



International  
Cancer  
Expert Corps

Partnering to transform global cancer care



Science & Technology  
Facilities Council  
10 Years of Impact and Inspiration

*Accelerating the Future:*

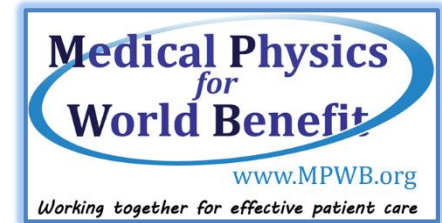
*Designing a Robust and Affordable Radiation Therapy Treatment System for Challenging Environments*

# Radiation Therapy Treatment System

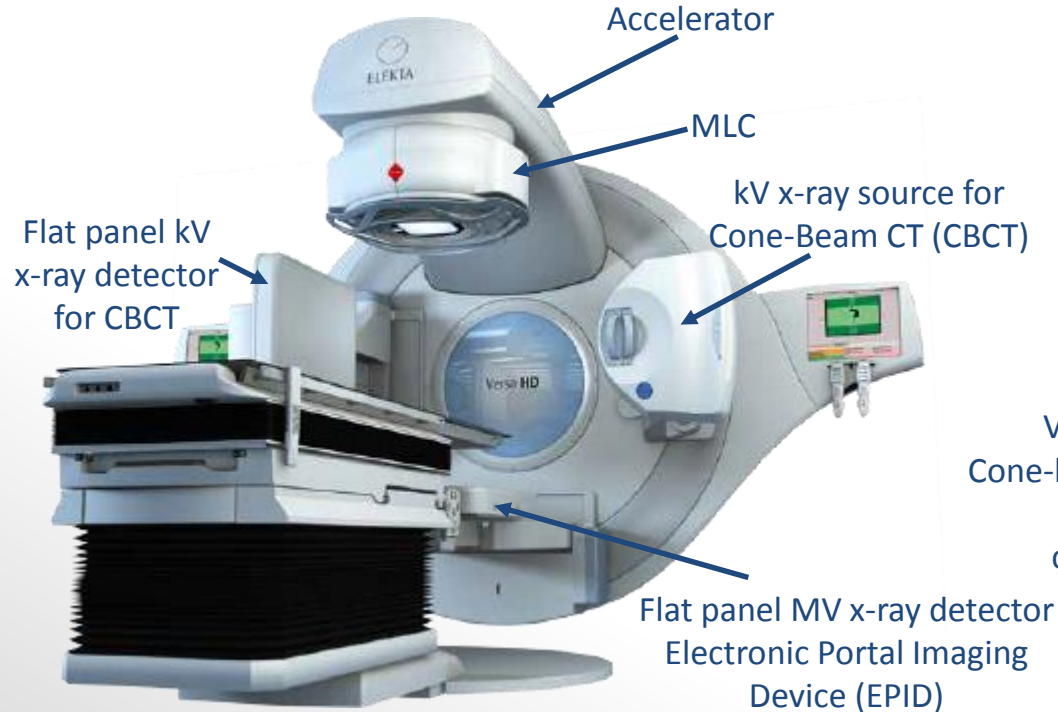
## Overview: From Source to Patient



Jacob (Jake) Van Dyk  
Professor Emeritus  
Western University, London, Ontario, Canada  
and  
Past-President, MPWB



