

Contribution ID: 4240 Type: Oral Competition (Graduate Student) / Compétition orale (Étudiant(e) du 2e ou 3e cycle)

(G*) Optical fiber holder for FLASH dosimetry at a medical cyclotron

Tuesday 28 May 2024 17:30 (15 minutes)

Proton therapy uses an external beam of protons to destroy cancerous tissue while reducing damage to healthy tissue. Of particular interest is the recent concept of proton FLASH therapy, where ultra-high dose rates (> 40 Gy/s) are delivered for under one second, with improved sparing of healthy tissue compared to conventional dose rates. The FLASH effect and the influence of beam properties and biological characteristics are not yet fully understood, hence, a sensitive dosimeter with high spatial resolution and in-situ relative dose information for FLASH is needed to bring it into the clinic. Optical fibers (OF) are gaining traction as dosimetry detectors in radiotherapy, including proton therapy, due to their superior spatial resolution, linear dose dependence, independence of dose rate, real-time response, and independence from electromagnetic fields and temperature fluctuations within the range of realistic clinical conditions.

At TRIUMF, characterizations of OF for proton FLASH dosimetry are ongoing. As beam-availability at the Proton Therapy Research Centre is limited, we are now exploring experiments at the TR13, TRIUMF's 13 MeV cyclotron, which is used to produce medical isotopes and where the beam is more regularly available. To characterize a fiber's light yield and radiation hardness, a fiber holder customized for the TR13 is needed. The fiber holder was designed based on Monte Carlo simulations in FLUKA as well as temperature calculations using in-house data.

Three different fiber holders were tested in simulations. Two designs were discarded because of energy deposition inhomogeneity in the fiber and other considerations. The third fiber holder showed promising results regarding beam deposition, heat transfer calculations, and radiation activation limitations.

The current fiber holder design can hold silica fibers up to a diameter of 350 um and withstand irradiations of up to 2 μ A beam current. This holder will allow systematic evaluation of OF for potential use with proton FLASH.

Keyword-1

FLASH dose rates

Keyword-2

medical cyclotron

Keyword-3

optical fibers

Author: HOHNHOLZ, Janina (Faculty of Chemistry and Biotechnology, University of Applied Sciences Aachen & TRIUMF)

Co-authors: PENNER, Crystal (TRIUMF); Dr TATTENBERG, Sebastian (TRIUMF & Laurentian University); Dr DUNLING, Eleanor (TRIUMF); PREVOST, David (TRIUMF); Dr BÉLANGER-CHAMPAGNE, Camille; Prof. PAULSSEN, Elisabeth (Faculty of Chemistry and Biotechnology, University of Applied Sciences Aachen & Department Radiation Science and Technology, Technical University Delft); Dr HOEHR, Cornelia (TRIUMF)

Presenter: HOHNHOLZ, Janina (Faculty of Chemistry and Biotechnology, University of Applied Sciences Aachen & TRIUMF)

Session Classification: (DPMB) T3-3 Biomolecular Condensates | Condensats biomoléculaires (DPMB)

Track Classification: Technical Sessions / Sessions techniques: Physics in Medicine and Biology / Physique en médecine et en biologie (DPMB-DPMB)