Activation measurements of interest in protontherapy

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PhDay Physics 2020
5 October

Dpto. de Estructura de la Materia, Física Térmica y Electrónica

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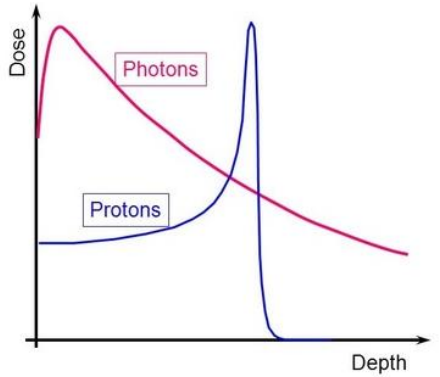
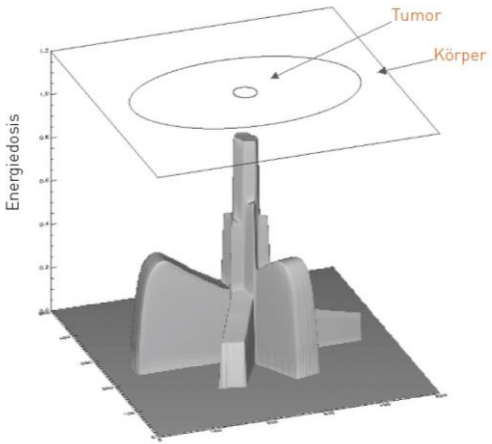
Despacho 239

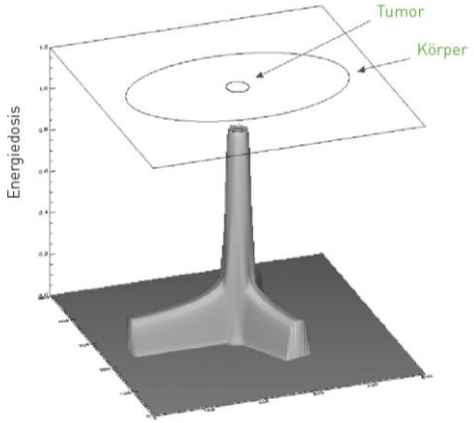
1. Increase **dose** deposition in the **tumour**
2. Prevention and **reduction** of radiation-induced **side effects**



