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Lung cancer heavy ion therapy CMOS tracking device

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In the past years, advanced techniques have been developed to treat lung cancer using particle therapy. This therapy aimed at delivering a more conformal dose to the tumor while minimizing damage to healthy tissues. However, treating moving tumors with ion beams remains a significant challenge. In the case of lung cancer, the patient's respiratory motion can cause inhomogeneities in the dose delivered and range shifts during both planning and treatment.
To address this issue, several range monitoring techniques have been investigated, including using secondary radiation produced during treatment (e.g., PET), but in this project, a new approach is proposed using a CMOS-based tracker system to detect the strong density gradients between the lung, tumor tissue, and bones, in order to provide a real-time monitoring of the beam position.
Preliminary experiments were conducted in 2022 but the final goal is to develop a conceptual version of this device, that could be used in clinical centers using carbon ion beam facilities with scanning pencil beam and gantry.
The proposed work involves conducting a full Monte Carlo simulation of a clinical case with GATE on real patient 4D-CT (breathing movement) with a pencil scanning beam treatment plan.
A complementary work to improve spatial accuracy of the reconstructed vertices include a deep learning algorithm for protons'scattering and another one will be built for the clustering and tracking of secondary particles with CMOS trackers.

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