CUMPC 2022 Abstract Submission

Welcome to the first annual Canadian Undergraduate Medical Physics Conference. Within this document you will find relevant information pertaining to abstract creation and submission. Prior to beginning the submission process, please take a few moments and review the information as it will help your abstract be successful and accepted.

General Requirements

- Submitted work should be original and reflect the presenter's contributions to the work.
- There is a limit of *one* unique submission per presenter. There is no requirement on the amount of progress made on the research.
- Work completed between abstract submission and presentation can also be included in the presentation.
- Within the abstract itself, there should be no identifying information such as author's names, institutions, affiliations etc. This information will be provided on the website in the submission form.
- The abstract should be limited to **300 words** with or without **1 Figure** and/or **1 Table**, and have the following structure: *Purpose, Methods, Results,* and *Conclusions*. Word count included from Figure and Table captions does not count towards the 300-word limit. The abstract should be limited to **two pages**.
- At the end of the submitted abstract, you may add a brief description of the current stage and time spent on the project (1-2 sentences). These 1-2 sentences will not be included in the word count.
- Abstract submission is open **July 25th** and submission deadline is **August 11th**, any abstracts submitted after this date will not be considered for presentation.

Submission Instructions

- Before submitting your abstract, please head to the conference's website www.cumpc.ca to create an account. *Note: this does NOT register you for the conference itself; registration will be back on the front page of the website.*
- Once signed in, a link for "Abstract Submission" should be viewable on the home page beside the sign in button.
- Upload your abstract as a single **.pdf**. Other formats will not be accepted and the presenter will be asked to re-upload the abstract in the correct format.
- No naming scheme is required for the submitted pdf file. If technical difficulties arise, please email organizers.cumpc@gmail.com.

Additional Information

- For any questions or if the presenter is having difficulty signing into the webpage or with abstract submission, please email organizers.cumpc@gmail.com.
- Please see page 2 for an example abstract.

Purpose: To examine the capabilities of plastic and hybrid scintillator detectors to accurately measure FLASH radiotherapy (FLASH-RT) dose-rates over sub-second intervals with an x-ray tube.

Methods: The output of five scintillators of varying materials was measured over short, sub- second irradiation intervals using a traditional x-ray tube and rotating shutter-wheel system. Two plastic scintillator dosimeters were made of BCF-10 and BCF-60, with three hybrid scintillators doped with lead at 0.5%, 1.4%, and 5%. Each scintillator was of constant volume of 7.18 mm^3. Scintillator temporal resolution was tested using intervals or 100 and 200ms with a constant tube-current of 25mA and tube voltage of 80kVp. At a constant tube voltage of 80kVp and tube current of 25mA, irradiation time was varied between 10-100ms to observe scintillator output. To test dose-rate independence, each scintillator was irradiated using a constant tube voltage of 80kVp and exposure time of 100ms with varying tube-current between 3-37.5 mA, which resulted in measured dose-rates between 3Gy/s and 128Gy/s. Energy dependence was tested using a constant exposure time of 100ms and tube current of 25mA with tube voltages ranging between 80-120kVp, resulting in doses between 5-26Gy. Scintillator signal was compared to Monte Carlo (MC) data.

Results: Temporal resolution for all probes showed excellent Monte Carlo agreement for irradiation intervals of 100, and 200ms (**Figure 1 a,b**). When irradiation time was increased between 10-100ms, scintillator output was shown to have $R^2 > 0.999$ for all probes tested (**Figure 1c**). Scintillator output was shown to be dose-rate independent between dose-rates of 3-128Gy/s, with $R^2 > 0.999$ for all tested probes (**figure 1d**). At larger tube voltages, it was shown that scintillator output exhibited a quenching effect, resulting in a maximum difference between experimental and MC data of 17% for the 5% lead-doped scintillator at 120kVp (**Figure 1e**).

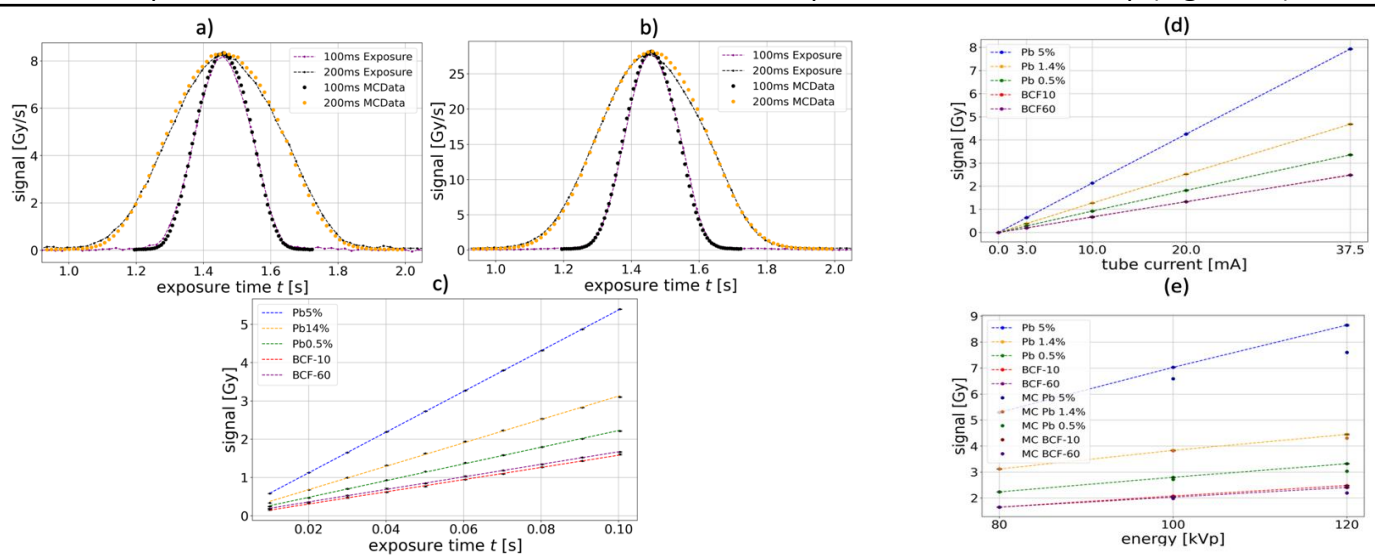

Figure 1: Comparison between MC and experimental data for probes BCF-60 (a) and Pb 5% (b) for irradiations of 100 and 200ms at a tube voltage of 80kVp and tube current of 25mA Scintillator output as a function of increasing irradiation time for all probes tested at a constant tube voltage of 80kVp and tube current of 25 mA (c). Dose-rate independence tested for all probes between tube currents of 3-37.5 mA corresponding to dose rates of 3.34-41.8 Gy/s for the Pb 5% probe at a fixed tube voltage of 80kVp and exposure time of 100ms (d). Energy dependence tested for all probes with varying tube voltages of 80-120kVp and fixed tube current of 25mA and exposure time of 100ms (e) demonstrates quenching effects of approximately 0.3%/kVp and 0.2%/kVp for the Pb 5% and BCF probes, respectively.

Conclusion: We have shown that plastic and hybrid scintillators have the capability to accurately measure FLASH-RT dose-rates over sub-second intervals. As most radiotherapy treatment will be at energies greater than 80kVp, further research will be needed to quantify scintillator output at larger tube voltages.

To date, time spent on the project has been 14 months with the expectation of an additional 8 months for project completion.