Total Skin Electron Treatment (TSET)

Scott W. Hadley PhD

Target of TST

- Entire Skin Surface
- Desired depth of Treatment
- Total Skin Electron Treatment

TSET Treatment Options

- Translational Methods
  - Radiation source scanned by patient
  - Patient on moving couch
- Large Field Rotation
  - Extended SSD
  - Multiple beams

Stanford Technique

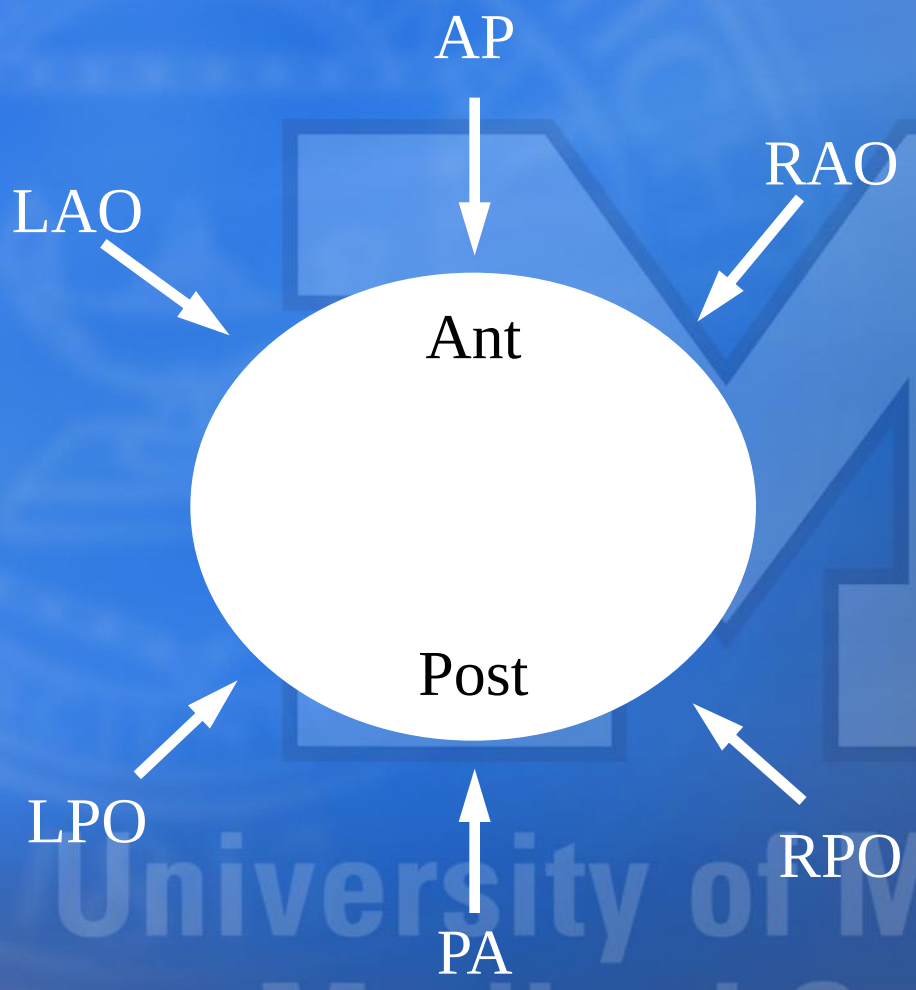
- **Dual Beam Technique**
- **Rotational Treatment**

A technique for large-field, superficial electron therapy

Karzmark CJ, Loevinger R, Steele Re, Weissbluth M

Radiology. 1960 Apr;74:633-44.