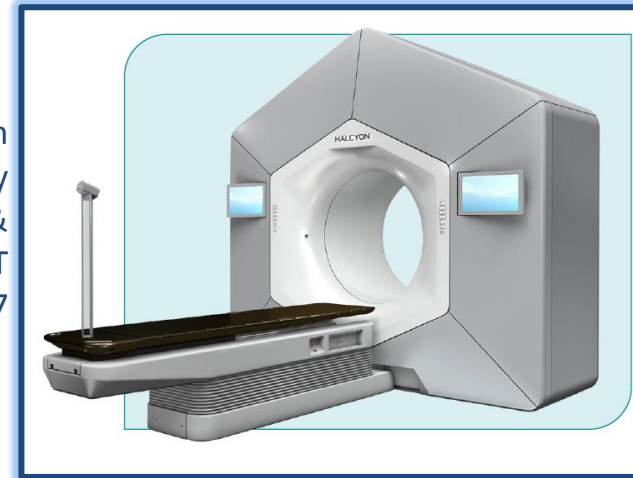
# Linac with IMRT & IGRT



TomoTherapy  
Helical "slice"  
delivery &  
helical CT  
2003

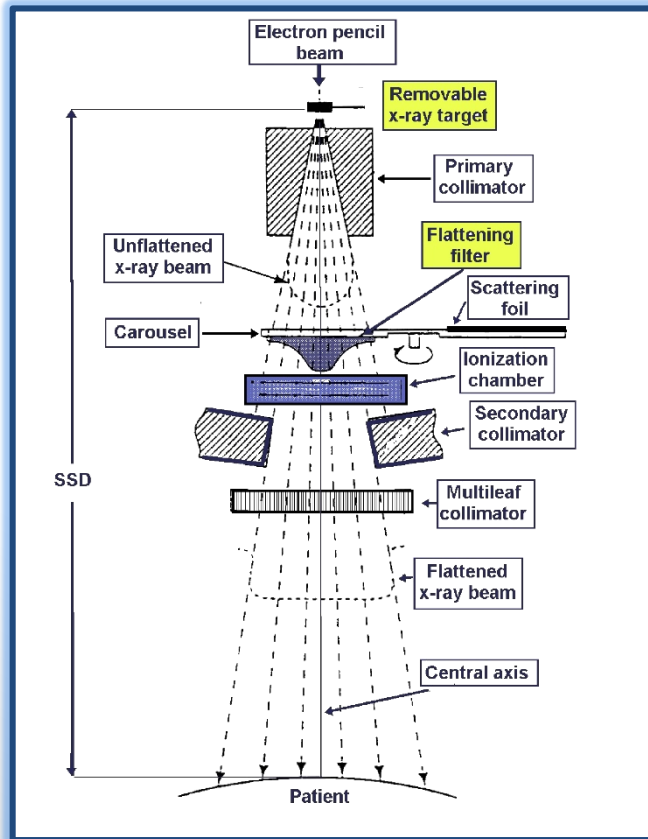


Varian Halcyon  
Cone-beam delivery  
(VMAT) &  
