Radiotherapy with particle beams

A proseminar talk by Erik Bührer

Table of contents

Terms

- **Radiotherapy:** treatment where radiation is used to kill cancer cells
- **Particle therapy:** form of radiotherapy, uses energetic protons, neutrons and positive ions
- **Dose:** amount of radiation distributed to an organism
- **Cancer:** disease, malignant, fast growing tumours

Technical realization

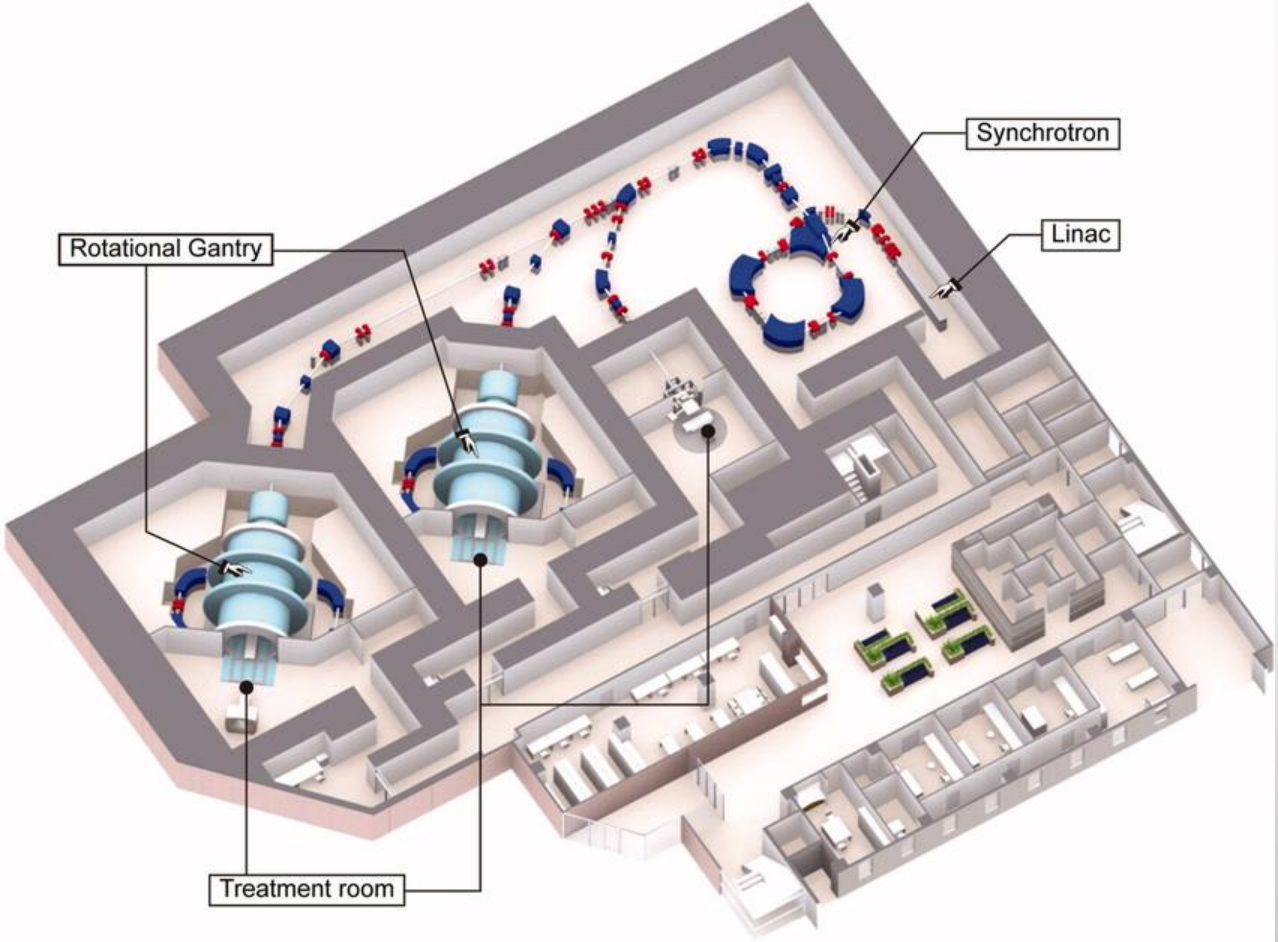

Figure 1:
Layout of the Fukui Prefectural Hospital Proton Therapy Center