6 Field Rotation Treatment



HDTSe^{-} Mode of Linac

- 6MeV Elections
- No Cone – Jaws at 36 x 36
- 888 MU/min

Beam Profile

Whopping Big Scanner

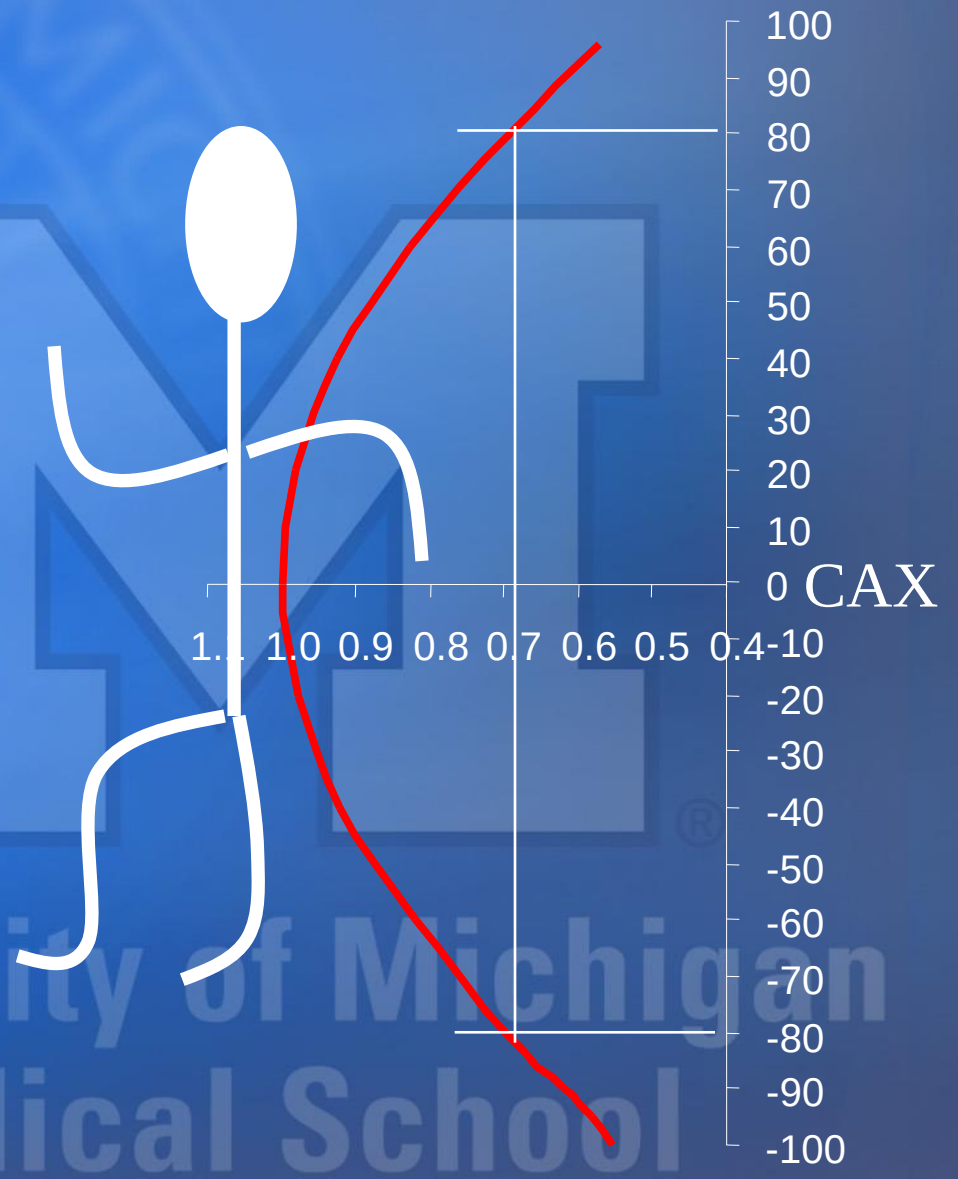
±100cm from CAX

Single Beam Profile

Single Beam at 450cm SSD

Gaussian Profile

± 80cm 30% reduction in dose

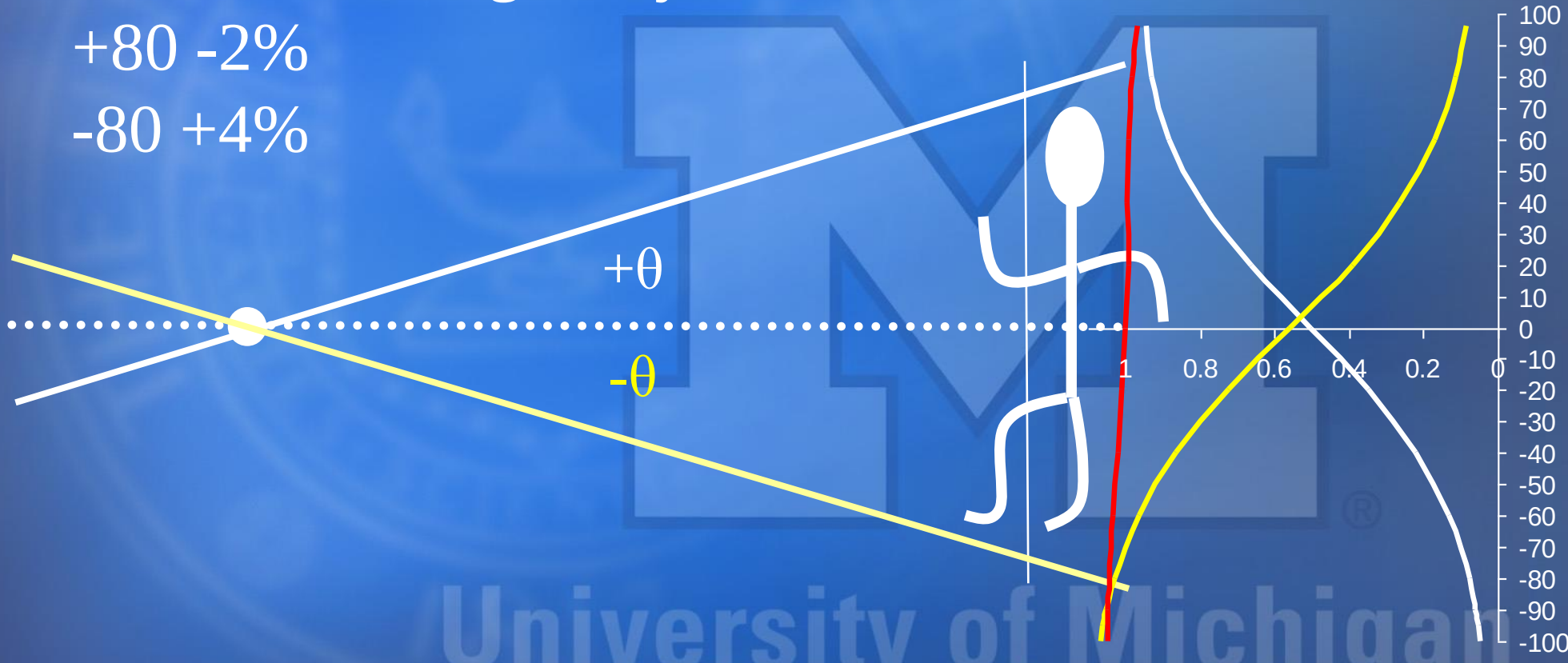


Dual Beam Profile

Increase Homogeneity

+80 -2%

-80 +4%



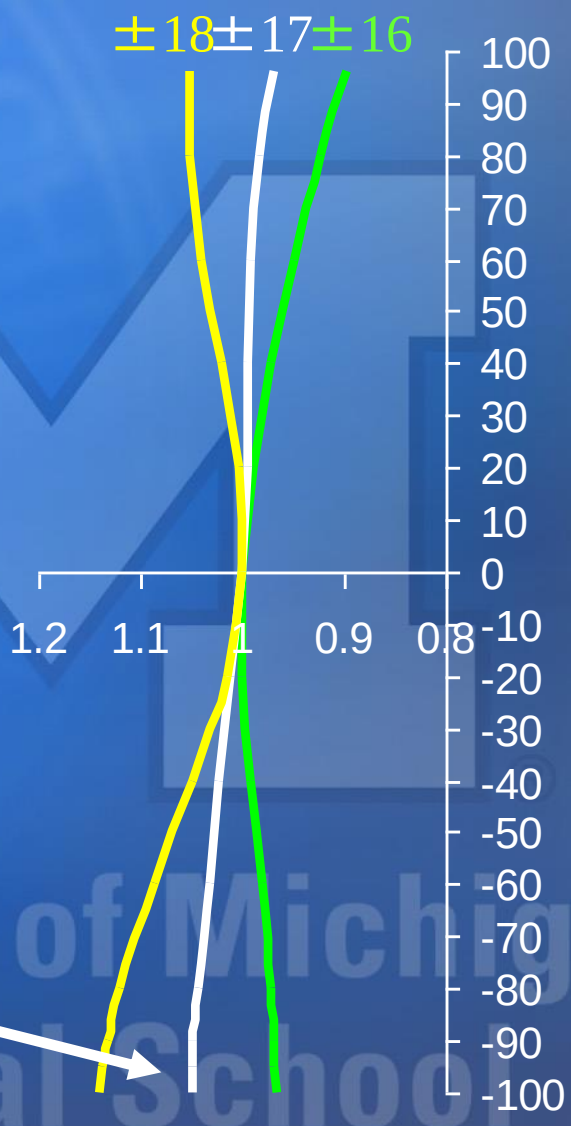
Dual Beam Matching

- Choose θ to match beam
- ± 18 degrees Over Matched
- ± 16 degrees Under Matched
- ± 17 degrees Just Right!

