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Mon-Mo-Po1.10-09 [117]: A quadratic approximation method for the limit value of magnetic stiffness in a high temperature superconducting levitation system

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In this paper we present a quadratic approximation method for the limit value of magnetic stiffness in a high temperature superconducting levitation system. The levitation configuration discussed is that of a cylindrical permanent magnet (PM) placed above a coaxial high temperature superconductor (HTS). The magnetic levitation force between the PM and the HTS is obtained on the basis of Kim's critical model and Ampère circulation theorem. The central issue of magnetic stiffness associated with the hysteresis of levitation force is discussed. To a given levitation gap between the PM and the HTS, the approximate values of magnetic stiffness are obtained corresponding to different displacement increments from 0.1mm to 3mm. In the first approximation the least squares method is used to curve fitting force-displacement table. Secondly, the limit value of magnetic stiffness is gained at the zero displacement increment in the polynomial fitting curve of these approximate values. The results show that the limit value of magnetic stiffness is dependent on the levitation gap and the movement direction of the levitated object, which is believed to be responsible for the penetration history of shielding currents distribution in HTS and magnetic field gradients. Some displacement increments, such as 0.5mm or 1mm, are usually used in superconducting levitation experiments. The difference between experimental data of magnetic stiffness and the limit ones is also investigated.

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