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Report on Sebastian Vanda Slukova's Master's Thesis

"Monte Carlo simulations of radiotherapy treatment with laser accelerated particles "

The thesis work is about the investigation of possible utilization of laser accelerated electron beams for radiation therapy.

The thesis is structured in five Chapters, followed by Discussion and Conclusions. In the first two chapters, the student reviews the state of the art of laser wakefield acceleration (Chapter 1), and the state of the art of very high energy electrons in radiotherapy (VHEE) (Chapter 2). In Chapter 3 the Methods utilized in this thesis are described. In Chapter 4 the treatment planning results are presented, and in Chapter 5 the work related to experiments at ELI-Beamlines is reported. The thesis is written in English language.

After reviewing the published work in the field of laser electron acceleration and VHEE radiotherapy, the student learned the Monte Carlo code FLUKA. In the beginning, her first simulations have been used to replicate previous works for benchmarking. After, she performed novel simulations with realistic beam parameters and irradiation geometry, sending the beam to realistic oncological patient's data (anonymized).

The student independently developed a simplified treatment planning strategy in order to optimize the irradiation for the specific laser accelerated beams, which are not monochromatic, divergent and smaller than the beams typically used in radiotherapy. As part of this development, the student tried to develop also a collimating system for the electron beam.

The quality of the student work attracted international collaborators to ask her simulations for positron beam treatment, where the student worked closely with scientist from other groups in order to perform proof-of-principle simulations. Also the internal ELI-Beamlines team recognized the quality of her work, involving her in a kHz electron acceleration experiments. She has been assigned different experimental tasks, and also she has been asked to perform Monte Carlo simulations to optimize the electron beam shielding and transport.

During her work, the student showed the capability of working independently to accomplish the goal of his thesis. In fact she teamed up with other scientists at ELI-Beamlines to set-up more realistic and efficient simulations. She demonstrated the ability to apply the knowledge acquired by university studies, and her self-drive and initiative led to results which exceeded the initial

expectations. For this reason I recommend the submitted thesis by student Vanda Slukova for defense. Given its high quality, I suggest that it be rated A-Excellent-výborně.

Dolní Brezany, 23.05.2022

Gabriele Maria Grittani, Ph.D.
vedoucí práce