Bragg peak



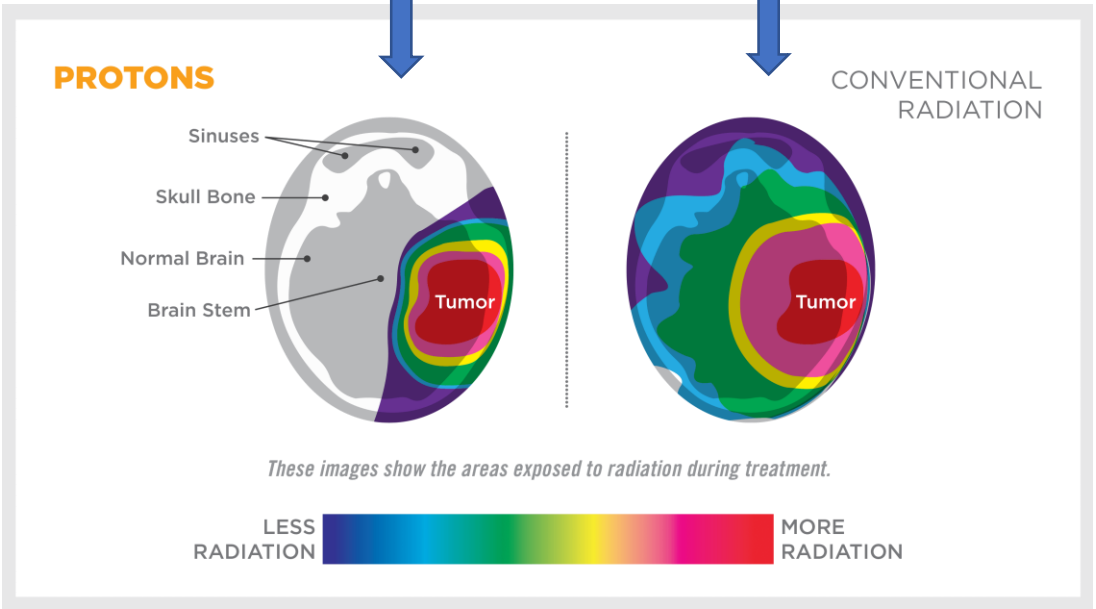
Photons



Protons

$$\text{Dose} = \frac{\text{Energy}}{\text{Mass}}$$

Tumor painting
with protons and photons

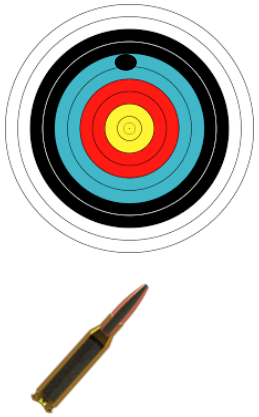


1. **Introduction.** Range verification problem

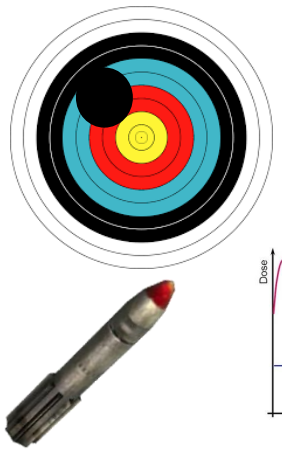
- A range undershoot has worst consequences in the case of protons. Safety margins around the tumour must be increased, making the treatment less effective.

- We propose the use contrast agents as a solution.

Contrast agents in protontherapy = Substances administered to the patient that can be **activated** with good efficiency, improve verification image quality by **increasing induced activity near the Bragg-peak region**

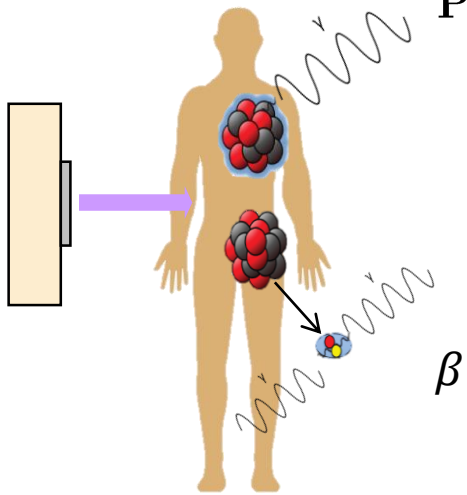


Protons

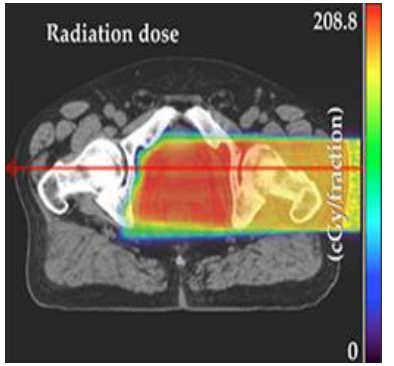


Photons

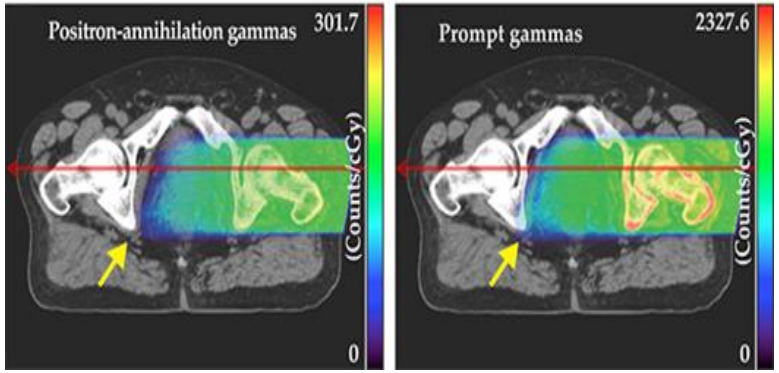
"With great precision comes great responsibility"

