DESIGN OF A BRA AND A SHIELD TO SPARE THE CONTRALATERAL BREAST TO REDUCE THE RISK OF SECONDARY CANCER DUE TO RADIOTHERAPY

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SOURCES of OUT-OF-FIELD RADIATION

1- Head Leakage,

radiation that penetrates through the accelerator head shielding and strikes the patient away from the treatment field.

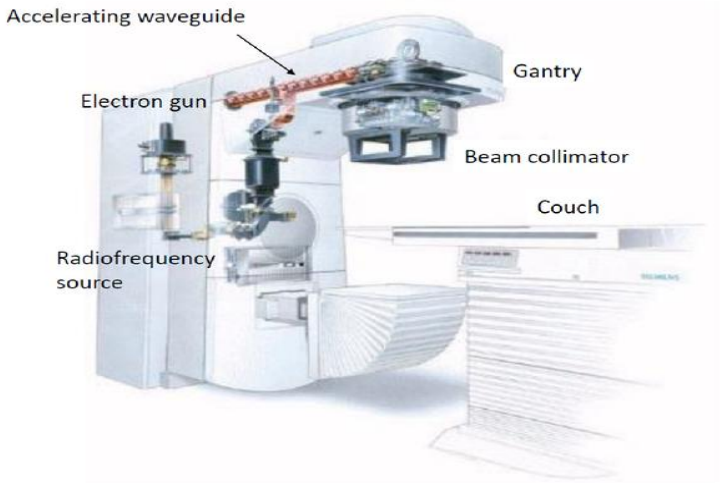
2- Collimator Scatter,

scatter of radiation in the head of the accelerator that exits the accelerator through the treatment field opening but strikes the patient outside the treatment field

-the collimators (blocks and multi leaf collimators),
-additional physical inserts (e.g. physical wedges, block trays, spoilers…)

3- Patient scatter,

is the unintended radiation generated outside of the target area when the beam entered the patient.



Impact of Out-Of-Field Dose

- Radiation is increasing risk of
  - Cardiovascular disease
  - Diabetes
  - Stroke
  - Hereditary effects
  - Second cancers

Organs sensitive to radiation-induced cancer

- Thyroid
- Breast (especially in children)
- Lens

Impact of Out-Of-Field Dose

Where do second cancers occur?

- – 12% within treated volume/geometric field
- – 66% at periphery of the treated volume (within 5 cm)
- – 22% out-of-field (>5 cm away) Diallo IJROBP 2009

(not limited to radiation-induced second cancers)

