

Radiation Doses from Image-Guided Modalities Used for Radiation Treatment

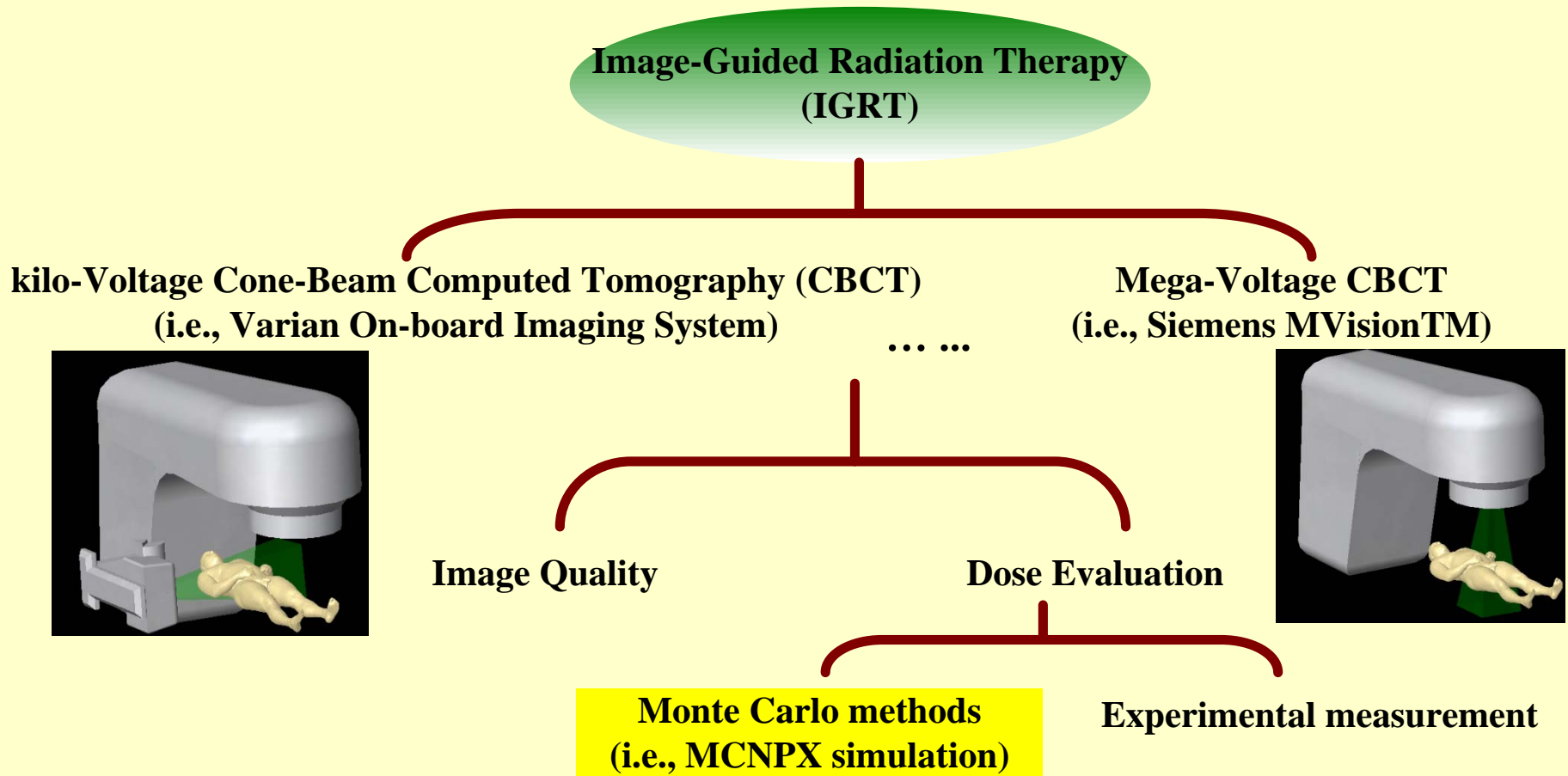
Graduate student: Jianwei Gu

Rensselaer Polytechnic Institute, Troy, NY

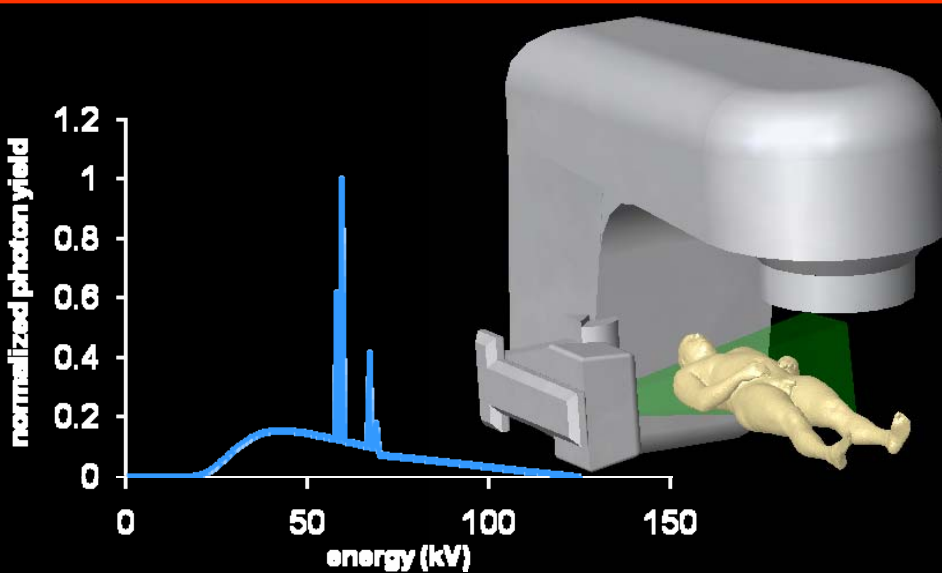
Oct 23, 2007



Motivation

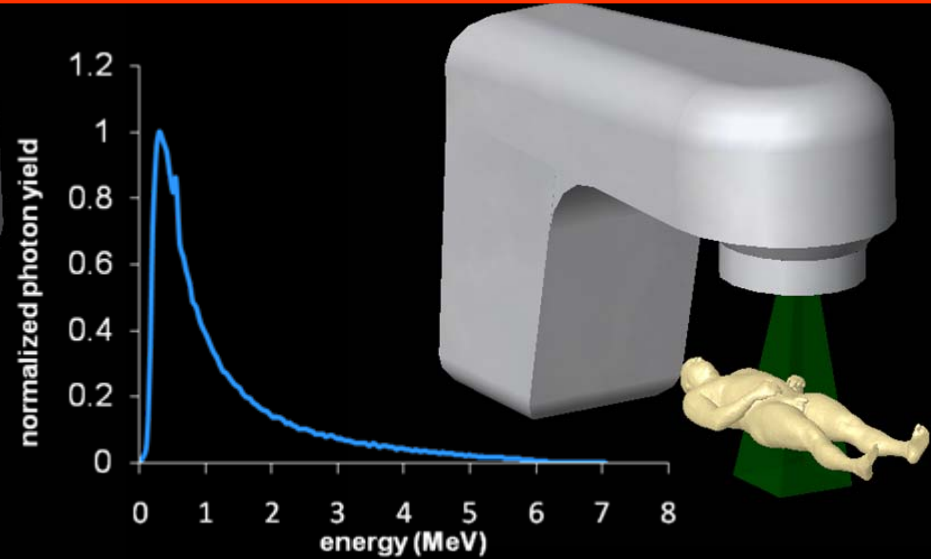


Model Parameters



(The photon energy spectrum for 125 kVp, courtesy of Steve B. Jiang)

kV CBCT



(The photon energy spectrum for 6 MV, courtesy of Bryan Bednarz)

MV CBCT

Basic Parameters	kV CBCT	MV CBCT
Field of view (at isocenter)	17cm x 25cm	27.4 cm x 27.4 cm
Tube potential	125 kVp	6 MV
Tube current or Monitor Unit	25 mA	2 MU
Exposure time	320 ms	/
Projection number	675	200
Total mAs for CBCT acquisition	5400 mAs	/
Angular range of projection views	364°	200° (rotation from 270° -110°)

VIP-Man Phantom and MCNPX Codes

- VIP-Man Phantom:

realistic whole-body anatomical model
(developed at RPI, <http://rrmdg.rpi.edu>)

- MCNPX:

