International Conference on Monte Carlo Techniques for Medical Application (MCMA2017) - *Napoli 15th-18th October 2017*

Monte Carlo evaluation of glandular dose estimates in X-ray breast computed tomography

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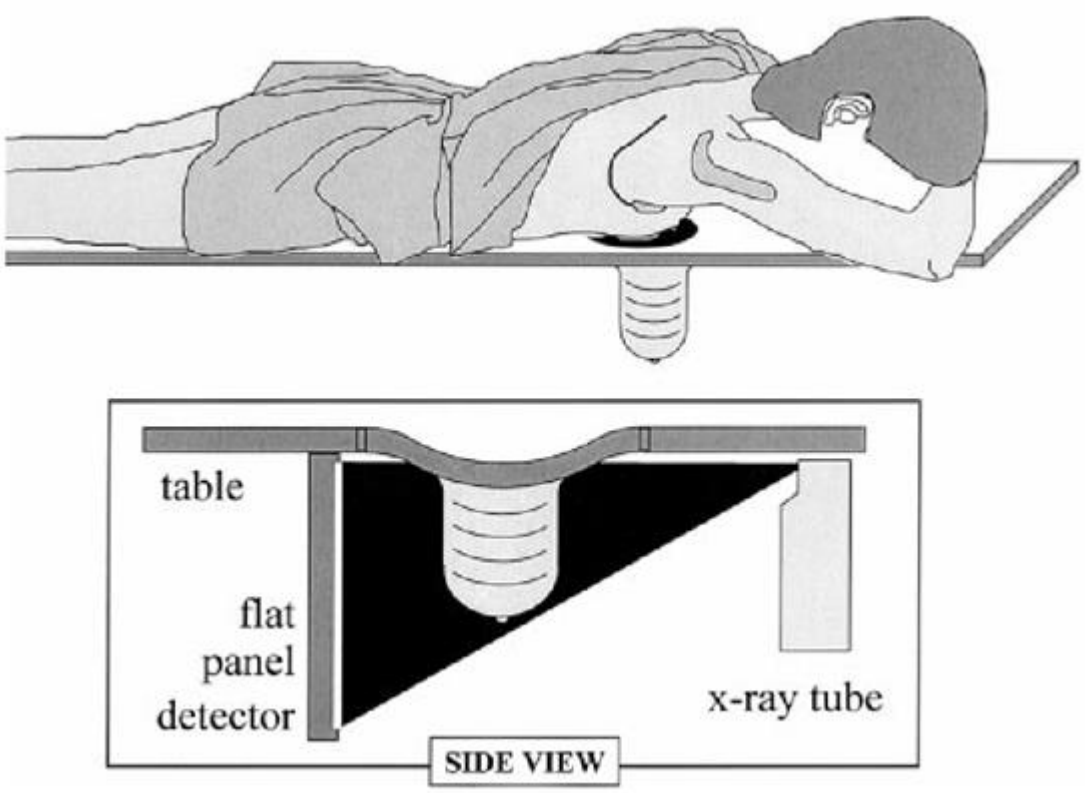
Computed tomography dedicated to the breast



