

On the use of PRESAGE detectors for the dosimetry of helical TomoTherapy small fields

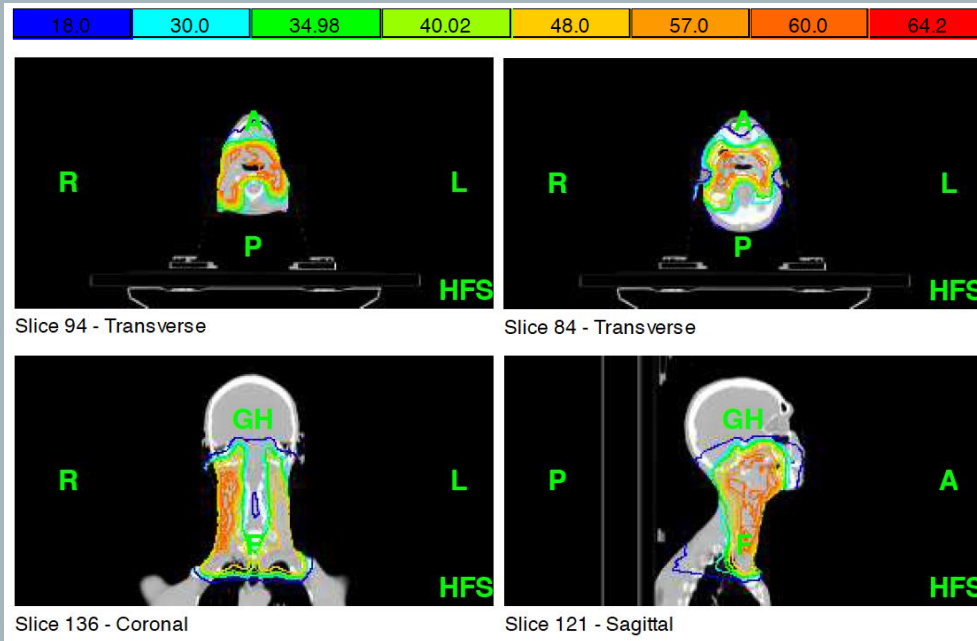
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Modern Radiotherapy Techniques

- ✓ Use of small fields (or beams)
- ✓ Steep dose gradients
- ✓ 3D, complex-shaped dose dist.

Verification

- ✓ Affects clinical outcome
- ✓ Dosimetric and Geometric verification in 3D
- ✓ No ideal dosimeter → **Multi-Detector approach** including research dosimeters

