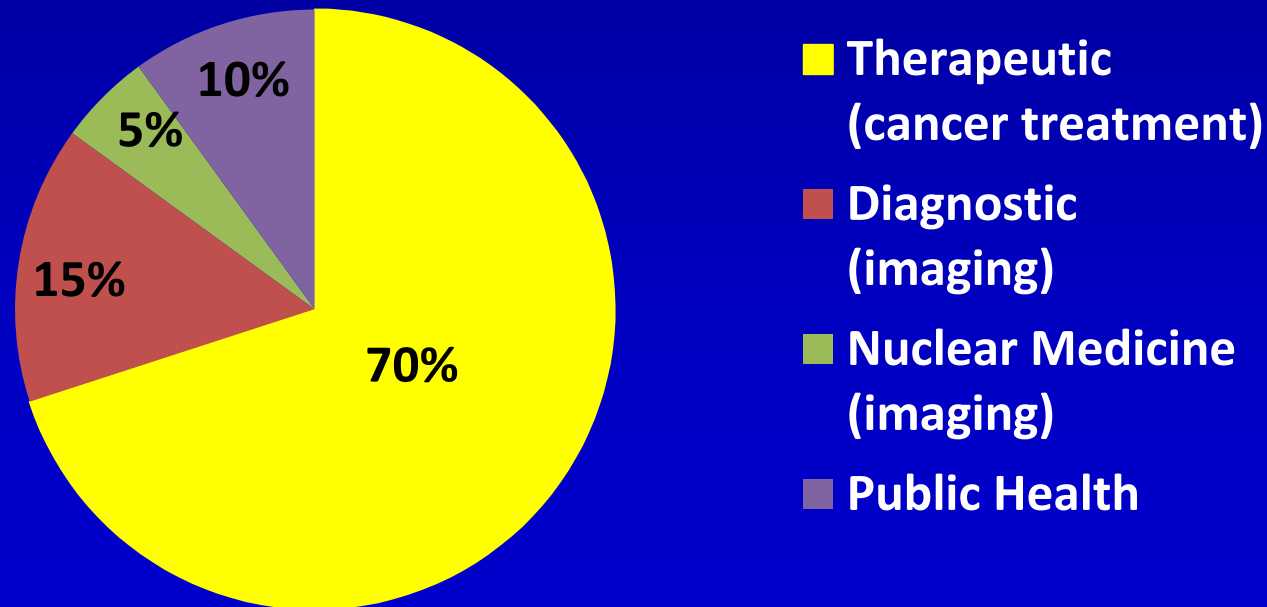


# Radiation in Medicine: Roles of Physicists

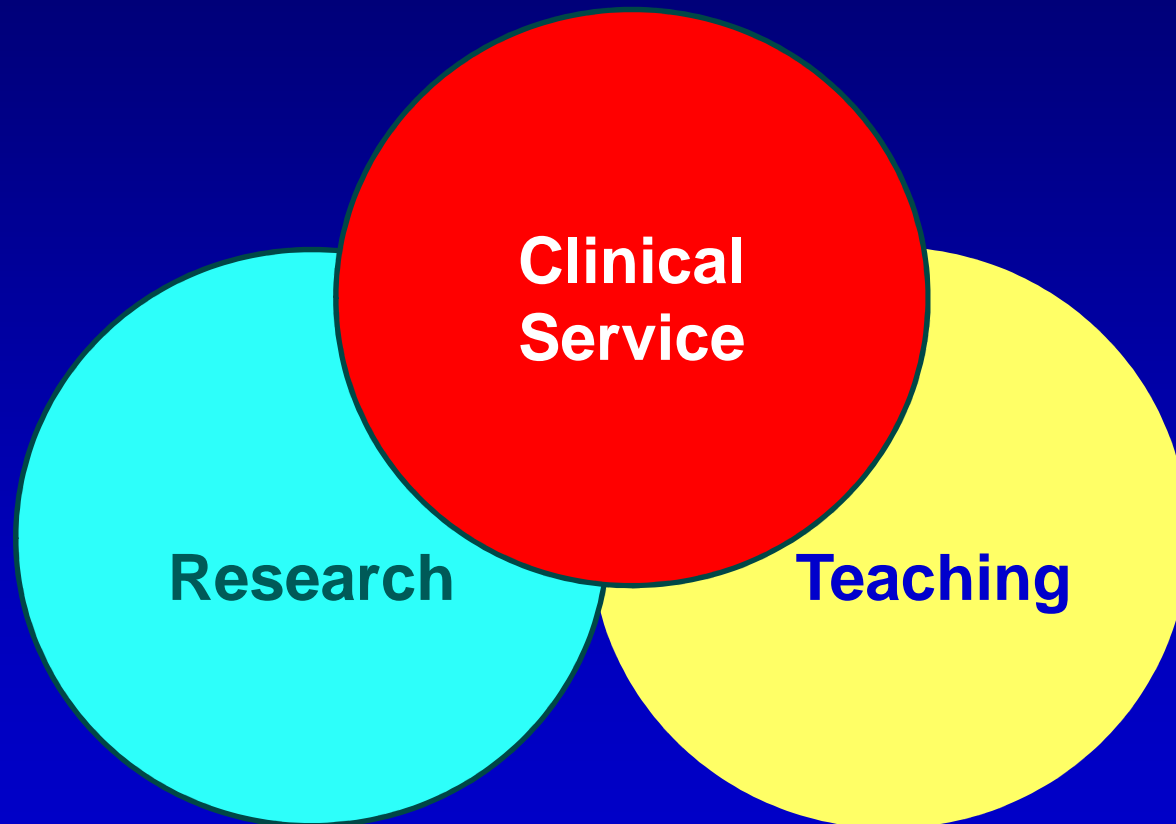
Ping Xia, Ph.D. Professor in Medicine  
Head of Medical Physics  
in Radiation Oncology  
Cleveland Clinic, Cleveland, OH, USA

