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Continuous Microdosimetric Photon Isoeffective Dose Model: experimental measurements

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This study presents the outcomes of combined radiobiological-microdosimetric experiments conducted in the same selected positions along the profile of a Spread-Out Bragg Peak (SOBP). The aim was to obtain the necessary parameters for a novel microdosimetric model for computing photon isoeffective doses in proton therapy [1-5]. This model, named Continuous Microdosimetric Photon Isoeffective Dose Model, depends on the first 3 moments of the lineal energy of microdosimetric spectra. In addition, these quantities are closely linked to Modified Linear Quadratic survival parameters that will be obtained from radiobiological experiments.

In this context, microdosimetric spectra measurements were conducted using two different Mini-TEPC microdosimeters in collaboration with Valeria Conte et al. (INFN). The sensitive volume of each microdosimeter was positioned at five predetermined measuring positions within solid water blocks, employing SOBP produced by a 148 MeV proton beam in the experimental room of the Trento Proton Therapy Centre.

Cell survival curves were generated at the same five designated positions, employing the same experimental setup used in microdosimetric experiments. These curves were constructed using doses of 0.5, 1.5, 3.5, 6, and 8 Gy, considering two different cell lines, JHU-11 and H460.

Radiobiological experiments involved the irradiation of two cell culture flasks at the same time positioned in the same way as the sensitive volume of the microdosimeter, so that they were exposed to a similar radiation field.

The model depends also on radiobiological parameters for a reference photon radiation. Survival curve for both cell lines were obtained using photons from the Xstrahl RS225 X-ray research irradiator available at TIFPA, considering the following doses: 0.5, 1.5, 3.5, 6, and 8 Gy.

[1] González et al. *The photon isoeffective dose in BNCT.* Radiat.Res.178.6(2012):609-621.
[2] González et al. *Photon isoeffective dose for cancer treatment with mixed field radiation based on dose–response assessment from human and an animal model: clinical application to BNCT for head & neck cancer.* Phys.Med.Biol.62.20(2017):7938.
[3] Perotti Bernardini et al. *Comparison of Photon Isoeffective Dose Models Based on In Vitro and In Vivo Radiobiological Experiments for Head & Neck Cancer Treated with BNCT.* Radiat.Res.(2022):134-144.
[4] Valeriano et al. (2023). *A new formalism in hadron therapy for dose calculations in photon equivalent units.* PTCOG Conference.
[5] Postuma et al. *Using the photon isoeffective dose formalism to compare and combine BNCT and CIRT in a head & neck tumour.* Sci.Rep.14.1(2024):418.

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