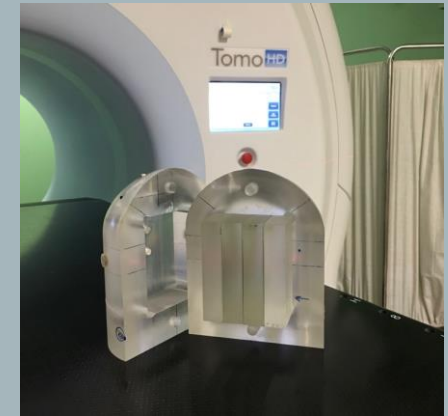
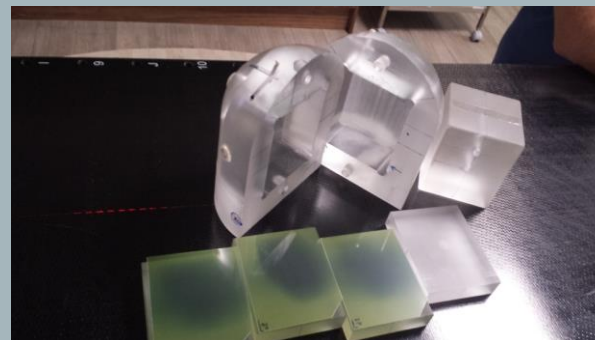
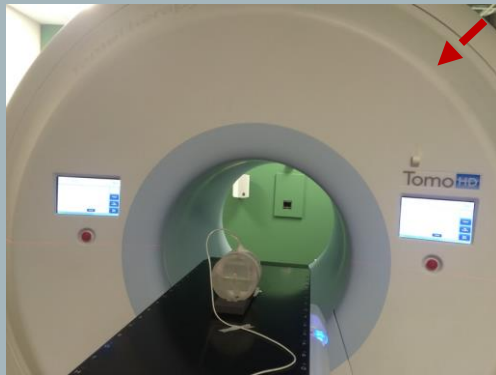
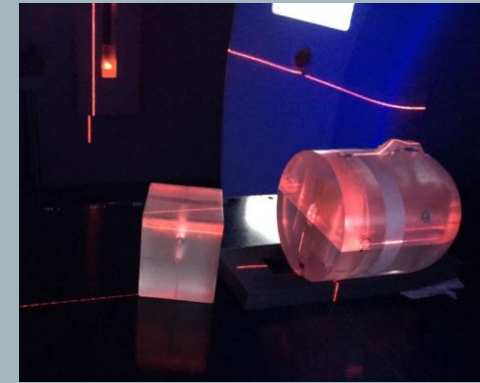
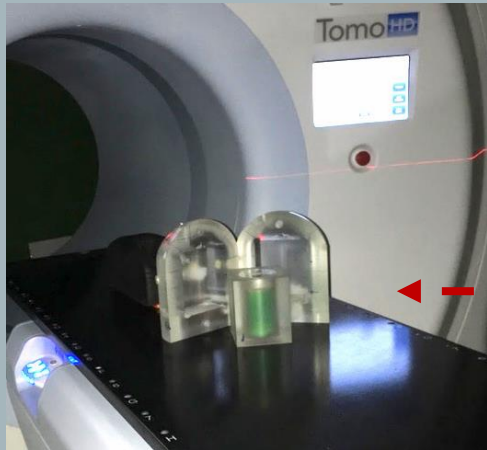
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Purpose: To apply 3D PRESAGE dosimetry for the verification of helical TomoTherapy dose delivery for a clinical prostate plan, and assess possible corrections of the A1SL ion-chamber response for a Plan-Class-Specific-Reference irradiation field (PCSR).



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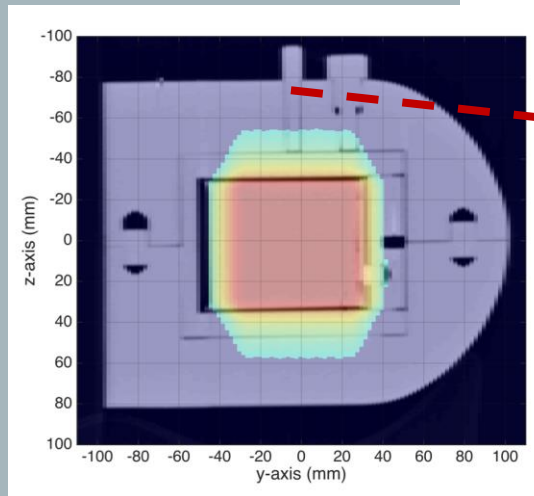
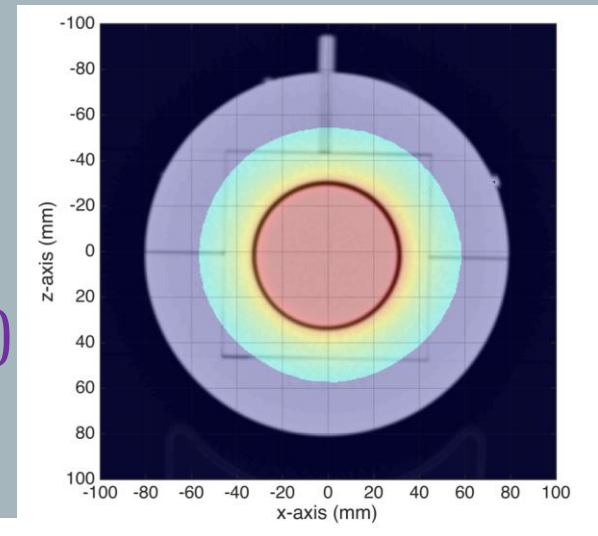
- In-house constructed PMMA phantom
- Adequate inserts permitting :
 - ✓ 3D PRESAGE dosimetry
 - ✓ Film dosimetry (EBT2, Gafchromic)
 - ✓ A1SL (IBA) ion chamber dosimetry



