Paediatric CT dosimetry

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Professor of Biomedical Engineering
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Chairman, AAPM Science Council
Co-Chair, AAPM Task Group 204 on Pediatric CT Dosimetry
Chairman, ICRU Committee on Patient Dosimetry in CT

Paediatric CT dosimetry

- Differences between Pediatric and Adult Dosimetry

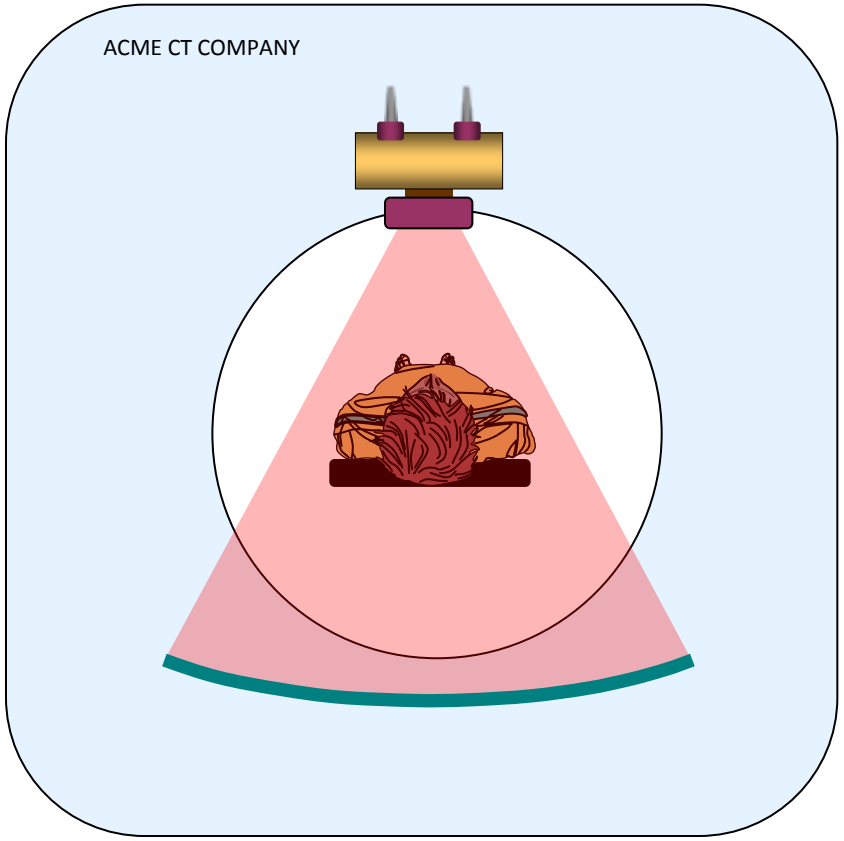
  Machine Output to Organ Dose

  Pediatric Patient Modeling

  Methods for Pediatric CT Dose Calculation

Paediactric Patients

- Smaller bodies
- More rapidly growing tissue
- Longer potential lifespan



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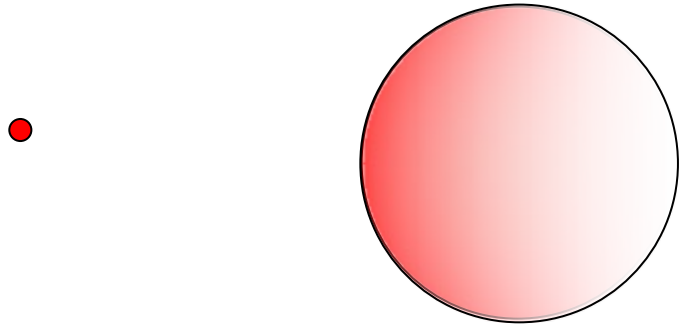

adult

Paediactric Patients

- Smaller bodies
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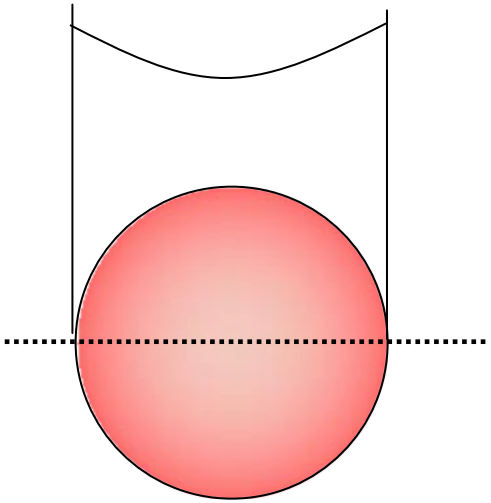
  Longer potential lifespan



adult

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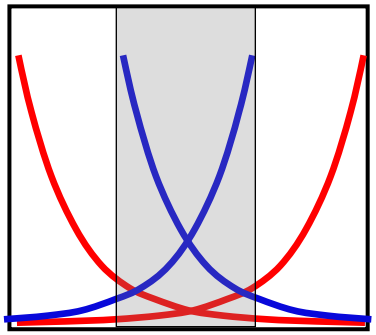
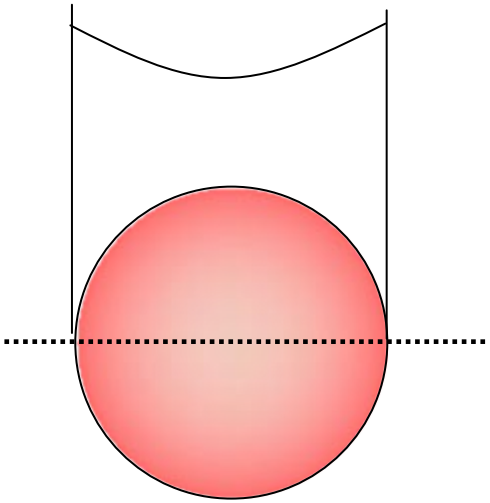
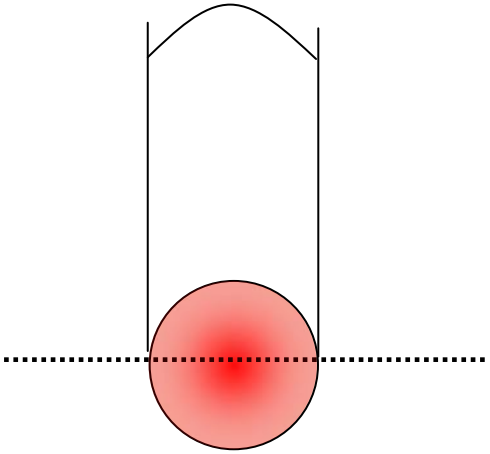