J. M. Boone et al. Dedicated Breast CT: Radiation Dose and Image Quality Evaluation1. Radiology 221(3), 2001

- Fully 3D images
- Uncompressed breast
- 49-80 kVp W spectra

Dosimetric parameters in breast CT

Breast CT scanner at UC Davis

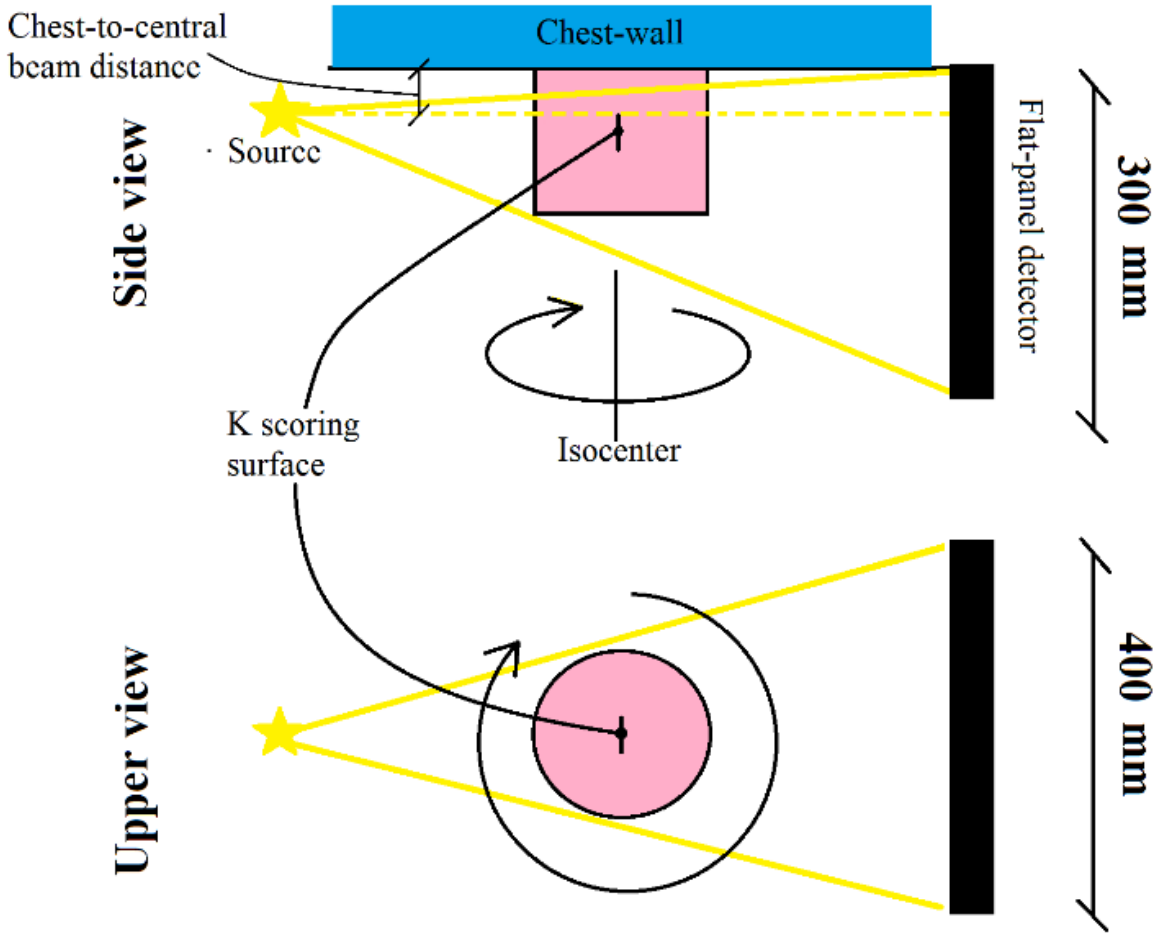