cone-beam CT  
2017

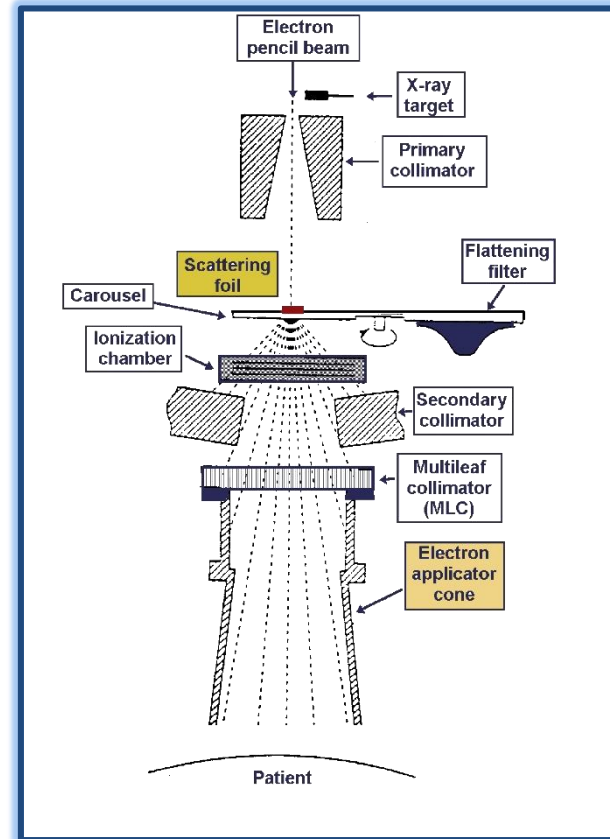


# Schematic: From Source to Patient

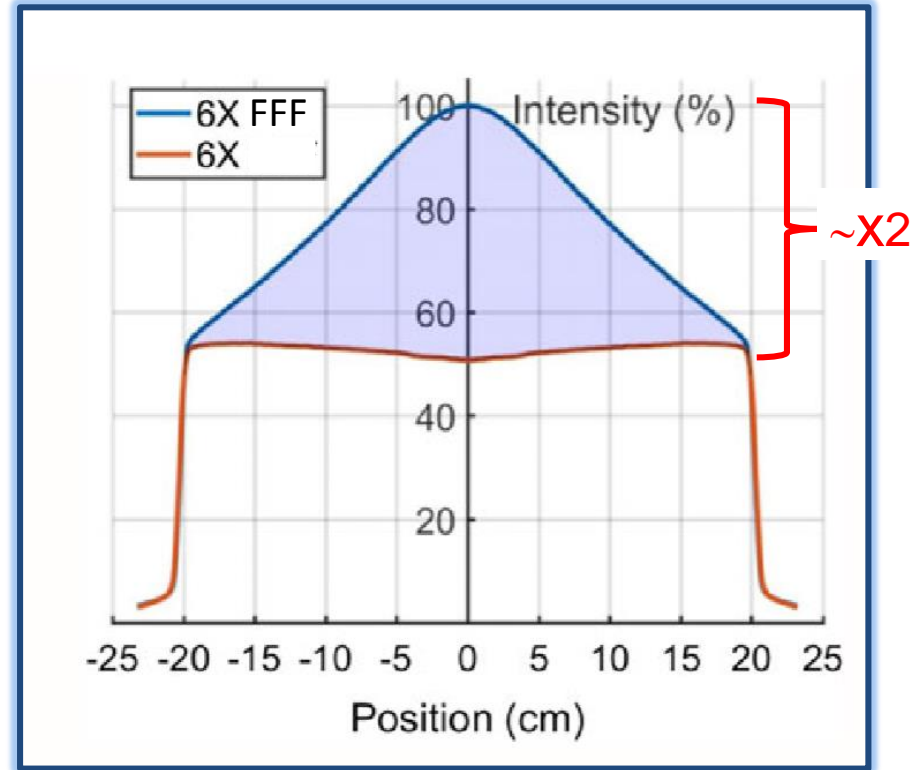
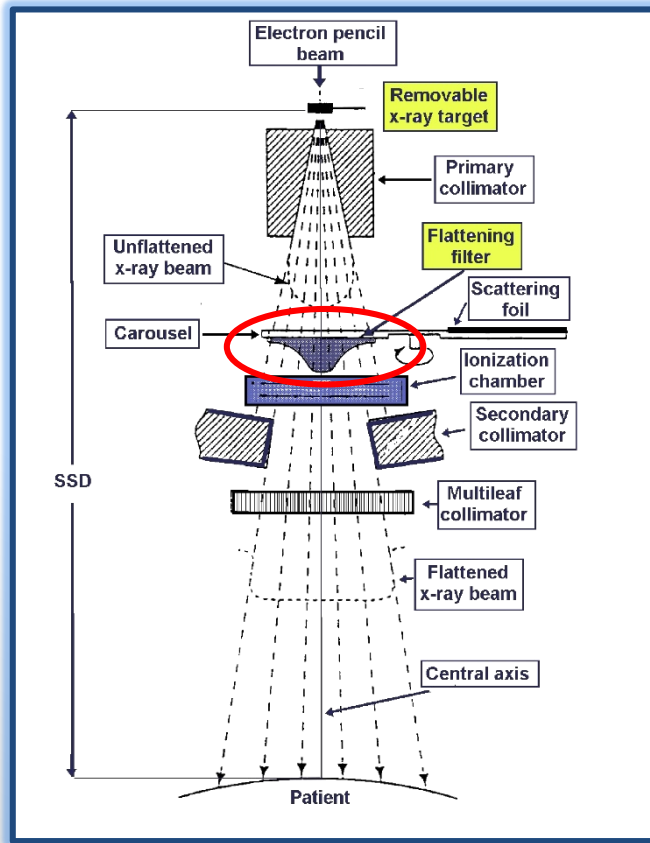
Conventional  
Photon  
Beams