opposing dose tails add



adult



child

Paediactric Patients

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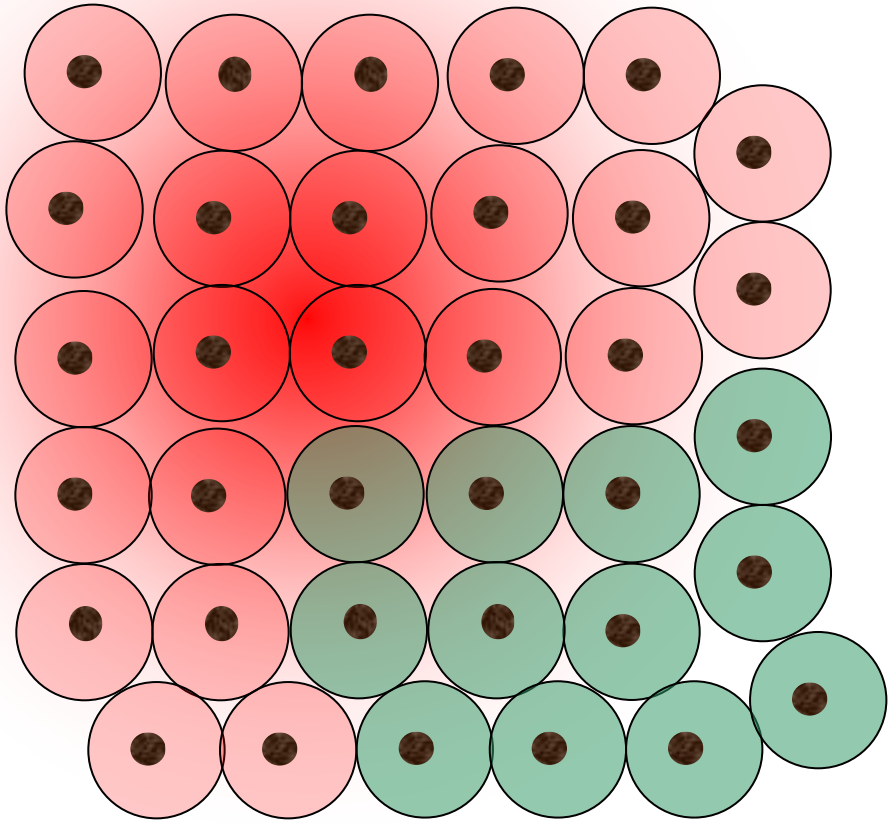

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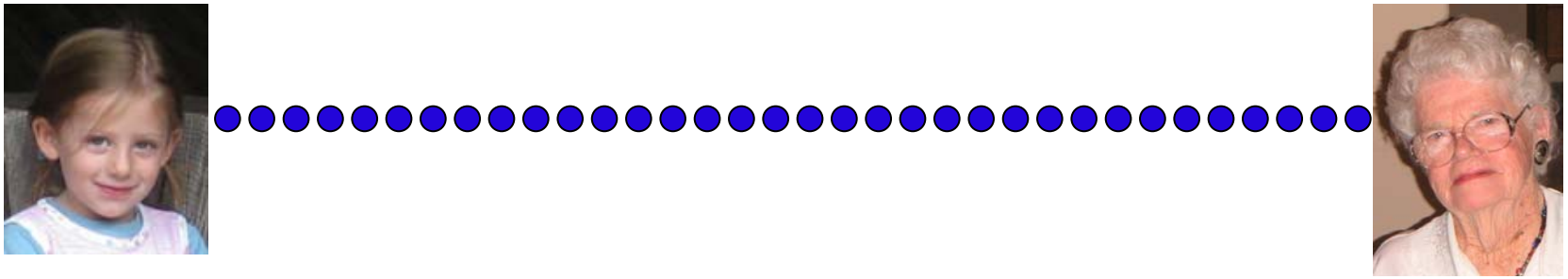
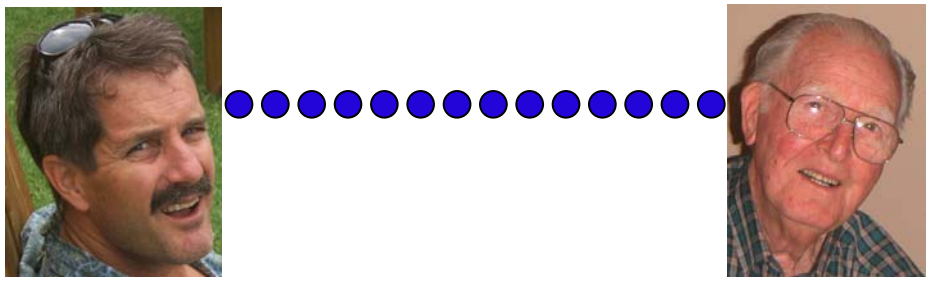


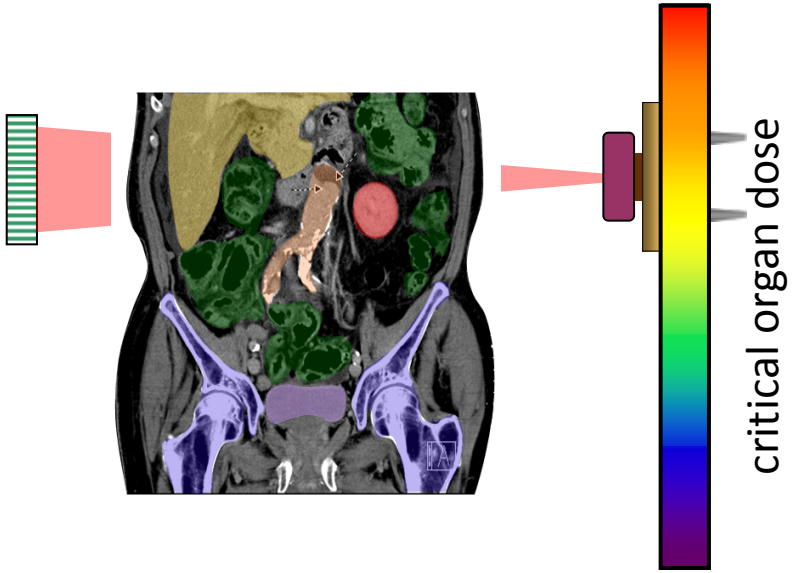


Paediatric CT dosimetry

- Differences between Pediatric and Adult Dosimetry
- Machine Output to Organ Dose
- Pediatric Patient Modeling
- Methods for Pediatric CT Dose Calculation

