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Thermal design and test results of the superconducting magnet for a compact heavy-ion synchrotron

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Heavy-ion radiotherapy has a high curative effect and low burden on patients, so it has been spreading in recent year. On the other hand, since heavy-ion radiotherapy system have large apparatuses such as injector, synchrotron, and rotating gantry, it is necessary to downsize these apparatuses in order to further wide spreading. Therefore, a project to develop a next generation small facility for heavy-ion radiotherapy called quantum scalpel has been started from 2016 at National Institutes for Quantum and radiological Science and Technology (QST). One of the aim of this project is to significantly downsize the synchrotron by applying superconducting technology, and we have been developing a superconducting magnet for a compact heavy-ion synchrotron. This superconducting magnet can generate a dipole field of 3.5 T with operating current of 265 A, and it's designed to be able to raise the magnetic field from 0.3 T to 3.5 T in a 5 second while adopting conduction cooling with GM-cryocoolers. Such high-speed excitation causes AC loss in the superconducting coil. The thermal design result including this AC loss will be reported. In addition, a short model with the same cross section as the designed coil were fabricated and excitation test was carried out. The test result will be also reported.

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