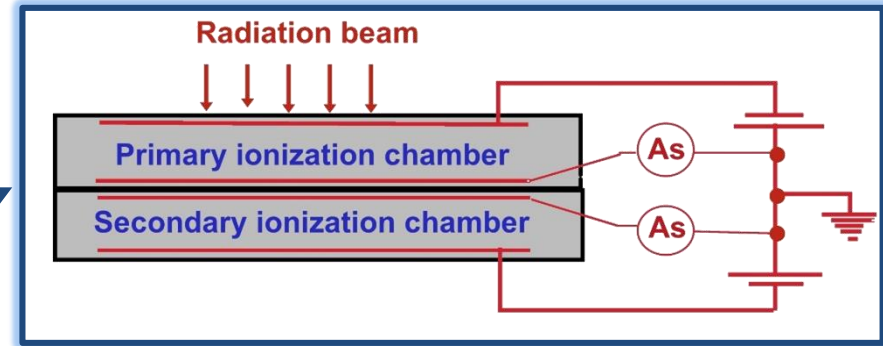
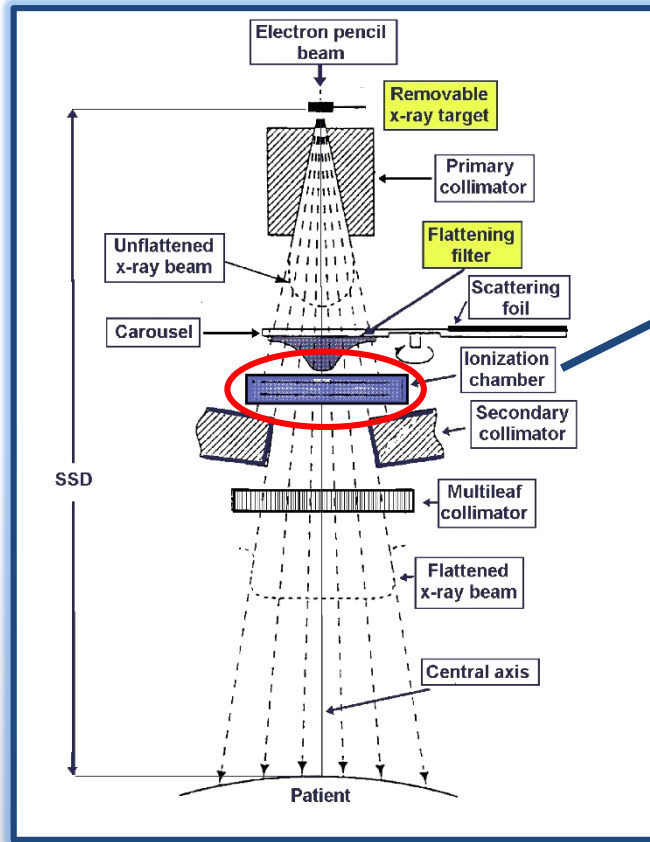
Electron  
Beams



