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## **Stem removal for plastic scintillation detectors in the MR-linac.**

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### **Purpose**

We are developing a dosimetry system that can provide time resolved dosimetry without image distortion in magnetic resonance linear accelerators (MR-Linac).

The system is based on a plastic scintillation detector (PSD) coupled to a PMMA optical fiber. These all-plastic detectors do not create artifacts on the MR images while having a high degree of water equivalence and dose-per-pulse time resolution. A challenge with plastic scintillators is separating the scintillation signal from the stem signal, primarily Cherenkov light generated by secondary electrons crossing the optical fiber cable. The magnetic field can change the amount of Cherenkov light seen by the instrument due to changes in the secondary electrons' trajectories relative to the guiding angle of the fiber cable.

### **Materials and method**

The PSD used in this study was a BCF-60 coupled to 15 m long PMMA fiber with the DTU developed readout equipment ME-40 system. Dose profile were acquired for 10 x 5 cm and 5 x 5 cm field sizes in a Viewray MRIdian 0.35 T MR-Linac, using the PSD, a PTW Semiflex 31021 ionization chamber and GAFchromic™ EBT3 film in PTW BEAMSCAN MR 3D water phantom or solid water.

### **Results and Conclusion:**

We found that the chromatic stem removal procedure removed the majority of the stem signal when the scintillator was in the primary beam. However, a slight asymmetry was still present when comparing directly with the ionization chamber leading to approximately 0.1 % overestimation of dose per cm of irradiated fiber inside the primary beam. In low dose regions where only fiber cable (not the scintillator) was directly in the primary beam, the residual stem signal can lead to an approximately 20 % overestimation of dose.

Additional work will be needed to establish if the apparent residual stem signal for the out-of-field measurements was related to the magnetic field or if it was caused, for example, by small temperature changes during the scintillator measurements.