

Mag-01H used for Field Measurements in Cryogenic Chambers

Objectives

To measure magnetic field strength and fluctuations in experimental setups operating at cryogenic temperatures.

Instrumentation

- Mag-01H: precision single axis fluxgate magnetometer
- F or G probes: high or low field cryogenic probes

Applications

Physics experiments: monitoring magnetic shielding effects within cryostats during particle experiments.

Background

Many experiments require the experimental environment to be controlled so as to isolate them from external influences. In experiments where magnetic fields can have an influence on the outcome, magnetic shielding is often used, with fluxgate probes providing feedback on the field strength inside the shielding.

Some experiments also require cryogenic temperatures and hence cryogenic fluxgate probes. Ordinary magnetometers do not function at cryogenic temperatures due to thermal contraction of components and different materials used in the manufacture of the sensor.



Method

The Mag-01H probes F and G have been designed to work at cryogenic temperatures, using materials which contract only a minimal amount. The Mag-01H design allows only the probe to be exposed to the low temperatures, minimizing the space used up within the cryogenic chamber. An interface soldering board delineates the ambient temperature components from the cryogenic components. The wires can be unsoldered, to be connected to the cryostat connectors and reconnected to the room temperature cable.

Cryogenic probes have been used to monitor the effectiveness of magnetic shielding during experiments to measure the Weak interactions between neutrons and superfluid helium [1] (see also AN0022: 'Mag-01H used for Verification of Magnetic Shielding'). A cryostat is used to maintain the superfluid helium at the required temperature of 4.2K. The experimental procedure requires magnetic fields within the cryostat to be kept to a minimum to prevent the Weak force interactions on the neutrons being obscured by spin induced from any magnetic fields. Thus, only the Weak interaction is observed.

The set-up contains three layers of magnetic shield. The smallest layer of shielding and the probe are positioned around the experimental apparatus within a cryostat. The Mag-01H is used to monitor any fluctuations in the magnetic field within the cryostat and feed back into a degaussing system in the shielding.

Reference

[1] Tasson J D 2002 Magnetic Shielding for an Experiment to Measure the $n - ^4\text{He}$ Weak Interaction, Northern Michigan University