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Microcalorimetry of carbon ion beam for medical treatment by transition edge sensor

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Heavy ion beam is used in radiotherapy for cancer. Unlike in other radiation therapies, direct ionization plays a large roll in heavy ion therapy. It is considered that the secondary electrons emitted in the minute area around the track of a heavy ion beam plays a roll in the direct ionization, which has not been quantitatively evaluated yet. In order to ultimately detect the energy transfer in this minute region (microdosimetry), a detector which has a greater energy resolution than conservative detectors is needed. In this report, we precisely measured the energy of each carbon ion in carbon ion beam for treatment using a transition edge sensor (TES).
Carbon ion beam of 100MeV/u which was irradiated by Heavy Ion Medical Accelerator in Chiba (HIMAC). The TES we used in this experiment is made of bilayer of Ir and Au, and a Sn absorber was connected to the bilayer.
In order to measure the energy of carbon ion beam where the beam is around the Bragg peak, attenuators made of Al was set between the beam port and the TES. The energy of the beam was so large that the absorber was saturating during events. Since there is a correlation between saturation time and the energy of the heavy ion, we decided to collect the length of saturation time for events and made a histogram. We changed the thickness of the attenuator and made histograms for each thickness. As the thickness of the attenuator increases, the saturation time which showed the peak of each histogram increased. This matches the Bragg Curve of carbon ion beam. In addition, it appears that the variation of the histogram increased, as the thickness of the attenuator increased. It is assumed that the TES was able to read out the variation of the physical events that occurs when a carbon ion goes through the attenuator.
We have succeeded in measuring the energy of each carbon ion in the carbon ion beam. This may contribute to the establishment of a new method of dosimetry of carbon ion beam for treatment.

Less than 5 years of experience since completion of Ph.D

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