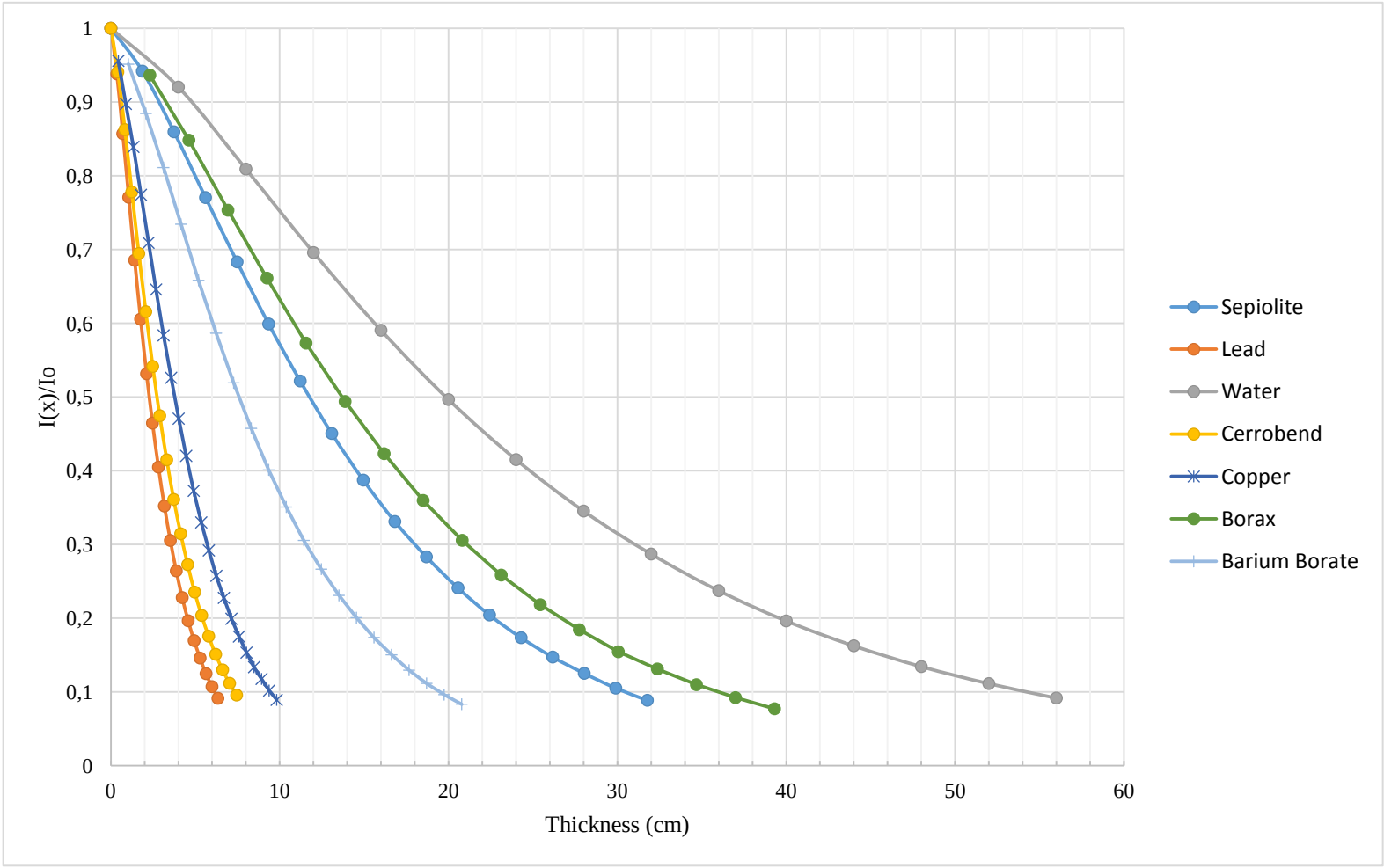
Impact of Out-Of-Field Dose

- A large multicenter case-control study found that women under 40 years who received greater than 100cGy to a specific CB quadrant had a 2.5-times increased risk for CB cancer than an unexposed woman. Stovall IJROBP 2008

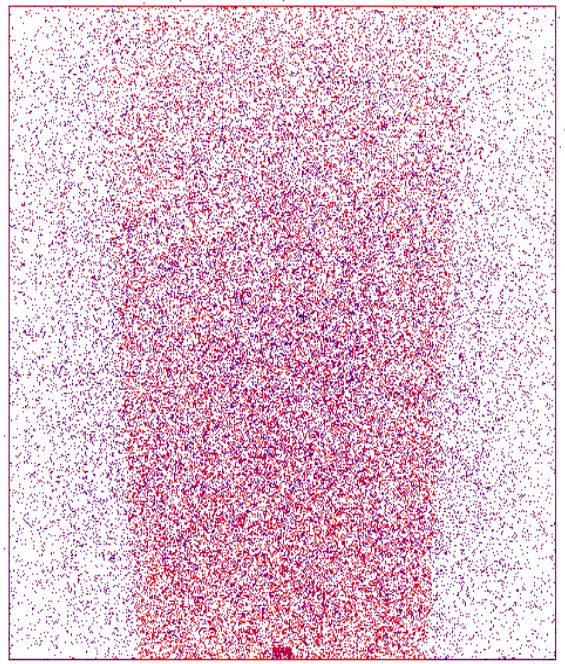
- Patients younger than age 30 treated with mantle irradiation have at least a 10-fold increase risk of breast cancer. Aisenberg AC *Cancer*. 1997

- The relative risk of CB cancer is between 1.32 and 1.59 compared to the RR of 1.01 for women older than 45 years. Boice NEJM1992

