High-dynamic Superconducting Linear Motor

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The force and power density of state-of-the-art linear motors (LMs) are limited by the magnetic field of permanent magnets and power dissipation in the coils. High temperature superconductors (HTSs) have the potential to surpass the limits facing resistive materials. HTS materials can carry a much higher current density than copper and HTS coils can produce stronger magnetic fields than that of permanent magnets, without any DC resistance.

The goal of the High-dynamic Superconducting Linear Motor (HSLM) project is to assess the possibilities of using HTS in high-performance linear motors and develop a prototype demonstrating the feasibility of the concept. We work on the frontier of current HTS technology to see how far it can improve on conventional LM technology. The HSLM concept has applications such as positioning systems in semiconductor equipment, but may also be applied in other areas, such as transportation or power generation.

During operation, the HTS coils in the machine will be subjected to a significant heat load in the form of AC loss. Herein lies the challenge to maximize force density, while at the same time ensuring thermal stability. As superconductors need to be kept below their critical temperature at all times, AC loss has to be minimized already in the motor design. Additionally, there is a cryogenics challenge in determining what is the optimal way of cooling the HTS coils in this dynamic system.