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# Modelling of Electrical, Magnetic and Thermal Issues for a Non-Insulated HTS-CCT Dipole Magnet

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The no-insulation (NI) coil technique has proven to be robust for realizing high-field magnets with REBCO high-temperature superconductors (HTS). While the stable operation and charging delay —both originating from the inter-turn current transfer —on one hand, ensure the success of NI coils, on the other hand, they limit their application scenarios. A possible solution to the charging delay issue is to power the coil with additional current, which could be achieved through either pre-simulation or active feedback control. However, apart from the additional Joule heating that may disturb the stable operation of a REBCO NI magnet, the inter-turn current may also deteriorate the field quality, which can be particularly problematic for an accelerator magnet. These issues, along with uneven current distribution among different turns and the screening current generated inside the HTS ceramics, could be even more critical. Despite these doubts, we believe it is still too early to directly forbid the NI technique on accelerator magnets.

At IHEP, we started to explore the feasibility of employing the NI technique in accelerator magnets since last year. The first step is to eliminate the field delay and realize the target field as we designed. To achieve this, we are developing two methods to simulate the current that should be charged to an NI coil to get the target field, as an alternative way of the dynamic feedback control. The relevant simulation and experiment results on a few small testing coils will be presented, which show a perfect charging of the magnetic field as we desired. Then, the recent progress on the modelling of a canted-cosine-theta REBCO dipole magnet will be presented, regarding the electrical, magnetic, and thermal characteristics during the charging of such a magnet using a multi-physics model that couples circuit grid, magnetic field, and heat transfer analyses.

## Topic

Coupled and uncoupled multiphysics problems

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