Technical realization

Figure 2:
Proton therapy
treatment room

Technical realization

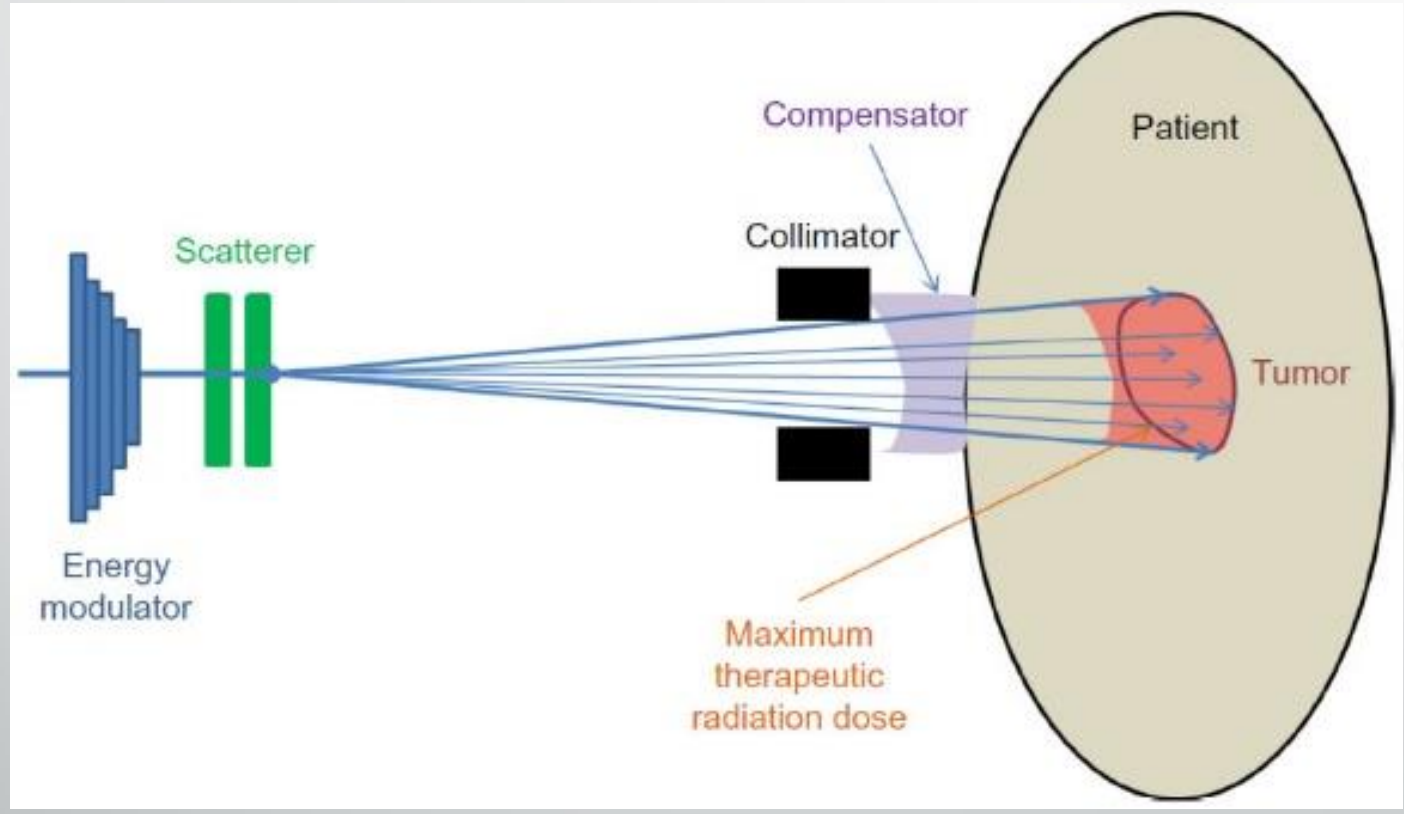

Figure 3: schematic structure of nozzle

Physics of particle therapy

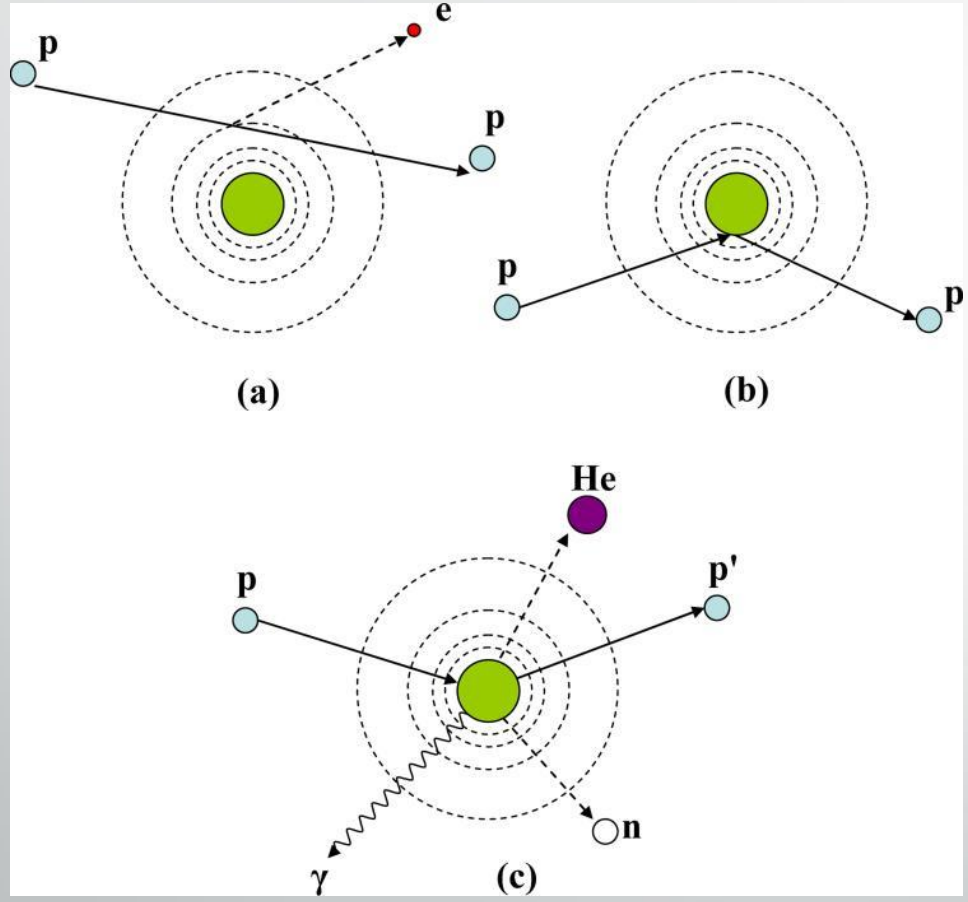

Figure 4:
Types of interaction with matter:

(a) energy loss via Coulombic interactions

(b) deflection of proton trajectory by repulsive Coulomb scattering with nucleus

(c) removal of primary proton and creation of secondary particles via non-elastic nuclear interaction

