Laser Plasma Accelerator for VHEE-RT: the ebeam4therapy project

Victor Malka[1], Arnaud Courvoisier[1], Anton Golovanov[1], Eyal Kroupp[1], Atul Sengar[1], Yang Wan[1]

[1] *Weizmann Institute of Science, Rehovot, Israel*

victor.malka@weizmann.ac.il

In pioneered works of C. DesRosiers [1] in Radiotherapy (RT) domain, a numerical study of dose deposition conducted with very high energy electron (VHEE) virtual beam and real photon beams has been performed. The conclusion shows that VHEE are providing similar target coverage than X ray, with better sparing of normal tissue in favor of VHEE-RT. In Y. Glinec [2] and T. Fuchs [3] works, similar studies with real electron beam parameters as those delivered by laser plasma accelerator, have confirmed this conclusion with in [3] a detailed numerical study in the real case of a prostate cancer irradiated at seven directions by X ray or by VHEE beam. Interestingly, as shown in [2], the use of focusing quadrupoles allows to change the on-axis dose deposition, permitting higher dose deeper into the patient while maintaining a lower dose at the entrance. This new level of control opens also rooms for improving future treatment.

Since these pioneer works, many workshops and publications dedicated to VHEE have been performed showing more and more benefits of VHEE-RT, such as better performances for deep seated tumors like cancer, prostate or brain tumors, better sparing of surrounding organs at risk, and relative ease of beam steering and manipulation. Compared to photons or protons, VHEE-RT has a low sensitivity to unexpected changes in the path of the beam. As a consequence, the number of projects on VHEE-RT has increased considering both Radio-frequency or plasma cavity technologies.

The progress realized these last years in developing laser plasma accelerators for delivering relativistic electrons of very high beam quality, in the hundreds of MeV energy range pertinent for RT, with an increasing stability and reliability, show the pertinence of VHEE for cancer treatment which can compete to the well-established X-ray RT machines that motivate to explore its commercial pertinence within the ebeam4therapy project.

Acknowledgments

The European Innovation Council for founding the ebeam4therapy project.

References

[1] C. DesRosiers, V. Moskvin, A. F. Bielajew, and L. Papiez, 150-250 MeV electron beams in radiation therapy, Phys. Med. Biol. **45**, (2000), 1781.

[2] Y. Glinec, J. Faure, V. Malka, T. Fuchs, H. Szymanowski, and U. Oelfke, Radiotherapy with laser-plasma accelerators: Monte Carlo simulation of dose deposited by an experimental quasimonoenergetic electron beam, Med. Phys. **33**, (2006), 155.

[3] T. Fuchs, H. Szymanowski, U. Oelfke, Y. Glinec, C. Rechatin, J. Faure, and V. Malka, Treatment planning for laser-accelerated very-high energy electrons, Phys. Med. Biol. **54**, (2009), 3315.