AD-4 / ACE : Antiproton Cell Experiment

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Introduction

A pioneering experiment at CERN studying the potential use of antimatter for cancer therapy has produced its first results [1-6]. Exploiting the unique capability of CERN's Antiproton Decelerator to produce a narrow monoenergetic antiproton beam at the right energy, the Antiproton Cell Experiment (ACE) has shown that antiprotons have been shown to be more effective than protons for neutralizing cancer cells by irradiation. [7]

Material and Methods

The LEAR (Low Energy Antiproton Ring) facility at CERN is able to produce a bunch of 3E7 antiprotons with 500 MeV/c every 90 seconds. The antiprotons are extracted into a target volume filled with a gel, into which leaving V79 WNRE Chinese hamster cells are disposed. The experimental hall is equipped for dosimetry measurements, i.e with liquid ionization chambers, alanine pellets and radiochromic films. Silicon particles detectors measure the secondary leaving particles in order to perform a real time imaging of the antiproton interactions.

Results

Antiprotons and protons exhibit near identical stopping powers and radiobiology when they penetrate into matter, in the plateau region. But when antiprotons come to rest, their behaviour is completely different as they annihilate with matter, and thus, release an energy of 1.88 GeV. Most of this energy is carried away by secondary particles (principally pions), but the energy deposited at the Bragg peak is 20-30 MeV per antiproton. The absorbed dose in this regions is 4 times higher compared to protons. Moreover, one can also measure an increase of the relative biological effect, explained by the fact that part of the emitted secondary particles have high LET properties.
Dosimetry experiments are performed and the radiobiological effects on leaving cells is investigated.

Discussion

The ACE experiment shows that when comparing antiprotons with protons, the relative biological effect in the plateau region is reduced by a factor 4 for the same biological dose deposited in the Bragg peak region.
The weekly interacting pions, leaving the target volume will be used to perform a real time imaging of the interaction vertex.
The biological effect of secondary particles leaving the target volume have to be studied in order to investigate the possible clinical use of antiproton beams.

References

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