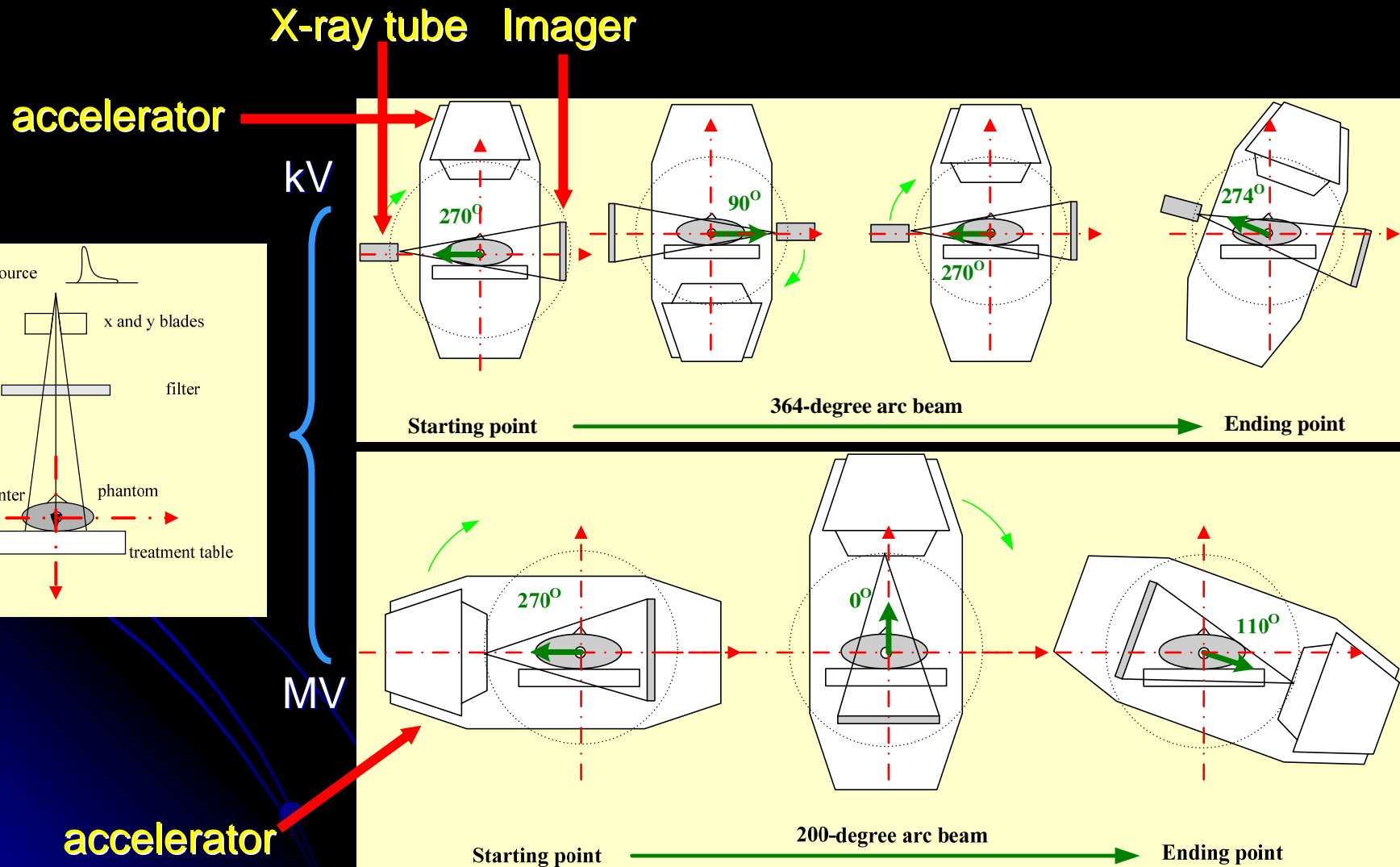
Tally F6: Energy deposition averaged
over a cell \rightarrow Mev / g / particle



Tissue or Organ	w_T ICRP 60
Gonads	0.20
Red Bone Marrow	0.12
Colon	0.12
Lung	0.12
Stomach	0.12
Bladder	0.05
Breast	0.05
Liver	0.05
Esophagus	0.05
Thyroid	0.05
Skin	0.01
Bone surface	0.01
Remainder	0.05