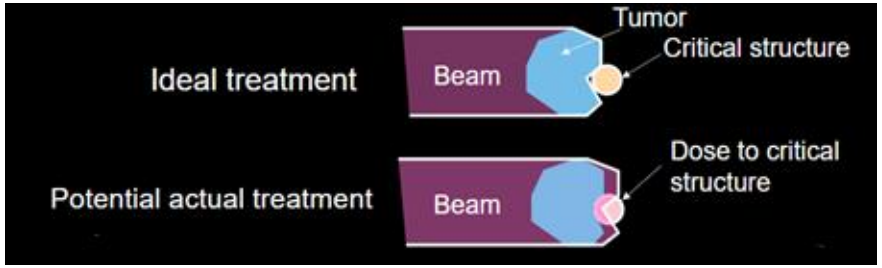


Prompt-γ



β^+





Kira Grogg et. Al, IEEE-MIC 15 Nov, 2014 Seattle, WA

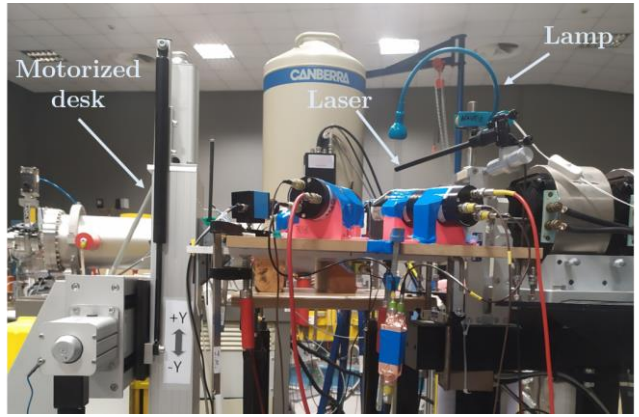
M. Moteabbed, S España, H. Paganetti (2011), *Phys. Med. Biol.*56, 1063

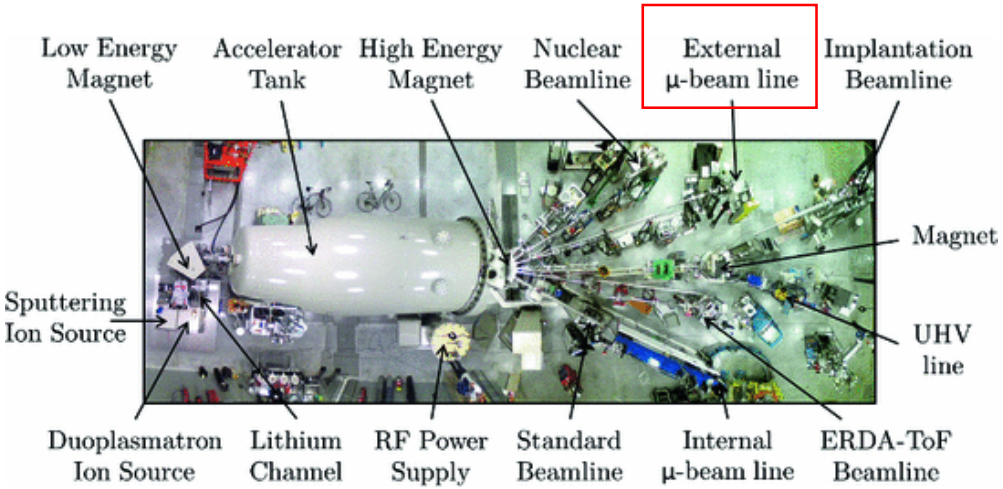
Pronto Protontherapy and nuclear techniques for oncology

2. Materials and methods. **Activation experiment**

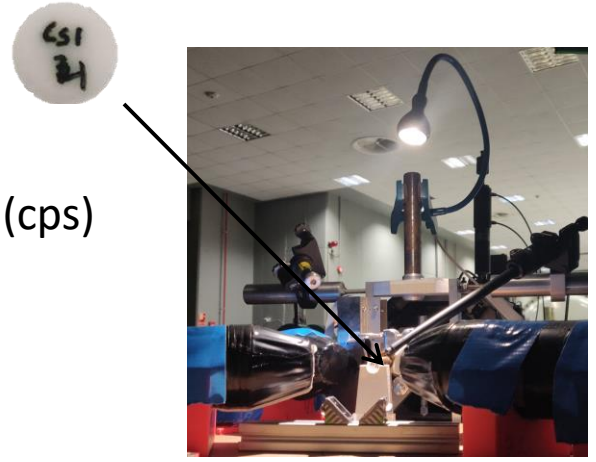
- Targets are irradiated with protons at the CMAM tandretom accelerator using the microbeam external line, in the 2-10 MeV energy range