# Who Are Medical Physicists?

- Have an MS or Ph.D. in medical physics, physics, or a related discipline
- Have training in clinical medical physics in four sub-specialties:



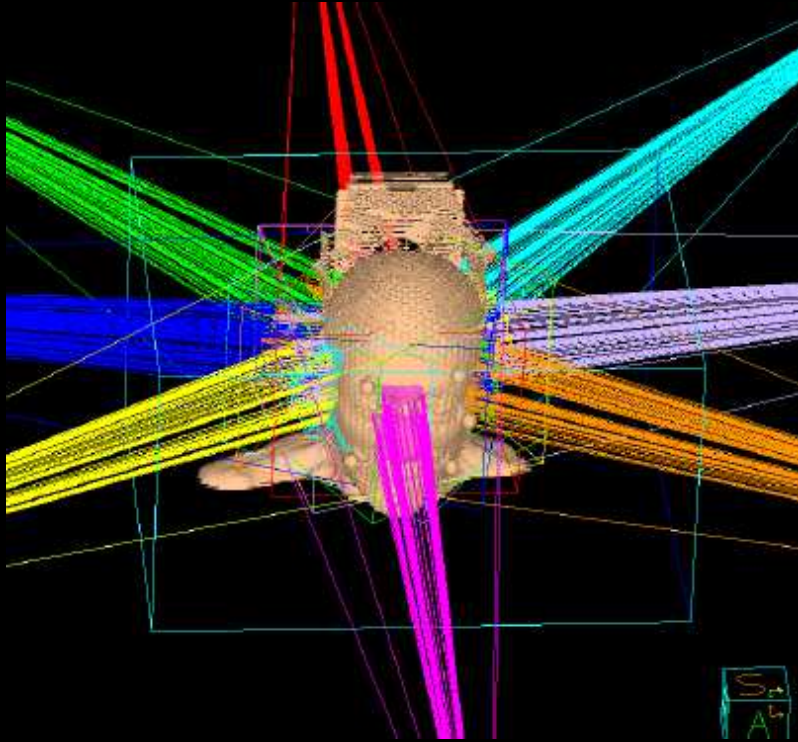
# What Do Medical Physicists Do?