SHIELDING MATERIAL – Monte Carlo



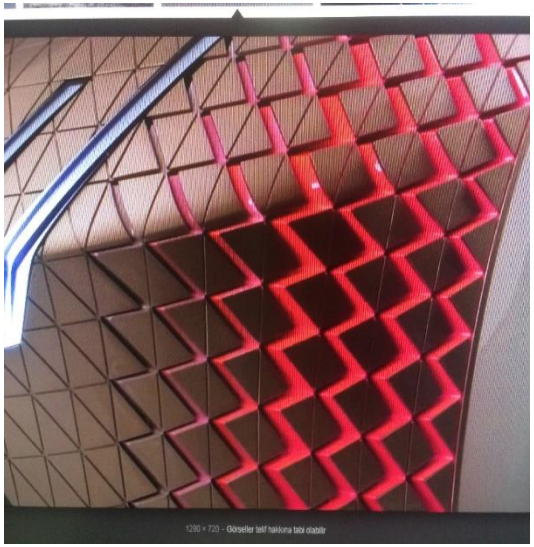
SHIELDING MATERIAL

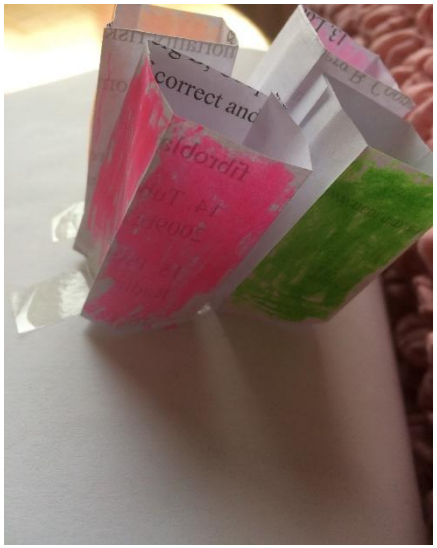


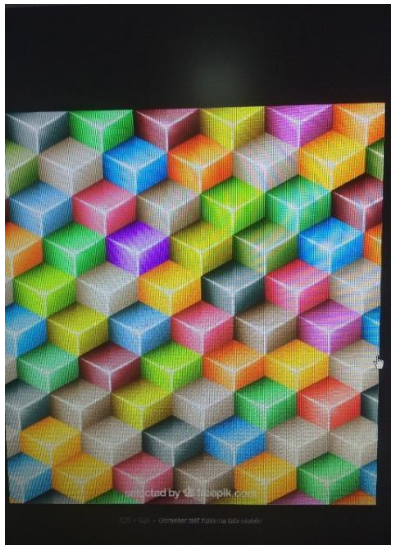
	Without Tissue	
	Half-Value Layer (cm)	Tenth-Value Layer (cm)
Sepiolite	11.78	30.47
Copper	3.78	9.44
Borax	13.69	35.95
Barium Borate	7.59	19.48
Water	19.85	54.28
Lead	2.28	6.15
Cerrobend	2.74	7.34

	Lead	Cerrobend
Elements	Pb	Bi (50%), Pb (26.7%), Sn (13.3%), Cd (10%)
Melting Point (°C)	327.5	73
Atomic Number	82	
Density (g/cm^3)	11.35	9.665