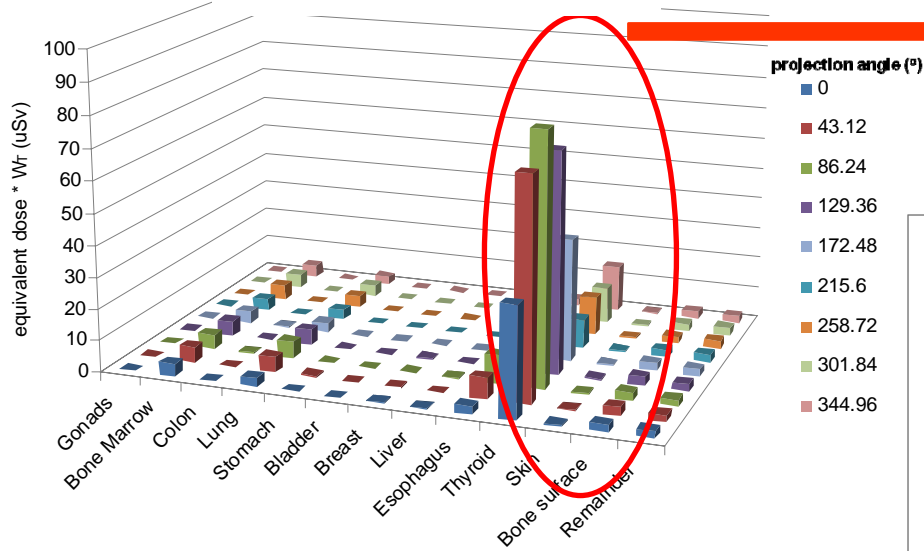
$$E \text{ (or } H_E) = \sum_T w_T H_T$$

