to the fusion reactor has been investigated numerically. To this end, a numerical code used in the finite element method has been developed for analyzing the shielding current density in a high-temperature superconducting film. In addition, the on/off method and the normalized Gaussian network (NGnet) method have been implemented in the code for the shape optimization of an acceleration coil, and the non-dominated sorting genetic algorithms-II have been used as the optimization method.

The results of the computations show that, for the NGnet method, even if the on-state of the filament is reduced by approximately 12% from the homogeneous current profile, the pellet speed of the SLA system increases by approximately 2.8 times. In addition, This is mainly because of the strength of the applied flux density generated by the optimized current profile using the NGnet method.

On the other hand, for the on/off method, the current profile is scattered, whereas the coil shape becomes hollow for the NGnet method. Consequently, the NGnet method is an effective tool for improving the acceleration performance of the SLA system and for obtaining a coil shape that is easy to design.

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