## PP07.13
## PRELIMINARY STUDY ON THE ROBUSTNESS OF VMAT-TBI TREATMENTS

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**Introduction:** VMAT optimizes TBI treatments by ensuring coverage of target, while sparing critical organs. However, it may be sensitive to patient positioning errors due to dose overlap between arcs with different isocenter. This study evaluates robustness of VMAT-TBI treatments against per-fraction isocenter shifts.
**Materials & Methods:** Five patients undergoing VMAT-TBI were immobilized using full-body vacuum mattress and face mask.
Plans (12Gyx6fractions) were created using MONACO-TPS (Elekta) and delivered on an Elekta-LINAC with Agility-MLC.
PTV was defined as the whole body minus a 3 mm margin from the skin, excluding lungs as OARs. Depending on patient height, 5 to 6 equidistant isocenters were used, with a
4-cm beams overlap minimum.
Online shifts were applied with CBCT imaging for each fraction and isocenter.
Treatment plans were recalculated, applying isocenters shifts on synthetic CTs generated by coregistering CBCTs with planning CT, preserving original CT in missing regions of the CBCT. Recalculated dose per-fraction was accumulated over the 6 fractions and compared with planned dose distribution to assess PTV coverage, mean OARs dose, and mean isocenter shifts.
**Results:** Patient positioning remained consistent with mean shifts less than 10 mm in all directions. OARs sparing was maintained, with lung doses consistently below 10Gy for each patient. Target coverage remained acceptable (V11.4Gy>95%), with minor discrepancies between planned and delivered doses in regions of beams overlap. Table 1 shows the comparison between planned and delivered statistics, averaged over all patients.
**Summary:** This study highlights the robustness of VMAT-TBI treatment against per-fraction patient positioning, maintaining organ sparing and target coverage.
**Appendix:**

| MEAN PATIENTS STATISTICS | | | |
|---|---|---|---|
| Structure | Dosimetric criterion | Planned | Delivered |
| PTV | V11.4Gy>95% | 98.38±0.01% | 97.33±0.02% |
| Lung_L | Mean dose <10Gy | 9.36±0.06 | 9.79±0.12 |
| Lung_R | Mean dose <10Gy | 9.44±0.09 | 9.81±0.19 |

**Table 1** Comparison between planned and delivered statistics, averaged across all patients.

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## PP07.14
## EVALUATION OF THE ABSORBED DOSE OF A NEW PHOSPHORUS-32 SOURCE FOR BRACHYTHERAPY USING MONTE CARLO SIMULATION

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**Introduction:** The use of flexible plaques in brachytherapy allows shaping the source in the treated region, adapting to the patient's needs. Phosphorus-32 ($^{32}$P) is promising for palliative treatment of spinal tumors due to its limited penetration, particularly suitable for treating the spinal cord region. Thus, this study aims to contribute to research on absorbed dose, aiming to minimize damage to healthy tissues [1].
**Materials & Methods:** Monte Carlo simulations were performed using the MCNP6.2 [2] and TOPAS 3.8 [3] codes to model the $^{32}$P source. This source is modeled in plaque format with dimensions of 5.0 × 5.0 × 0.04 cm$^3$, inserted above a homogeneous phantom containing water, cortical bone, and soft tissue. The beta spectrum was extracted from the International Atomic Energy Agency (IAEA) website, with an average energy of 0.695 MeV and a maximum energy of 1.71 MeV. Absorbed dose was calculated using *FMESH4 with DE/DF and *F8 tallies for MCNP6.2, and "EnergyDeposit" scoring for TOPAS.
**Results:** Figure 1 illustrates the Percentage Depth Dose for the MCNP6.2 and TOPAS codes for different materials. The maximum range for water, cortical bone and soft tissue was 7.4 mm, 4.1 mm and

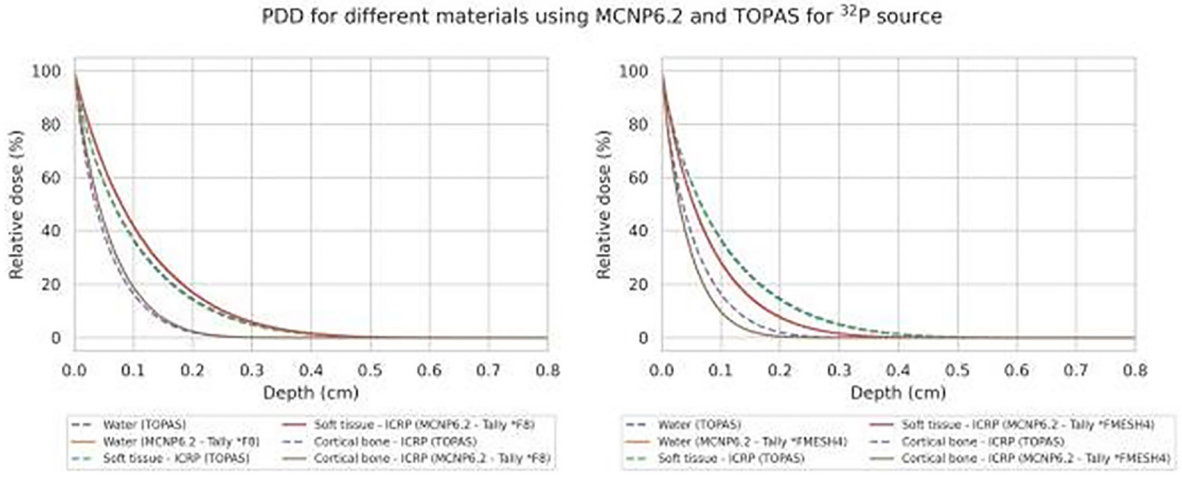


**Figure 1** (abstract PP07.14): Relative Dose (%) of $^{32}$P source for different materials using MCNP6.2 and TOPAS codes.