Experimental yields = Reactions/proton





$$\Gamma(t) = Y\phi$$



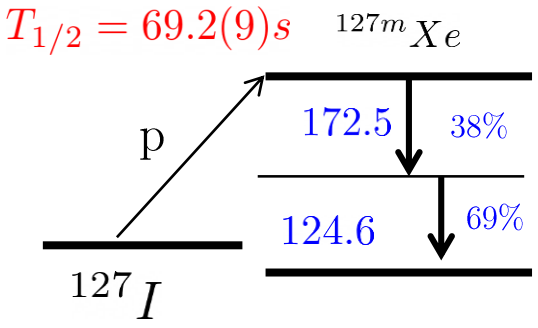
→ $\Gamma(t)$ = Activity in the four detectors (cps)

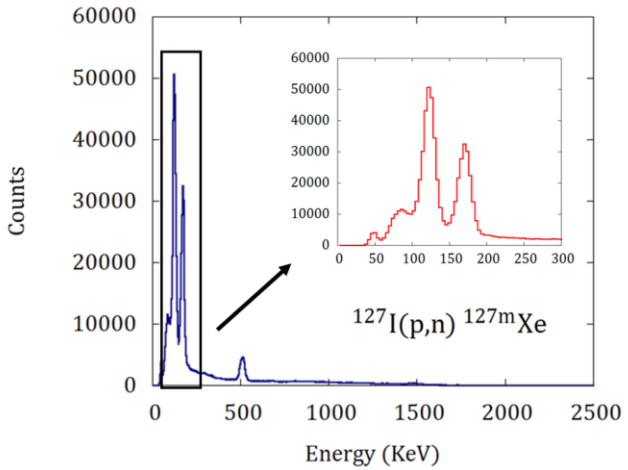
→ ϕ = Proton flux (s^{-1})

5 MV **tandetron** accelerator

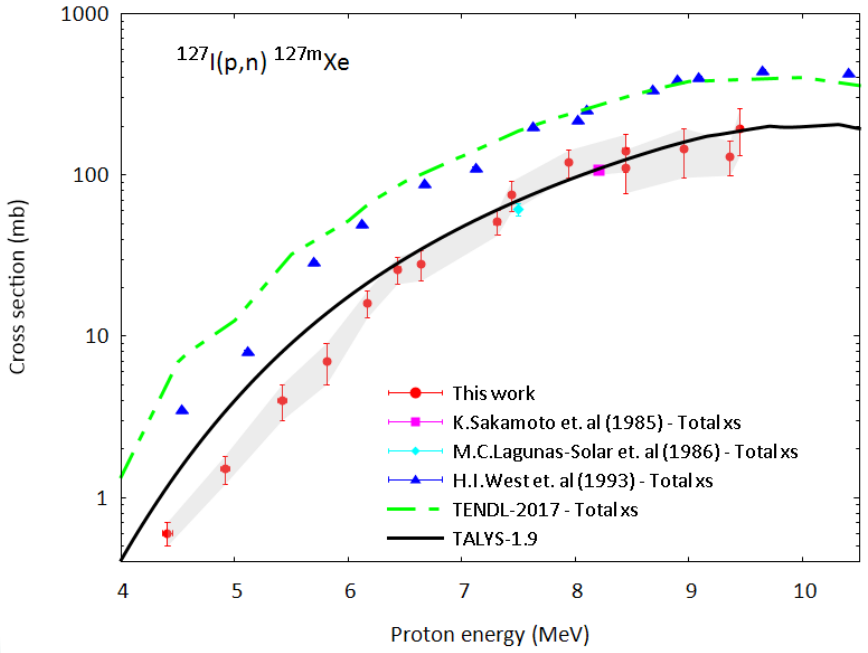
3. Results and conclusion

- Gamma spectra and cross section





$$Y = n \int_{E_{th}}^{E_o} \frac{\sigma(E')}{dE'/dx} dE'$$



- Cross section is characterized by a **small energy threshold**
- The activity peak surrounds the distal end of a proton field
- The **short half life** 127mXe makes it suitable for in-beam or
- in-room verification imaging
- Iodine is already approved as a contrast agent in CT

127I is a promising candidate contrast agent for protontherapy range verification.

Thank you!

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