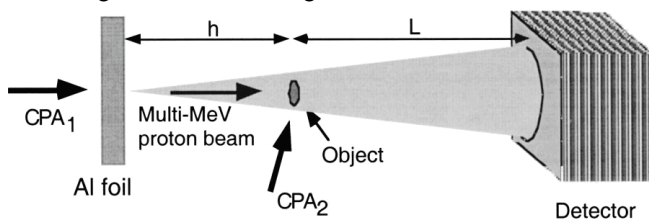


Proton Imaging and Fighting Cancer

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Proton Imaging was first investigated in the 1960's, but was abandoned due to the better quality of the x-ray computed tomography (CT). The better quality of the x-ray CT was from the spatial resolution. The proton imaging had a lot more scattering, which led to the poor spatial resolution. The way CT works is by reconstructing three dimensional images of an object from two dimensional x-ray images. These images are taken from the same point of rotation. When an x-ray beam is sent through the body, scattering and absorption occur and are seen on the detectors, creating an image. Different materials respond differently to x-rays and this is similar to that of protons.

Proton Imaging works similarly to the x-ray CT. Proton CT detectors record the coordinates of the protons entrance/exit and angles. A calorimeter also measures the residual energy. An image is then formed using a reconstruction algorithm.



In development is a proton CT that uses silicon microstrip detectors. In a study the scattering of protons was observed, which causes the poor spatial resolution. To correct the problem a correction must be made. The issue was corrected by looking at the real path of the protons. It is not actually possible to calculate the actual path; therefore the most likely path (MLP) method was developed. The MLP method works by accounting for the multiple scattering of the protons. This is done by using the spatial information from the tracker and the residual energy.

The MLP method developed helped improve the quality of the images. Before the images were blurry with lost details and after the implemented MLP method the images were significantly improved. The MLP method used the back-projection of the last proton coordinates to account for the scattering. The conclusion of this study was that proton CT can be successfully implemented.

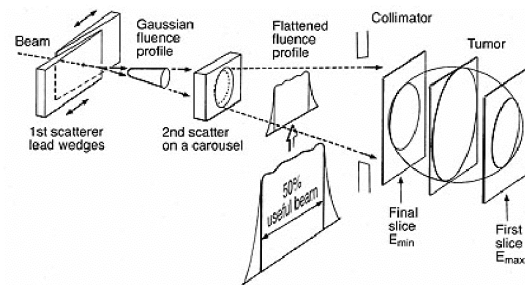
The study of proton CT and proton imaging is an important topic, because the use of a proton beam to kill cancer tumors will provide a better treatment than that of x-ray. Research is showing that the proton beam treatment can provide a more accurate image and targeting of a cancer tumor. Also using a proton beam would reduce the patient's exposure to radiation. Many patients are treated with radiation therapy, x-rays. These patients could benefit from proton therapy.

Proton therapy is more ideal because unlike x-ray therapy, which can not easily kill cancer cells without killing healthy cells as well, proton therapy can be targeted to kill cancer cells without killing healthy cells. Energized protons are sent by orbiting electrons of another atom, the positive charge attracts the negatively charged electrons, which results in the pulling of the electron out of its orbit. This process is known as ionization and it changes the atom.

The change is the important change in all forms of radiation, changing of the atom. This change damages the internal molecules within a cell, which ultimately leads to damaged DNA in the cells, meaning it can't regenerate. The cell develops enzymes to repair the damage but with extensive damage the cell cannot be repaired and dies.

Protons will release their energy at the end of their path. This is an important fact, because it means that cancer cells can be targeted directly, while avoiding healthy cell death. The proton beam is fine tuned for each patient. The beam is delivered to the targeted cells and when the protons slow down to the critical speed, it will deliver its energy and ionization occurs.

This method is a superior method to x-rays, because the cancer cells are better targeted. The patients feel nothing during the therapy and are exposed to less radiation. Currently proton beams are used in 7 locations. The beam is used with CT scans to better



target the tumors. The problem with proton therapy is that a proton beam is an expensive device to construct.

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