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A versatile bulk superconducting MgB_2 cylinder for the production of holding magnetic field for polarized fuels and targets

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The production of an internal magnetic field in a compact space is a challenging problem and a versatile solution is being pursued. The property of a hollow superconductor is exploited in order to trap a specific configuration of magnetic field, which could shield the interior from externally applied fields. This can be achived applying the desired magnetic configuration during the cooling process through the transition temperature.
This solution, in the longitudinal field configuration, would be useful for polarized fuel for nuclear fusion test.
In the transverse field configuration, instead, would be useful for transversely polarized nuclear target.
A bulk superconducting MgB_2 cylinder has been characterized measuring the interior field retention, the capability to exclude an externally applied field and the corresponding long-term stability performance. The measurements have been done just in its center at 1 T transverse magnetic field at around 13 K.
The present programs are focused on mapping the trapped field along the symmetry axis, at higher magnetic field, and at lower working temperature in a transverse magnetic field.
Afterwards the cylinder will be tested in a longitudinal field, but also prepared in a transverse field and then immersed in a longitudinal field to test its capability on shielding the latter.
In the context of an electron scattering experiment, such a solution will minimize beam deflection and energy loss of the reaction products, while also will eliminate the heat load to the target cryostat from current leads that are required for superconducting electromagnets.
In the context of polarized fuel for fusion its use is straightforward, because the system can trap the magnetic field required during fuel production, and then provide the holding field for its transfer in fusion test facilities.

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