Is the Cristy dosimetry phantom good enough?

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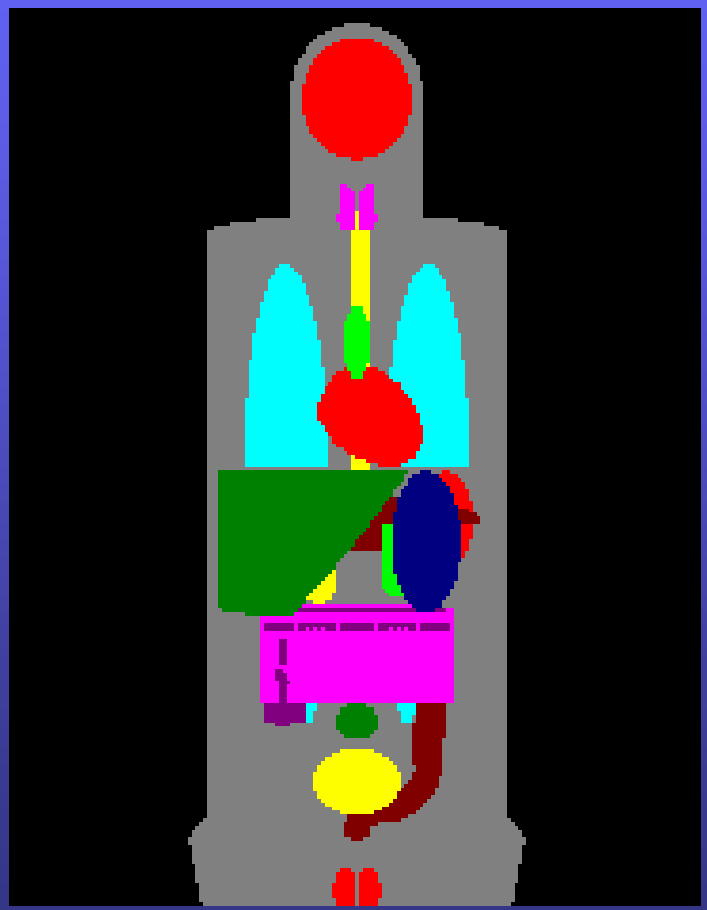
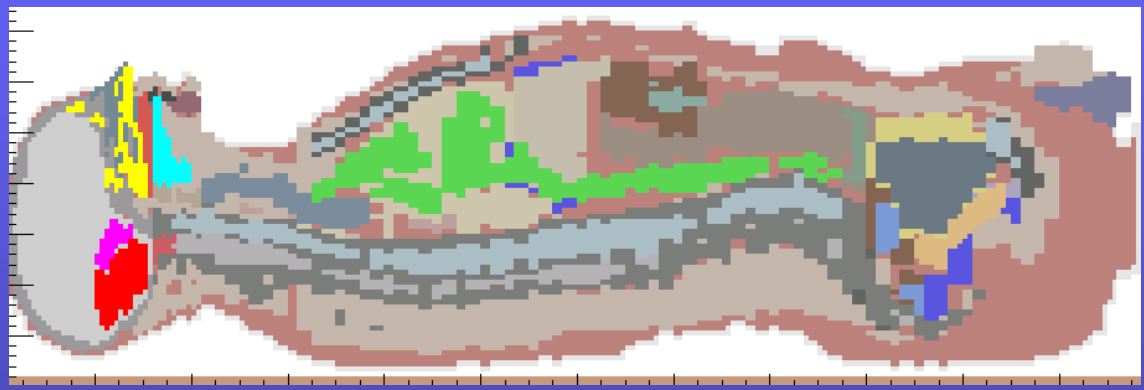
The trouble with Cristy



