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HTS solenoids for the PSI Positron production project in the context of the CHART FCCee injector study

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This work presents the concept of the HTS solenoid-based adiabatic matching device for the CHART FCCee Injector study. The first results of in-house made and tested non-insulated HTS coils are shown.

The CHART P-cubed project at Paul Scherrer Institut is the proposed proof-of-principle experiment for the FCC-ee positron source. The main challenge for this study is capture and transport devices of the secondary positron beam from the production target to the damping ring. To meet the requirements of the experiment, a novel approach using HTS-based NI coils for the matching and focusing solenoid magnet is proposed.

This technology takes the advantage of the high current density, high stability, and relatively straightforward cryogen-free cooling at ~ 20 K producing considerably higher positron yield with respect to the state of the art. Conventional insulation could be subject to irradiation damage, and constitute a thermal barrier for the extraction of heat from the coil. All of these make solder-impregnated NI coils ideally suited for compact DC applications. For this reason, PSI has licensed NI coil technology from Tokamak Energy Ltd (TEL) and applied it in a first demonstrator solenoid.

Here we present the design, coupled thermo-electromagnetic modeling, and powering results of the first HTS NI solenoid demonstrator, built and tested in-house with TEL technology. The new cryogen-free teststand upgraded and redesign for this project will be shown too. It's equipped with two cryocoolers, allowing for powering tests up to 2 kA with FPGA based quench detection system.

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