# Flattening Filter Free (FFF) Machine

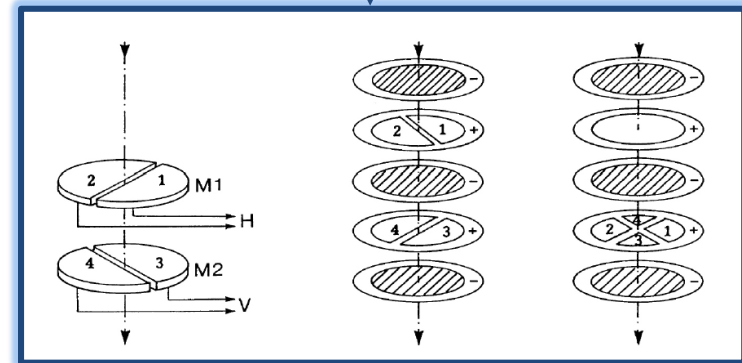


# Monitor Ionization Chamber

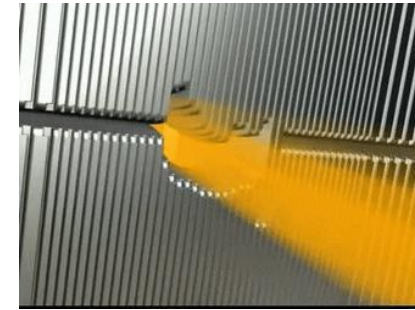
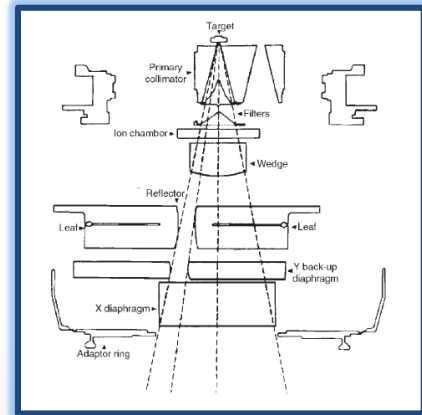
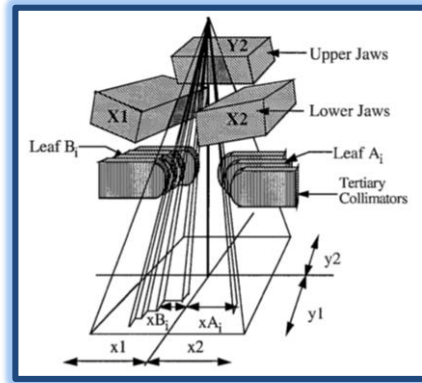
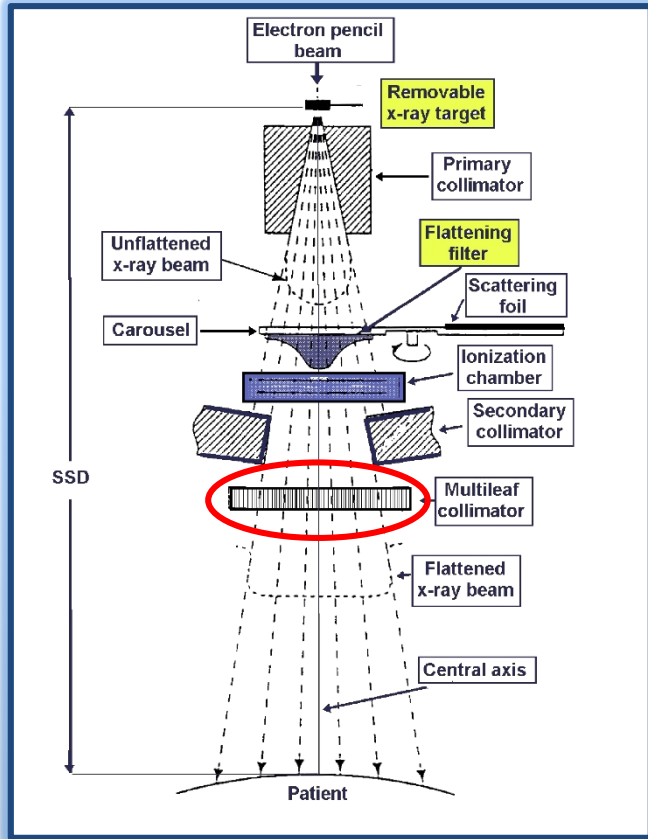