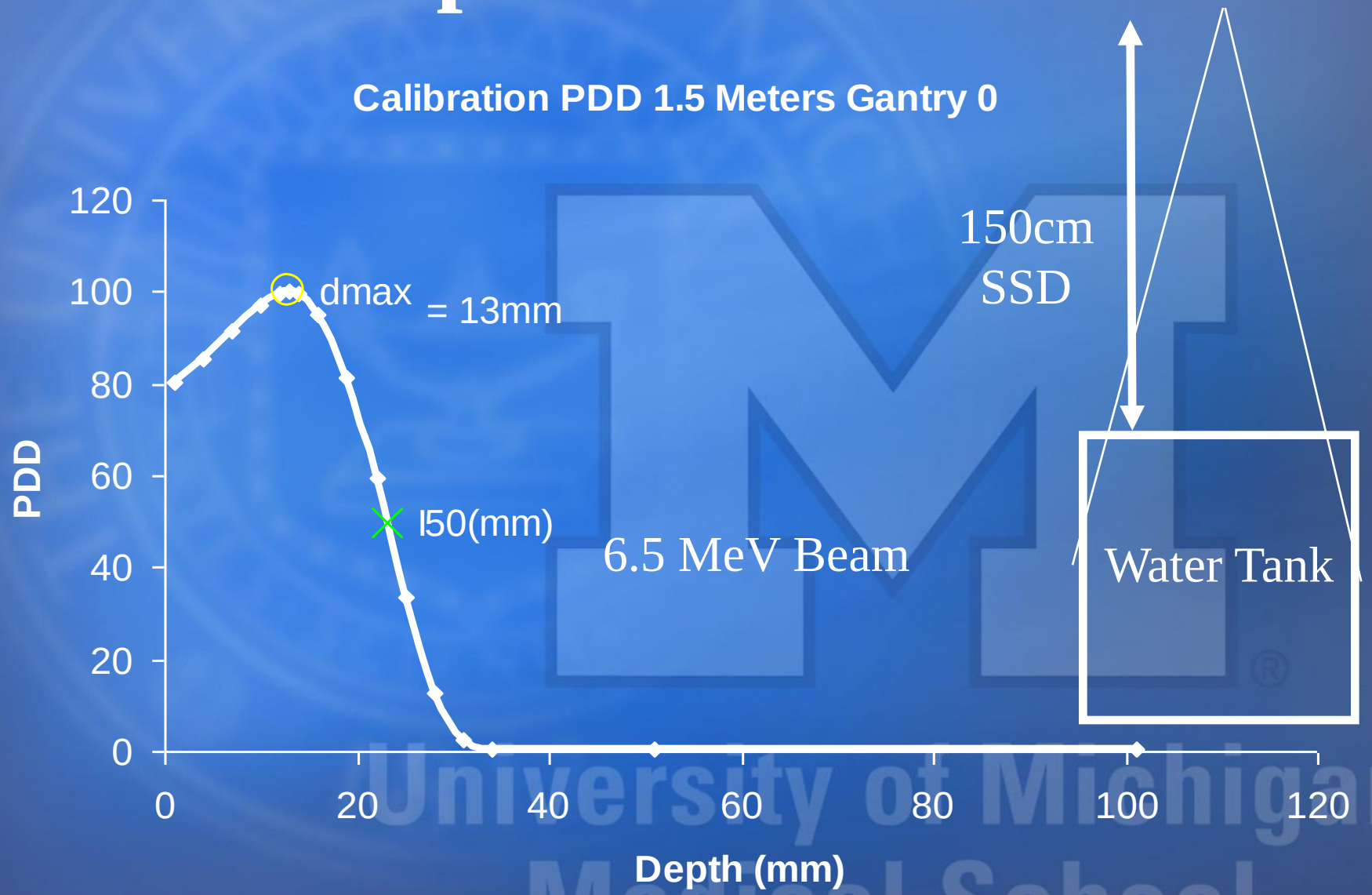
+ 80cm -2%

- 80cm +4%

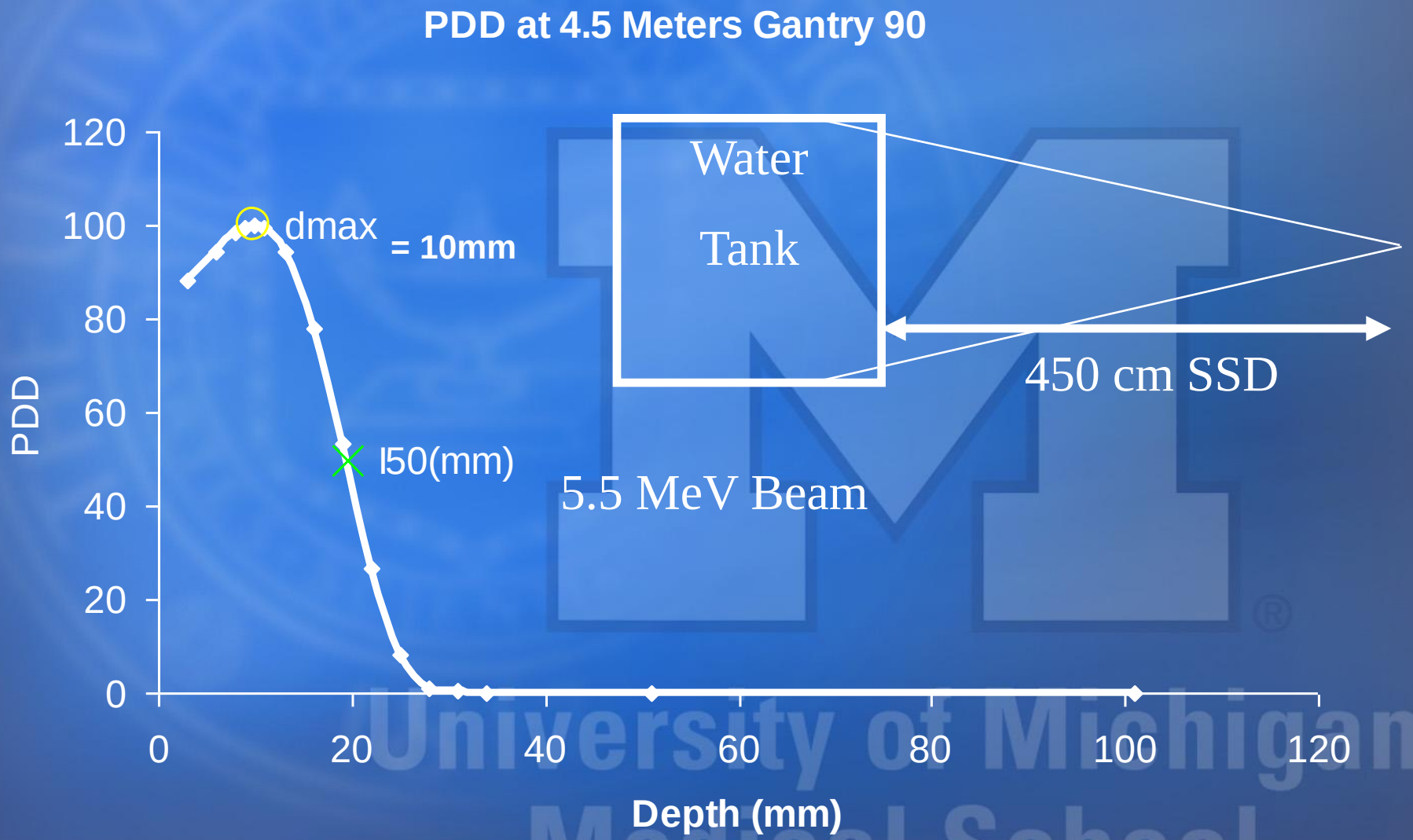
Dose Increase at Floor!