Machine Output to Organ Dose

- Monte Carlo Modeling
  Accurate input to Monte Carlo Model



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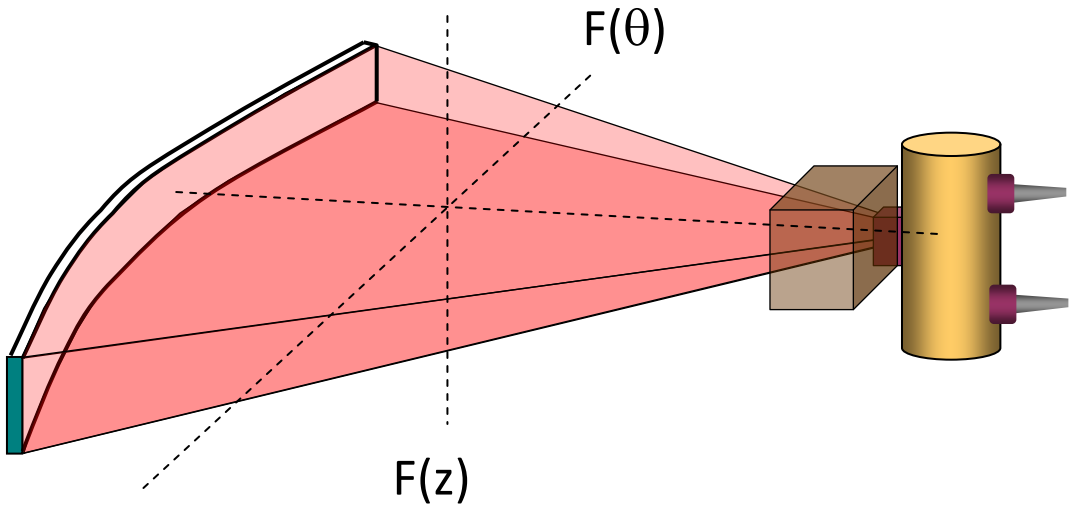
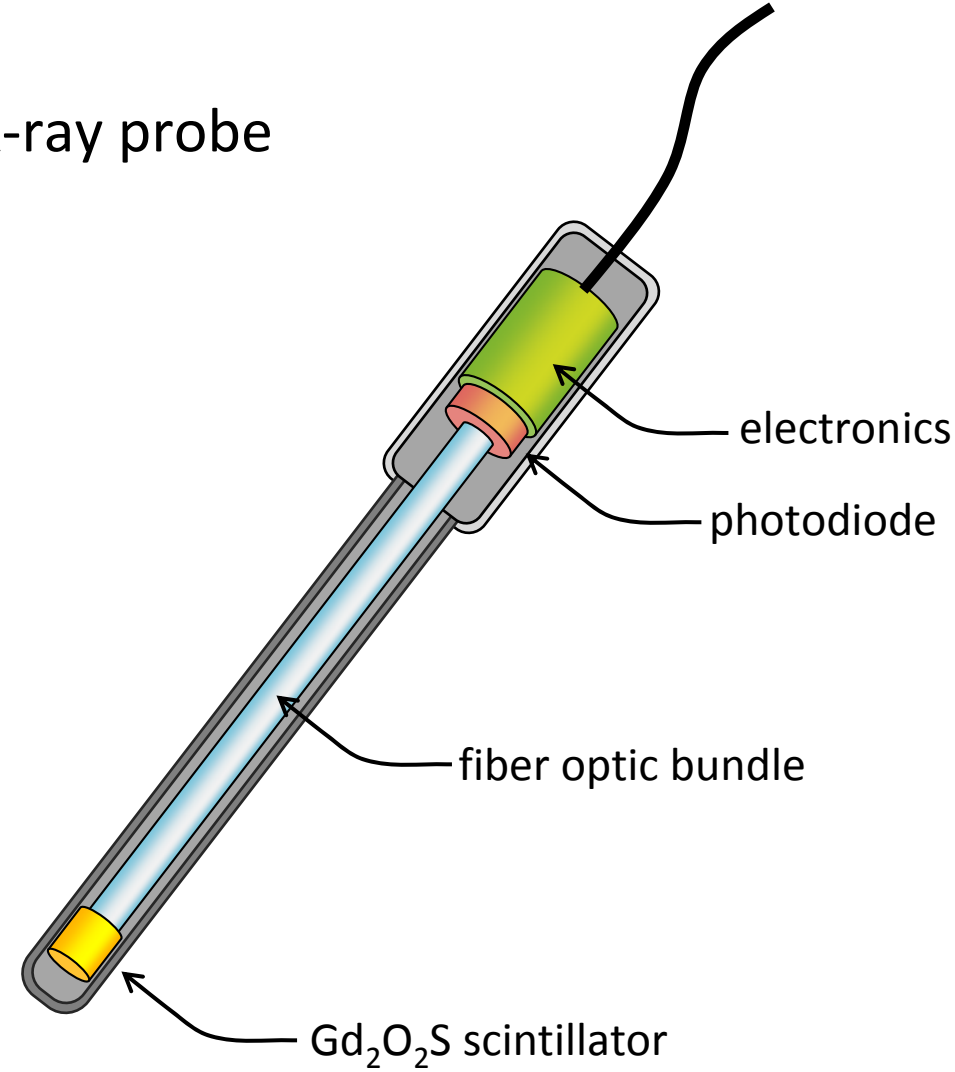


Real Time x-ray probe



Machine Output to Organ Dose

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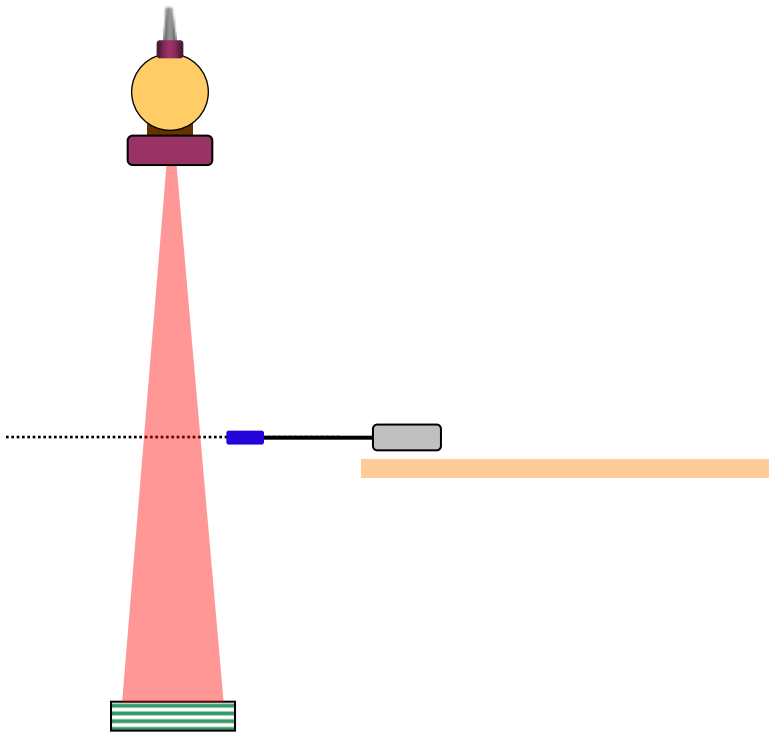