DESIGN of the SHIELD

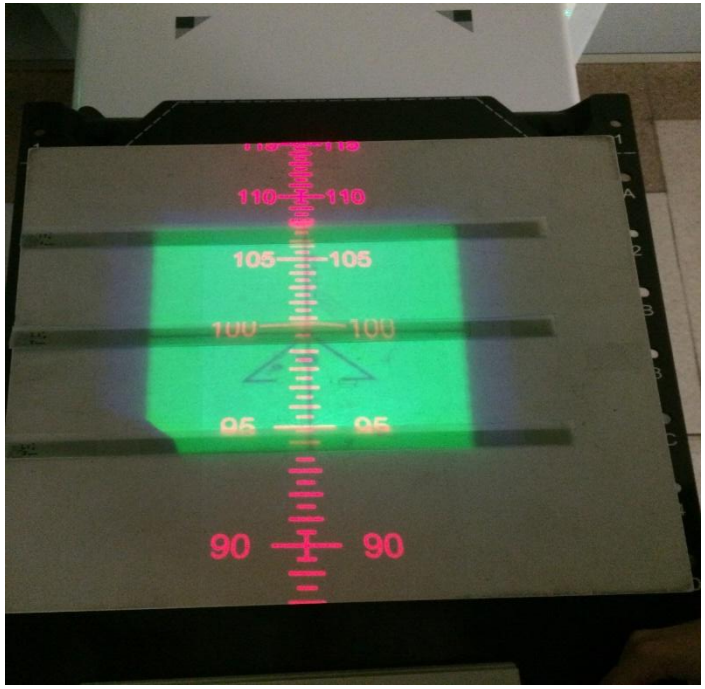


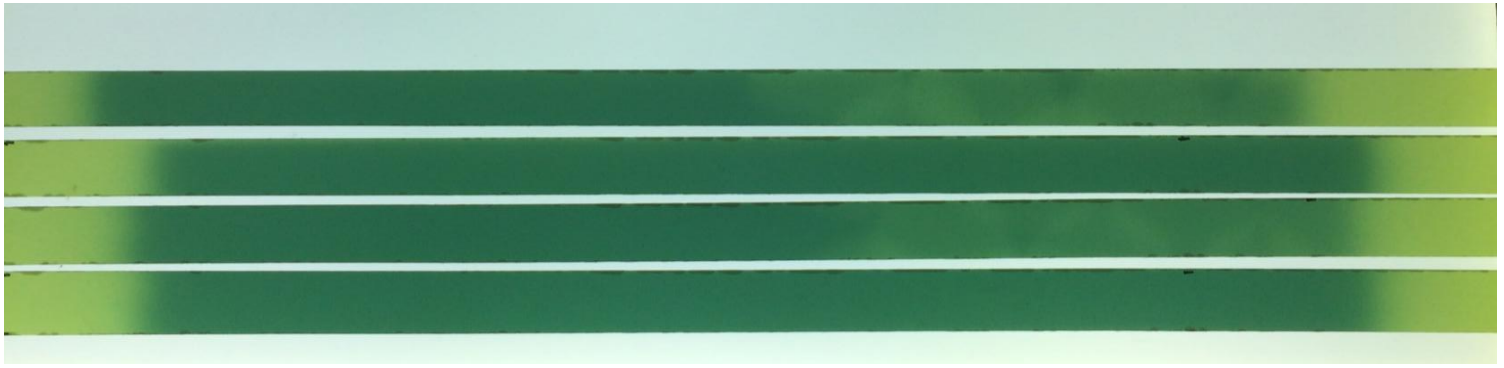




DESIGN of the SHIELD

