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Title: **Screening of an inhomogeneous magnetic field using bulks and coated conductors: how do the characteristics of the applied field influence the screening properties?**

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This communication deals with applications of bulks and coated conductors used as magnetic screens. The purpose of magnetic screening is to reduce the low-frequency, inhomogeneous stray magnetic field emanating from large scale applications, in order to protect people or equipment [1]. A superconducting magnetic screen can be planar and operates efficiently under an inhomogeneous magnetic field. Both bulk superconductors and loops of coated conductors can act, separately, as passive magnetic screens. Each of them has its own advantages: the bulks are very efficient screens over a few cm² while closed-loop coated conductors are less efficient but are easily scalable. In our previous works [2,3], we have shown that combining bulks and closed-loop coated conductors to make a 'hybrid' screen allows us to benefit from the advantages of both. The typical geometry of a hybrid magnetic screen is shown in figure 1. It consists of a disk-shaped bulk surrounded by one or several sets of coated conductors wound as naturally short-circuited eye-shaped loops [4]. The screened surface area of a hybrid screen is considerably extended compared to that of a bulk sample alone.

While the screening properties of hybrid superconducting screens have been previously demonstrated for a given type of magnetic field source, it is important for practical applications to understand and predict the behaviour of such screens under different types of inhomogeneous applied field. Hence, the present work investigates the influence on the screening properties of (i) the geometric parameters of the field and (ii) its time-dependence. This studied is carried out both experimentally and numerically. Experiments are carried out at 77 K on screens made of 30-mm diameter bulks ($GdBa_2Cu_3O_7$/Ag) from CAN Superconductors combined with $GdBa_2Cu_3O_7$ coated conductors from Shanghai Superconductor Technology, using a bespoke 3-axis cryogenic Hall probe [5]. Numerical modelling is performed using Gmsh and GetDP and adapting the open-source codes available at [6].

In inhomogeneous field conditions, the magnetic field lines reaching the superconducting screen are always curved and the geometric parameters may have a strong influence on the screening properties. Typically, varying the distance between the coil and the screen changes both the gradient and the curvature of the field lines reaching the screen. In this work, we highlight experimentally and numerically that reducing this distance may improve significantly the measured screening properties, considering that the current in the coil is adjusted to maintain the same magnitude of the applied field at the bottom surface of the bulk.

Regarding the time dependence of the field, an important point to investigate for practical applications is whether the screening properties are maintained upon the repetition of several applied field cycles. In the present work, we investigate numerically the evolution of the field attenuation (screening factor $SF = \mu_0 H_{app}/B$) under these conditions. After the initial decrease in SF when the field is ramped up from zero to its first maximum, we show that the relative decrease of SF between the following field maxima is smaller than the natural decay (due to current relaxation) that would be obtained if the maximal field was maintained. The extremely small decrease of SF was confirmed experimentally for a few cycles. This result is important regarding the use of superconducting passive screens for practical applications.

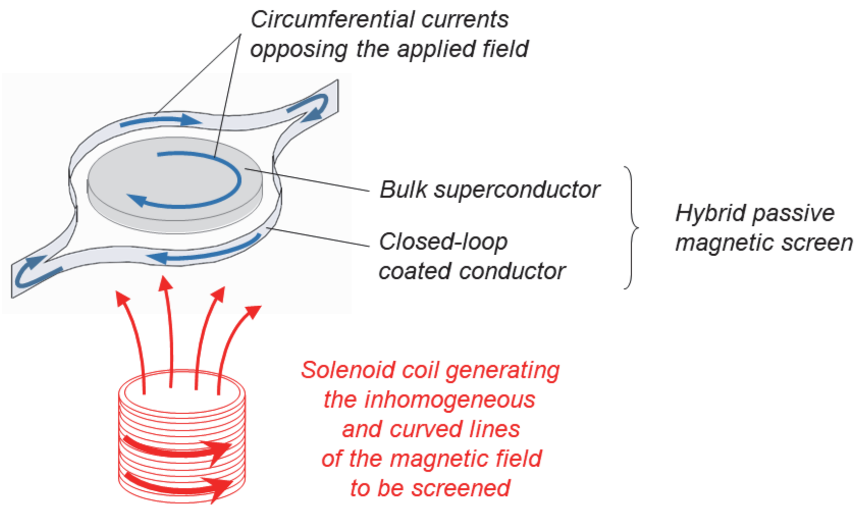

Figure 1 Schematic illustration of a hybrid passive magnetic screen.

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