GERMAN CANCER RESEARCH CENTER
IN THE HELMHOLTZ ASSOCIATION

Research for a Life without Cancer

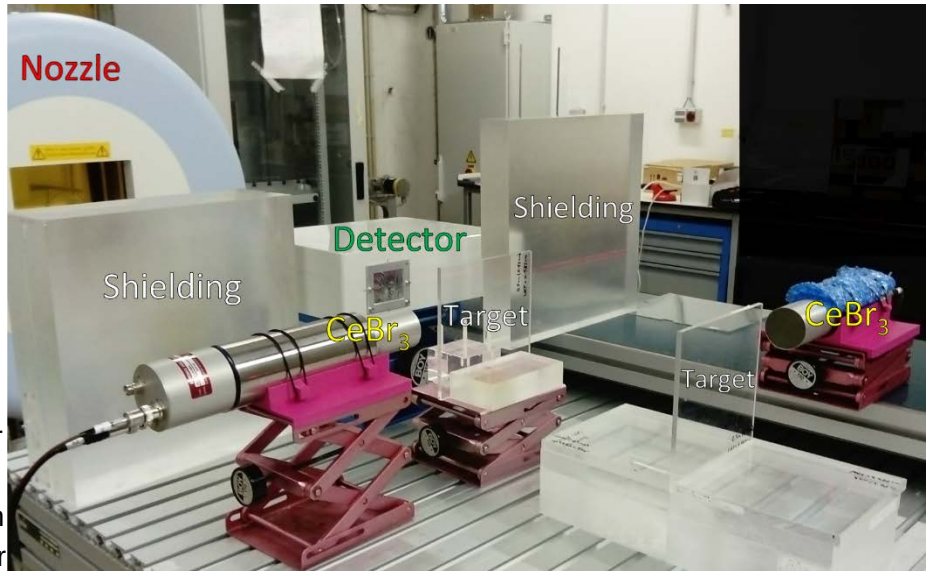
TECHNOLOGY OFFERS

Detector and method for tracking an arrival time of single particle In an ion beam (P-1428)

Detector for tracking single particles in ion beam therapy

EXECUTIVE SUMMARY

Ion beam therapy offers an effective mode of treatment and can be directed with high precision, causing fewer side effects. With the advancement of technology there is still a room for improvement in the range verification as it determines the quality of the treatment. This invention describes a detector and a method for tracking the arrival time of single particles in the patient during the proton and ion beam therapy. The detector element was constructed and integrated into a combined evaluation device for time-of-flight measurements of prompt-gamma following the interaction of single particles within the tissue of the patient. The detector is used for tracking the arrival time of single particles and the evaluation device determines the prompt gamma radiation. Both information is combined to achieve optimal time and spatial resolution.



Caption / Copyright

Category	Indication	Development stage	Seeking
Device and Method	Solid cancer	Initial measurements completed	Licensing, Development partner

BENEFITS

- The detector and the method is capable of tracking the arrival time of a single particle in the ion beam, which is useful in prompt gamma imaging applications.
- The large size of the envisioned detector is useful to scan large areas within the patient and obtain the detailed information about the time structure of the beam.
- This method improves the accuracy of the treatment delivery by reducing the particle range uncertainties.
- A good time resolution was already achievable and will be further improved.
- Particle identification based on the energy deposition can be used for beam diagnostics of the incident beam.

TECHNOLOGY BACKGROUND

A detector for tracking the arrival time of single particles comprises a scintillating material in the form of scintillating fibers layers perpendicular to the direction of the beam. The scintillating material is responsible for generating the radiation and further a detector element measures the signal from the radiation. After the interaction of the incident ion beam with the patient, prompt gamma radiation is measured. A processor is configured for the verification of the single particle range and dose delivered to the patient based on the prompt gamma radiation and the arrival time of the single particle.

DEVELOPMENT STAGE

The small-scale prototype was investigated for an irradiation area of 4 X 3 cm^2. The single carbon ions were tracked up to the maximum clinical intensities. Proton beams are however more challenging. New configurations within the embodiments of the filed patent are being evaluated to handle the very high proton intensities.

APPLICATIONS

This invention provides a method for the verification of the particle range and dose delivery in a patient by tracking single particles. The dose difference between the treatment plan and data acquired during the actual treatment can be detected and verified by means of time-of-flight measurements of prompt-gamma following the interaction of single particles within the tissue of the patient.

INTELLECTUAL PROPERTY

A priority patent application US16/375,322 “DETECTOR AND METHOD FOR TRACKING AN ARRIVAL TIME OF SINGLE PARTICLES IN AN ION BEAM”has been filed at the USPTO April 4th2019.

PUBLICATIONS & REFERENCES

1. “A single- particle trigger for time-of-flight measurements of prompt-gamma ’’ (2019) - by Magalhaes Martins et al’’
2. “Prompt Gamma Spectroscopy for absolute range verification of ^{12}C ions at synchrotron based facilities’’ (2019) – by Dal Bello et al ’’
3. “Results from the experimental evaluation of $CeBr_3$ scintillators for ^4He prompt gamma spectroscopy’’- Medical Physics, v. 46, n 8, p. 3615-3626. DOI: 10.1002/mp.13594 : (2019) :- by Dal Bello et al .

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Working at the interface of research and industry, the Office of Technology Transfer of the German Cancer Research Center (DKFZ) helps to get new cancer medications, diagnostic tests, and research instruments onto the market as quickly as possible.

The DKFZ with its more than 3,000 employees is the largest biomedical research institution in Germany. At the Center more than 1,300 scientists investigate how cancer develops, identify cancer risk factors and endeavor to find new strategies to prevent people from getting cancer. They develop novel approaches to make tumor diagnosis more precise and treatment of cancer patients more successful. DKFZ is a member of the Helmholtz Association of National Research Centers, with ninety percent of its funding coming from the German Federal Ministry of Education and Research and the remaining ten percent from the State of Baden-Württemberg.