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Characteristics of magnetic force interaction of CC-tape windings with a permanent magnet guideway.

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High-temperature superconductors have significant potential for application in systems based on magnetic levitation: levitation bearings, magnetically suspended transport, flywheel energy storage devices, motors and generators. Bulk REBCO (where RE stands for rare earth elements) is currently a widely used material. However, the widespread use of coated conductors tapes (CC-tapes) allows to use them as an alternative to bulk superconductors. However, the majority of researches on the magnetic transport focuses on the study of stacked arrays of tapes. But the good flexibility of CC-tapes makes it possible to create more complex configurations on their basis. One of the possible options is CC-tape windings.

In this paper, we present new experimental results on the study of the magnetic force interaction of CC-tape windings with a permanent magnet guideway. For measurements, a commercially available 4 and 12 mm wide CC-tape produced by SuperOx was used. On the basis of the tape, windings of various shapes with a different number of layers were made. An assembly of permanent magnets in the form of a Halbach array was used as a guideway. Both the vertical levitation force and the lateral restoring force were measured. The measurements were carried out both in field cooling and in zero field cooling modes. The levitation characteristics are compared with CC-tapes stacks . It is shown that CC-tape windings can exhibit greater lateral stability in comparison with stacks. This may be relevant for the development of hybrid levitation systems using permanent magnets to increase the levitation force.

Numerical simulation of levitation force and restoring force by the finite element method has been carried out in the Comsol Multiphysics simulation environment. The calculation results are in a good agreement with the experimental data.

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Primary authors: Mr OSIPOV, Maxim (National Research Nuclear University MEPhI); Mr STARIKOVSKII, Alexandr (National Research Nuclear University MEPhI); ANISHENKO, Irina (National Research Nuclear University MEPhI); POKROVSKII, Sergei (National Research Nuclear University MEPhI); ABIN, Dmitry (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute)); RUDNEV, Igor (National Research Nuclear University MEPhI (Moscow Engineering Physics Institute))

Presenter: Mr OSIPOV, Maxim (National Research Nuclear University MEPhI)

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