Treatment planning studies for laser-driven proton therapy

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Abstract:

Laser-driven proton acceleration may become a cost- and space-efficient alternative for radiation therapy with proton beams in the future. Currently, the properties of these beams are very different compared to conventionally accelerated protons. Laser-driven protons exhibit a pulsed structure with a high proton number within ultra-short bunches at low bunch repetition rates (few Hz at best). Moreover, the energy spectrum is very broad. Over the last years, we developed a treatment planning system (including three-dimensional dose calculation and plan optimization on patient computed tomography datasets) which can handle these properties. It includes various dose delivery modes (conventional spot scanning as well as axial or lateral clustering techniques) and it can be used to investigate the feasibility (e.g. in terms of dosimetric quality of the plan and the required treatment time given by the number of required laser shots) of laser-driven proton therapy under various assumptions. We report on results for different gantry and beam line designs, and discuss the importance of the initial number of protons contained in one bunch immediately after the laser target. Furthermore, the influence of random shot-to-shot fluctuations on the plan quality can be analyzed.

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References:

Hofmann K.M., U. Masood, J. Pawelke, J.J. Wilkens: “A treatment planning study to assess the feasibility of laser-driven proton therapy using a compact gantry design” Medical Physics 42(9), 5120-5129, 2015.

Schell S. and J.J. Wilkens: “Advanced treatment planning methods for efficient radiation therapy with laser accelerated proton and ion beams” Medical Physics 37(10), 5330-5340, 2010.