kV and MV CBCT Model

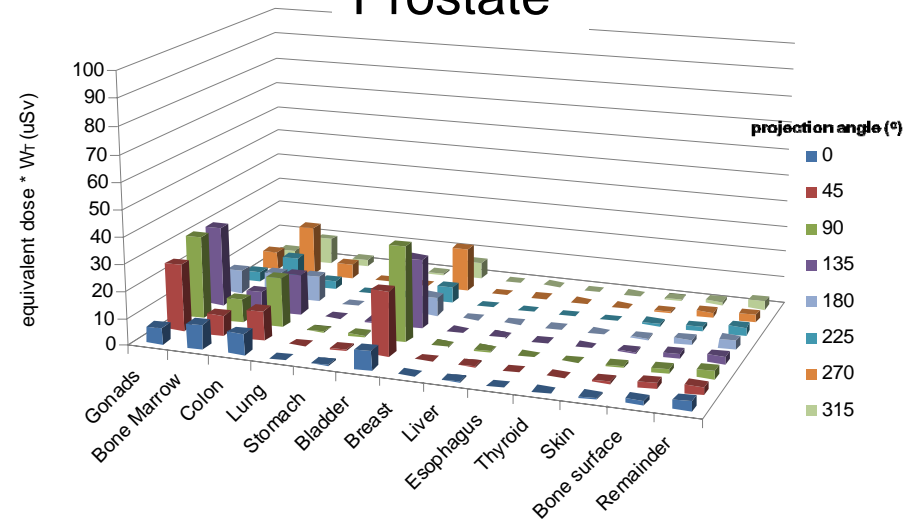


Organ Dose Analysis for kV CBCT

Head and Neck

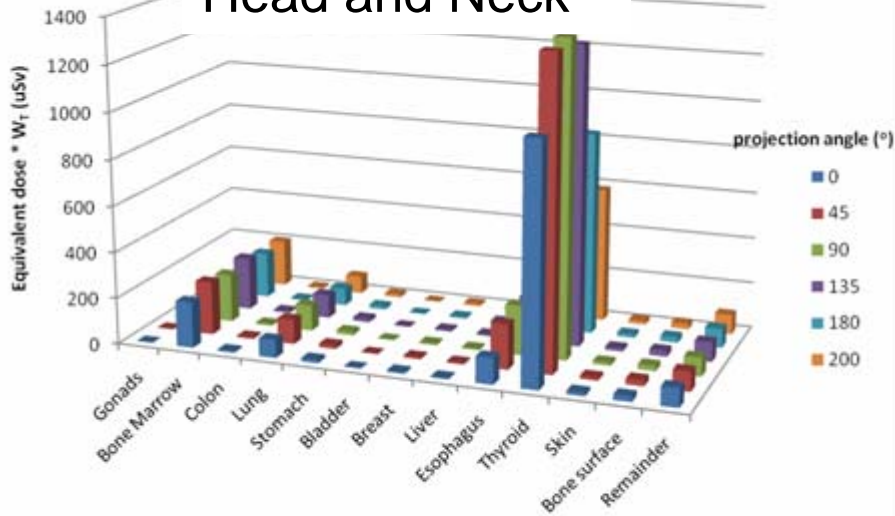


Prostate

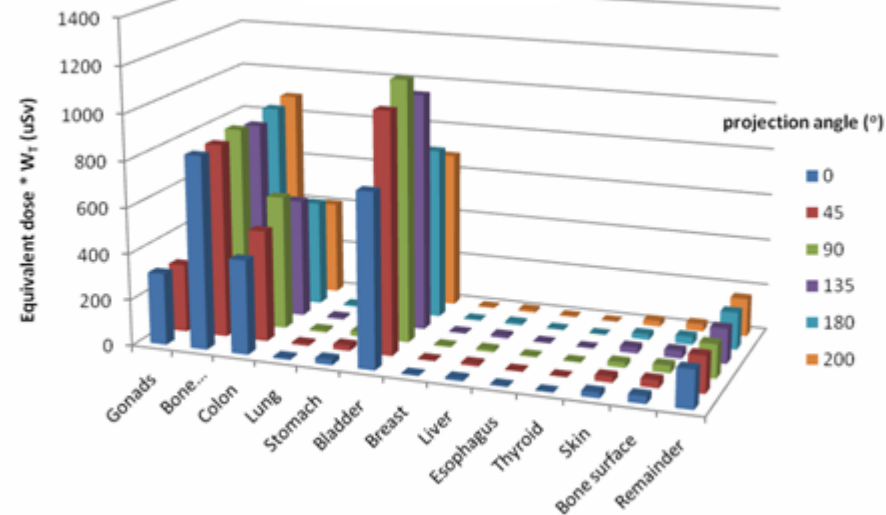


Organ Dose Analysis for MV CBCT

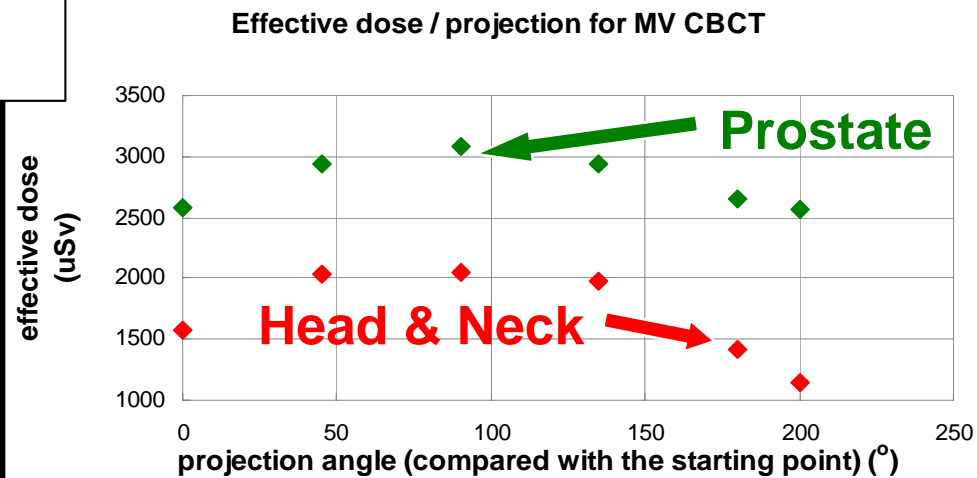
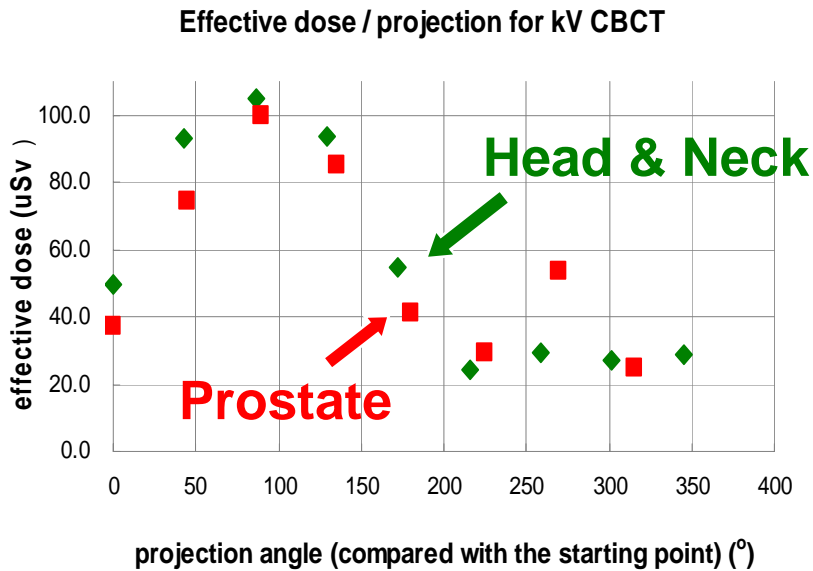
Head and Neck