DOSE MEASUREMENTS





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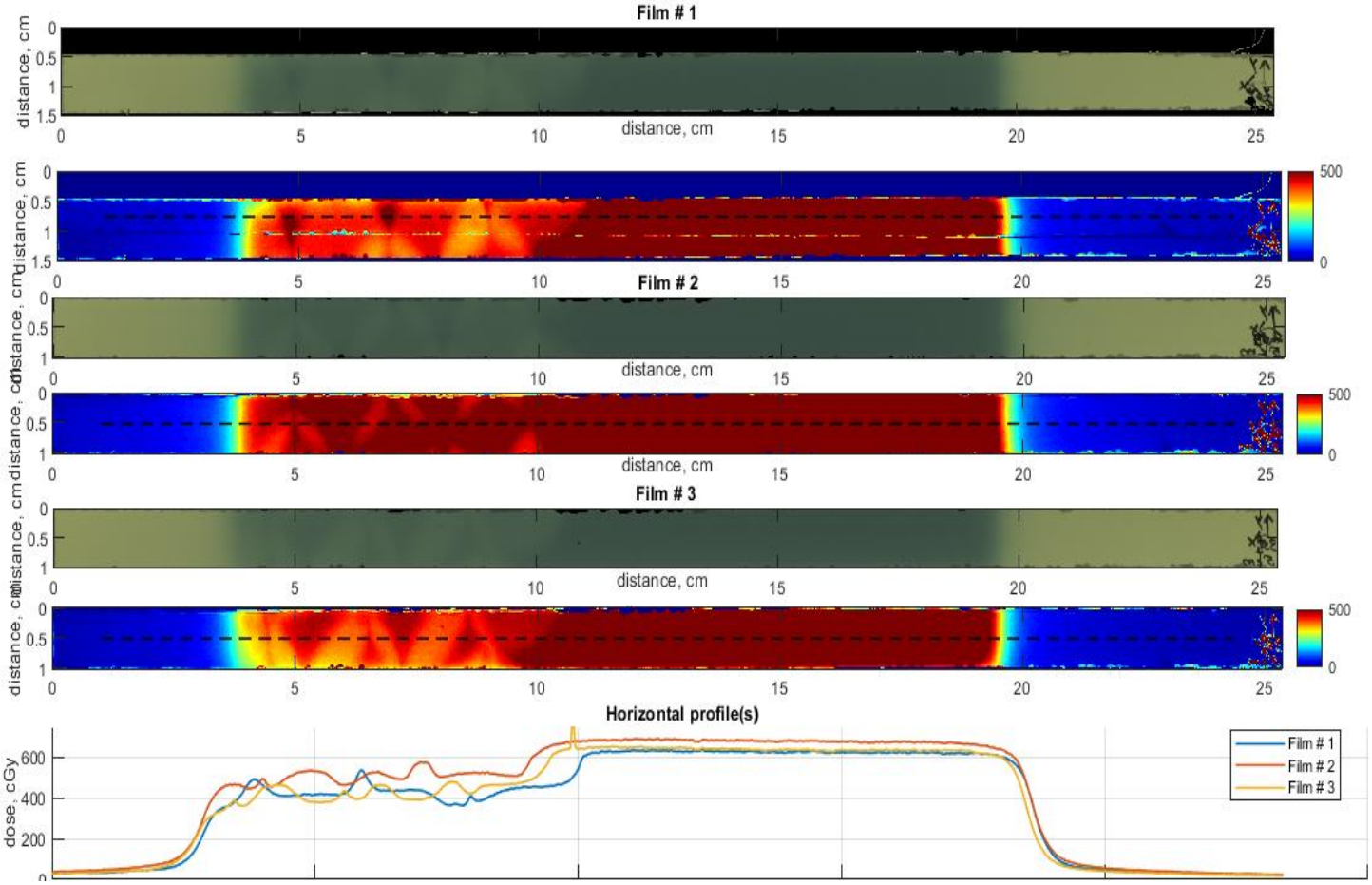