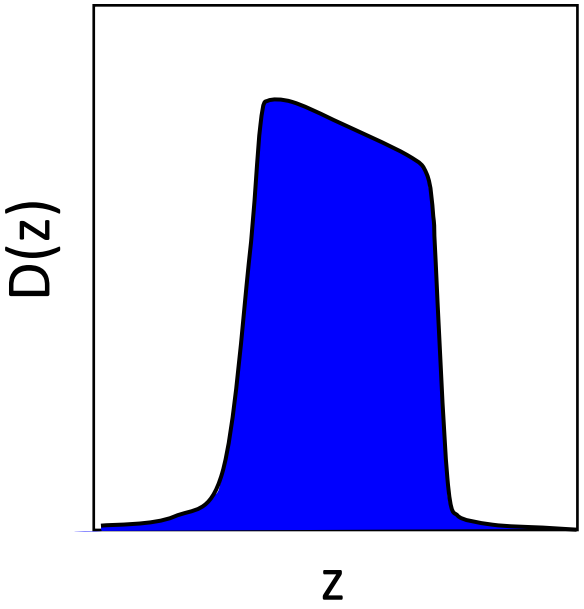

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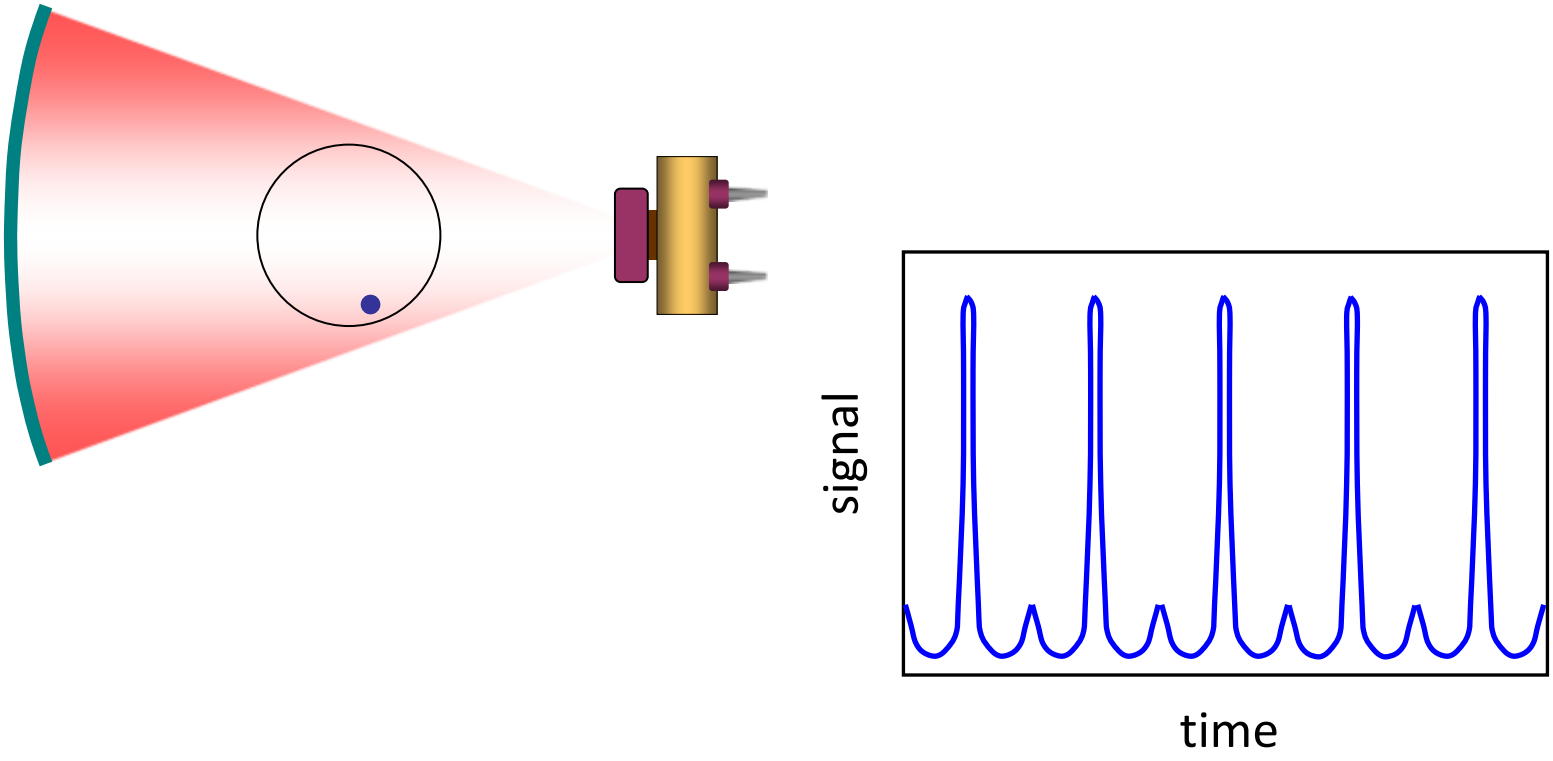

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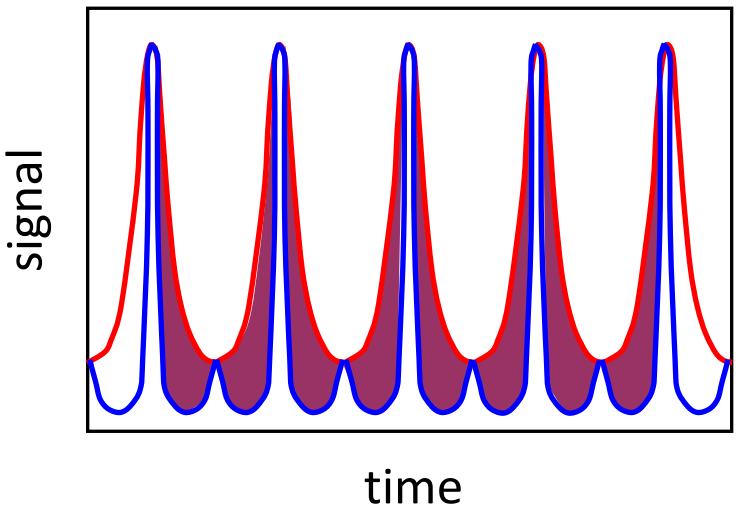

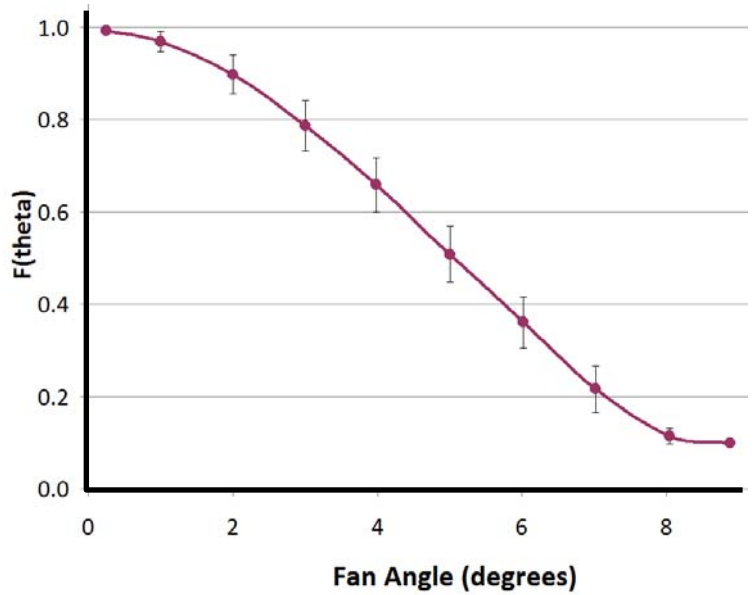

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Method for evaluating bow tie filter angle-dependent attenuation in CT: Theory and simulation results

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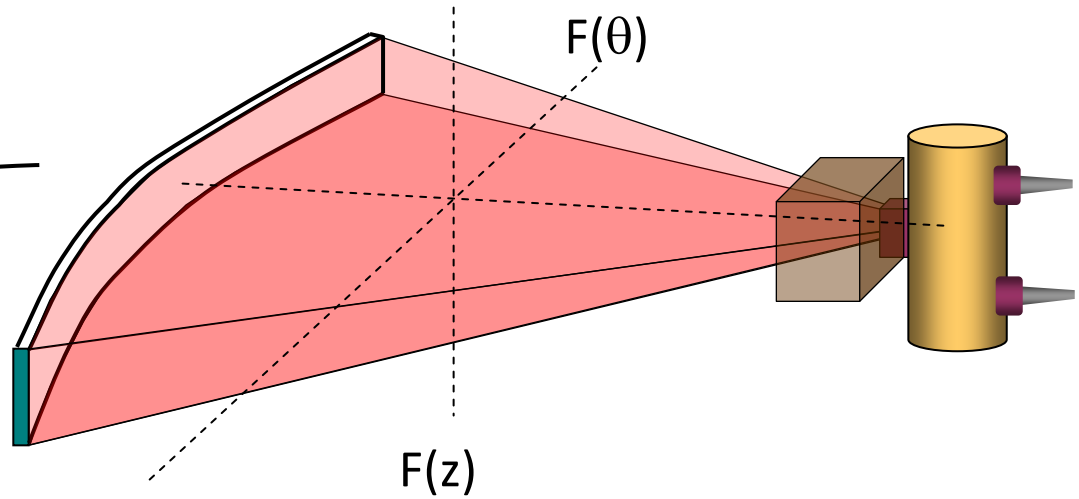

