A Rotational Seismometer Utilizing the Pinning Effect of a Superconductor

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ABSTRACT

A superconductive rotational seismometer implemented with a magnetically levitated proof mass is currently developed for geophysical applications. The magnetic field generated by a permanent magnet inside the mass is trapped (pinned) by a collocated high-Tc superconductor, and supports the mass without mechanical contacts. This design has significant advantage to achieve a high rotational sensitivity because the mass is virtually free to rotate about its primary (vertical) axis, while it is tightly constrained in other degrees of freedom due to the symmetry of the magnetic fields. The orientation of the levitated mass is detected by optical transducers and stabilized by the force applied by electrostatic actuators. The ground rotation angle is obtained from the servo signals for the stabilization.

The characteristics of the proof mass, particularly its controllability have been studied and preliminary observations were attempted using the first generation prototype seismometer. Technical details, the results of those studies and forthcoming upgrades of the instrument are reported and discussed in this poster presentation.

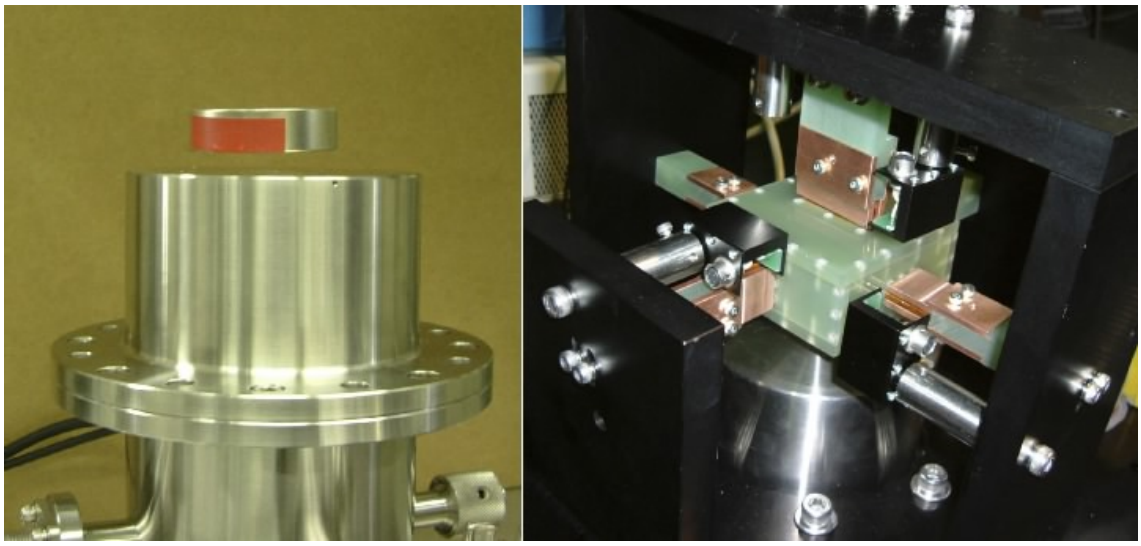

Figure: (Left) A permanent magnet is levitated by the magnetic field pinned by a superconductor located inside the lower vacuum tank. (Right) The proof mass of the first prototype seismometer, surrounded by optical transducers (black brackets) and electrostatic actuators (copper plates).