
PIANOFORTE – Travel Grant Activity Report Ana Vaniqui, SCK CEN – 06-10/12/2022

A Linear Energy Transfer (LET) Workshop and measurement campaign was held at the Danish Centre for Particle Therapy (DCPT) at the Aarhus University Hospital in Denmark. DCPT has four proton beam gantries, in which three are used clinically and one is dedicated to research applications, i.e. from dosimetry to small animal experiments. This activity was an initiative from European Radiation Dosimetry Group (EURADOS) Working Group 9 – Radiation dosimetry in radiotherapy, organized by Dr. Liliana Stolarczyk. The workshop was a combination of presentations from participants and invited speakers, and a multi-institutional measurement campaign. Fruitful discussions were promoted of different aspects of LET in clinical practice: from radiation protection to treatment optimization. DCPT provided a highly reproducible measurement setup for further inter-comparison: all groups were able to irradiate their dosimeters using the clinical gantries with the same treatment plans, experimental devices and will be provided the Monte Carlo model. An important goal was to discuss, establish methodologies and try to bridge the limitations of clinical practice, where a constant factor is currently used even though the variable LET behaviour is recognized.

The experience was very positive. The workshop started with measurements for both active and passive detectors. Different passive detectors were included: EBT3 radiochromic films, thermoluminescent dosimeters (TLD) types MTS, MCP and TLD-100, CaSO₄ and Li₂B₄O₇ polycrystalline powders, track etched detectors, fluorescent nuclear track detectors, alanine, radiophotoluminescence (RPL) and optically stimulated luminescence (OSL) dosimeters. The active detectors were the Microplus and the Timepix. The measurement positions were at the entrance region of a monoenergetic (160MeV) field and at three different positions in the spread-out Bragg peak (SOBP): middle, R75 and R95. In front of all detectors, there was a 25 mm layer of PMMA in addition to a combination of Perspex and Solid Water slabs to reach each selected range.

The workshop followed with a day of presentations from both participants and external speakers. Different talks on microdosimetry by Anatoly Rozenfeld (Wollongong, Australia), Giulio Magrin (MedAustron) and Pawel Olko (IFJ PAN) and on new arrays of silicon 3D cylindrical micro-detectors (IMB-CNM). LET in a clinical scenario, considering treatment planning, optimization, evaluation and commissioning by Anne Vestergaard (DCPT) and Monte Carlo by Niels Bassler (DCPT). The participants presented their methodologies to measure LET using all active and passive detectors. Ana Vaniqui presented the mini tissue equivalent proportional detector (mini-TEPC), which was developed in Italy (INFN Legnano) in collaboration with SCK CEN.

A. Vaniqui and M. De Saint-Hubert (SCK CEN) irradiated the passive TLDs (MCP/MTF) and the active Microplus and Timepix. A. Vaniqui was able to run a large set of experiments for the Microplus using the experimental beam line. It was very important for acquiring experience with detection in proton irradiation conditions. The best-achieved combination from initial experiments was later used for the clinical plans, which will be further used in inter-comparisons. Different Timepix detectors were used in a very reproducible setup to measure clinical plans on the edges of the beam. All measurement data is under analysis for further comparison and publication.