

# NUCLEAR PHYSICS IN MEDICINE

TECHNOLOGY, INNOVATION, PHYSICS AND HEALTH. THE FUTURE IS NOW.

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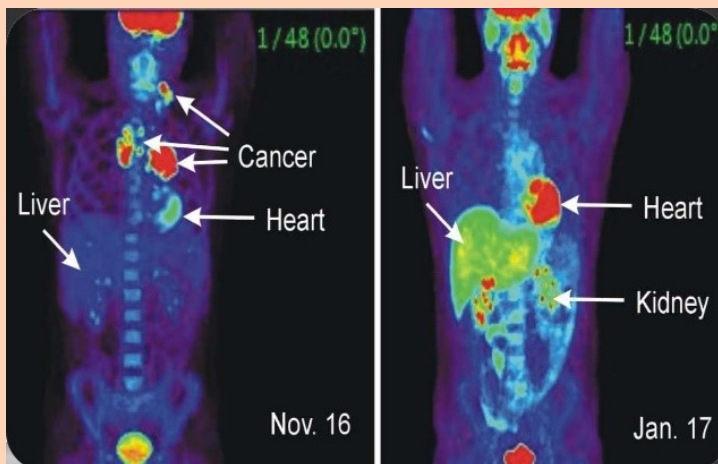
## PET-SCAN

PET-SCAN, short for Positron Emission Tomography, is a functional imaging technique that uses radioactive isotopes to visualize and measure higher activity of cells. PET-scans are used to detect cancers.

Before you enter the scanner, tracers are injected. The isotopes most commonly used are  $\beta^+$ -emitters.



<https://www.istockphoto.com/fr/search/2/image?excludenudity=false&phrase=pet%20scan%20machine>



<http://www.orthohyd.com/home/know-your-disease/pet-scan>

$\beta^+$ -decay will occur when the unstable nuclide converts a proton into a neutron. Positron annihilation will take place when the positron collides with an electron. Annihilation converts all the energy into two gamma rays, which are emitted in opposite directions. The gamma rays are detected by the scanner, and an image can then be built up based on where in the body the reaction took place.

### ADVANTAGES

- 👍 Relatively low radiation dosage
- 👍 Detects diseases before symptoms show
- 👍 Painless & non-invasive
- 👍 The ability to differentiate between non-cancerous and cancerous tumours

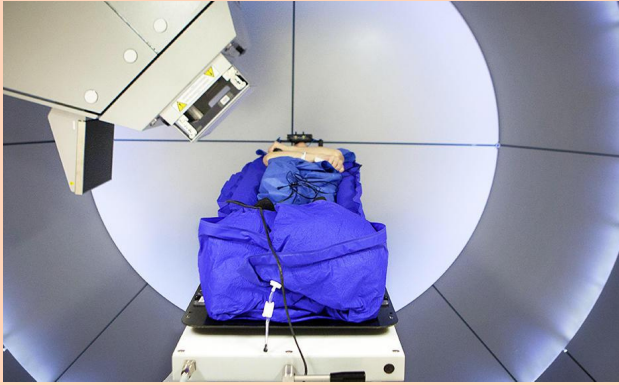
### DISADVANTAGES

- 👎 Patients are still exposed to radioactive rays
- 👎 Chance of developing cancer in fast-growing cells
- 👎 High initial cost and ongoing operating costs
- 👎 Chance of getting a false negative result

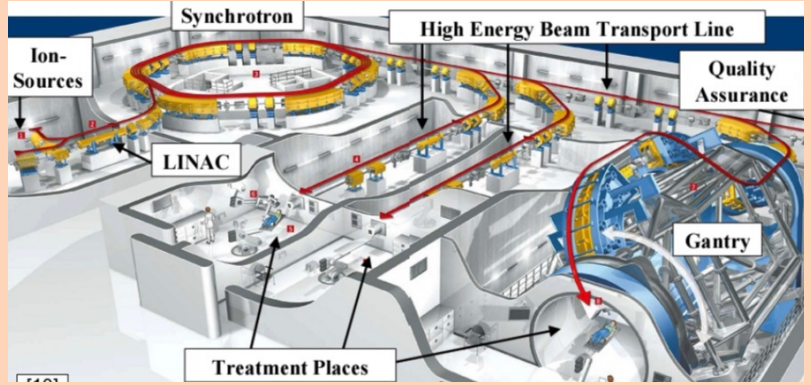
# HADRON THERAPY

Hadron therapy is a type of radiation therapy, a way to treat cancer with ionizing radiations, with less damage to healthy tissues.

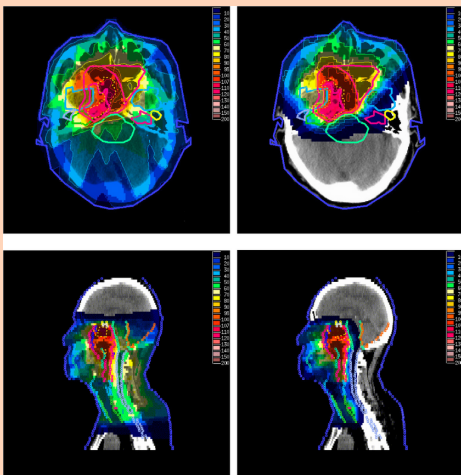
This therapy uses beams of energetic neutrons, protons, carbon ions and hadrons, made up of quarks.



<https://news.cnr.fr/articles/hadron-therapy-ready-for-takeoff>



[https://slac.stanford.edu/slac/sass/talks/aiden\\_sass.pdf](https://slac.stanford.edu/slac/sass/talks/aiden_sass.pdf)



[Comparison of dose distributions between IMPT \(right\) and IMRT \(left\).jpg \(1200x1222\).](#)  
([wikimedia.org](http://wikimedia.org))

Through a synchrotron atoms are accelerated, new subatomic particle beams are created and they reach the necessary energy to kill the tumour. Atoms that have lost their electrons are extracted, then protons or carbon ions are selected by magnetic fields, sent to treatment rooms and they hit cancer cells.

The DNA of their nucleus is damaged, and they are eliminated by the immune system.

## ADVANTAGES

## DISADVANTAGES



Low radiation dosage



There could be side effects



Wide range of tumours are treatable



Everyone has different necessities



Can treat children and tumours that are near vital organs



No studies to compare to classic therapy



You don't have to change your lifestyle!



Few data