Percent Depth Dose



Percent Depth Dose

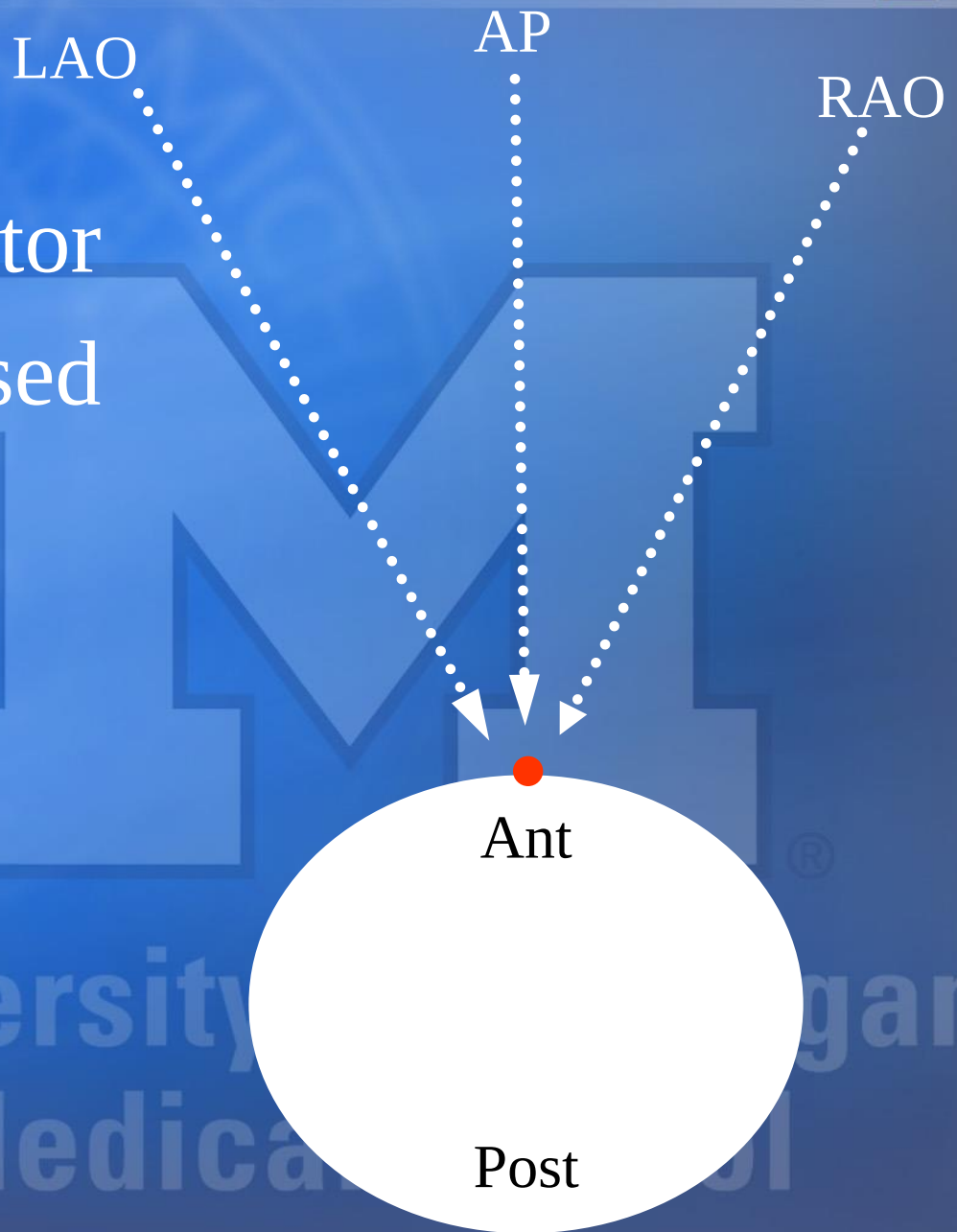


Calibration of HDTSe$^-$ Mode

- 1.2 cGy/MU at d_{max}, 150 cm SSD, Gantry 0
- 0.108 cGy/MU at d_{max}, 450 cm SSD, Gantry 90
- 0.054 cGy/MU at d_{max}, 450 cm SSD
  Gantry 73/107

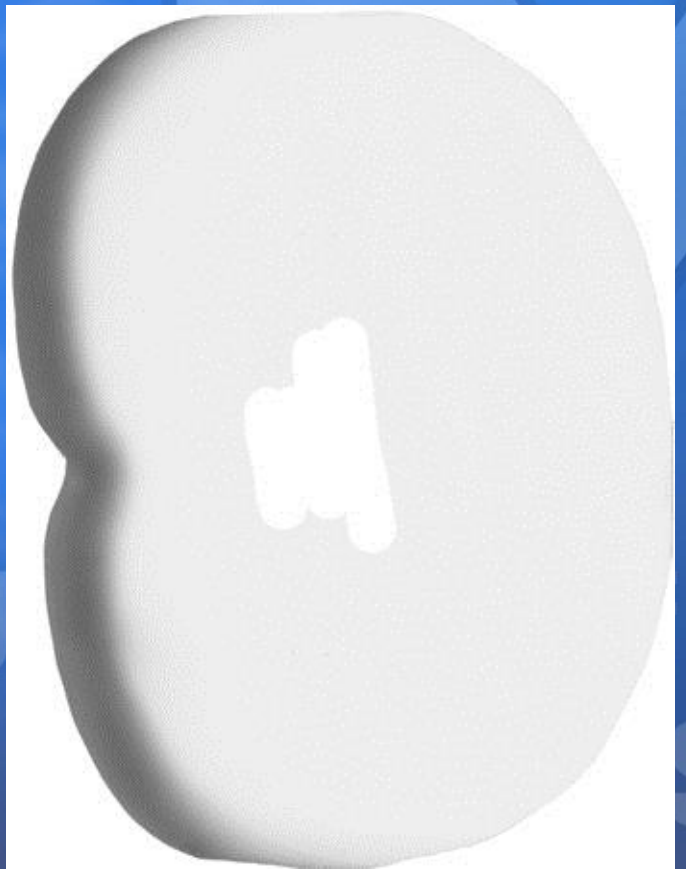
B-Factor

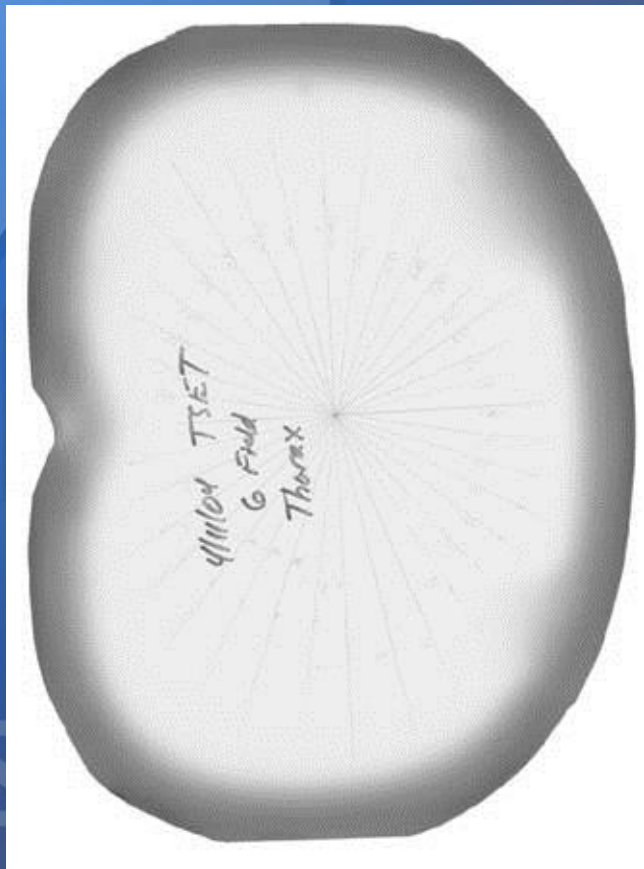
- Beam Overlap Factor
- Dose Increase caused by 6 dual beams



