Silicon-based micro-dosimetry system for advanced radiation therapies

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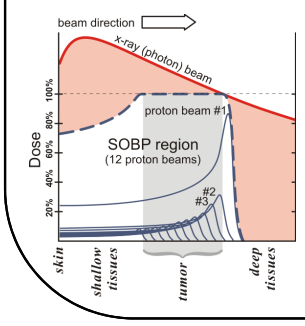
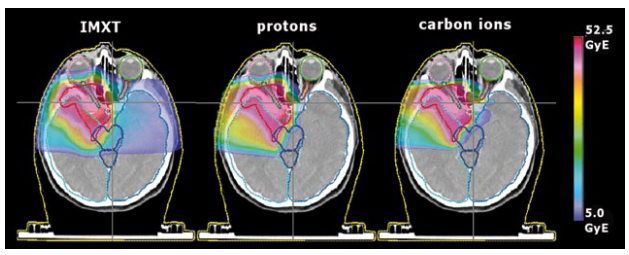
Introduction

- 1 out of 2 persons born today will be diagnosed with cancer in their lifetime (*SEER Cancer Statistics Review 1975-2013*)
- > 50% of all cancer patiens will receive radiotherapy for curative or palliative aims
- **Hadrontherapy** is a fast-growing modality of radiation therapy





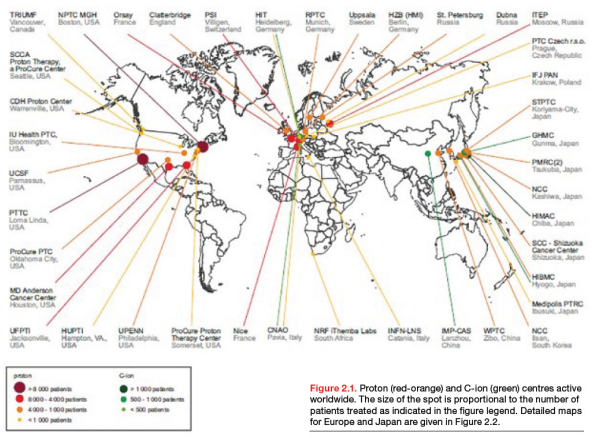
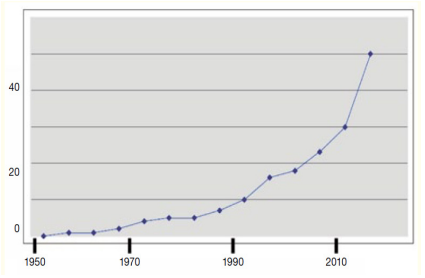


Figure 2.1. Proton (red-orange) and C-ion (green) centres active worldwide. The size of the spot is proportional to the number of patients treated as indicated in the figure legend. Detailed maps for Europe and Japan are given in Figure 2.2.



Proton therapy centers 1950-2015

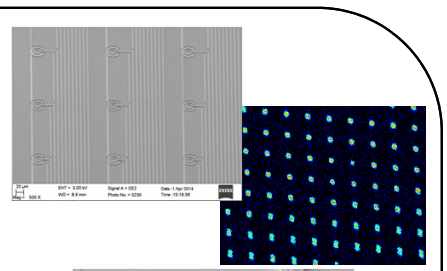
There are 61 hadrontherapy centers in the world with 32 others under construction (19 and 10 in Europe, respectively). (*Nuclear Physics European Collaboration Committee)*

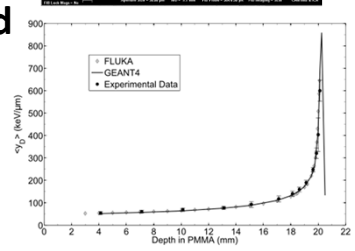
The Need

- Treatment planning systems are used to determine the dose distribution obtained for a certain beam arrangement to be applied to a tumor volume.
- **No adequate bio-dosimeters are currently available** for the routine verification of biological dose in hadrontherapy

The Expertise

- ✓ The Spanish National Center of Microelectronics (IMB-CNM) **has more than 15 years' experience of producing advanced silicon detectors for nuclear and high energy physics experiments**
- ✓ Together with experts in dosimetry (USC) and radiobiology (IMNC), CNM has developed a silicon microsensor technology that can provide **cell-like silicon sensitive volumes to allow for unprecedented spatial and dose resolution**.
- ✓ **Proof-of-concept devices have already been used** to characterize with high accuracy the radiation quality parameters of carbon and proton beams.





The Idea

Our objective is the **realization of a complete microdosimetry system** for the verification of the biological efectiveness of hadron treatment plans based on this novel silicon technology.

We propose to address this challenge with a **well-balanced, multidisciplinary team with a strong combination of expertise** including: microelectronics technology, electronics, system integration, data processing, Monte-Carlo simulation, radiation therapy and radiobiology.

Potential Impact

The successful development of a new type of silicon-based microdosimetry system will improve the cancer treatment planning in the growing modality of radiation therapy with hadrons. **Millions of cancer patients worlwide** could be benefited.

The system could also address the **radiation protection requirements in avionics and space** radiation environments, helping to understand and thus minimize the cancer risk for aircrew personnel and astronauts.