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Tue-Af-Po2.16-02 [17]: Practical Estimation of Superconducting Dynamo Losses

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In High Temperature Superconductor (HTS) direct current (dc) magnet applications much of the cryocooler load required for continuous operation is imposed by the external current leads. Operation of HTS dc magnets at high currents requires large cross-section leads, but these leads provide a large thermal bridge between the ambient current supply and the cryogenic superconducting components. Removing these leads would allow smaller cheaper cryocoolers to be used on these magnet systems, and reduce ongoing operation costs.

Superconducting dynamos are a non-contact method of energising HTS coils, and are capable of producing currents in the connected superconducting circuits far in excess of the current supplied at the ambient components. As a non-contact system, the current leads are eliminated. Additionally, this technology eliminates the need for a large high current source to drive high current magnets, further reducing capital and operating costs.

Previous work on superconducting dynamos has focussed on driving larger currents, and understanding the constraints which govern the efficacy of the energisation behaviour. It is known that the varying magnetic field strength at the superconducting surface of the superconducting dynamo will result in some AC losses, however in the quest for higher currents the extent of these losses and other system losses have not been considered.

In this work the losses of a multi-stator “squirrel-cage” superconducting dynamo are investigated experimentally, and compared to the losses expected in the conventional copper current lead based energisation method. At present, the thermal load associated with conduction cooled copper leads prevents practical application of kilo-amp class dc HTS magnets. However, the superconducting dynamo investigated here offers an energisation method to enable feasible portable high current HTS magnet systems.

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