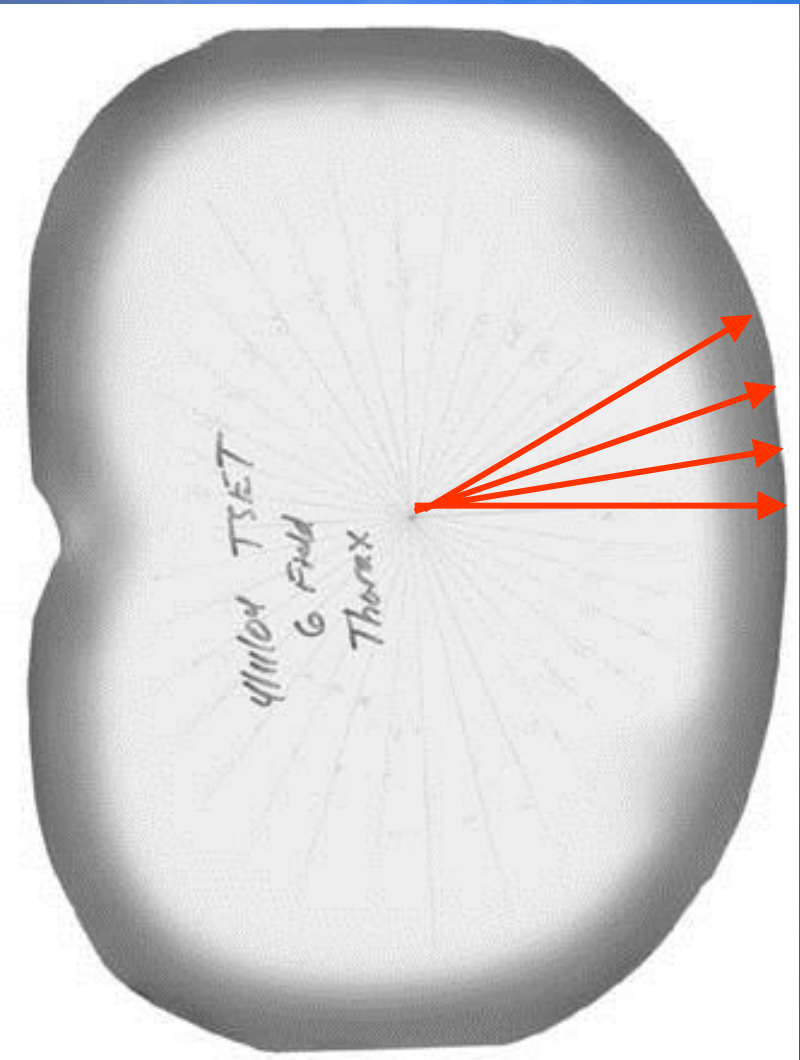
B-Factor Film

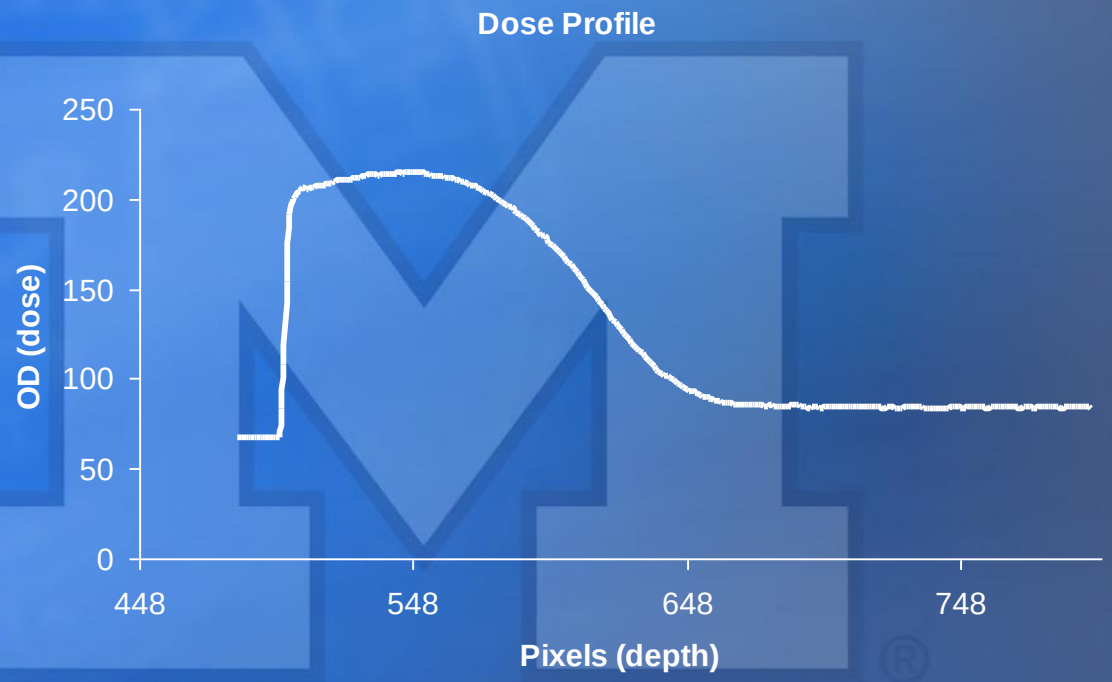
Film dosimetry to compare single field to 6 field