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Methods 1: Plan-Class-Specific Reference field (f_{PCSR})

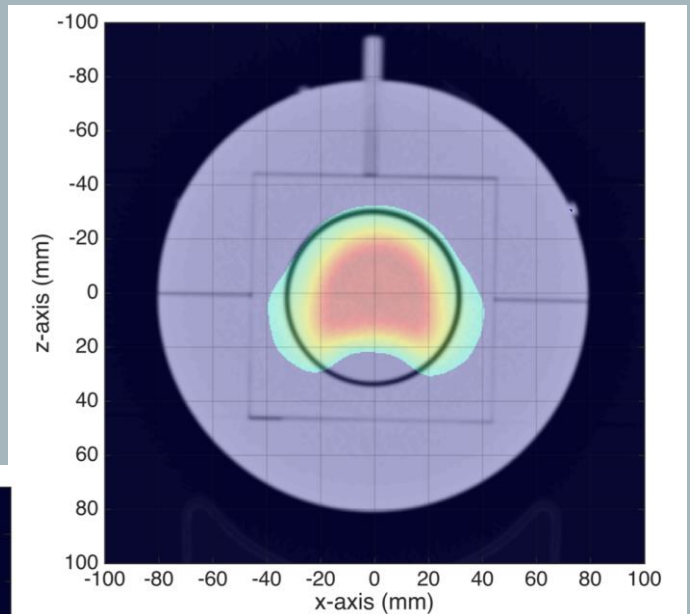
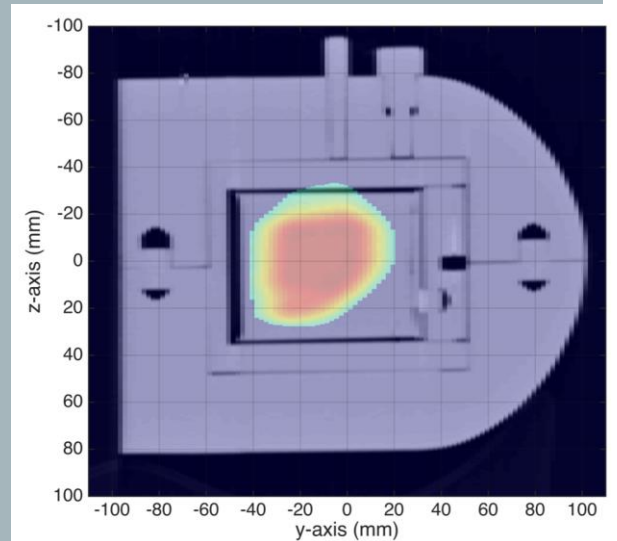
- TG-148 recommendations:
 - ✓ 2.5 cm collimator
 - ✓ 0.287 pitch
 - ✓ 2.0 Modulation Factor
 - ✓ Homogenous Dose distribution (4 Gy)
(Cylinder: 5 cm long and 5 cm diam.)
- pre-irradiation CT-scan
- A1SL: $k_{Q_{\text{ref}}, Q_0} = 0.996$



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Methods 2: Prostate clinical plan

