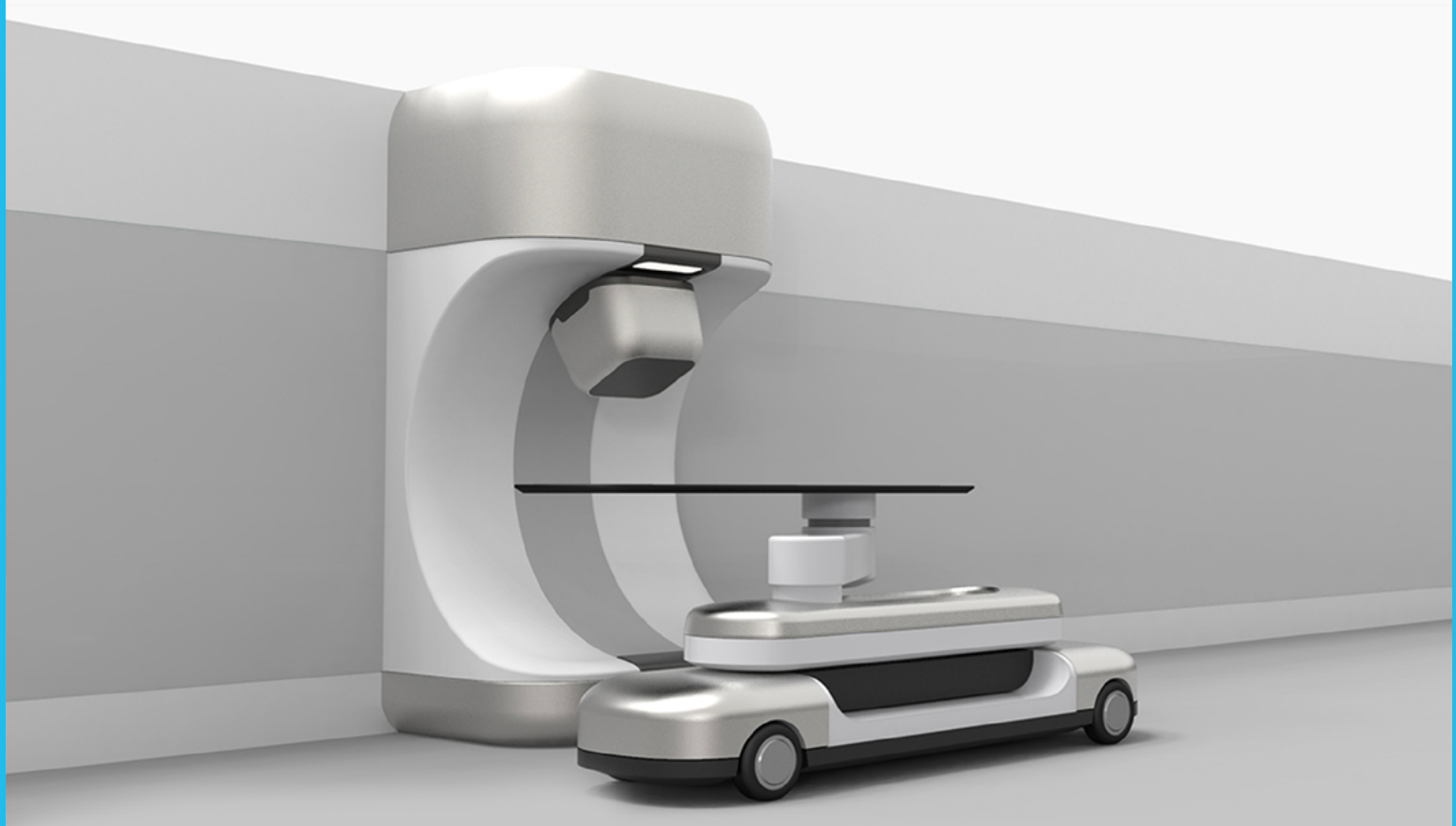
SUPERCONDUCTOR WEEK

B dot Medical Develops Ultra-compact Proton Therapy System



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Konstanz to Develop Hybrid Super/Semiconductor Computing Technology

The University of Konstanz, as part of an international research network, has been awarded a Future and Emerging Technologies (FET) research grant of €3.0 million ($3.6 million) from the European Union to develop a novel superconducting technology that has the potential to be combined with conventional semiconductors for creating the next generation of energy-efficient supercomputers and quantum computers. The research project, called SuperGate, seeks to lay the foundation for hybrid computing platforms that would not only exhibit higher energy efficiency and better performance than conventional computers, but would be more robust towards noise and able to operate in a wider range of environments. The project will run until August 2024.

Hardware developers face pressure to make rapid advancements in order to usher in a new quantum era. Hybrid computing platforms have the advantage of combining conventional semiconductor devices, which can be fabricated with high scalability and reliability, with superconducting devices that can help reduce the energy dissipation of computing systems.

"We believe that hybrid computing platforms can be fundamental in the next years to reduce the energy costs of large-scale computers, supercomputers," commented Konstanz Professor Angelo Di Bernardo. "These are currently under development and require an amount of energy comparable to that produced by a small (~1 GW) power plant in order to operate,"

NEST Breakthrough Makes SuperGate Possible

Until recently, it has been very difficult to combine semiconductor and superconductor systems in hybrid architectures. This is because semiconductor devices are controlled by voltage, whereas superconductors are typically driven by current.

In 2018, researchers from the NEST (National Enterprise for nanoScience and nanoTechnology) lab of the Italian National Research Council (CNR) in Pisa made a breakthrough discovery, demonstrating that it is possible to use an applied voltage to control the logic state of superconducting devices. Even though the effect had been demonstrated, the physical mechanism responsible remains elusive. Once researchers understand the mechanism at play, it might be possible to better control the effect and therefore optimize the performance of electronic devices based on it, which is fundamental for future applications.

"The goal of our program is to develop the first prototypes of circuits based on the combination of voltage-driven superconducting devices with conventional semiconductor devices," said Di Bernardo. "The long-term objective is to embed these circuits, thanks also to the support of bigger companies from the information technology industry, in the next generation of supercomputers to reduce their energy consumption. In addition, our technology can also find applications in the quantum computing systems currently under development."

Project to Proceed in Four Phases

The idea for the project stemmed from scientific discussions between Di Bernardo and researcher Francesco Giazotto of the Superconducting Quantum Electronics Lab in Pisa who then refined the concept with other investigators involved in the grant network. Also participating in the project are the CNR, the University of Technology and Economics of Budapest, the Delft University of Technology, Sweden's Chalmers University of Technology, and the Italian office of SeeQC.

The research program will develop through four phases. First, the team will research the physical mechanism that makes it possible to control superconductivity via an applied voltage. Next, they will research the best materials and device geometries for technical applications, and then embed them into a prototype device. Finally, they will integrate the optimized devices into an electric circuit which will be tested in combination with a circuit based on conventional semiconductor technology. The first two phases of the program are projected to be completed within the first year and a half of work, whilst the next two phases will be developed during the second and third year.

"One of the partners of our grant network is a company (SeeQC) that has expertise in manufacturing and commercialization of logic devices based on superconducting technology," said Di Bernardo. "Throughout the program, however, we will seek collaboration with other industrial partners that could facilitate further development as well as commercialization of our technology after the completion of the research program." ■