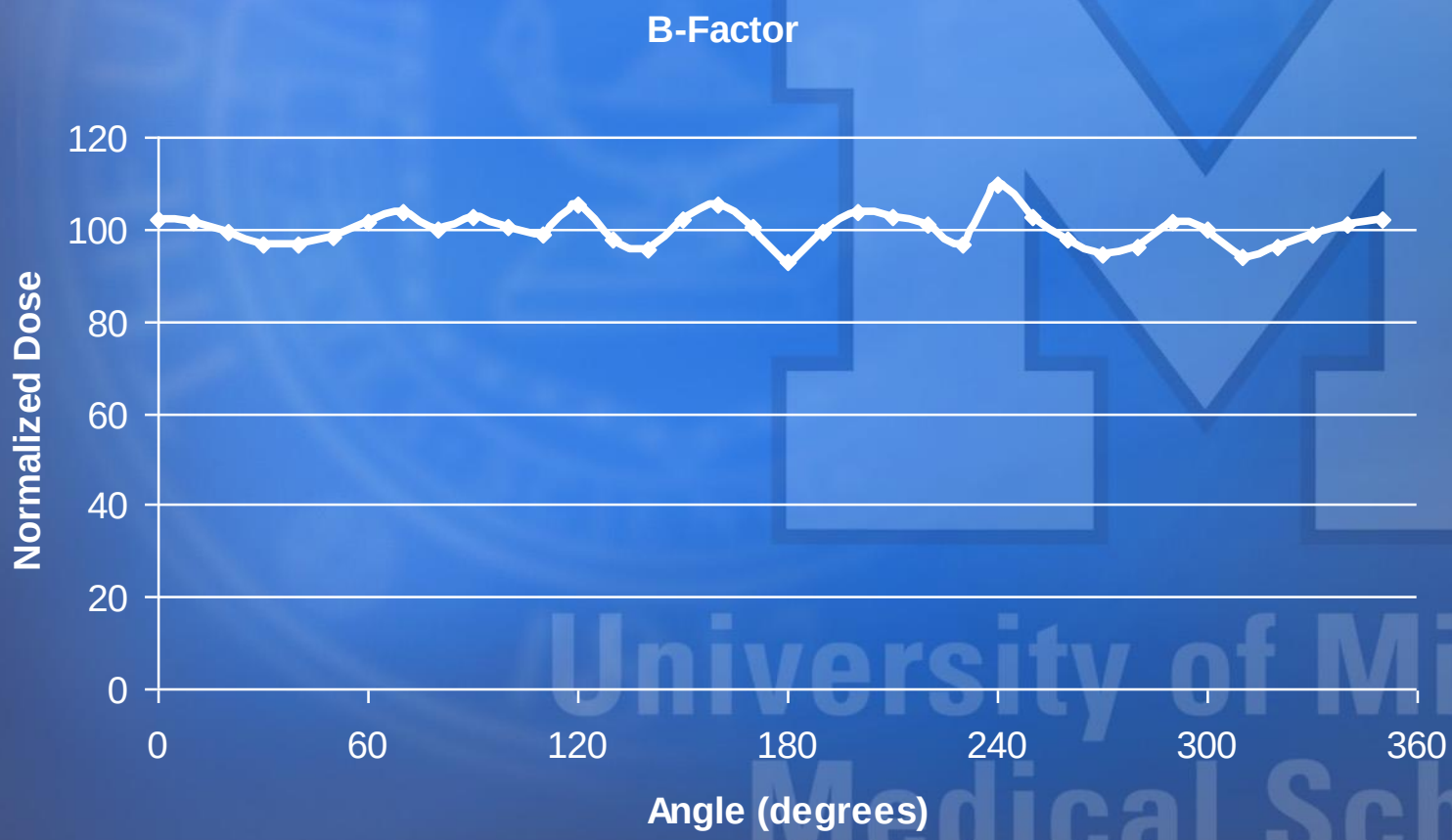
B-Factor Analysis





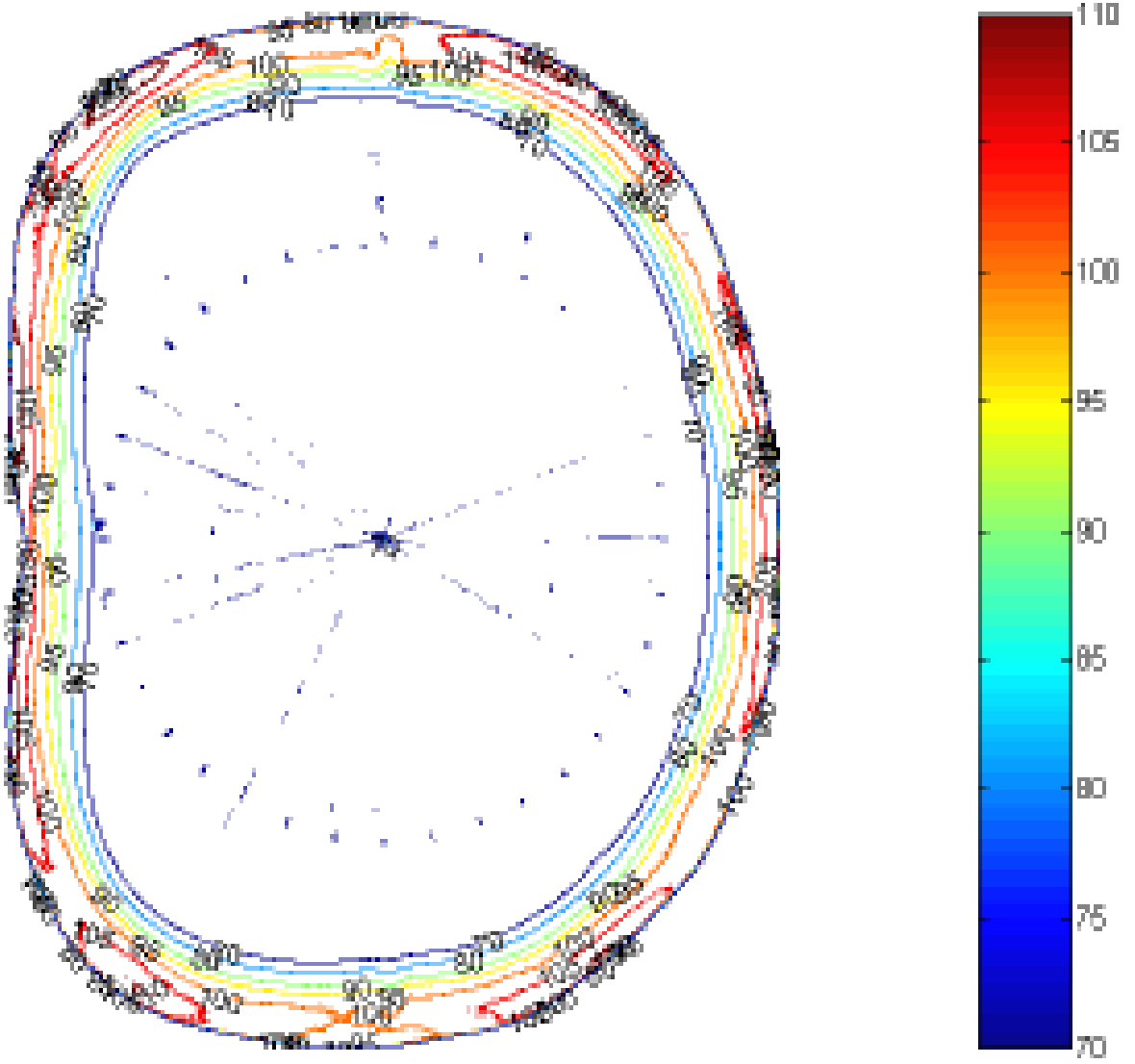
B-Factor Analysis

B-Factor = Average OD / Single Beam OD = 2.37



Homogeneity
-7 %
+10 %

B-Factor IDL



MUT

MU=Rx / [Calibration * B-factor * 2 beams]

771 = 200 / [0.0547 * 2.37 * 2]

No patient specific factors! ☺

Tx Technique

- One fraction over two days
  - Mon &Thurs AP, LPO and RPO
  - Tues &Fri PA, LAO, RAO
- Bolus over feet
- Eye Shields
- Nail Shields