$$MGD = DgN_{CT} \times K$$

Air kerma at scanner isocenter

Normalized glandular dose coefficient in CT calculated via **MC simulations**

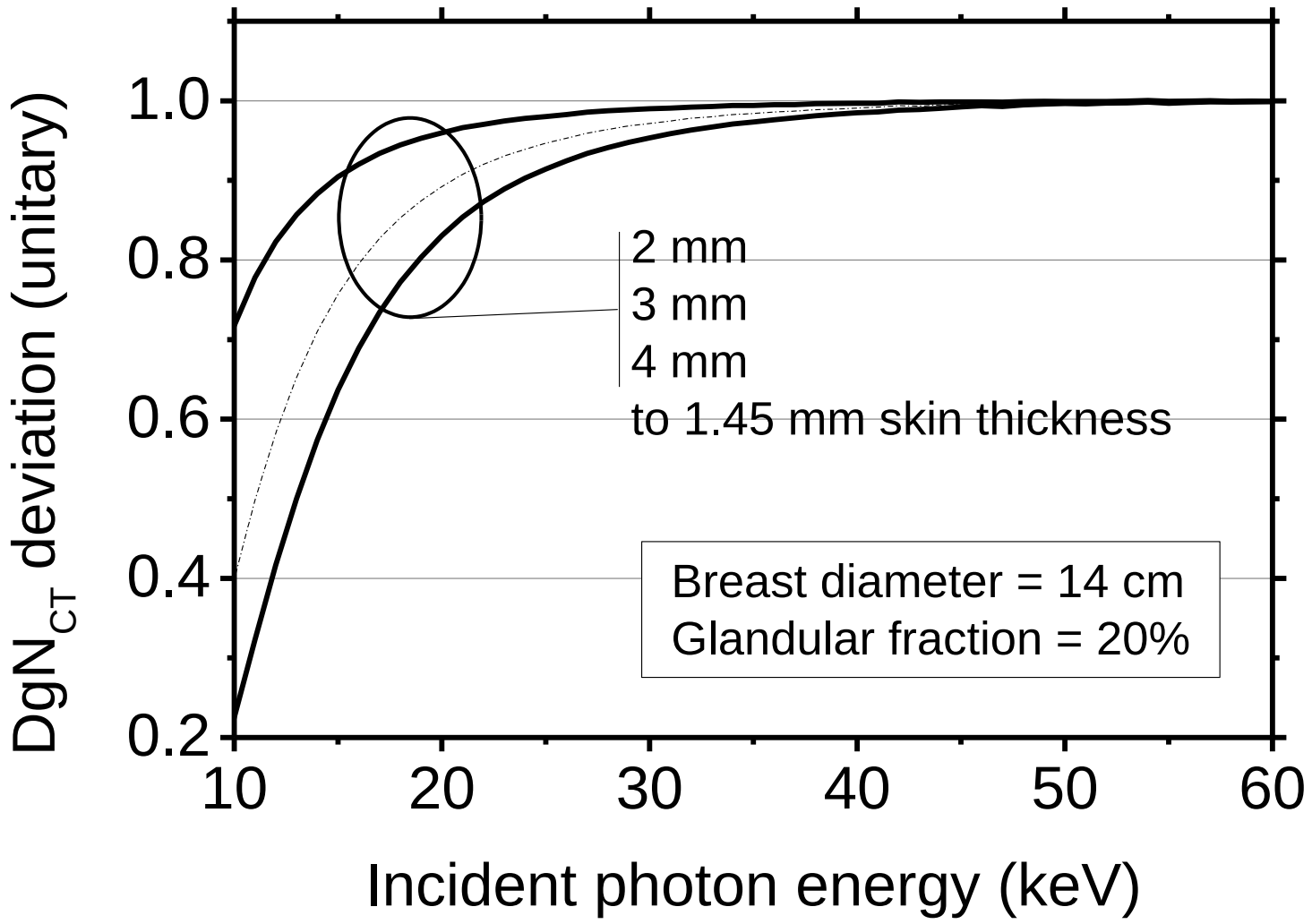
- Boone JM et al 2004 Med. Phys.
- Thacker and Glick 2004 Phys. Med. Biol.
- Sechopoulos et al 2010 Med. Phys.