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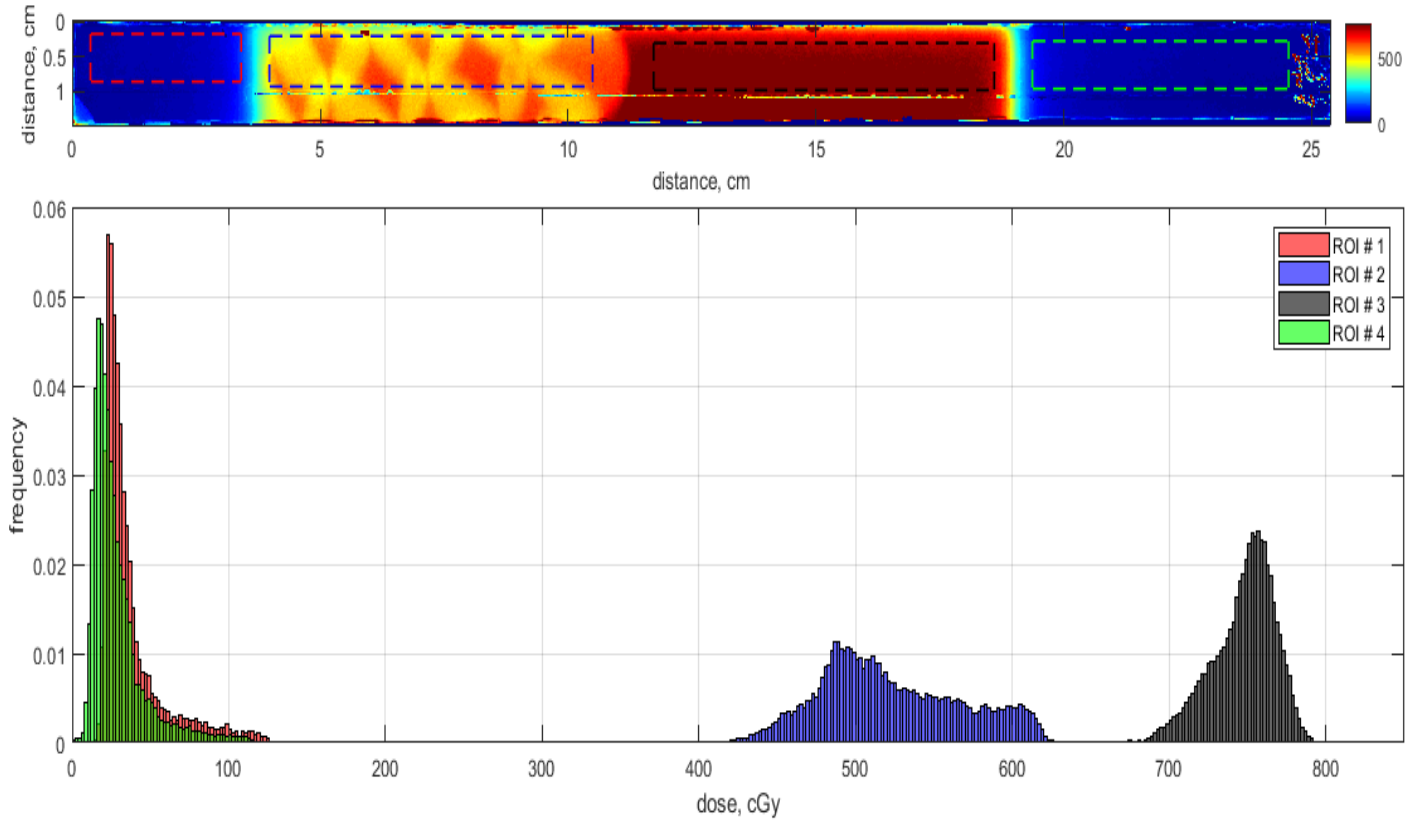
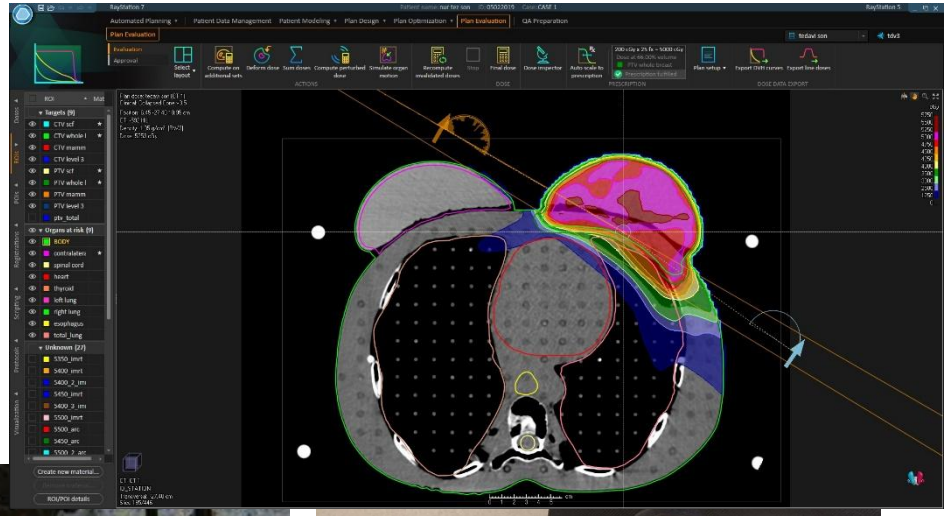
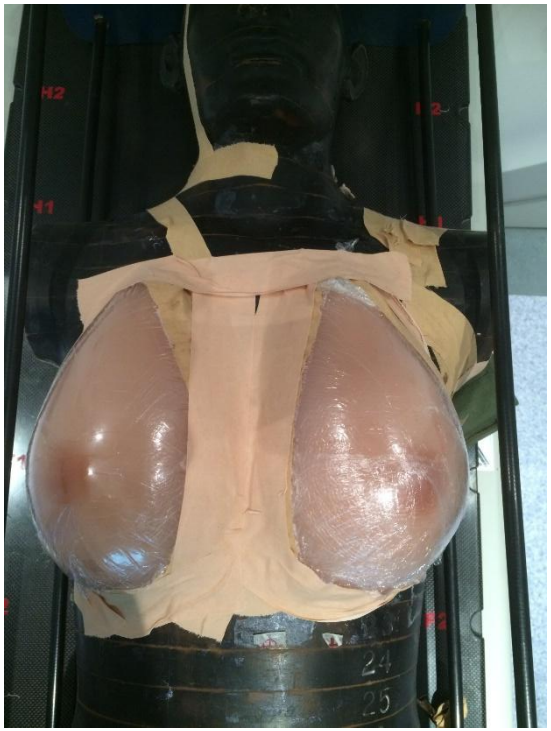


