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Superconducting magnets for antimatter traps or neutron traps –designed and manufactured in industry

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Bilfinger NOELL GmbH is active in the field of superconducting magnets for particle traps. We report on two types of traps: a magnet for a neutron trap and several magnets for antiproton traps.
Bilfinger NOELL has developed, manufactured and delivered a large volume magnetic storage device for ultra-cold neutrons to Technical University of Munich in June 2020. The magnet of PENeLOPE (Precision Experiment on the Neutron Lifetime Operating with Proton Extraction) serves to measure the lifetime of the free neutron with unprecedented accuracy. The magnetic and mechanical design as well as the manufacturing and testing is described. The NbTi superconductor coils are cooled with liquid helium and the magnet provides high magnetic field gradients at high field levels, built into a complex cryogenic structure as the neutrons are trapped in vacuum.
The magnets for antimatter-traps, usually Penning traps, request in particular a high homogeneity in a long cylindrical volume. The magnets designed and built throughout the last few years all have been "cryogen-free", i.e. with G-M or pulse-tube cryocoolers and conduction cooling. There are two magnets that allow being transported while operating at full field. Therefore, active and passive magnetic shielding is foreseen to reduce magnetic fringe field to a very low level.

Primary authors: HOBL, Achim (Bilfinger Noell GmbH); Mr AMEND, Johannes (Bilfinger Noell GmbH); Mr GERHARD, Thomas (Bilfinger Noell GmbH); Mr STEINMANN, Jochen (Bilfinger Noell GmbH); Mr WALTER, Wolfgang (Bilfinger Noell GmbH); Mr WU, Hong (Bilfinger Noell GmbH)

Presenter: Mr WU, Hong (Bilfinger Noell GmbH)

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