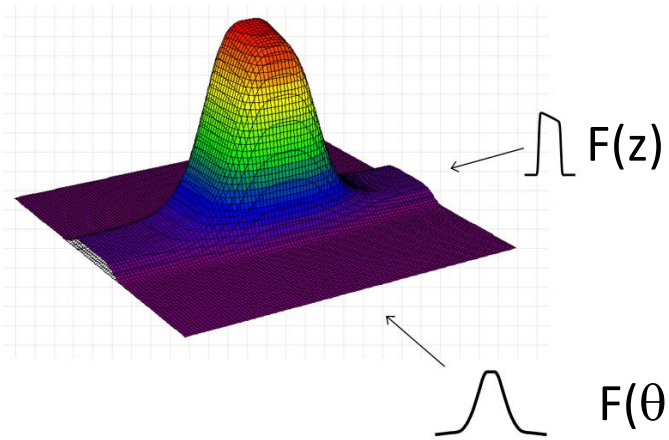

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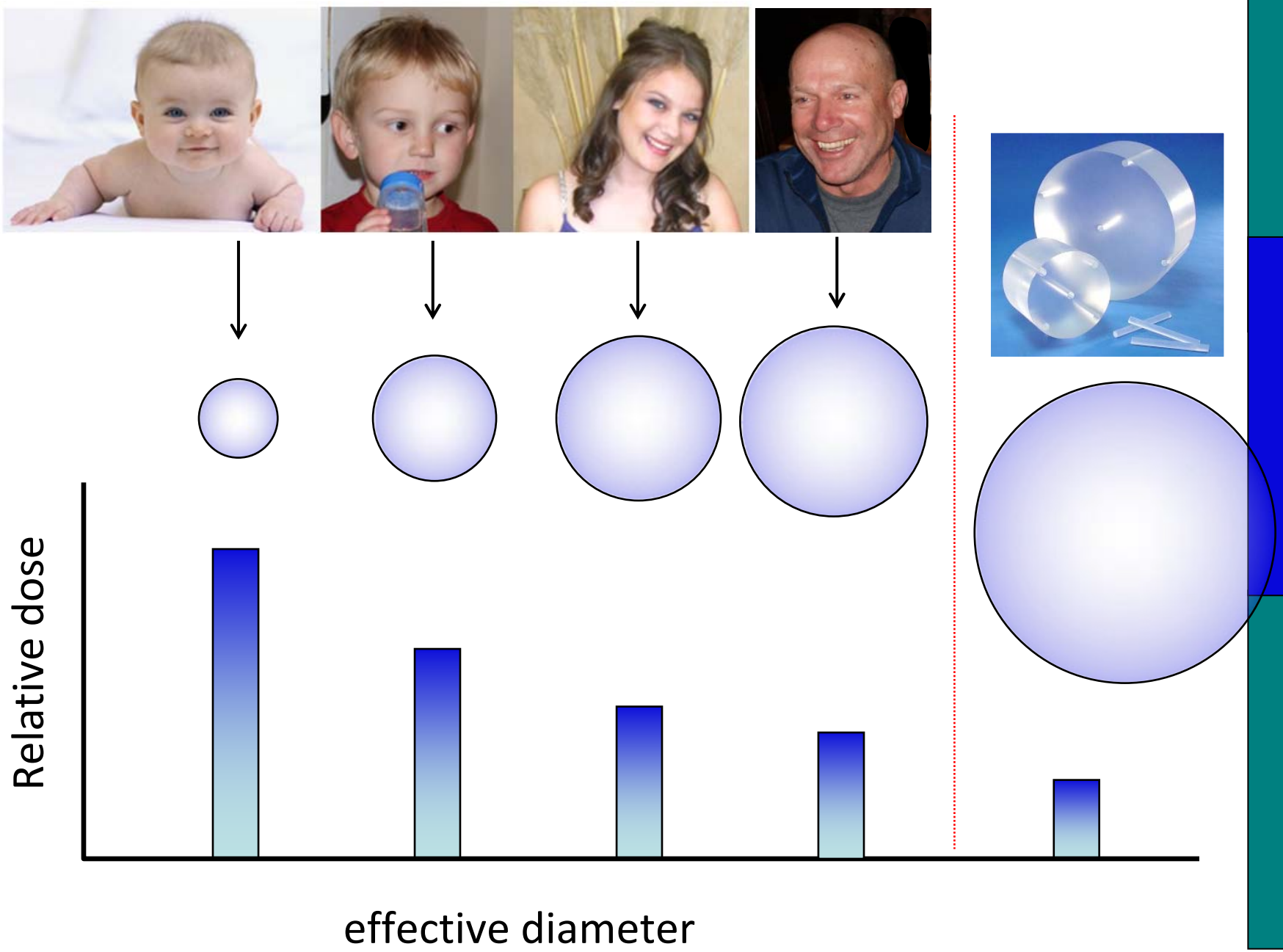
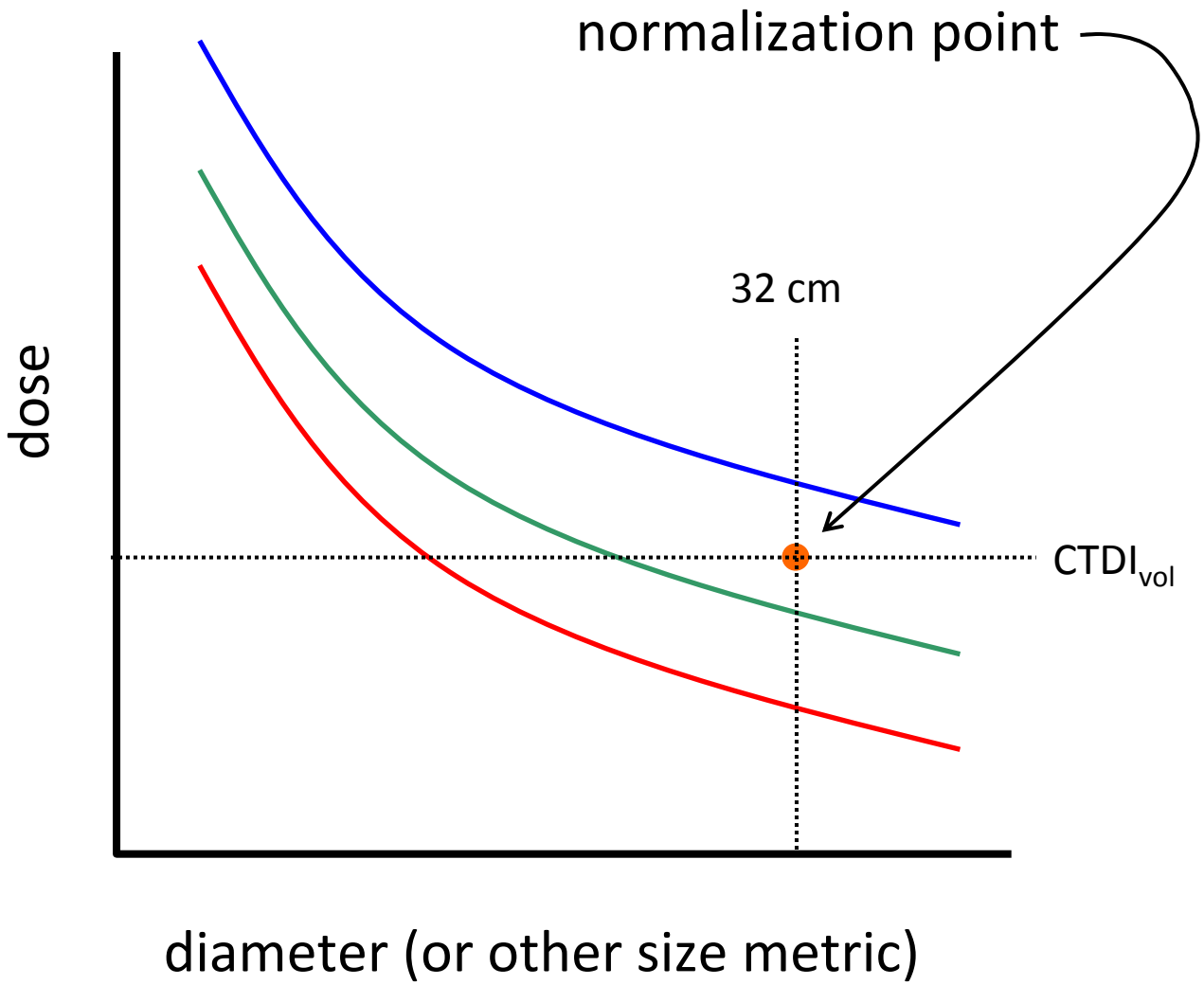
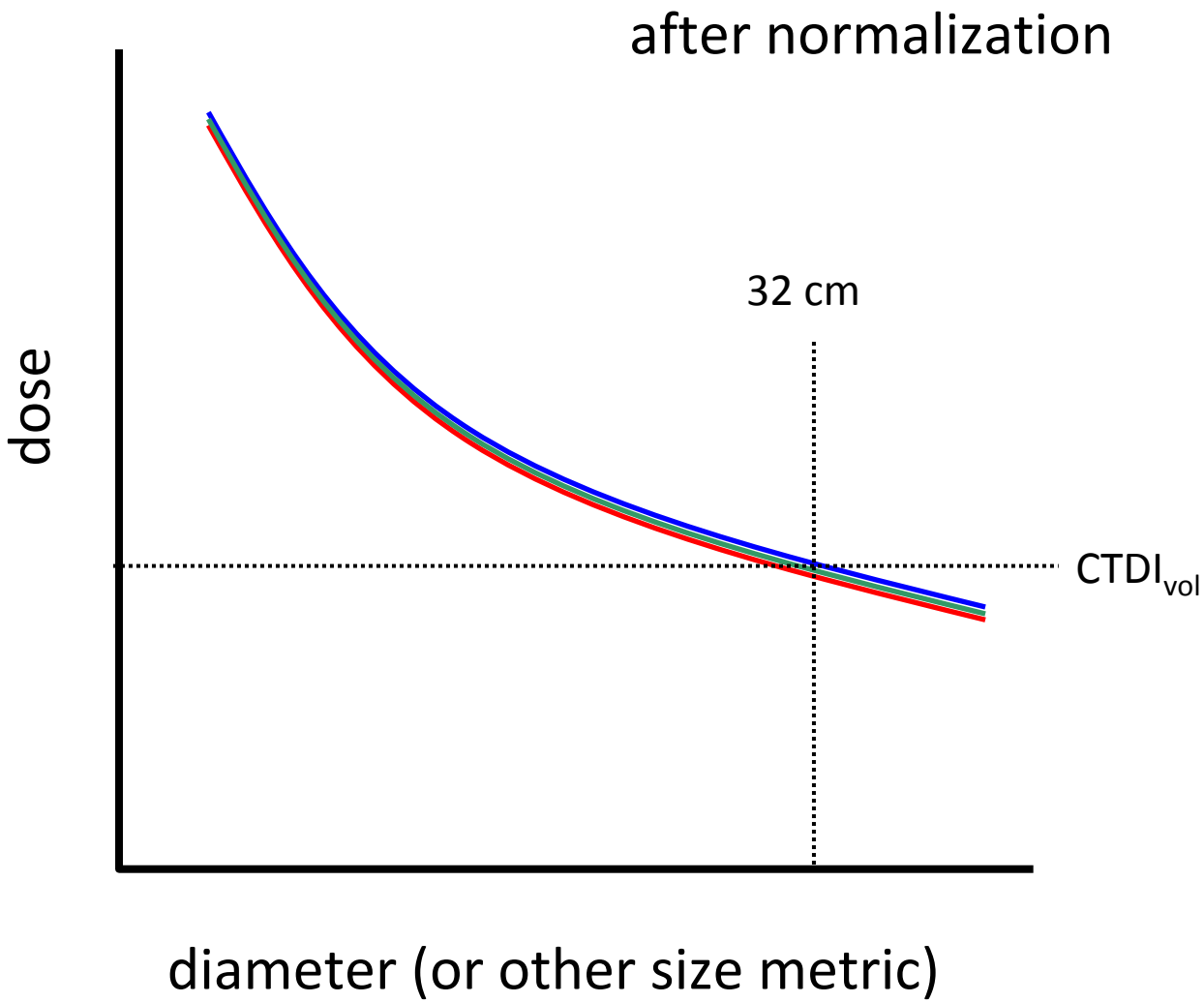