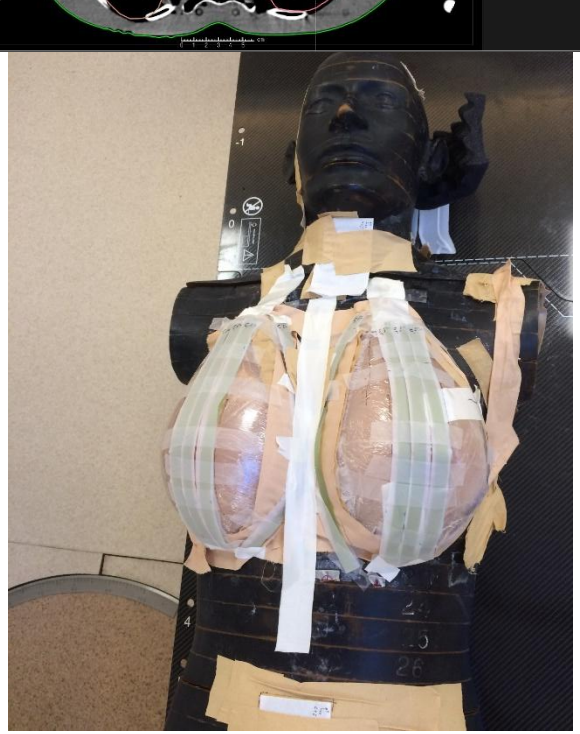
DOSE MEASUREMENTS with RANDO PHANTOM

Partial arc for left breast
Measurements from:

