

Mag-01H

Verification of Magnetic Shielding

Principle aim

To measure the effectiveness of magnetic shielding using magnetometer measurements.

Used in

Physics experiments, measuring Weak force interactions, nuclear spin measurements.

Background

Magnetic shielding is made from high permeability μ material (mumetal), which concentrates any incident magnetic field within the shielding material and deflects the field around the shielded area. A typical shape used for shields is a cylinder. There are usually three concentric layers or cylinders with a space between each layer. The principle of multi-layering amplifies the shielding from each layer, reducing the field experienced at the centre to a minimum. Alignment of the shield normal to the incident field maximises its effectiveness.

To measure the reduced field inside the shielding, a probe is mounted on a plastic or aluminium rail and measurements are taken at various lengths along the cylinder in a number of orientations. To increase the accuracy of each measurement, a first reading is taken with the probe in one orientation, and then a second is taken with the probe rotated to face the opposite direction. The average of the absolute values is taken as the measurement.

Method

Shielding is less effective if the shields have become magnetised. When magnetised the incident field lines do not concentrate within the material and are not deflected away from the target area. If this occurs then the layers can be individually degaussed. Mag-01H can be used to test whether degaussing is required and also to test the results of degaussing.

The expected level of shielding is calculated using the shape and dimensions of the shield, and is a proportion of the external field.^{1,2} If the field measured does not correlate to the expected value then the shield may be magnetised.

There is a level of measured field which cannot be removed by degaussing; this is caused by a small amount of magnetism which is present in the shield. This shows that the principle of the effects of shielding increasing with layers is only true to a certain point. It is not possible to shield 100% of the field.

Probes are also mounted inside the shielded area during experiments, and connected to a feedback system which is used to cancel out any fluctuations during the experimental process actively.

- 1 Tasson J. D. Undergraduate Research Project Magnetic Shielding for an Experiment to Measure the n - ^4He Weak Interaction, Northern Michigan University 2002.
- 2 Gan K. PhD Dissertation, A Parity-Violating Spin Rotation Measurement of Transversely Polarised Cold Neutrons Through a Liquid Helium Target, George Washington University 2011.