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Numerical Evaluation on Quench Behavior of REBCO Coil System of Skeleton Cyclotron for Cancer Therapy

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In recent years, advanced cancer treatment technologies have been required to deal with cancer patients with various disease sites and stages. Especially, targeted alpha-particle therapy is expected. In targeted alpha-particle therapy, a targeted drug labelled by alpha-emitting-RI is administered in a cancer patient. Therefore, nuclide production facilities are required, and alpha-emitting-RI must be produced in a facility close to the hospital because of short-lived nuclide. Accelerators are promising device to solve these problems. However, reducing the operation cost and miniaturization for easy installation are essential to widely use accelerator for medical application. Therefore, in order to further promote the use of medical accelerators, we have proposed Skeleton Cyclotron applied high temperature superconducting (HTS) coils with non-insulation (NI) winding technique. The NI HTS coil can make both high current density and high magnetic field, so it can achieve miniaturization of its size and high intensity beams. Furthermore, in NI coils, the current flows not only in the coil winding direction but also in the radial direction. Therefore, even if the local normal transition occurs in the coil windings, the current can bypass into the neighboring wires and thermal stability can be improved. On the other hand, when the normal transition and quench occur, the electromagnetic and mechanical behaviors in NI coils are different from those of conventional insulated coil. Therefore, we developed a current distribution analysis code for non-insulation HTS coils, and simulated the current, magnetic field, electromagnetic force distributions, and evaluated its electromagnetic and mechanical properties during the normal transition and quench in NI REBCO coil system for Skeleton Cyclotron.
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