Hand and Foot Shields

Toe Side

Heal Side

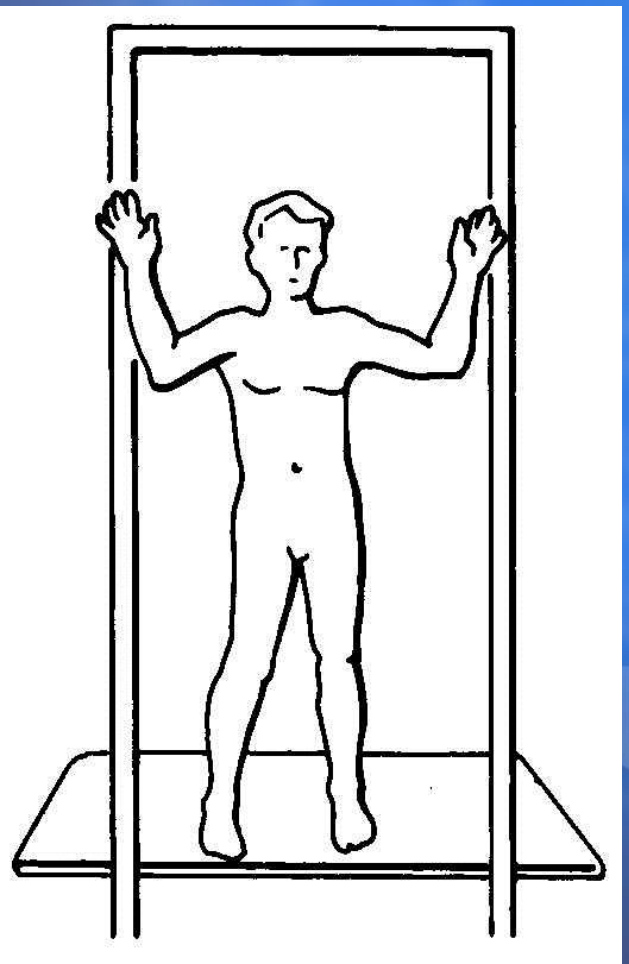
Hand Up

Hand Down

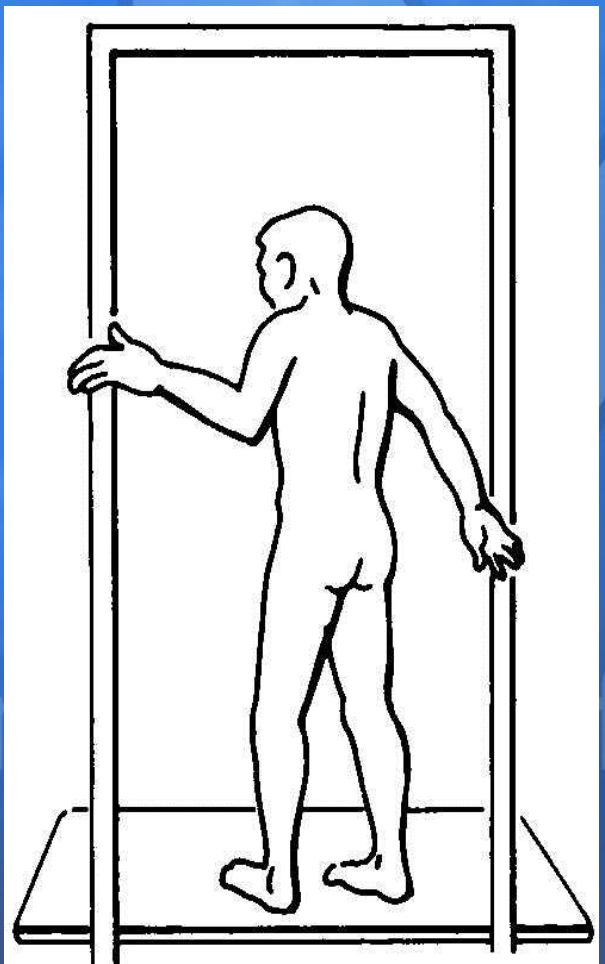
Tx Technique M&T

Monday & Thursday

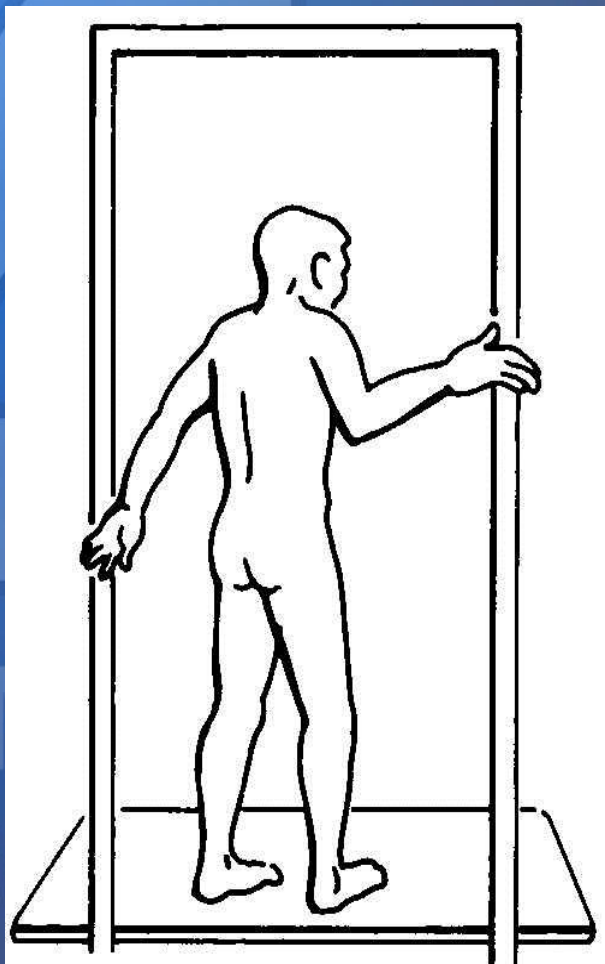
AP



LPO



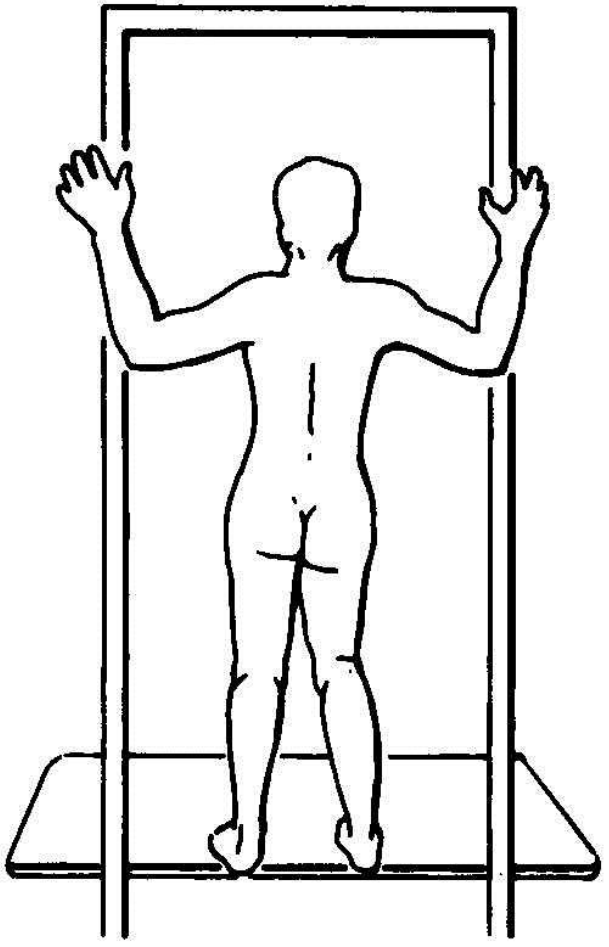
RPO



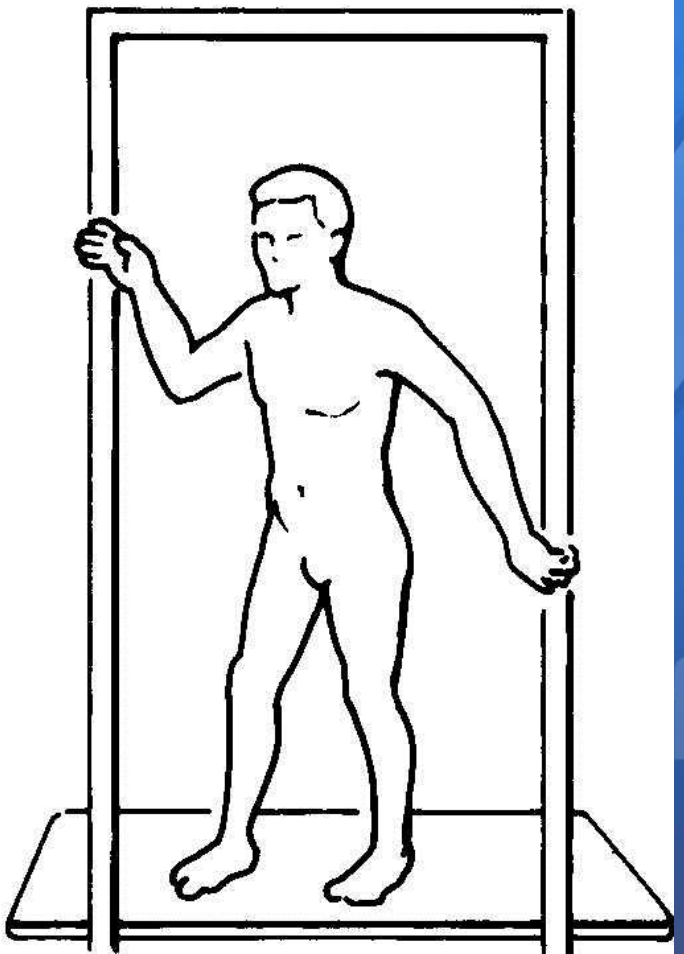
Tx Technique T&F

Tuesday & Friday

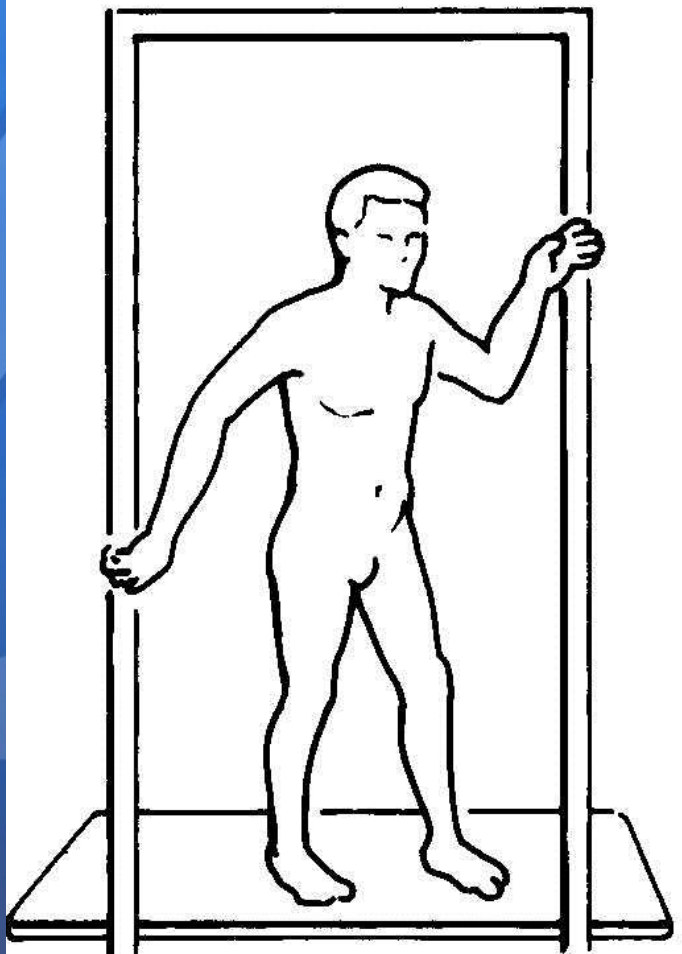
PA



LAO

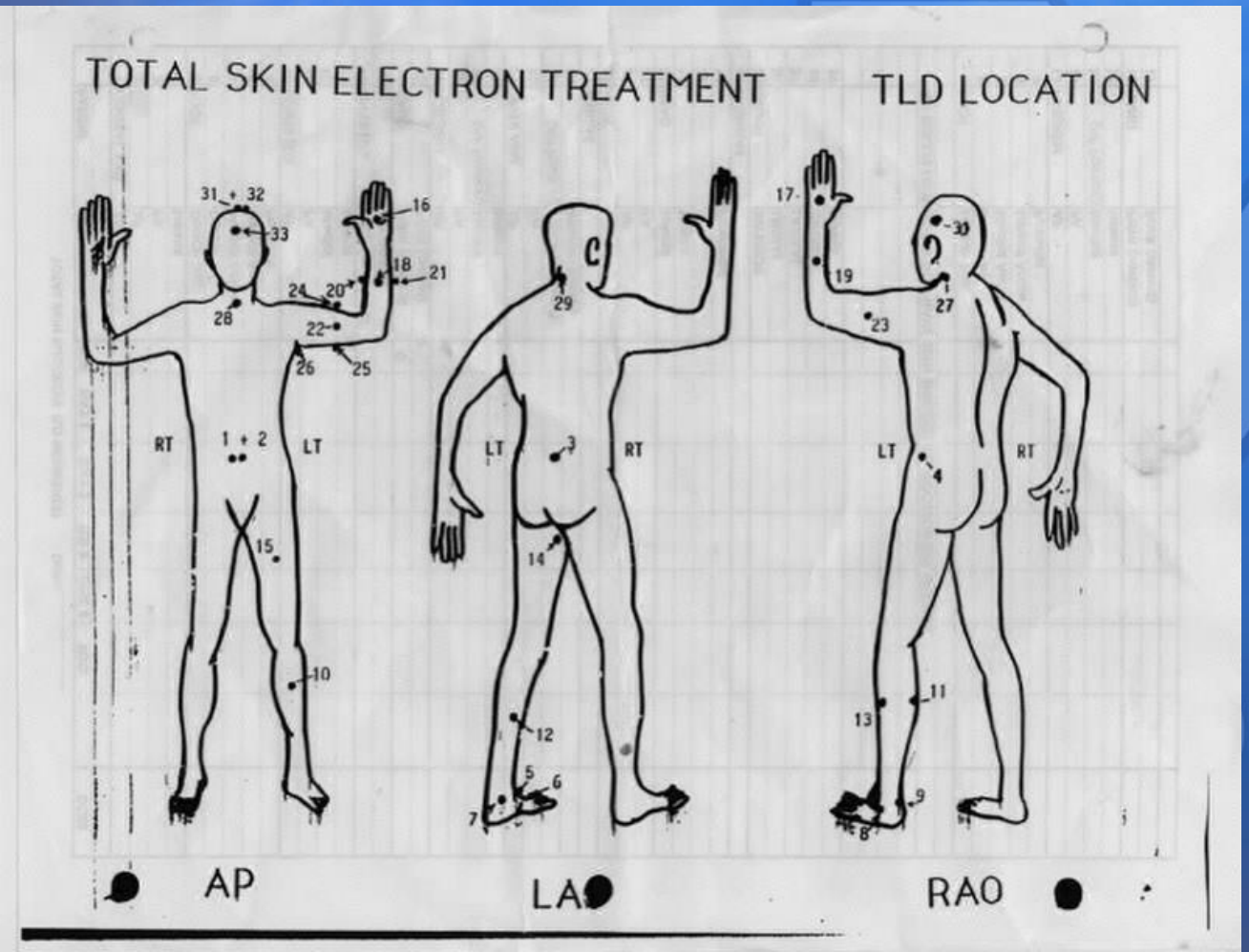


RAO



Patient Dosimetry

- 34-39 TLDs on first two fraction



Central	4
Feet	9
Leg	6
Arms	8
Hands	2
Neck	3
Head	4
Perineum	1
Breast	5

TLD Results

Table 2. Variation in dose for flat surfaces of the body

Location (N)	Average % of prescription dose	Standard deviation (1 s)
Umbilicus (22)	103%	8%
Forehead (20)	103%	7%
Sternal notch (13)	102%	12%
Mid chest (19)	100%	11%
Mid back (4)	104%	5%

Table 3. Variation in dose for tangential surfaces of the body

Location (*N*)	Average % of prescription dose	Standard deviation (1 s)
Right lateral hip (22)	100%	12%
Inner thigh (22)	109%	24%
Left lateral calf (20)	104%	16%
Left outer ankle (12)	97%	5%
Mid axillary line (3)	110%	9%

Table 4. Variation in dose for thin areas of the body

Location (*N*)	Average % of prescription dose	Standard deviation (1 s)
Right palm (13)	81%	10%
Right back of hand (22)	84%	17%
Right mid finger (posterior) (13)	111%	18%
Right mid finger (anterior) (7)	108%	22%
Right foot between toes (3)	71%	6%