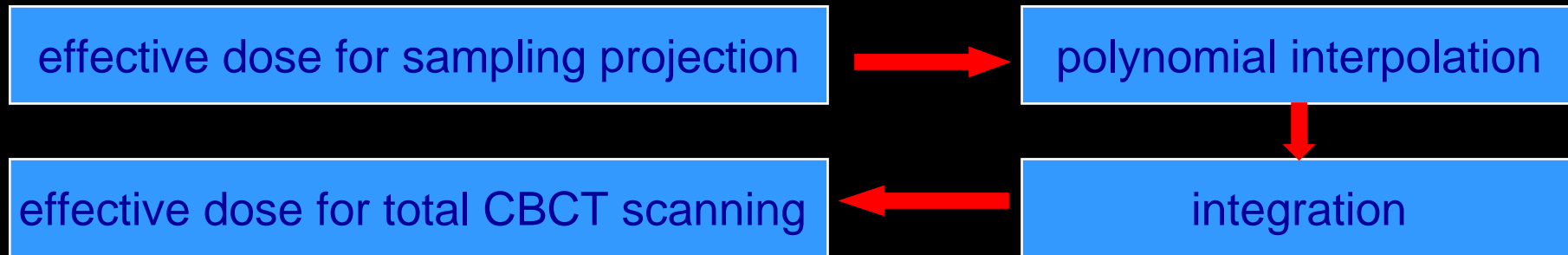
Prostate



Effective Dose from kV CBCT and MV CBCT

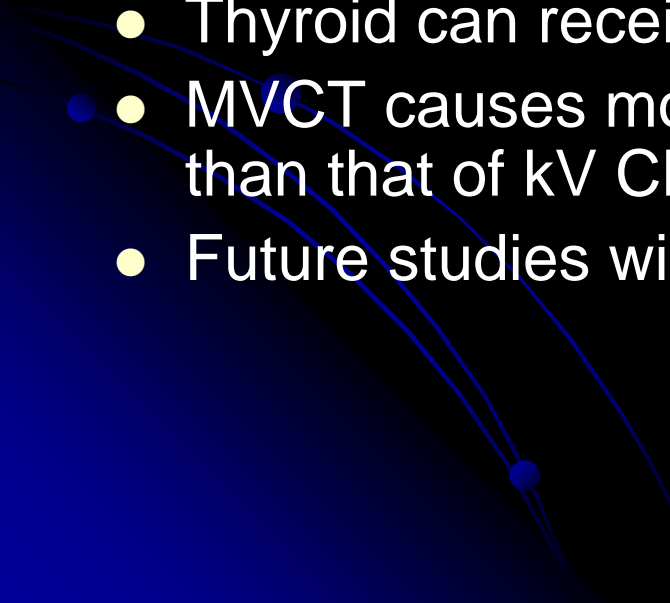


Effective dose for kV/MV CBCT



	Effective Dose (mSv)	
	kV CBCT	MV CBCT
Head and Neck scanning	37.9	369.6
Prostate scanning	36.5	574.4

Conclusion

- Exposure from IGRT procedure is an emerging concern
 - Detailed imaging modalities and procedures are considered
 - Organ dose and effective dose are calculated using the realistic anatomical model
 - IGRT imaging is different from diagnostic procedures
 - Thyroid can receive high dose in head & neck case
 - MVCT causes more than 10 times greater effective dose than that of kV CBCT due to higher photon energy
 - Future studies will investigate image quality vs. dose
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Acknowledgement

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