

Theme: Physics

Abstract No.: PTCOG-AO2025-ABS-0036

Abstract Title: Feasibility Assessment of the Revised TRS398 Protocol for Dosimetry in Pencil Beam Scanning Proton Therapy Systems

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Background / Aims:

- The Technical Report Series (TRS) 398 was updated and republished in 2024, incorporating revised beam quality correction factors K_{Q0} for the majority of ionization chambers used in proton beam therapy.
- This study aims to conduct a Feasibility Assessment of the revised TRS398 Protocol for Dosimetry in Pencil Beam Scanning Proton beam Therapy Systems.

Subjects and Methods:

- PPC05, Roos, and PPC40 ion chambers were used for the measurement.
- All measurements were done on Proteus Plus Proton machine with Isochronous cyclotron (IBA, Belgium) for energies ranging from 70 MeV to 226 MeV with a 10 MeV energy gap
- A uniform field was generated using a single layer with a field size of 10×10 cm², a spot spacing of 2.5 mm, 1 MU per spots.
- The absorbed dose to water was calculated as per TRS398.
- Both the previous and the revised K_{Q0} values were used from TRS398.
- Ksat factor was evaluated for continuous as well as pulsed beam formalism.



Figure 1. Setup for absorbed dose to water measurement

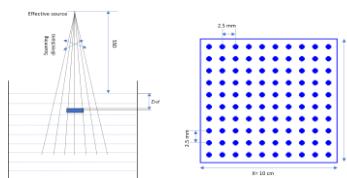


Figure 2. Schematic diagram of the setup used for absorbed dose measurement (left) and spot pattern used (right).

Result:

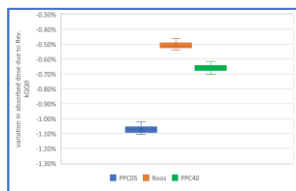


Figure 3. Variation in absorbed dose due to revised TRS398 K_{Q0} for PPC05, PPC40, and Roos ionization Chamber.

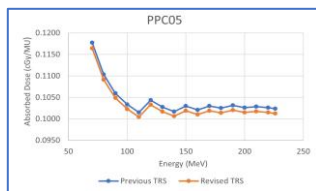


Figure 4. Absorbed dose with previous and revised TRS398 K_{Q0} for PPC05 ionization Chamber.

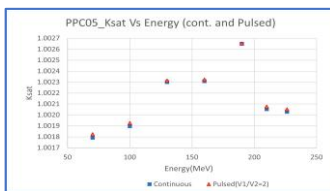


Figure 5. Ksat using continuous and pulsed beam formalism at different proton energies with a PPC05 plane parallel ionization chamber.

- The revised K_{Q0} results in a mean deviation of -1.07%, -0.51% and -0.66% in absorbed dose measurements for the PPC05, Roos and PPC40 chamber.
- The maximum deviation in the Ksat value between calculations using the continuous and pulsed beam formalisms was 0.0020%.
- Existing institutions are encouraged to independently evaluate the impact of the revised TRS-398 on their absolute dosimetry protocols.
- Newly established centres may adopt the reference conditions outlined in the revised TRS-398 for absolute dosimetry in PBS proton beams.