MATTER AND TECHNOLOGIES

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Lead-based Rapid Cryogenic Current Comparator (CCC) Prototyping

A Cryogenic Current Comparator (CCC) is a non-destructive, metrologically-traceable, charged particle beam intensity measurement system for the nano-ampere range. Classical CCCs for beamline applications consist of a superconducting meander-shaped shielding, a su-perconducting pick-up coil with a highly permeable flux-concentrating core, and a Supercon-ducting Quantum Interference Devices (SQUID). A first CCC (GSI-Pb-CCC, 1996 completed, 2014 upgraded, free inner diameter of 145 mm) was made of lead. Later versions (DESY-Nb-CCC 2010 tested at HZ Berlin; CERN-Nb-CCC, 2015 completed, currently in operation at CERN Antiproton Decelerator; GSI-Nb-CCC-XD for the CRYRING@ESR with a free inner diameter of 250 mm) were made of niobium.
It has been shown that the construction of a CCC shield with a complex meander structure using niobium is possible but also inflexible, time-consuming, and expensive. This work shows that it is possible to measure main parameters like the noise behaviour of a CCC with flux-concentrator-core by a lead-foil dummy-CCC without meander shielding. We found good agreements between the low-frequency (100 pA/√Hz @ 1 Hz) and white noise (3 pA/√Hz @ 10 kHz) of the GSI-Nb-CCC-XD and a dummy-Pb-CCC-XD with the same core type (GSI328plus). Using a different meander-design it is also possible to create a complete CCC with meander shielding from lead-foil to test a coreless CCC version [1].

References

[1] V. Zakosarenko et al., Coreless SQUID-based cryogenic current comparator for non-destructive intensity diagnostics of charged particle beams. Supercond. Sci. Technol. 32 (2018) 014002 (6pp), https://doi.org/10.1088/1361-6668/aaf206.

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