IAEA slides

- Controls:
- Total dose
  - Flatness
  - Symmetry



# Multileaf Collimator

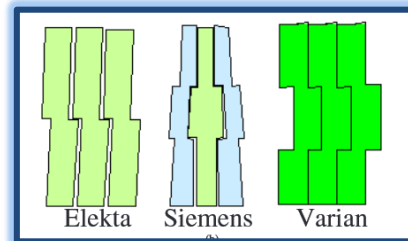


TomoTherapy



Varian

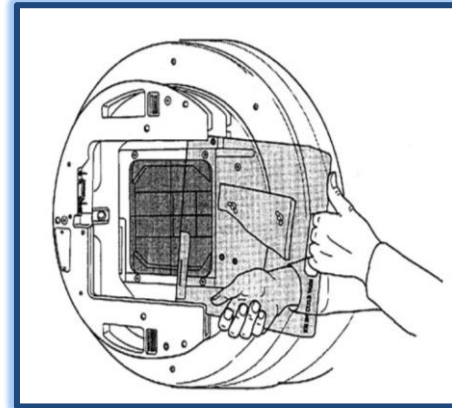
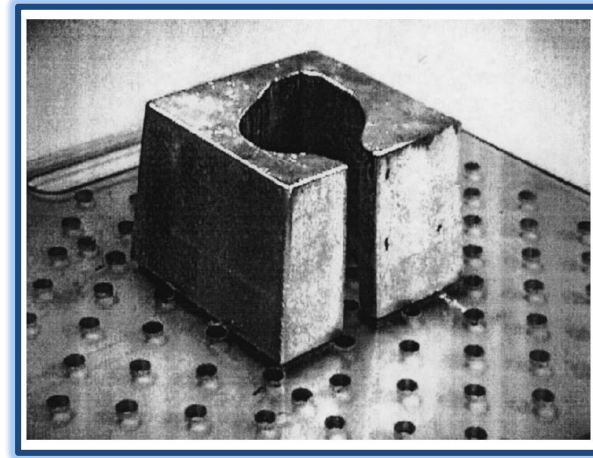
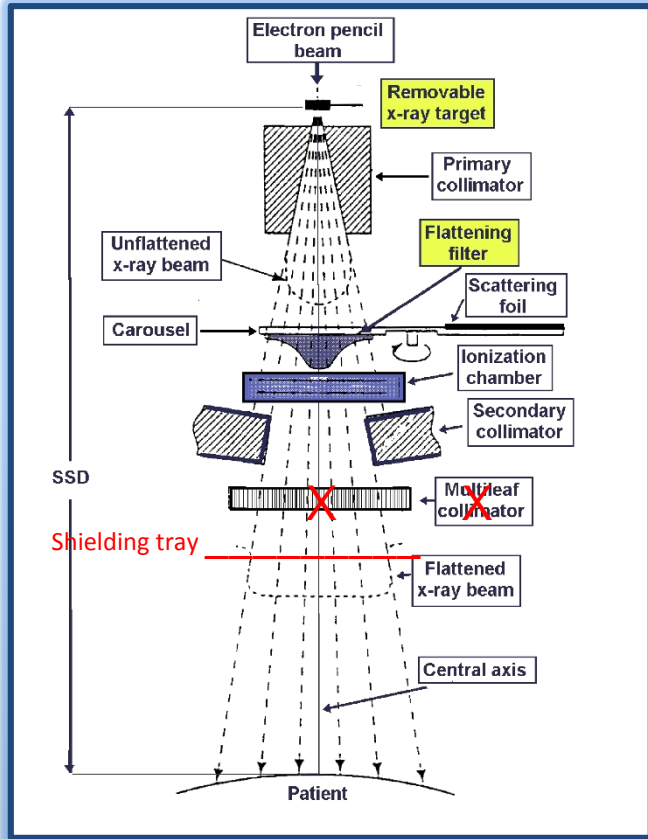
Elekta