7.1 mm, respectively. The absorbed dose evaluated at 1.0 mm from the source for each material exhibited differences below 4.8%.

**Summary:** The accuracy of dose calculations is crucial for patient treatment. Simulation results are promising for optimizing dose delivery and minimizing healthy tissue exposure. This work advances accurate methods for brachytherapy applications.

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**Appendix:**

**References:**

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## PP07.15
## EXPERIMENTAL DETERMINATION OF THE $K_S$ FACTOR OF DIFFERENT IONIZATION CHAMBERS IN PROTON AND CARBON-ION BEAM

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**Introduction:** The determination of the saturation correction factor ($k_S$) for ionization chambers is important for precise dose measurement in radiotherapy. This study aims to determine the $k_S$ factor for four different ionization chambers when exposed to proton and carbon-ion pencil beams at clinical dose rates.

**Materials & Methods:** Farmer Chamber TM30013, Advanced Markus TM34045, Sun Nuclear SNC-125C and Pin Point TM31015 were irradiated under reference conditions in a water equivalent depth of 2 cm. Each chamber was irradiated at four different energies resulting in four different dose rates for protons in the range of 3 Gy/s and 6 Gy/s for carbon-ion. The voltage range was 100 V up to 500 V. The saturation correction factor was determined using the Jaffé diagram and the 3-voltage method [1].

**Results:** As shown in figure 1 for the Advanced Markus chamber irradiated with protons, the following $k_S$ factor was calculated for the four energy levels:

E017 (60 MeV/u) = 1.0073 ± 0.0007, E039 (81 MeV/u) = 1.0071 ± 0.0005,
E070 (104 MeV/u) = 1.0042 ± 0.0033, E296 (221 MeV/u) = 1.0054 ± 0.000003.

**Summary:** The results have shown that for the Advanced Markus chamber the four $k_S$ factors are above the threshold value of 1.001, which must therefore be considered according to DIN 6801-1 [2]. Furthermore, the chambers will be evaluated under ultra-high dose rates.

**Appendix:**

**References:**

[1] Rossomme S *et al.* 2020 *Phys. Med. Biol.* 65 045015

[2] DIN 6801-1: Procedures of dosimetry with probe-type detectors for proton and ion radiation – Part 1: Ionization chambers

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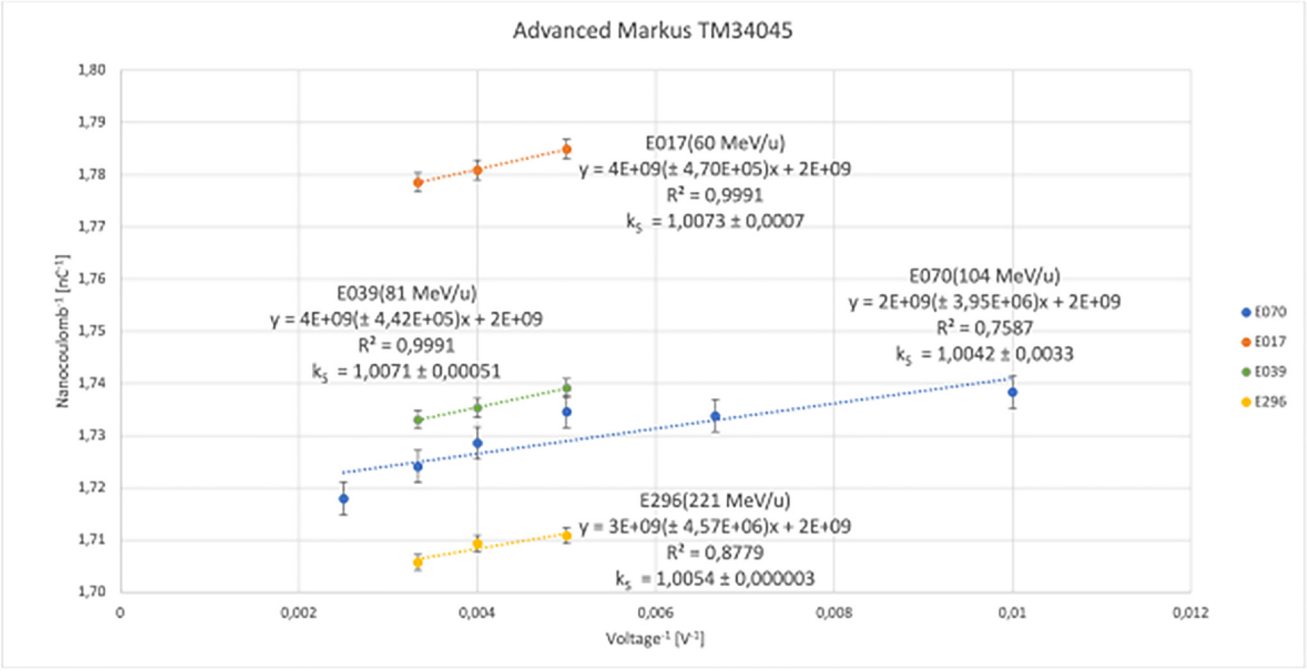


**Figure 1** (abstract PP07.15): Jaffé diagram for the Advanced Markus chamber irradiated with protons at four different energies.