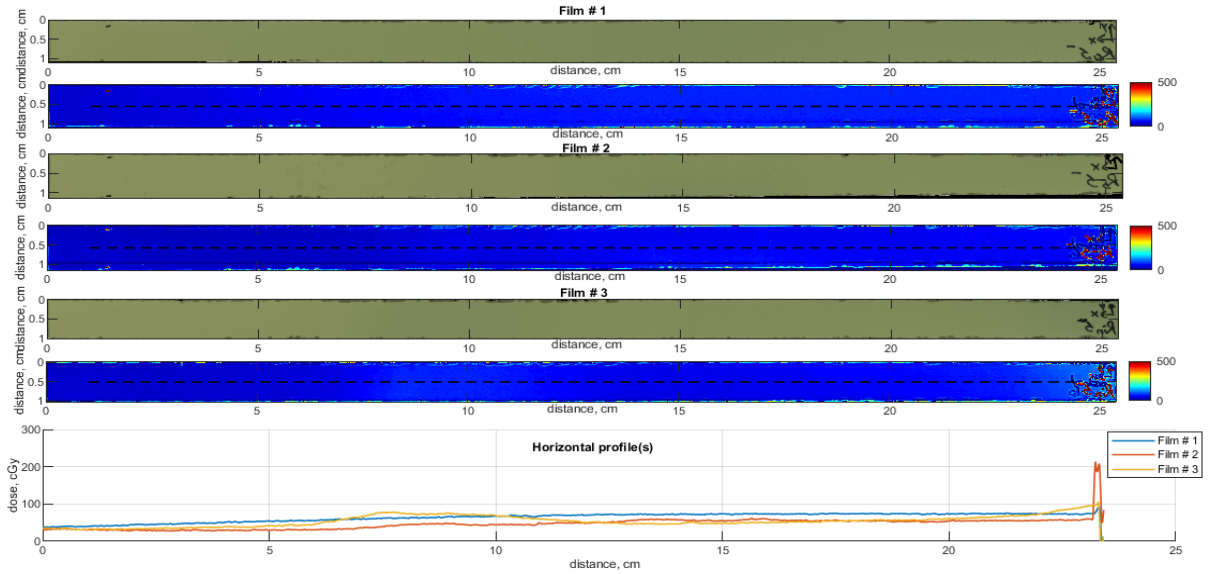
- Breast
- Thyroid
- Heart
- Abdomen

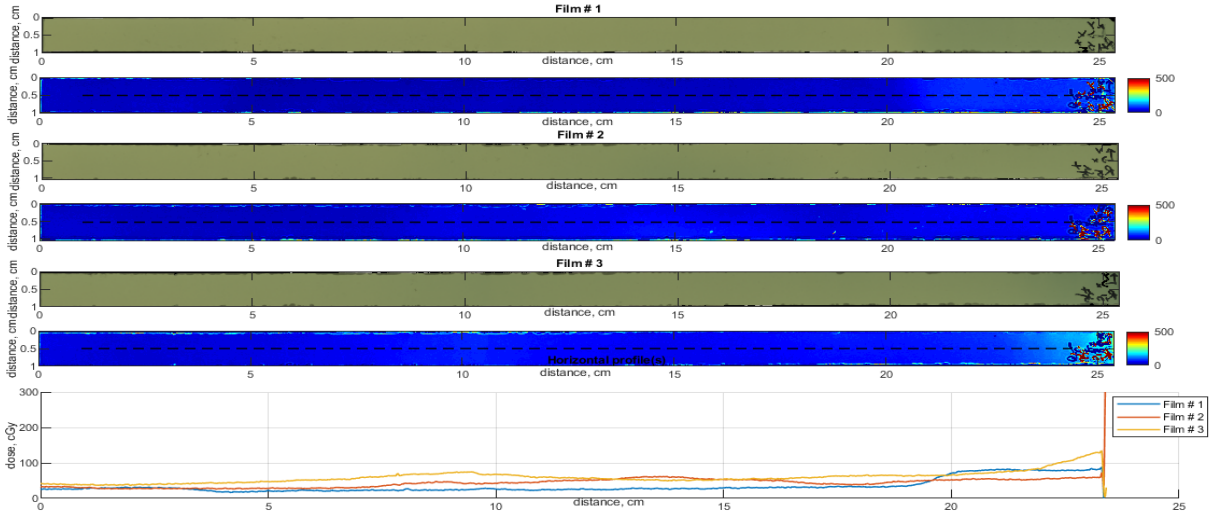






Right Breast





CONCLUSION

- Dose reduction at least 100 cGy in the in field region.

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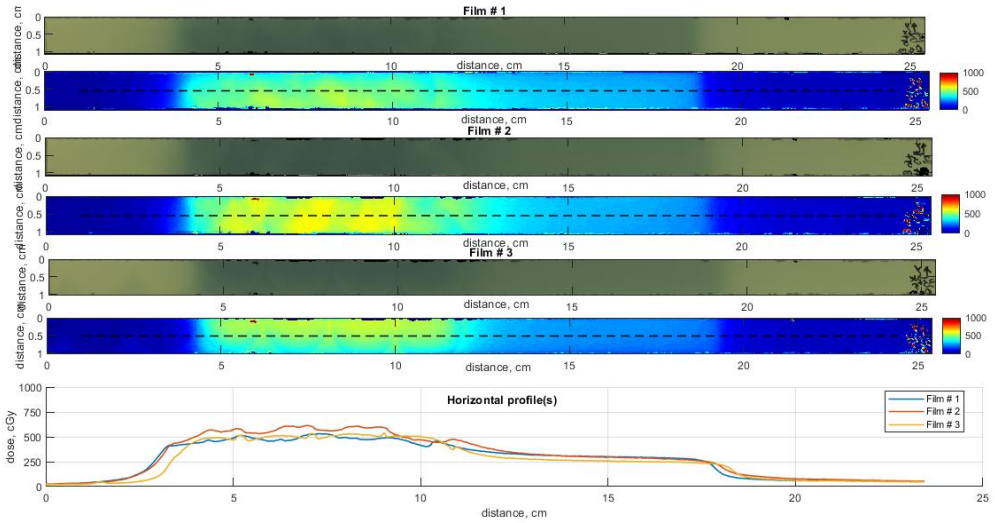
- Careful to the overlap parts in in-field region. Because the shield can increase the surface dose (build-up effect- Monte Carlo).



- For neutrons, boron polyethylene can be added.

THANK YOU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TURK PATENT
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This Certificate
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