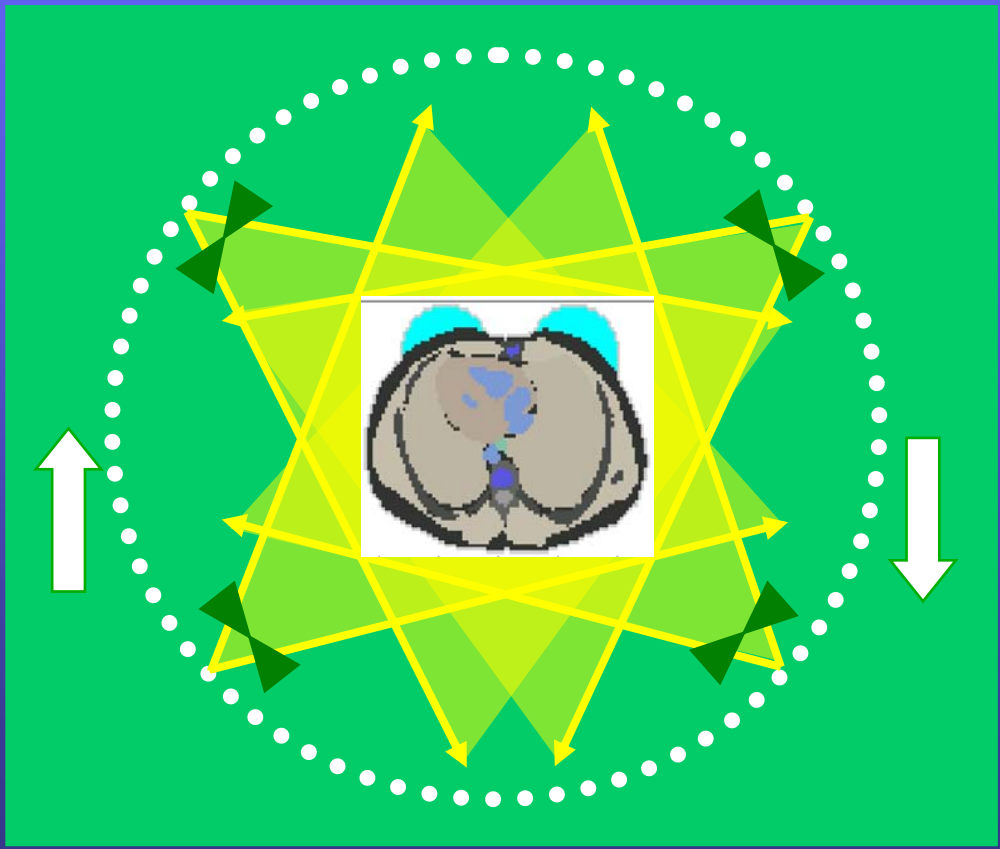
- Geometric shapes
  - e.g. bowel
- Organ distribution
  - Lung / liver boundary
  - Location of intestines

Yale: an alternative phantom



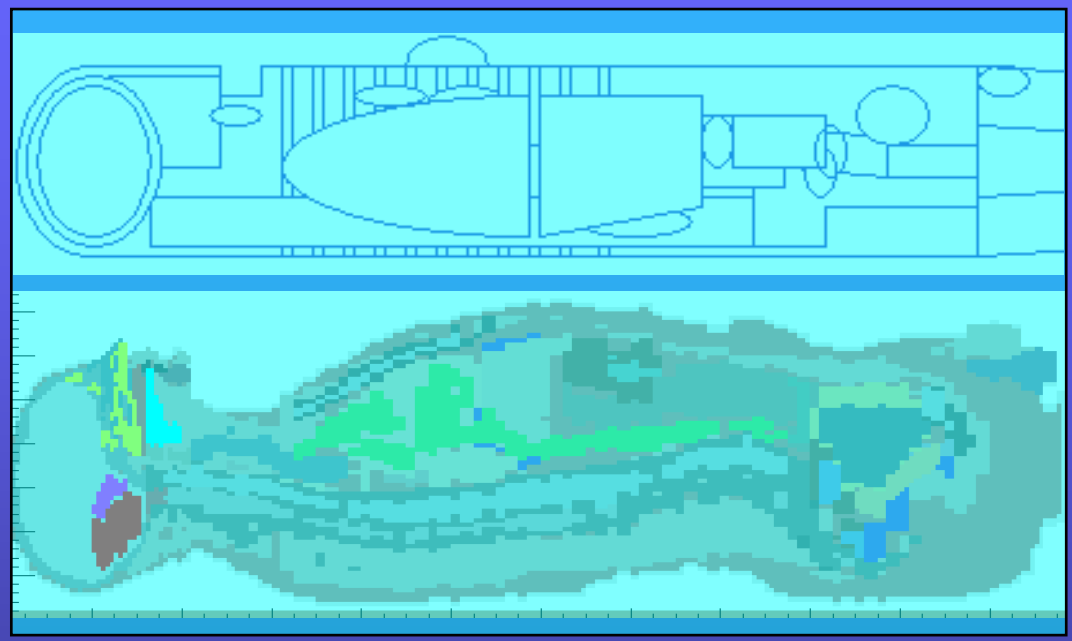
- From CT scan of adult male (Zubal 1994)
- Voxel array
- Segmented organs
- Breasts, ovaries and couch added

