

AP7-4

The world's largest superconducting magnetic bearing for cosmic microwave background polarization experiments

*Yuki Sakurai¹, Peter Ashton^{1,2,3}, Akito Kusaka^{3,4,5,6}, Charles Hill^{2,3}, Kenji Kiuchi⁴, Nobuhiko Katayama¹, Osamu Tajima⁷

Kavli Institute for The Physics and Mathematics of The Universe (WPI), The University of Tokyo, Japan¹

Department of Physics, University of California, Berkeley, USA²

Physics Division, Lawrence Berkeley National Laboratory, USA³

Department of Physics, The University of Tokyo, Japan⁴

Kavli Institute for the Physics and Mathematics of the Universe (WPI), Berkeley Satellite, The University of California, Berkeley, USA⁵

Research Center for the Early Universe, School of Science, The University of Tokyo, Japan⁶

Department of Physics, Kyoto University, Japan⁷

We describe the design of a large-diameter superconducting magnetic bearing (SMB) employed in a continuously rotating cryogenic half-wave plate (CHWP) polarization modulator for cosmic microwave background (CMB) polarization experiments. A precise measurement of the CMB polarization will enable improved constraints on cosmic inflation, which describes a rapid expansion of the early universe. The CHWP system is a key instrument for suppressing 1/f contamination (mainly due to atmospheric noise) and mitigating systematic uncertainties that arise when differencing orthogonal polarization detectors. To ensure a sufficient field of view and to reduce thermal emission from the modulator, the CHWP must have a clear-aperture diameter of > 500 mm and must operate at cryogenic temperatures. We have developed an SMB with an inner diameter of 550 mm, which is the largest used in CMB polarization experiments to date. Here we present the design of the SMB and its mechanical and thermal performance.

Keywords: Superconducting Magnetic Bearing, Polarization Modulator, Cosmic Microwave Background, Cosmic inflation