AbstractID: 5579 Title: Monte Carlo simulations using whole-body pediatric and adult phantoms as virtual patients to assess secondary organ doses in proton radiation therapy

Introduction: Early cancer detection combined with new treatment technologies has resulted in higher numbers of long-term cancer survivors. The risk of radiation-induced secondary cancers to tissues away from the PTV is a growing concern in particular for pediatric patients. The focus of this project is to use whole-body pediatric phantoms in Monte Carlo dose calculations in order to determine the effective dose from secondary radiation in patients undergoing proton treatment.

Methods: Age and gender specific pediatric phantoms have been implemented into the Geant4 Monte Carlo package for organ dose calculations. A proton therapy treatment plan for a pediatric head and neck tumor case was chosen to address the significance of age dependent phantoms for radiation protection calculations. To mimic radiation therapy treatment, the setup of the phantom position was based on field parameters (based on a full treatment head model), including gantry angle, couch angle, and iso-center position. We distinguish between secondary radiation from the treatment head and secondary radiation generated within the patient.

Results: Results using an adult phantom as well as phantoms of a 4-year old female and an 11-year old male were analyzed. Organ doses and radiation and tissue weighting factors were used to calculate the effective dose. For proton treatments with double-scattering system, range modulator and aperture, a significant number of secondary neutrons are generated in the treatment head. More important, differences between phantoms (age dependent) were found with respect to dose to specific organs and relative importance of neutrons generated in the patient versus neutrons from the treatment head.

Conclusion: We present results of doses to various anatomic sites in the human body for whole-body phantoms. The magnitude of secondary dose in organs/tissues depends on the distance from the PTV. For the first time, the significance of age-dependent phantoms for secondary dose calculations was studied.