Superconductivity in Medical Accelerators for Cancer Treatment with Charged Particles

Arno Godeke*

Varian Medical Systems Particle Therapy GmbH, Troisdorf, Germany

**Corresponding author: arno.godeke@varian.com*

The rapidly increasing market of medical accelerators for particle therapy will likely become the third large commercial application of superconductivity, after MRI, and magnets for high-field NMR. At present, there are 76 proton therapy sites in operation globally, but less than 3% of the cancer patients that could benefit from this form of treatment have access, and the needs will increase further as a result the increase of life expectancy. The root causes for the limited availability are the large installation- and operating costs, which are driven by the overall system size, weight, and complexity. By replacing copper magnets with superconducting versions dramatic reductions in size and weight can be achieved, and by designing the magnets to utilize the advantages that superconductors can provide, patient throughput can also be increased significantly. The use of superconductors therefore has the potential to provide substantial cost reductions if the higher conductor cost, and added complexity due to the cryogenic cooling requirements, can be mitigated. In this presentation, I will provide a brief introduction into the treatment of cancer with charged particles and explain where in the systems the use of superconductors could be beneficial. I will sketch the typical parameter space in which the superconductors will need to operate and highlight specific complications that emerge. To conclude the presentation, suggestions for research and development will be given, which the applied superconductivity community could consider, to simplify or enable the implementation of superconductivity in medical accelerators, and to help to advance this emerging and exciting field that poses direct and measureable benefits for humanity.