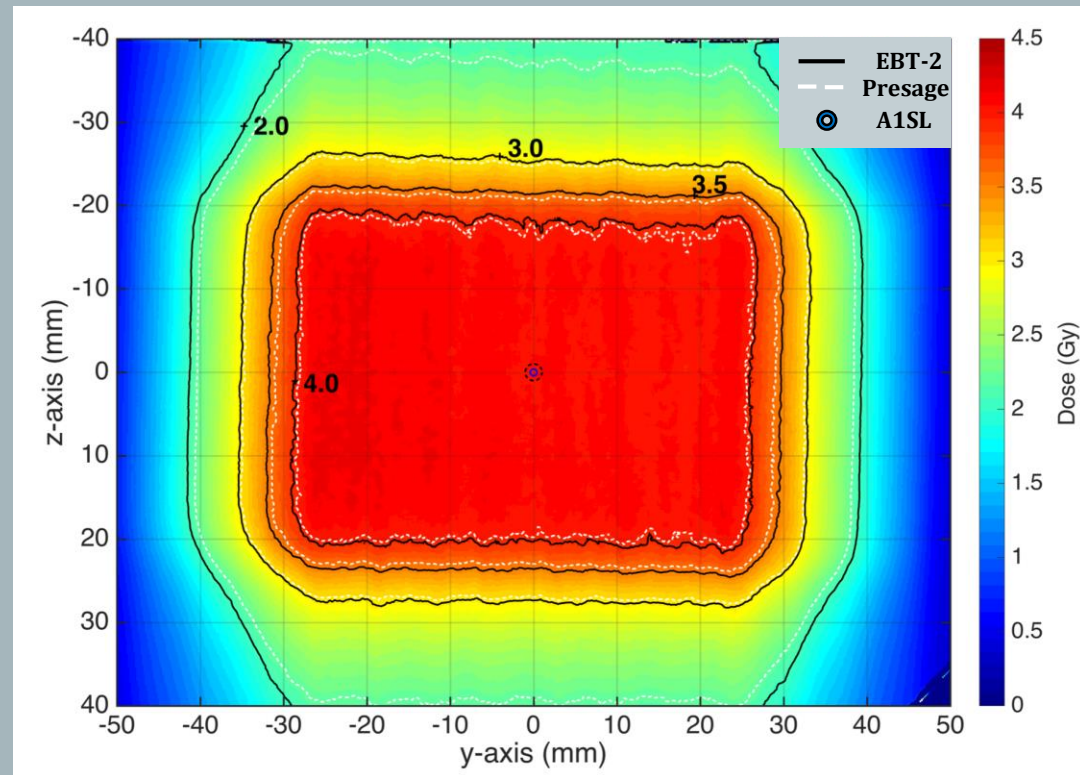
- ✓ 3 x 2.4 Gy to Prostate
- ✓ 3 x 2.9 Gy to Seminal vessels
- ✓ 2.5 cm collimator
- ✓ 0.287 pitch
- ✓ 2.4 actual MF



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Results: PCSR plan

Detector	D_{PCSR} (Gy)
PRESAGE	3.98 ± 0.10
EBT-2	4.03 ± 0.12
A1SL	4.09 ± 0.05
$k_{Q_{ref}, Q_{PCSR}}^{f_{ref}, f_{PCSR}}$	$0.98^a \pm 0.03$