Relative dose
effective diameter

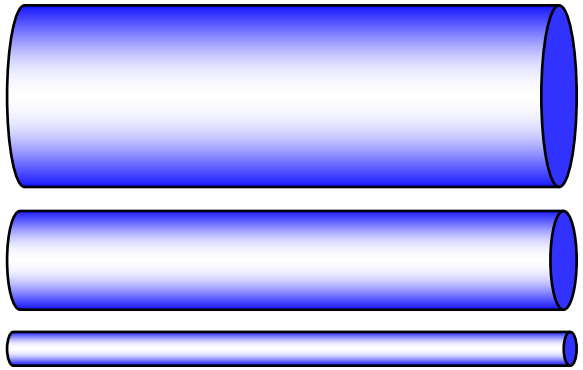

normalization point
32 cm
dose
CTDI$_{vol}$
diameter (or other size metric)


after normalization
32 cm
dose
CTDI$_{vol}$
diameter (or other size metric)

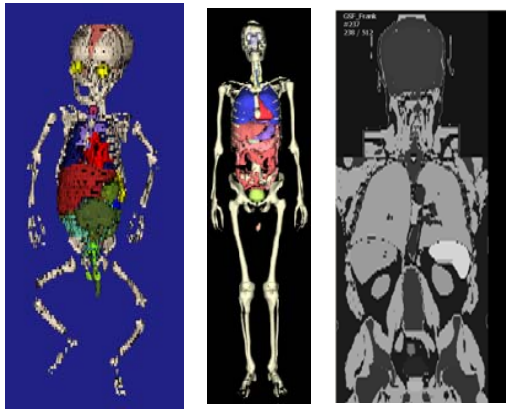
Family of physical phantoms
Cynthia McCollough, Mayo Clinic

standard phantoms
Tom Toth & Keith Strauss

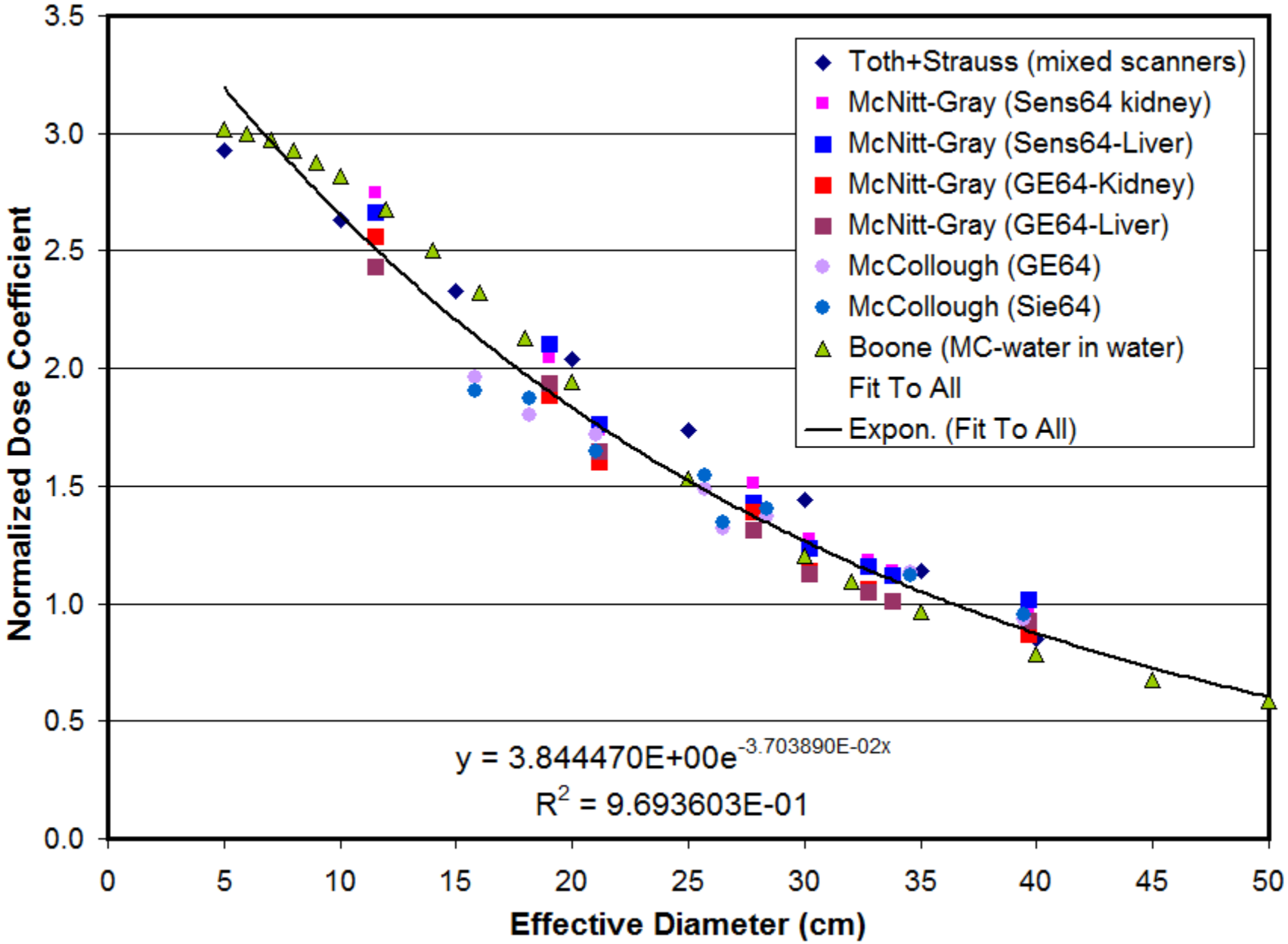
AAPM Task Group 204 – Pediatric CT Dose



Monte Carlo phantoms (1 – 50 cm)
John M. Boone, UC Davis



Anthropomorphic Monte Carlo phantoms
Mike McNitt-Gray, UCLA


Normalized Dose Coefficient
Effective Diameter (cm)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
5
10
15
20
25
30
35
40
45
50
Toth+Strauss (mixed scanners)
McNitt-Gray (Sens64 kidney)
McNitt-Gray (Sens64-Liver)
McNitt-Gray (GE64-Kidney)
McNitt-Gray (GE64-Liver)
McCollough (GE64)
McCollough (Sie64)
Boone (MC-water in water)
Fit To All
Expon. (Fit To All)
y = 3.844470E+00e^-3.703890E-02x
R^2 = 9.693603E-01

