AbstractID: 8098 Title: Computational modeling of beam-customization devices for heavy-charged-particle radiotherapy

Purpose: This work is aimed to improve the computational model of the beam-customization devices for treatment planning of radiotherapy with heavy charged particles, where only a single collimator and a compensator have been commonly handled with inaccuracy of unphysical collimator dependence in the middle of large fields. **Method and Materials:** The phase-space theory is applied to the beam transport through the beam-customization devices to enable handling of multiple collimators and a compensator in any order. The theoretical model was experimentally tested with a carbon-ion beam, where two jaw and a multileaf collimators, a 3-cm PMMA half plate for a range compensator, and an 8-cm square aperture for a patient collimator were concurrently used. In the model, a matrix of pencil beams was transported through the devices and a two-dimensional in-air dose distribution on the isocenter plane was computed within ten seconds. For comparison, the penumbra sizes at the field edges formed by the effective collimators were analytically estimated and the dose profiles along four axes on the isocenter plane were experimentally measured. **Results:** The model computation agreed with the measurement and analytic estimation at a submillimeter level in penumbra size and reproduced the measured dose fluctuation in the middle of the field due to the range-compensator scatter. **Conclusions:** The model computation is fast, accurate, and readily applicable to pencil-beam algorithms in treatment planning to enable combinational collimation for the best use of beam-customization devices.