IEEE-CSC, ESAS and CSSJ SUPERCONDUCTIVITY NEWS FORUM (global edition), Issue No. 57, Oct 2024

Grand Challenges, Strategic Roadmap and Consortia for Healthcare

Kathleen Amm[2], Joseph Minervini[1], Arno Godeke[3]

[1]Novum Industria LLC, Harvard, Massachusetts, USA
[2]National High Magnetic Field Laboratory, Tallahassee, Florida, USA
[3]Senior Consulting for Superconductivity, Hengelo, Overijssel, Netherlands

E-mail: ammk@bnl.gov

***Abstract*–The most widely used commercial application of superconductivity is in healthcare, specifically for Magnetic Resonance Imaging (MRI) magnets. MRI is an extremely advanced imaging modality that has revolutionized the non-invasive medical diagnosis of diseases in soft tissues and is now a critical tool in oncology planning and treatment, like radiation treatment and focused ultrasound. Moving to higher field MRI magnets will continue to expand the resolution and quantitative chemical studies in MRI, and several significant projects have been and will be completed at fields above 11T. Future advances in superconducting magnet technology, such as helium-free magnets or High Temperature Superconductors (HTS), could lead to the proliferation of MRI technology in remote locations and developing countries. A secondary but growing application area is Particle Beam Radiation Therapy (PBRT), where superconducting cyclotrons are being increasingly used as particle accelerators. PBRT uses light ions, typically protons or carbon atoms, accelerated by superconducting or conventional magnets. The ion beams exhibit a very sharp Bragg peak in a patient's body, enabling the concentration of a dose within a tumor while minimizing the dose to the surrounding normal tissues, in contrast to radiation treatment with conventional X-rays, where significant dose depositions in healthy tissue cannot be avoided. The use of superconductivity in a cyclotron can reduce its mass by an order of magnitude and size by a factor of 3-4 over conventional resistive magnet technology, yielding a significant reduction in the overall cost of the device, the accelerator vault, and its infrastructure, as well as reduced operating costs. In this paper, we discuss the grand challenges and the elements of a strategic roadmap for superconducting devices in healthcare, which, when implemented, will enhance medical diagnoses and treatment worldwide.**

***Keywords (Index Terms)*–Superconductivity Global Alliance (ScGA), healthcare, MRI, Particle Beam Radiation Therapy (PBRT)**

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Presentation given at ASC 2024, Sept 2024, Salt Lake City, Utah, USA.