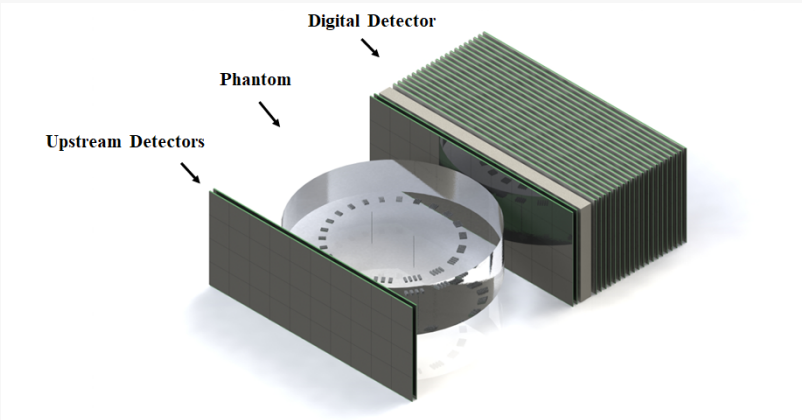
Hi’CT: Revolutionary Pixel Sensor-Based Image Device Enhances Precision in Ion Therapy

FAYETTEVILLE, GA, USA, July 31, 2023 /EINPresswire.com/ -- By directly measuring Relative Stopping Power (RSP) with ions, a pixel sensor based named “Hi'CT” project with multi-layer structure reduces the risk of range uncertainty, a major contributor to dose imprecision in ion therapy. With enhanced high-precision imaging capabilities and a fully digital design, Hi'CT can be integrated into compact treatment room, ensuring efficient clinical pre-scanning and positioning verification. This novel approach reduces safety margins, significantly improving treatment accuracy and ultimately enhancing patients' quality of life. The Hi'CT system heralds a promising future for the advancement of cancer treatment, providing new hope for more effective and precise radiotherapy.



The figure illustrates the conceptual assembly method of the detector. The beam is incident on the system perpendicular to the upstream detector, passing through the phantom, and eventually stopping in the sampling layers of the digital detector. Through

To fullfill the clinical demand for carbon ion therapy, this study presents the technical design of the Hi’CT system, which directly obtains precise estimates of carbon ion range, achieving precise image guide to protect healthy tissues around the target. Instead of using conventional X-CT, Hi’CT does not rely on HU value conversion but directly uses the reconstructed clinical ion trajectories for imaging, enabling an accurate estimation of RSP. Additionally, several imaging algorithms are proposed for various clinical purposes. Moreover, the system employs the same therapeutic beam for imaging, holding the potential for real-time image-guided therapy in the future.

The Hi’CT system features a fully digital architecture with a compact length of approximately 10 cm, facilitating seamless integration into space-constrained heavy ion therapy devices. The core of Hi’CT is the digital segmented multi-layer detector, comprising upstream and downstream detectors, a compensator block, and sampling layers. This design accurately measures the

endpoint of particle range near the Bragg peak with excellent detection efficiency. Its compact design allows for broader adaptability and easy integration, significant improving treatment qualities.

The Hi'CT system equips rapid imaging algorithms that do not require tracking process, eliminating the need for lengthy pre-scanning wait times. Fast acquisition of carbon ion CT images facilitates fast patient positioning verification. The Hi'CT system aims to achieve real-time image-guided during ion therapy. It is expected that the imaging time can be shortened to within 3 min in the future, substantially reducing off-target shift caused by organ motion and breathing movement.

###

References

DOI: 10.1007/s41365-023-01251-x

Original source URL: https://link.springer.com/article/10.1007/s41365-023-01251-x

Journal: Nuclear Science and Techniques

Wendy Chen
TranSpread
+1 865-405-5638
email us here