

Theme: Physics

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Abstract Title: Independent Dose Verification for Proton Therapy Using the MCsquare Monte Carlo Platform: A Preliminary Study

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Background / Aims:

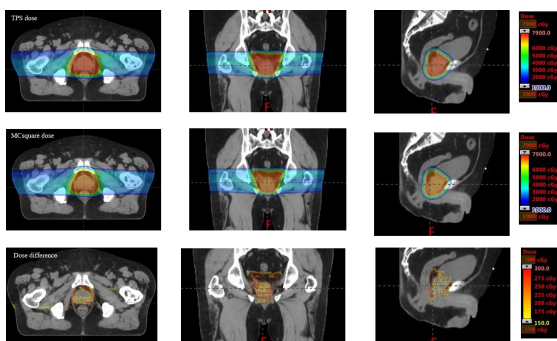
- To establish an independent proton dose calculation model using the MCsquare Monte Carlo platform at Cancer Hospital, Chinese Academy of Medical Sciences, Shenzhen Center.

Subjects and Methods:

- A beam model of proton PBS was built in MCsquare based on commissioning data from gantry room 4 of IBA Proteus®Plus system in our center, which completed clinical commissioning in May 2025.
- The data included: (1) integral depth-dose (IDD) curves in water for energies ranging from 70.19 to 226.09 MeV in 5 MeV increments ; (2) in-air beam spot lateral profiles at corresponding energies; and (3) absolute dose measurements following TRS-398 protocols, with a PPC05 chamber positioned at depths of 2–8 cm depending on energy.
- Using identical beam parameters, dose distributions were calculated for four head and neck cases, three prostate cases, and one liver case using RayStation 7.0 and independently recalculated in MCSquare. Dose calculations in MCsquare used a 1% statistical uncertainty. A 3D gamma analysis (3%/3 mm) was performed for dose comparison.

Result:

- The MCsquare beam model demonstrated high accuracy, with range R80 deviations <0.3 mm and peak dose deviation <0.5% compared to measurements data.
- The average gamma passing rate across all test cases was 99.4%, indicating excellent agreement with TPS results.



Comparison of Doses Calculated by TPS and MCsquare for a Prostate case

Conclusion:

- An independent Monte Carlo dose calculation model has been established and validated across multiple anatomical sites, showing excellent agreement with commercial TPS. Further validation with additional patient cases is ongoing.