The Monte Carlo code



- Based on Sandborg et al 1994
- Adapted to CT scanning geometry
- Bowtie filter added
- 50M photon histories
  - Statistical error <1%

Validation of Monte Carlo model

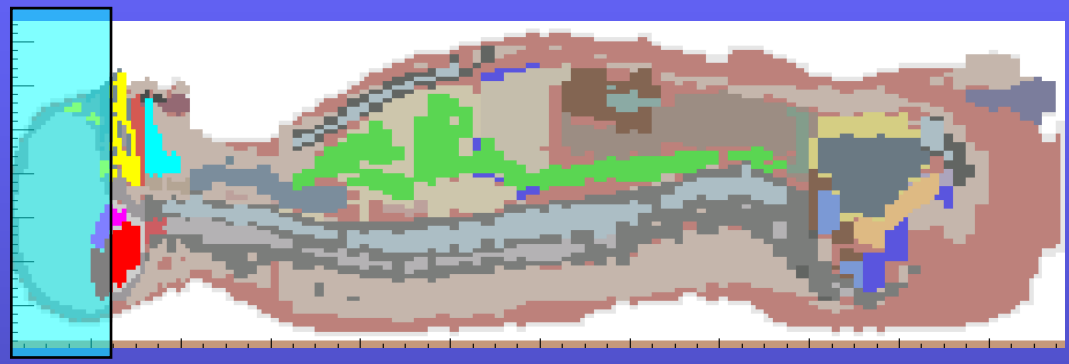


- HiSpeed CT/i scanner
- Phantom dimensions matched
- 120kVp, 10mm contiguous slices
- Full body scan

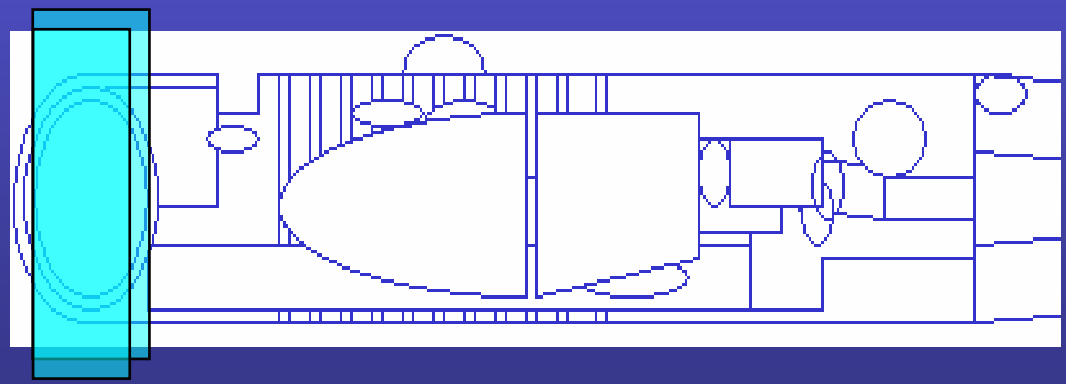
Clinical scans

- Validation model
- MC simulations for Yale phantom
  - Brain, lung, abdomen, pelvis
- ImPACT dose calculations
  - Anatomical markers matched
  - Scan range matched
  - Irradiated fractions of organs matched