Breast model and irradiation geometry

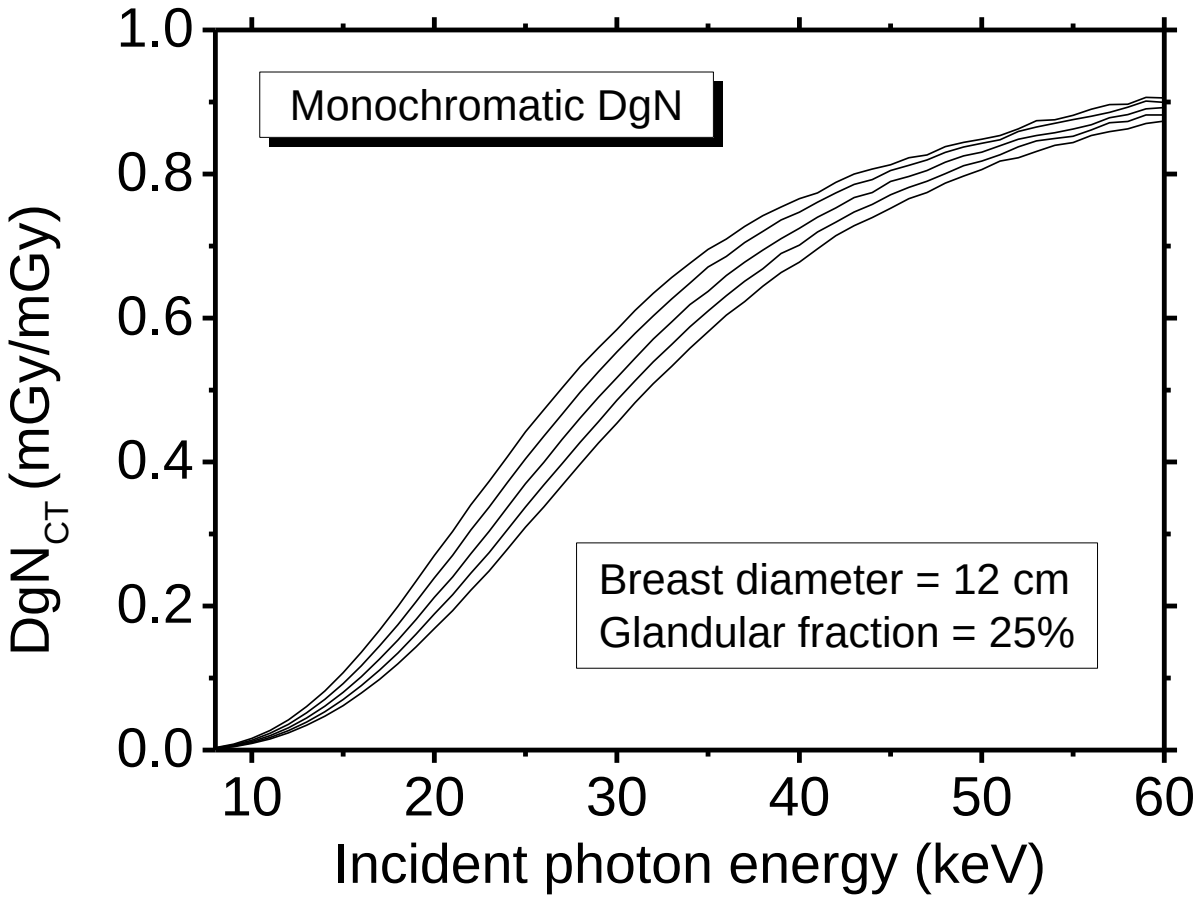


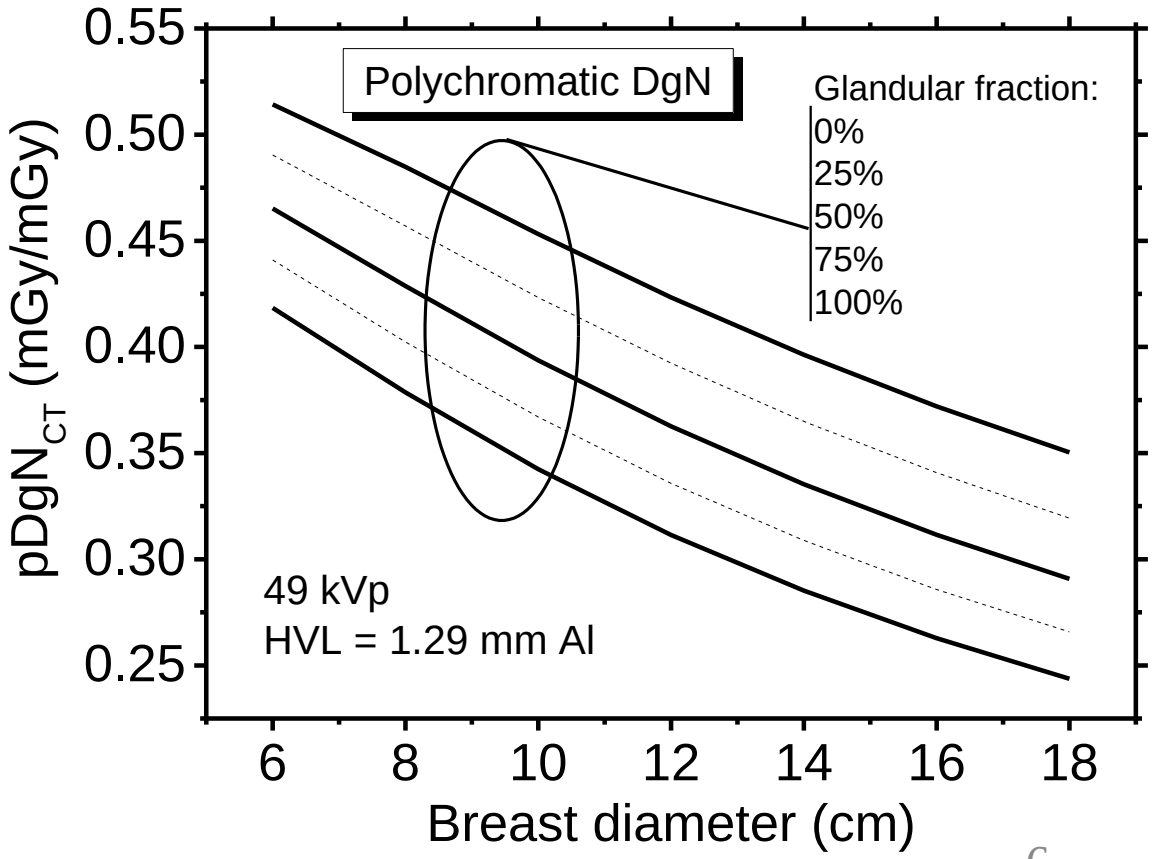
- Cylindrical breast
- Breast height = 1, 1.5, 2*breast radius
- Homogeneous adipose/glandular mix
- Skin thickness = 1.45 mm
- Chest-to-central beam = 0 cm