Table 5. variation in dose for special areas of the body

Location, (*N*)	Average % of prescription dose	Standard deviation (1 s)
Top of head (18)	85%	26%
Perineum (22)	32%	22%
Axilla (21)	75%	28%
Under breast (women) (7)	40%	40%
Top of eyelid (18)	124%	11%
Panniculus (1)	2%	0%
Soles of feet (0)	No measurements made	No measurements made

Weaver et al. Evaluation of dose variation during total skin electron irradiation using thermoluminescent dosimeters. Int. J. Radiat. Oncol. Biol. Phys. (1995) vol. 33 (2) pp. 475-8

TLD Results

Table 4. TLD results for 19 patients treated with current total skin irradiation technique on Varian Clinac 2100C

Site	No. of measurements	Mean dose (% of prescribed dose)	Range (% of prescribed dose)
Scalp (top rear)	17	105 ± 8	89–120
Scalp vertex	17	87 ± 20	49–114
Top of shoulder	36	74 ± 8	59–88
Elbow	35	90 ± 13	60–115
Axilla	43	60 ± 25	3–105
Hand (mid dorsum)	36	85 ± 6	71–97
Upper thorax	18	93 ± 4	86–100
Upper back	18	93 ± 7	76–105
Anterior abdomen	21	100 ± 4	91–106
Lower back	19	91 ± 7	79–106
Lateral abdomen	40	98 ± 6	84–113
Upper-medial thigh	19	59 ± 23	7–93
Buttock	19	58 ± 14	26–80
Foot (mid dorsum)	36	117 ± 7	102–132

The dose error is reported as 1 sample SD.

Antolak et al. Utilization of thermoluminescent dosimetry in total skin electron beam radiotherapy of mycosis fungoides. Int. J. Radiat. Oncol. Biol. Phys. (1998) vol. 40 (1) pp. 101-8

Boost

- Scalp
- Soles of feet
- Perineum

Fin

University of Michigan
Medical School