Huq et al, PMB 47: N159-N170; 2002

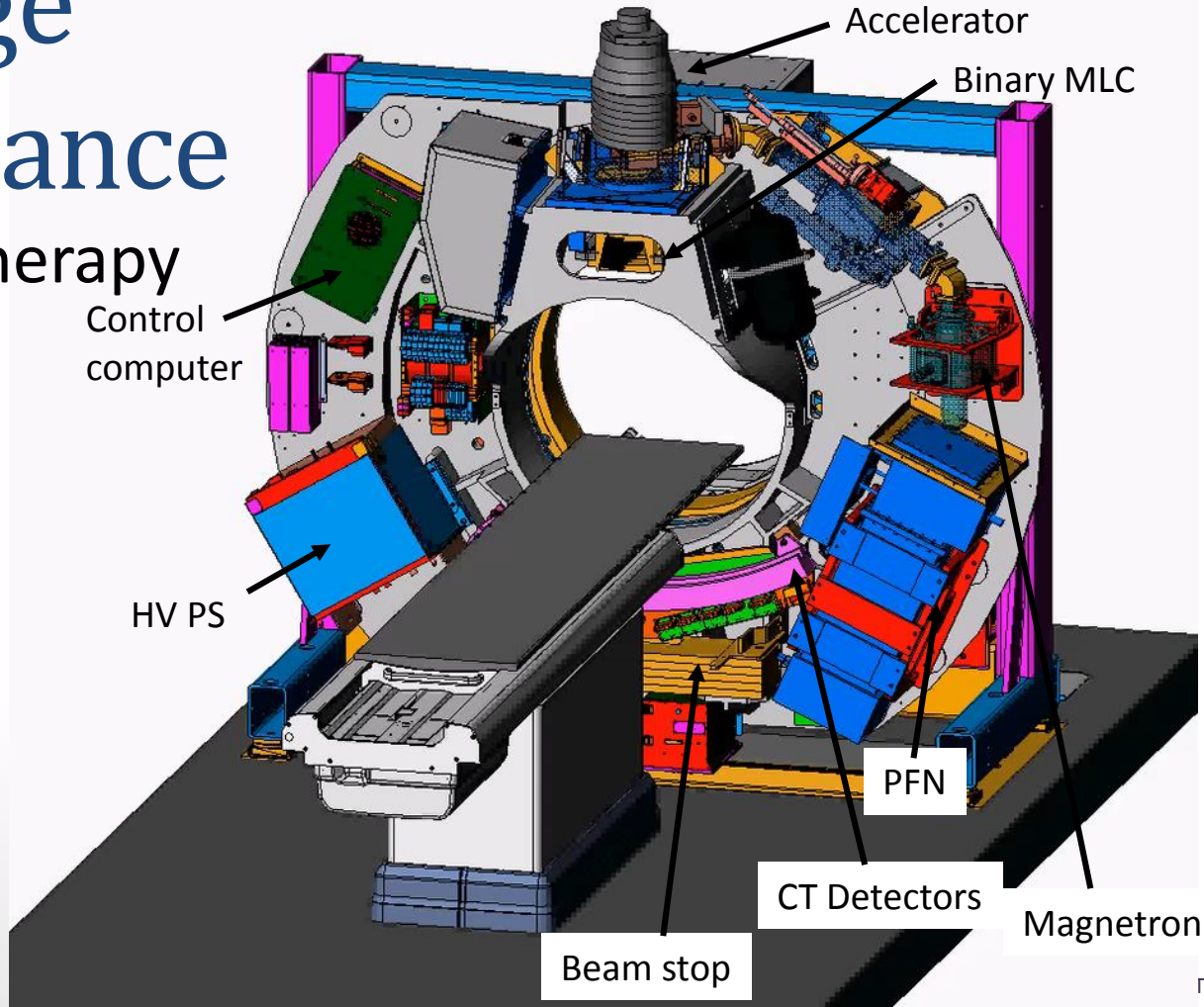


# Shielding Blocks



# Image Guidance

## TomoTherapy





# Tomotherapy MV CT Image Guidance

The screenshot displays the Tomotherapy MV CT Image Guidance software interface. The top menu includes Scan, Register, Treat, Calibrate, and Manual Control. The Manual Control panel features 'Automatic Calculation' and 'Manual Control' options, with 'Start Auto' and 'Start Manual' buttons. A central window shows a TomoImage of a patient's chest with a green overlay indicating alignment. A large blue box labeled 'MVCT' is overlaid on the top-left image, and another labeled 'kVCT' is overlaid on the bottom-left image. A green arrow points from the MVCT image to the kVCT image. On the right, two panels show adjustment values: 'Translational Adjustments (mm)' and 'Rotational Adjustments (degrees)'. The translational adjustments are Lateral (IEC Tx) 3.08, Longitudinal (IEC Ty) -3.98, and Vertical (IEC Tz) 5.5. The rotational adjustments are Pitch 0, Roll 0, and Yaw 0.