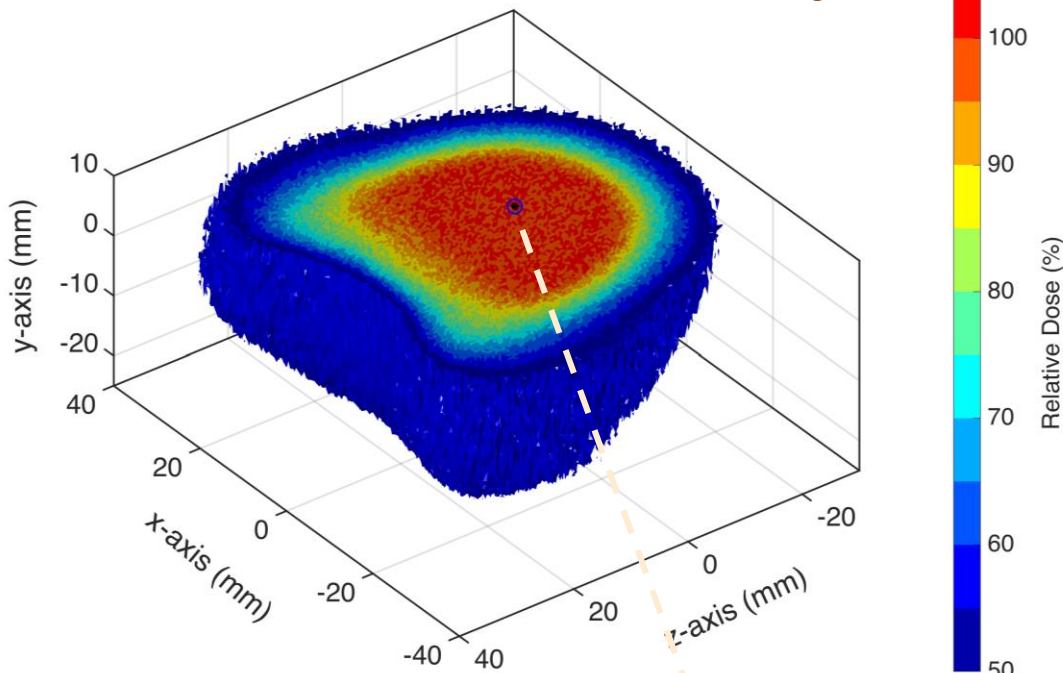
^a Although within uncertainties, A1SL was found to overestimate D_{PCSR} by 2% - in accordance with Gago-Arias *et al.* {*MedPhys*, **39**, 1964 (2012); doi: 10.1118/1.3692181}

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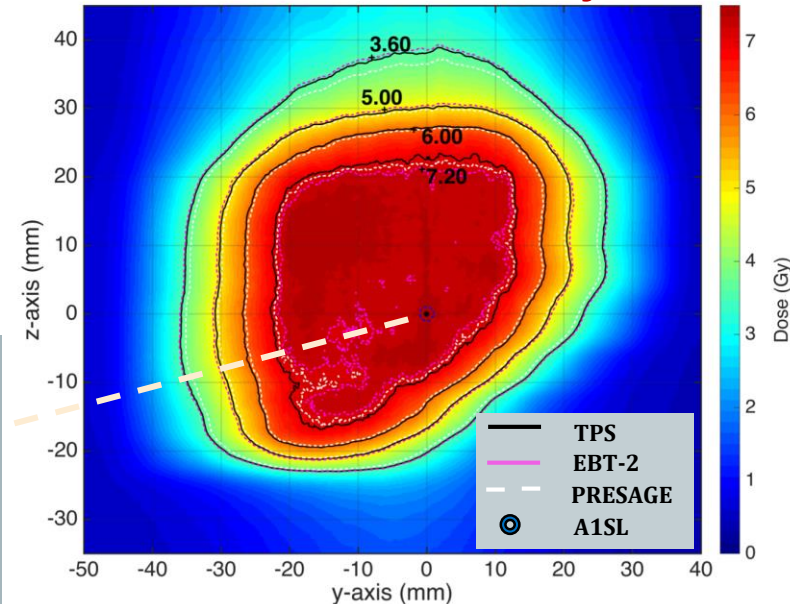
Results :

Prostate clinical plan

PRESAGE 3D dosimetry



film dosimetry



A1SL :

(7.21 ± 0.03) Gy

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Conclusion

Besides water equivalence and exquisite spatial resolution, necessitated for small field dosimetry and determination of appropriate correction factors, PRESAGE dosimeters offer the advantage of 3D dose verification.

