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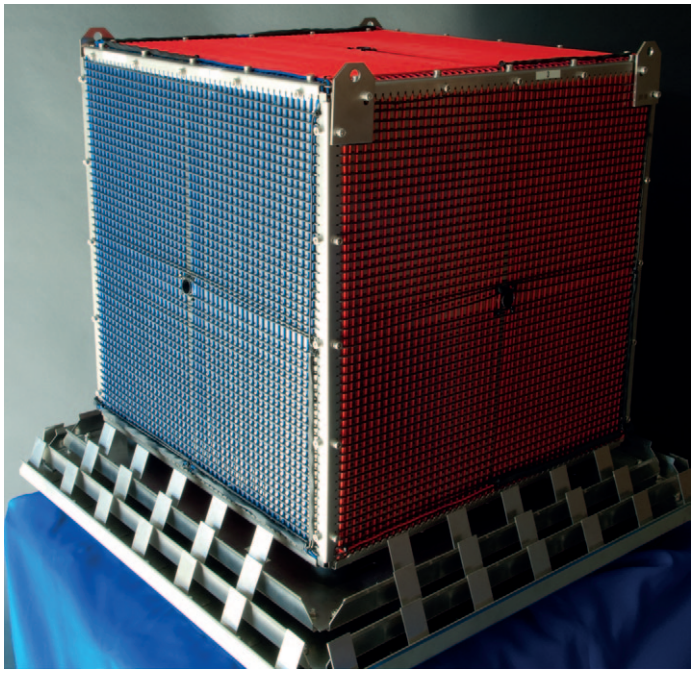
HOMIE (Homogeneous Fields in Experiments)

Several scientific experiments require magnetic fields of very high spatial homogenity or defined field gradients. Such experimental setups are used for the characterization of high precision magnetic field sensors or in other fields of atomic or nuclear physics, neuroscience and in nanoparticle research.

In many cases quasi-static field vectors with magnitudes in the sub-mT-range are needed that can be adjusted in two or three dimensions within a highly spatially homogeneous volume. To generate precise field conditions in this range, an effective shielding of the earth's field and of laboratory fields is required.

Low-frequency and DC magnetic fields can only be shielded by the method of flux guidance, preferrably with a closed boxlike shape and several layers of the high-permeability shielding material MUMETALL®. Defined magnetic fields inside the shielded space can either be generated by permanent magnets or by electrical currents.



HOMIE is based on electrical currents to be able to adjust the magnetic field strength without mechanical changes. As the shielding materials also interact with the generated internal fields, a concept is needed that lets the passive shielding support the generation of the homogeneous field instead of interfering with calculationally optimized air coil systems. Many conventional setups use Helmholz coils, whose theroretical field homogenity is limited to the 2nd order and is additionally affected by surrounding shielding material.

The HOMIE system is based on a different approach that uses the shielding material to even improve the field homogeneity. In principle (limited by the practiced constructional effort), the whole interior can be filled with an absolutely homogeneous field. It therefore offers a large utilizable volume fraction for experiments and in contrast to solenoidal coil systems e. g., it is easily accessible from the outside. Effects on the field homogeneity by customer-specific openings can be minimized by a sophisticated current diversion method. Besides, the whole interior can be kept free of electrically conductive material which is important if higher frequency experiments are to be performed under controlled quasi-static magnetic field conditions.

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Advantages of the HOMIE System

- 1D/2D/3D magnetic fields <mT
- shielding factor of 10000 (80 dB) against external fields
- higher field homogeneity than Helmholtz systems
- wider homogeneous volume than with active dynamic compensation
- easily accessible interior
- customer-specific adaptions possible (size, shielding requirements, openings, electronics, software...)
- optional: Demagnetization of shielding material
- defined field gradients
- already in use by several research labs

The HOMIE Setup

The shown HOMIE shielding box consists of five layers of MUMETALL®, a very high-permeability and low-coercivity material that is used for shielding applications with highest demands. This minimizes stray fields and effects of remanent magnetization to a minimum.

The homogeneous magnetic Field is introduced by a sophisticated array of cables that is applied to the innermost shielding layers. So the shielding works both as an external field suppressor and a field homogenizer.

The control unit is delivered externally and consists of power supplies and a control device. It is optimized to provide stable current conditions for an absolute minimum of time-dependent field fluctuations.

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