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First high-inductance Dual-core Cryogenic Current Comparators of the new CCC-Sm series

Cryogenic Current Comparators (CCC) are presently used at CERN-AD (100 mm beamline diameter) and in the FAIR project at CRYRING (150 mm beamline diameter) for non-destructive absolute measurement of beam currents in the range of below 10 μA (current resolution 10 nA). Both sensor versions (CERN-Nb-CCC and FAIR-Nb-CCC-XD) use niobium as superconductor for the DC-transformer and magnetically shielding. The integrated flux concentrators have an inductance of below 100 μH at

4.2 Kelvin. The new Sm-series (Smart & Small) is designed for a beamline diameter of 63 mm and is using lead as superconductor. The first sensor (IFK-Pb-DCCC-Sm-200) has two core-based pickup coils ($2 \times 100 \mu\text{H}$ at 4.2 K) and two SQUID units, to eliminate Barkhausen current jumps as part of the low frequency $1/f^2$ -noise. During the construction some basic experiments on noise behavior (fluctuation-dissipation theorem, white noise below 2 pA/ $\sqrt{\text{Hz}}$) and magnetic shielding (core-inductance/meander-shielding-capacity resonance, additional mu-metal shielding) were undertaken, the results of which are presented here. Finally, a current resolution of 500 pA could be achieved in the laboratory.

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