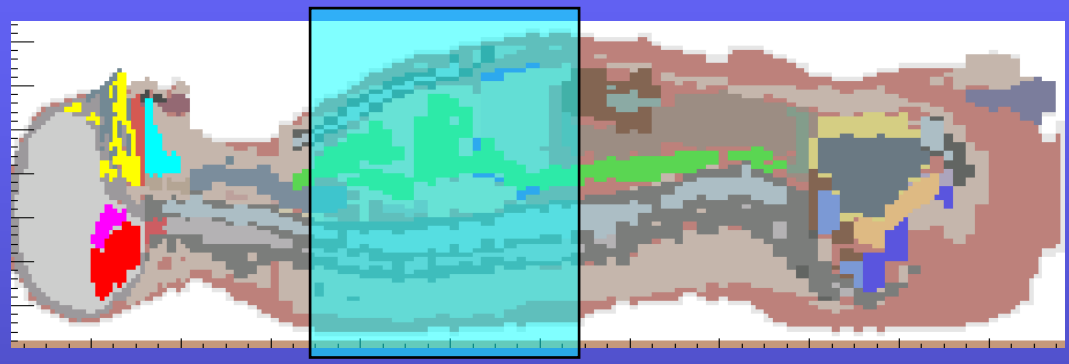
Brain scan



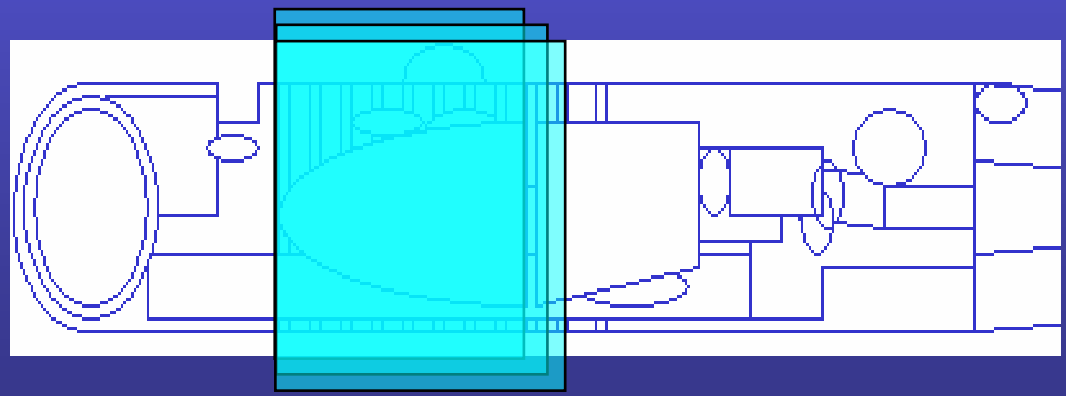
1.0 of brain irradiated



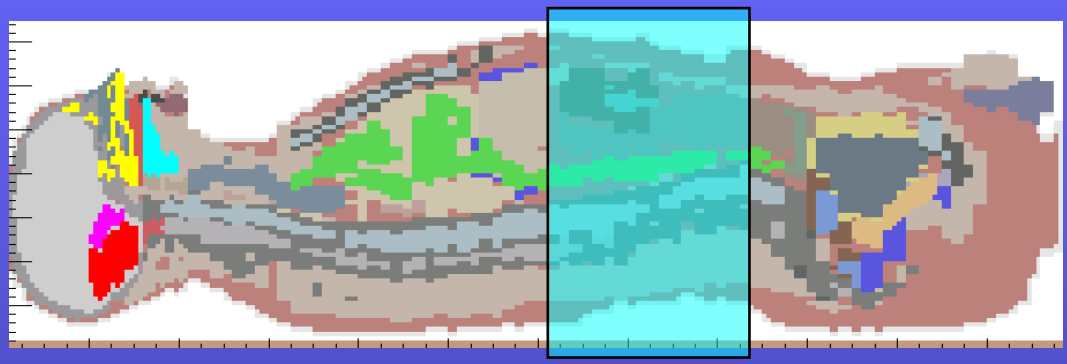
Lung scan



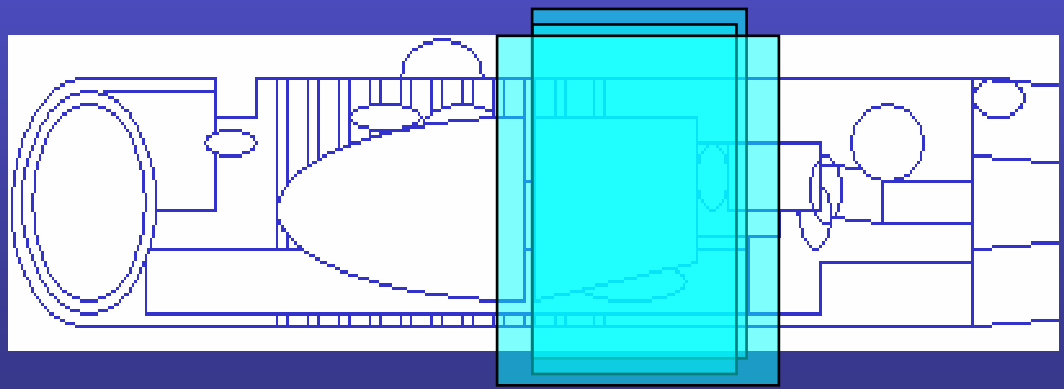
0.2 of liver irradiated



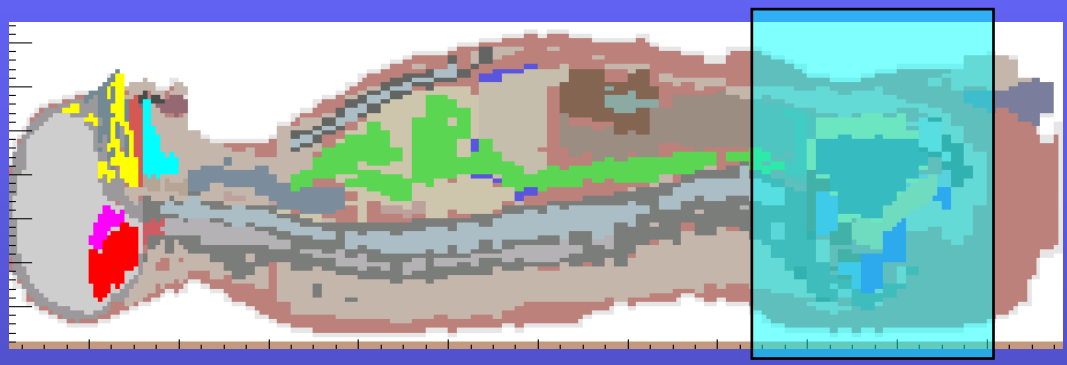
Abdomen scan



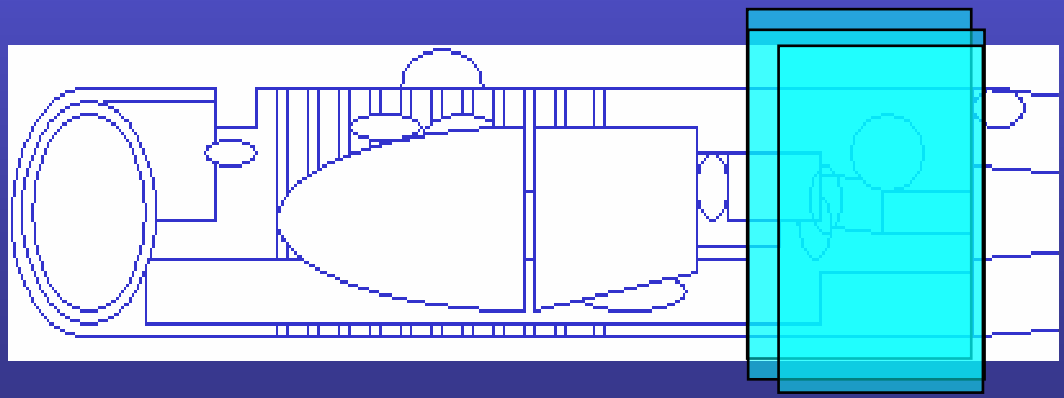
0.2 of lungs, 0.6 of colon, 0.0 of ovaries irradiated



Pelvis scan



0.3 of testes, 0.4 of colon, 1.0 of ovaries irradiated



Validation results

- ED 7% higher for MC model
- Scanner matching satisfactory
- Phantoms equivalent
  - Attenuation properties

Scan results

	Effective dose for 100mAs per rotation mSv			
scan	Yale	Anatomy matched	Range matched	Fraction matched
brain	0.33	0.36	0.45	0.36
lung	3.9	3.0	3.2	3.5
abdomen	3.9	2.4	2.8	3.3
pelvis	2.6	2.8	3.0	2.5

Conclusions

- Phantoms are equivalent
- Scan ranges based on anatomy should not be used
- Choose scan range to reflect fraction of organs irradiated
  - Prioritise organs of dosimetric importance
  - Fraction may be difficult to determine