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A Dual-Stator HTS Modular Linear Vernier Motor for Long Stroke Applications

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This paper proposes a dual-stator high-temperature-superconducting modular linear vernier motor (DS-HTS-MLVM), suitable for long stroke applications. The dual stators are two pure slotted-cores and staggered by half the stator pole-pitch. The mover adopts a modular structure, installed with HTS excitation windings and copper armature windings. The cryostats for HTS windings also adopt a modular structure. In space, the HTS windings and the copper windings are perpendicular to each other and installed in different slots. The main merits of the proposed motor are that:1) the staggered stators with simple structure help to significantly suppress force ripple; 2) the distribution of the two sets of windings can eliminate the conflict of slot space; 3) the modular mover, and the modular cryostats for HTS windings reduce the installation difficulty; 4) the motor without permanent magnets can reduce the overall cost, especially when it is applied to long stroke applications. In this paper, the structure and the working principle of the proposed motor are elaborated. With the help of the finite element method, the electromagnetic performance of the proposed motor is analyzed, and compared with its counterpart. The results show that the proposed motor can significantly improve the thrust force and suppress force ripple. Specifically, compared with its counterpart, the proposed motor increases the average force from 42.97 N to 144.41 N, while the force ripple reduces by 85%.

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