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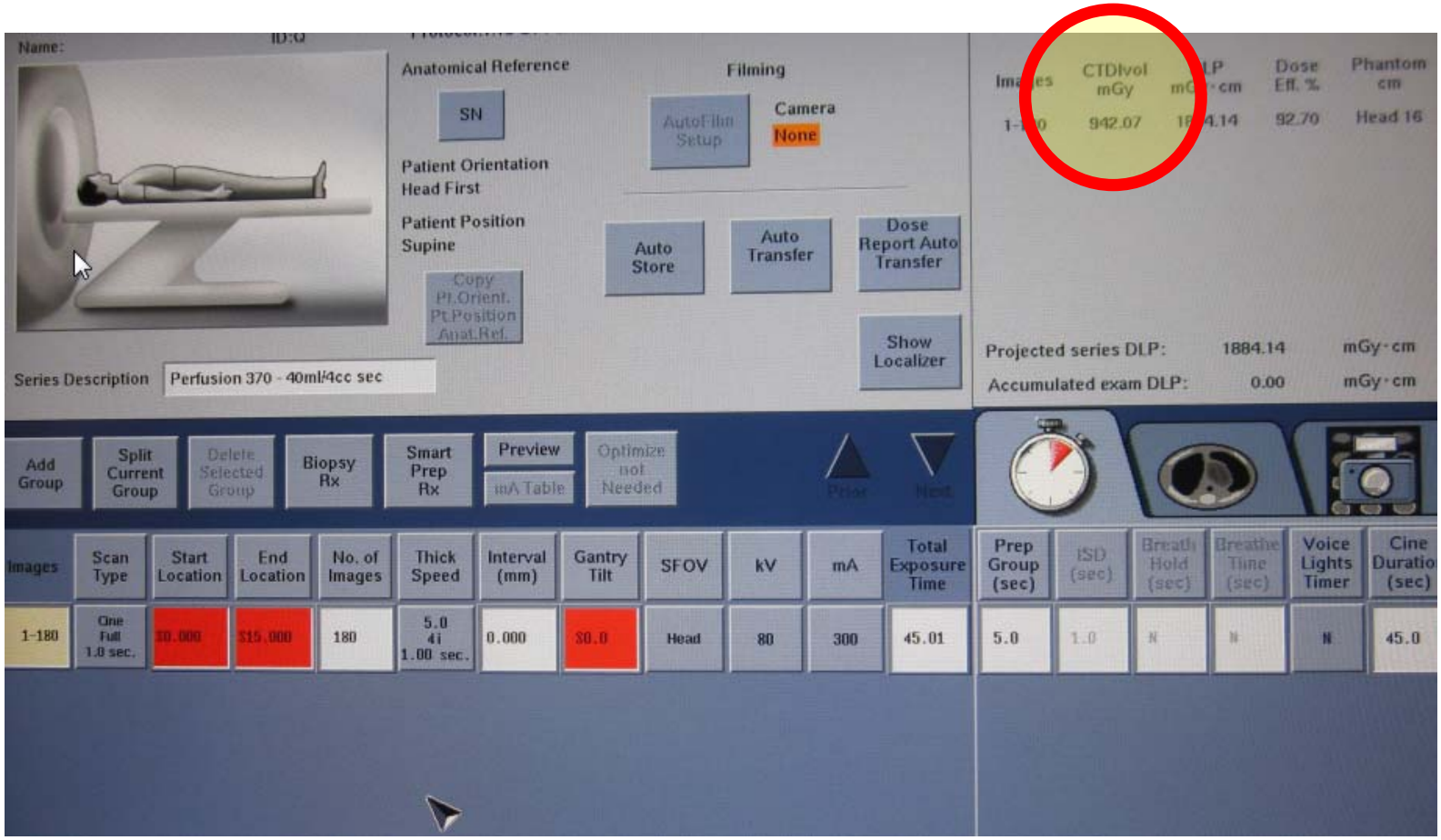
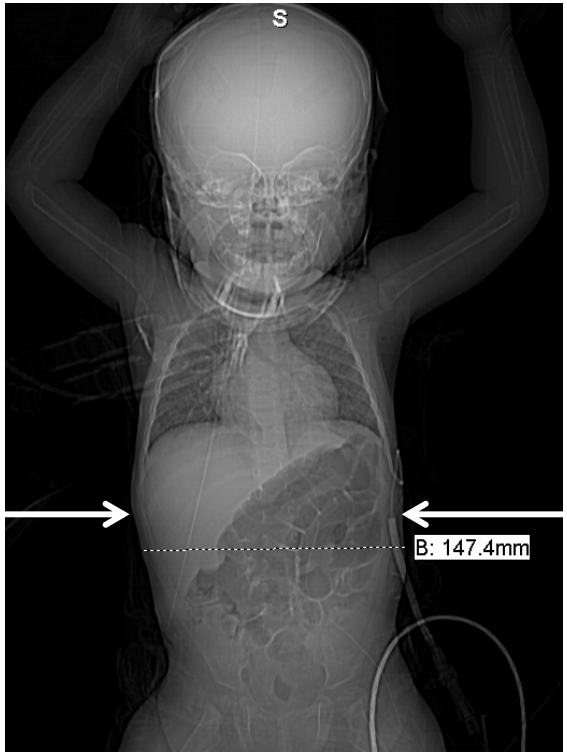
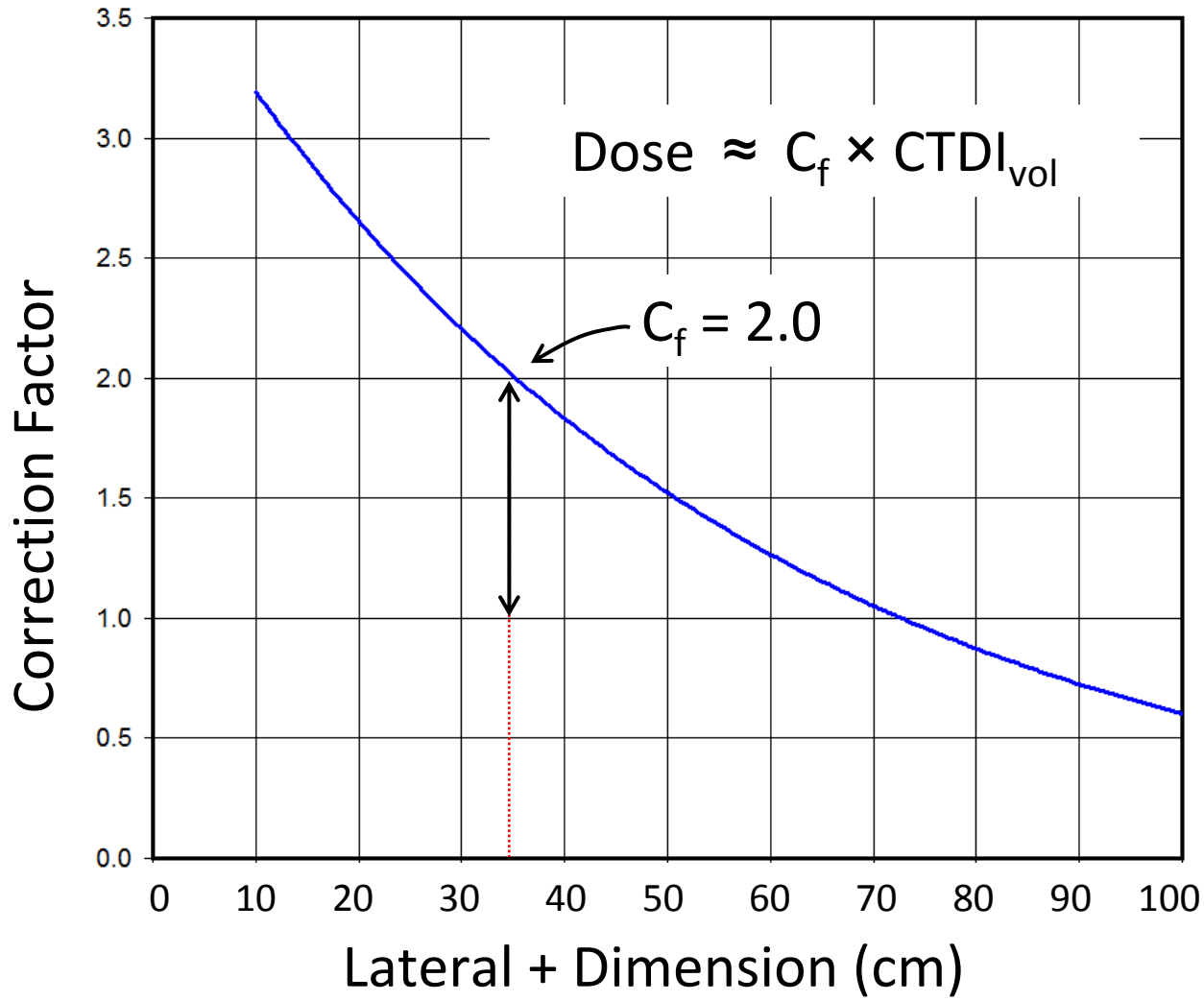
Dose Index value ($CTDI_{vol}$) is displayed on most scanners.....



Measure lateral dimension of topogram



Topogram / Scout View / Scanogram


Dose ≈ C_f × $CTDI_{vol}$
C_f = 2.0
Correction Factor
Lateral + Dimension (cm)
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
0
10
20
30
40
50
60
70
80
90
100

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- Summary

Task Group 204

In collaboration with

Paediatric CT dosimetry

International Commission on Radiation Units and Measurements

Image Quality and Patient Dose in CT: Chapter 5

Paediatric CT dosimetry

Differences between Pediatric and Adult Dosimetry

Machine Output to Organ Dose

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Methods for Pediatric CT Dose Calculation

Summary