# AbstractID: 10188 Title: 4D Monte Carlo dose calculations for particle therapy combined with a computational biomechanical model of lung motion

**Purpose:** To evaluate the impact of respiratory motion on particle therapy and to realize 4D planning while keeping CT exposure as low as possible. To accomplish this, we develop a Monte Carlo dose calculation system combined with a computational biomechanical model of lung motion. **Method and Materials:** The human lung was CT scanned for a single phase of a respiratory motion. The CT images were transformed into tetrahedral elements by automated segmentation. Then, the respiratory motion was simulated using a computational biomechanical model called the spring network model, and the calculated 3D shape of the lung for a given phase was transformed to a voxel data set. For each phase, assuming carbon-ion beam irradiation, biological dose distribution was calculated using the Monte Carlo particle and heavy ion transport code PHITS coupled with a microdosimetric kinetic model. The dose was mapped onto the reference data set to obtain the accumulated dose. **Results:** We have developed the first version of the 4D dose calculation system. The lung motion is realistically reproduced. The Monte Carlo module can successfully read the data set for each phase and calculate the accumulated dose. How many phases to use and their weights can be set arbitrarily, without need of additional CT scanning. Our first simulations for a 70 MeV/u carbon ion beam with a diameter of 2 cm indicate that the dose distribution can significantly change with phase and that many data sets may be needed to accurately evaluate the dose to the surrounding normal tissue. **Conclusion:** The impact of the system we developed is two-fold: in the short term, it can be used to investigate different issues of 4D treatment planning; our goal is an entirely simulation-based 4D planning from a single CT scanning. The system is being developed further.