Contribution ID: **116** Type: **Oral presentation**

Medical facilities in Japan

There are 7 carbon synchrotron and 12 proton synchrotron in operation for particle therapy in Japan. Advanced slow extraction technique has been developed for raster scanning irradiation for carbon ion therapy in HIMAC and other facilities such as double RF knock-out method for ripple reduction and multiple-energy operation using extended flattop. This technique have enabled the scanning irradiation for respiratory moving organ such as Lung, Liver, and Pancreas, and the treatment for large radioresistant tumor such as bone and soft tissue cancer within a reasonable irradiation time. The newest carbon ion therapy facility, East Japan Heavy Ion Center, Faculty of Medicine, Yamagata University, has 600 available beam energies to control the beam range by 0.5 mm step. Beam extraction parameters are tuned by many energies with use of interpolation to reduce ripples and spike in the extracted spill. This facility also have a superconducting rotating gantry, 15-degree step operation for 600 energies are successfully commissioned by March 2023. Stable extraction control is also utilized for physical experiment which needs extremely low intensity of ~100 particles per second.

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Session Classification: Facility Overview