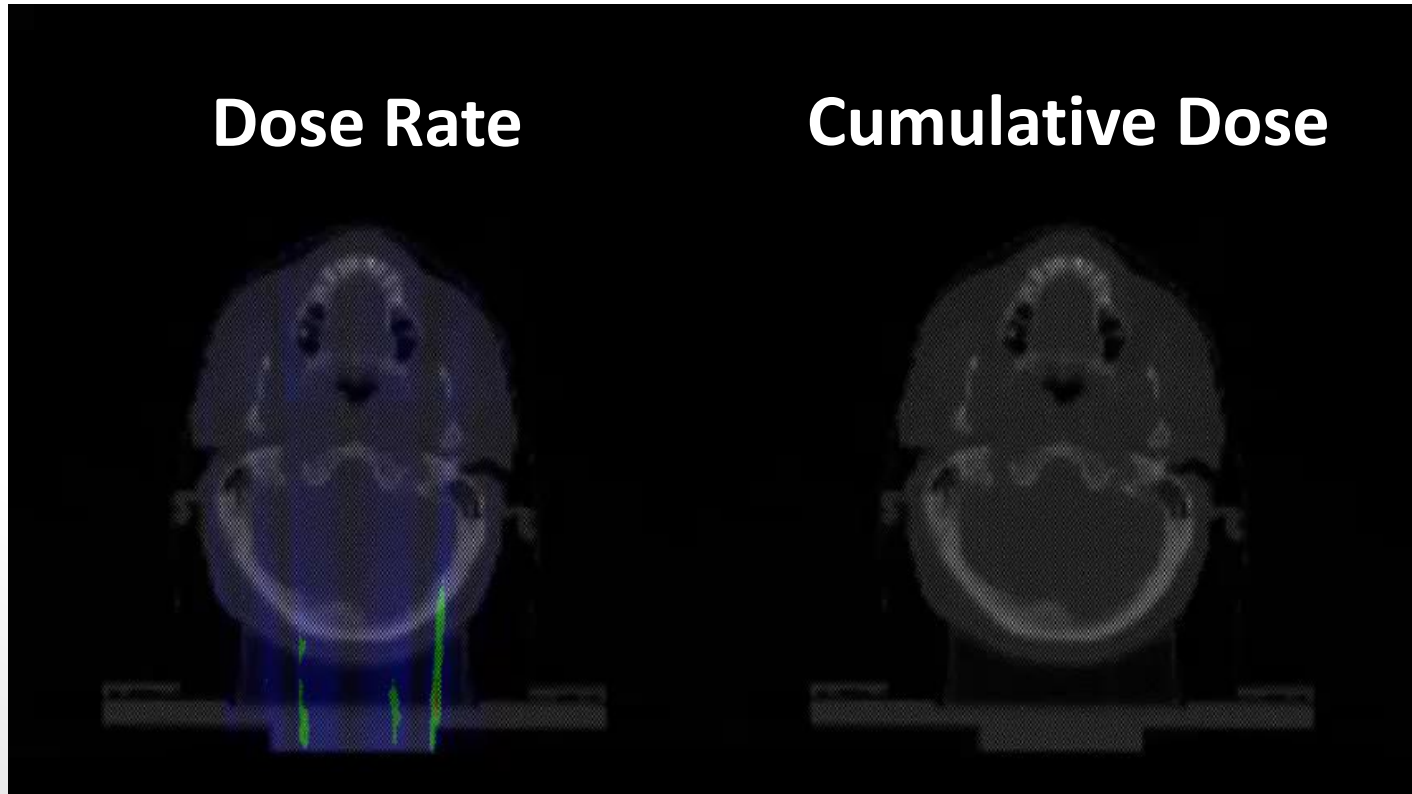
Translational Adjustments (mm)		
Lateral (IEC Tx)		3.08
Longitudinal (IEC Ty)		-3.98
Vertical (IEC Tz)		5.5

Rotational Adjustments (degrees)		
Pitch		0
Roll		0
Yaw		0

Auto Fusion has completed.

Manual alignment or grey scale alignment with mutual information algorithm

# Nasopharynx ... TomoTherapy



... results similar to VMAT

# Summary

- Treatment system: source to patient
  - Multiple designs
    - Conventional ... photons & electrons
      - IMRT, VMAT with photons
    - Rotational slice imaging & treatment
      - Tomotherapy
    - Rotational cone beam imaging, VMAT delivery
      - Halcyon