Physics of particle therapy

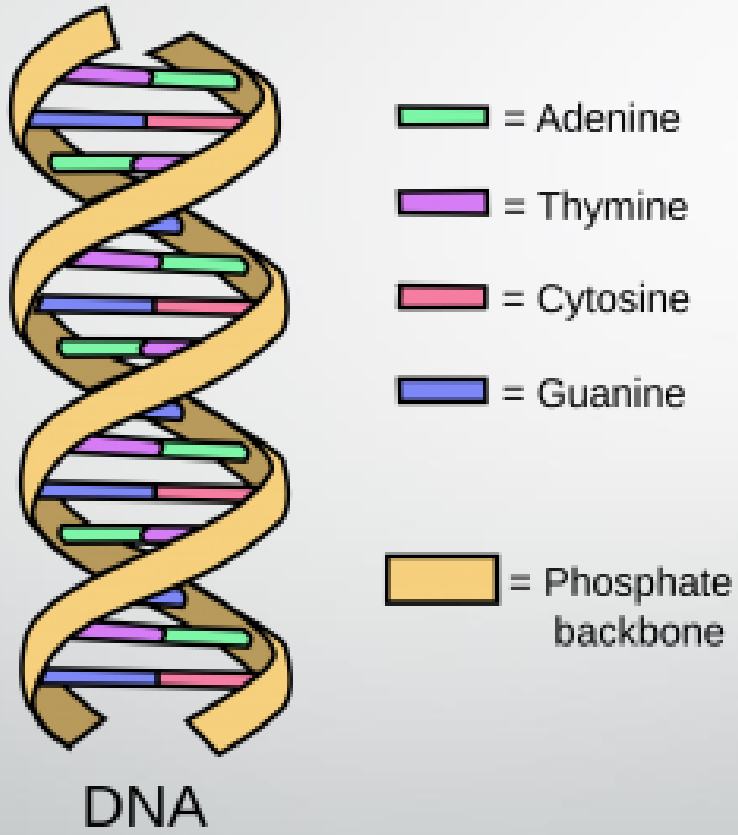

Figure 5:
Structure of DNA

Comparison of therapy methods

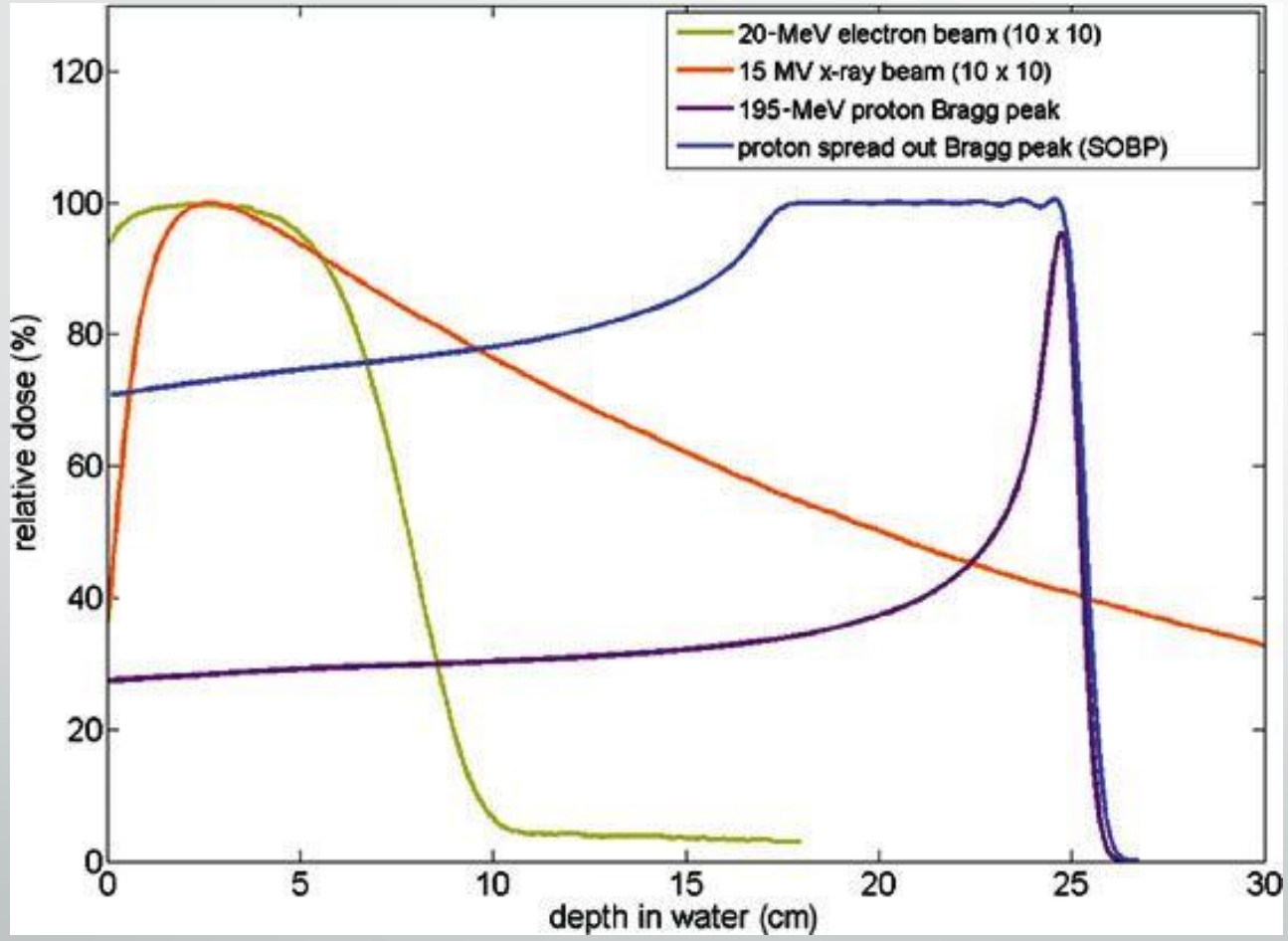

Figure 6:
Depth-dose curve for electrons, X-rays and protons

Summary

- After acceleration protons are guided by strong magnetic fields to body of patient
- Ionizing radiation causes damage to DNA, which leads to cell death
- Due to special dose distribution proton therapy is advantageous for treatment of certain tumour types

Image sources

1. https://www.researchgate.net/figure/277380525_fig20_Figure-1-Layout-of-the-Fukui-Prefectural-Hospital-Proton-Therapy-Center-The
2. http://www.hamptonproton.org/wp-content/uploads/2013/09/tour-gantry-treatment-room.jpg
3. https://www.dovepress.com/cr_data/article_fulltext/s65000/65594/img/fig2.jpg
4. Source: Newhauser, W. D., & Zhang, R. (2015). The physics of proton therapy. *Physics in Medicine and Biology*, *60*(8), R158
5. https://medivizor.com/blog/wp-content/uploads/2016/05/dna-structure.png
6. https://oncohemakey.com/wp-content/uploads/2016/07/00497.jpeg

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