

Killing Tumors with Quantum Beams

-Cancer therapy realized by integration of medical and engineering technology-

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What Kind of Research are You Doing?

Today, one out of two Japanese gets cancer, and one out of three dies from it. Cancer is a disease you cannot avoid but should accept and fight. We are developing technology to use proton beams, one of the **quantum beams**, to kill cancer and get a healthy body back. Medical treatment that uses **proton beams** is a highly-anticipated new technique. Accurate irradiation with proton beams can effectively destroy tumors while sparing surrounding normal tissue. Compared to surgical procedures or chemotherapy, it is less invasive for elderly patients and can provide a smooth social recovery after treatment.

Proton beams give relatively small doses when passing through the human body (amount of provided energy) and reach the maximum just before they stop (Fig. 1: Bragg peak of proton beams). These characteristics allow us to concentrate doses on tumors without damaging the surrounding normal tissue. In this way, only cancer cells can be killed or will lose the ability to multiply, and preserve body functions or shapes.

In our collaboration with the radiation oncology field of the Graduate School of Medicine at Hokkaido University and the Hokkaido University Hospital, we developed the world first proton beam therapy system which combines real-time tracking (which can precisely focus on moving tumors due to respiration) and a spot scanning technology (Fig. 2: a method to irradiate tumors by scanning a proton beam) through medicine-engineering and industry-academia partnerships. Hokkaido's first Proton Beam Therapy Center which uses this state of the art system started therapy in March, 2014 at the Hokkaido University Hospital, and we are involved with its operation and continuing development.

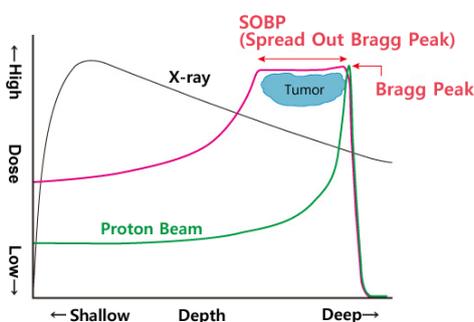


Fig. 1 Dose Distribution of Proton Beam in Human Body. A Bragg peak can be used to concentrate proton beams on a tumor.

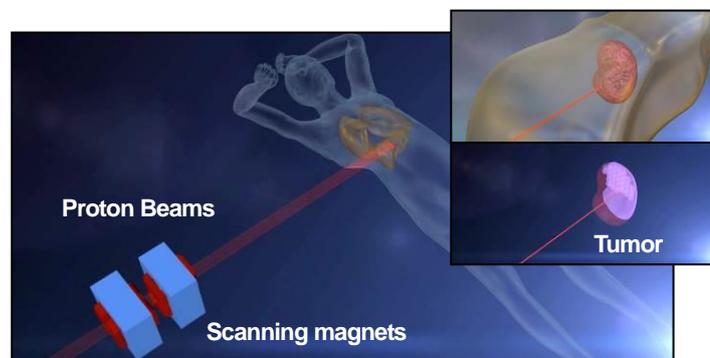


Fig. 2 Proton Beam Therapy using Spot Scanning Technique. A proton beam is scanned along the shape of a tumor by scanning with electromagnets.

What Kinds of Devices are You Using?

To perform the proton beam therapy, the system is composed of a proton synchrotron accelerator, beam transport systems, a rotating gantry which enables the proton beam irradiation from any angle and other devices. In order to realize the system that fully applies engineering technology to medicine, research and development which combines engineering and medicine is required. In addition, to achieve a high-precision therapy, we are researching and developing treatment planning systems that optimizes the dose distributions.

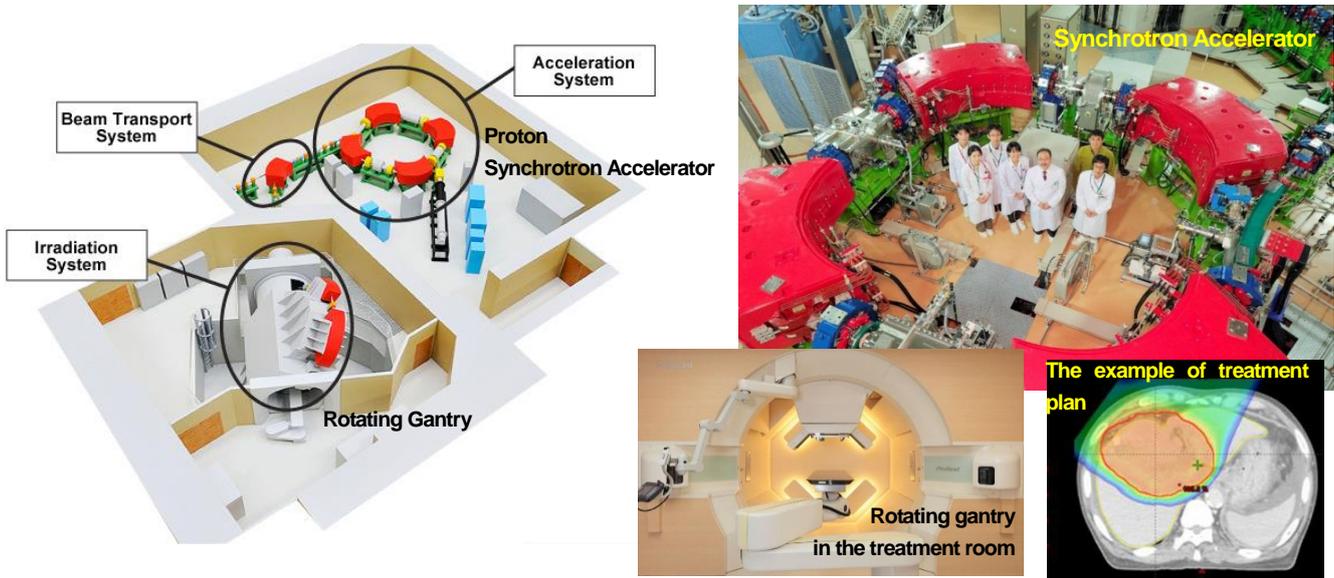


Fig. 3 Proton Beam Therapy System

A proton beam accelerated by a proton beam synchrotron accelerator is transported to a rotating gantry via a beam transport system. In the therapy room inside the rotating gantry, a proton beam can be irradiated onto patients' cancer lesions from all directions, 360 degrees around.

What Will be Your Next Goal?

We will continue to keep Research and Development on next generation diagnosis and therapy which use quantum beams and radiation application technology in order to realize early detection and advanced treatment of cancer. Our research is not limited to the Faculty of Engineering. The Hokkaido University Hospital has the Proton Beam Therapy Center where we are involved in the development and responsible for the operation. We hope to go beyond the limits of engineering and medicine. Our engineering and medicine partnership is essential for the future to develop new technology in advanced medicine.

We are expecting the participation of highly motivated students. We would like to advance research toward the future together under the motto: "Toward future human life through innovative technology with quantum beams."

References

The following is hard to understand but recommended for those who would like to study.

- (1) C-M Charlie Ma, Tony Lomax, "Proton and Carbon Ion Therapy," CRC Press.