Skin thickness influence on MGD

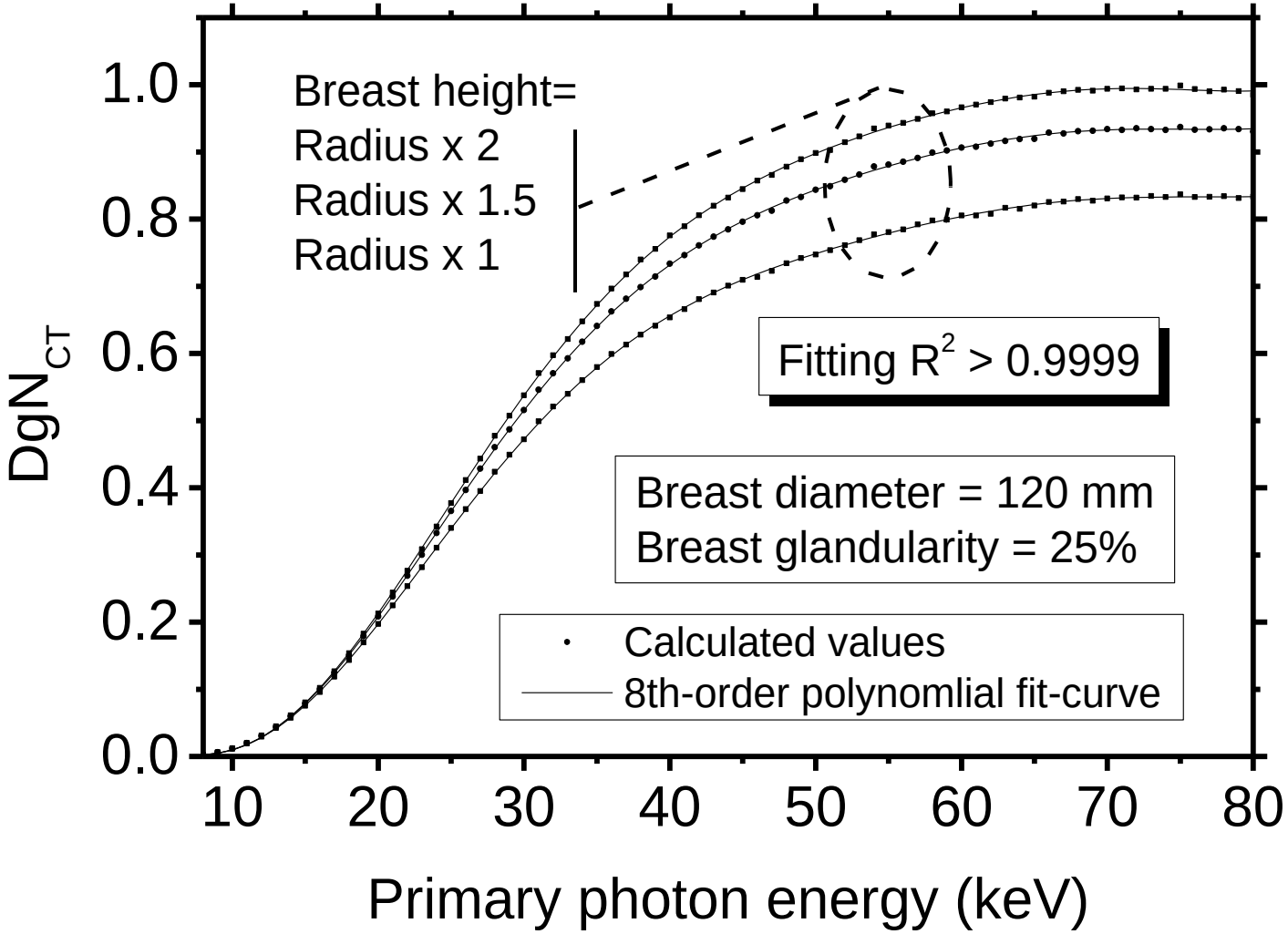


Monoenergetic and Polyenergetic DgN_{CT}

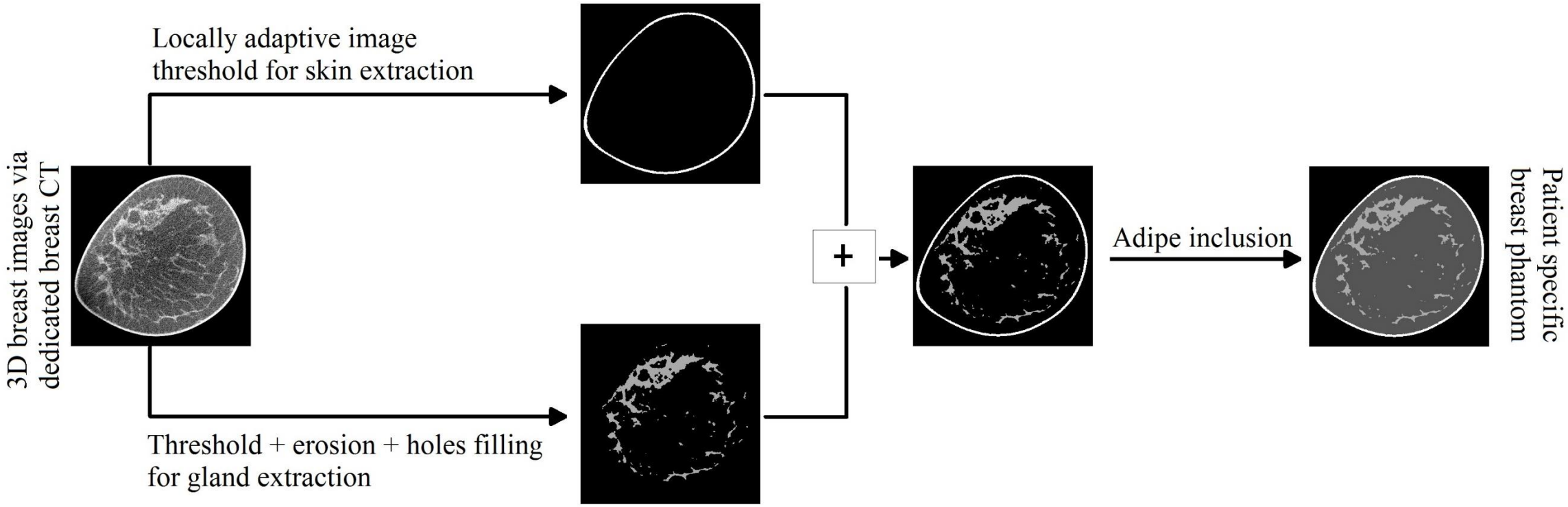




Dataset for monoenergetic DgN_{CT}

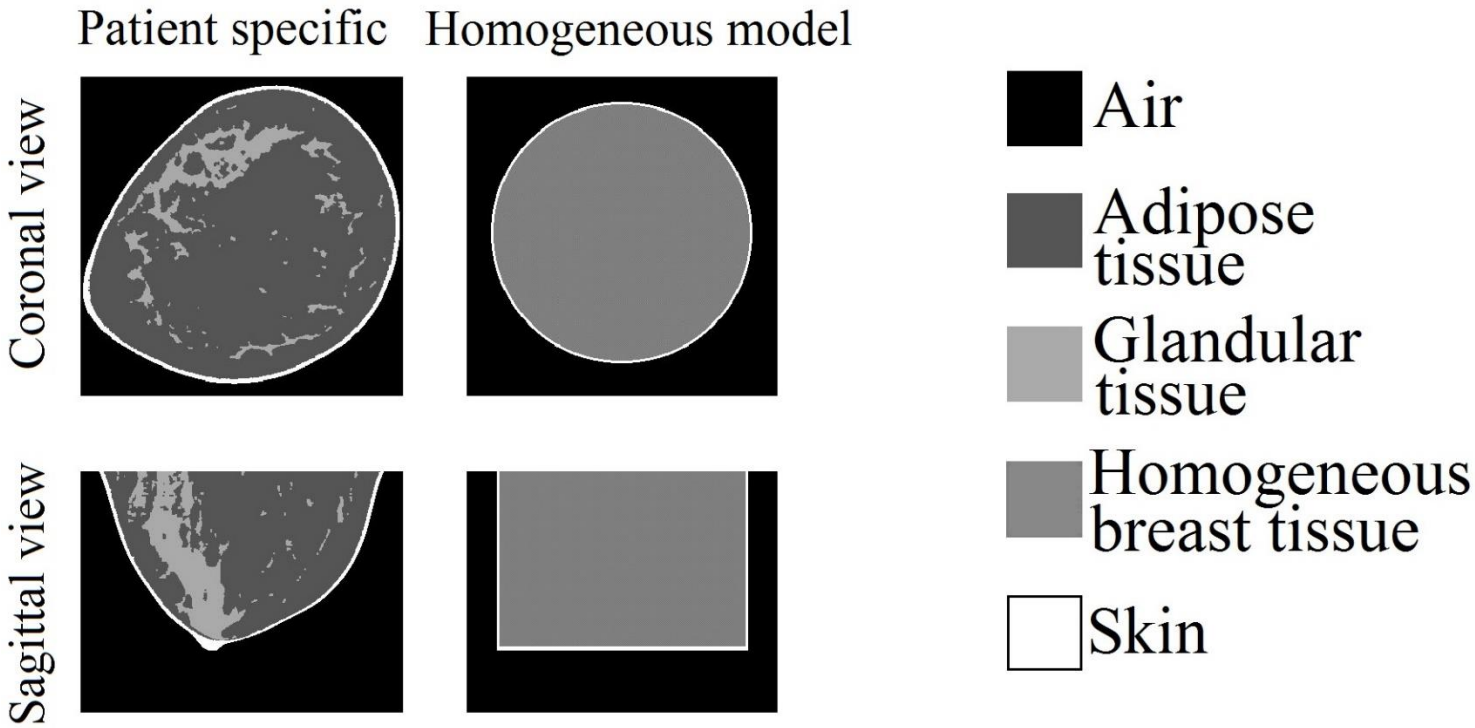


Patient specific breast phantoms



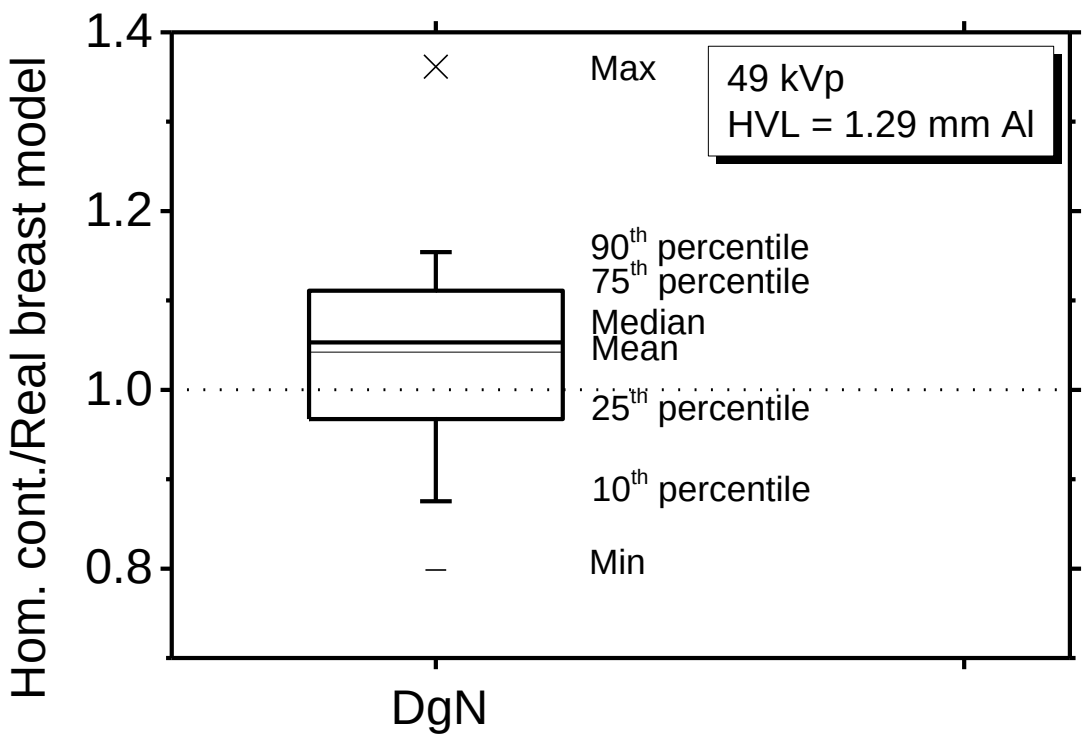
Simple model vs patient specific breast phantoms

A case study



In this specific case the MGD calculated with the homogeneous cylindrical model is 21% lower than that calculated with the patient specific phantom (49 kVp; W/Al)

DgN_{CT} coefficients validation



20 segmented 3D breasts

	Mean	Std	Min	Max
Glandular fraction (%)	28.0	22.6	4.9	76.0
Diameter (cm)	11.2	2.1	6.4	14.6

*results presented at ECMP 2016 by A. Sarno

Conclusions

- A breast model for MGD evaluation in breast CT has been presented;
- Monochromatic and polychromatic DgN coefficients have been provided;
- The dose estimates with a simple model led to MGD differences when compared to that evaluated with patient specific breast phantoms;
- The ongoing work for patient specific dose estimates has been shown.

Thank you!!!

Any questions?

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