# Clinical Services

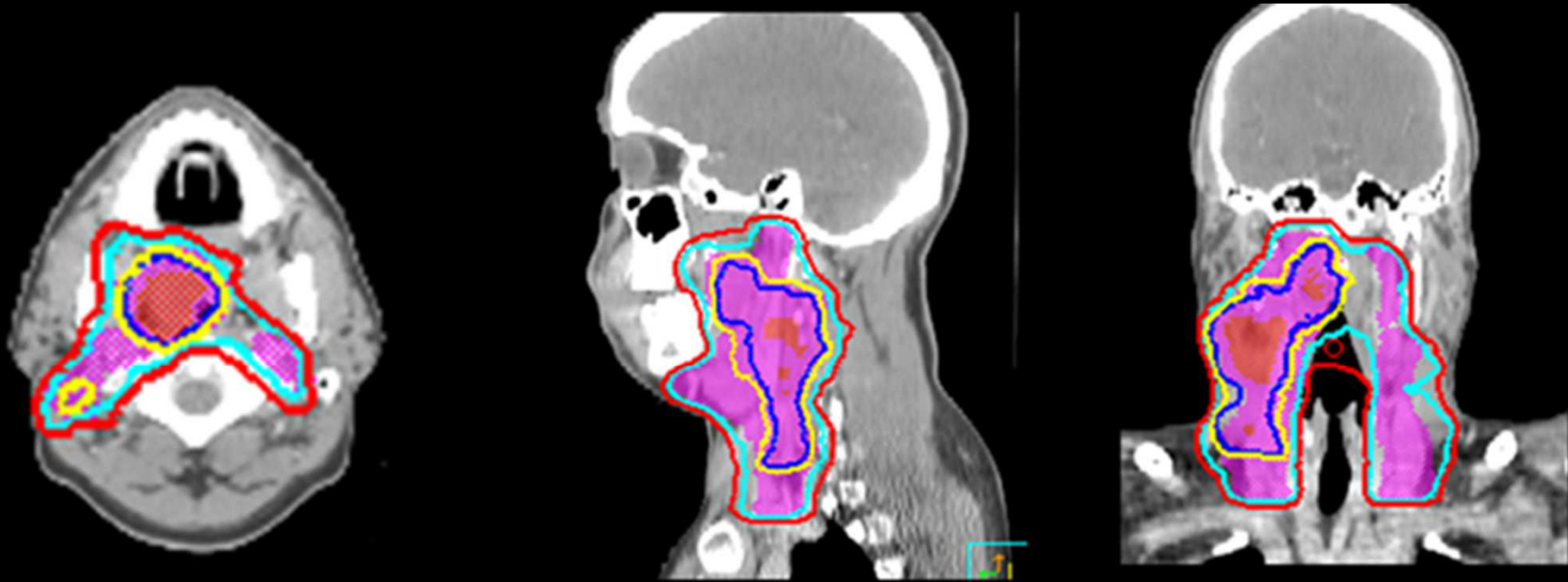
- Treatment planning design for radiation treatment of cancer patients
- Quality assurance (QA) of radiation outputs
- Quality control in imaging systems
- Monitor radiation exposure to patients and employees

# Treatment Planning Design



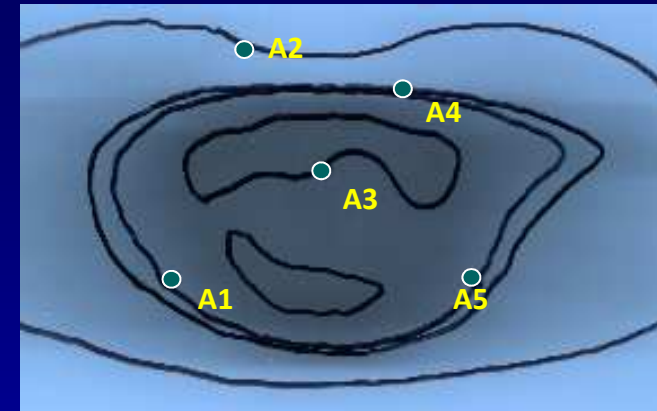
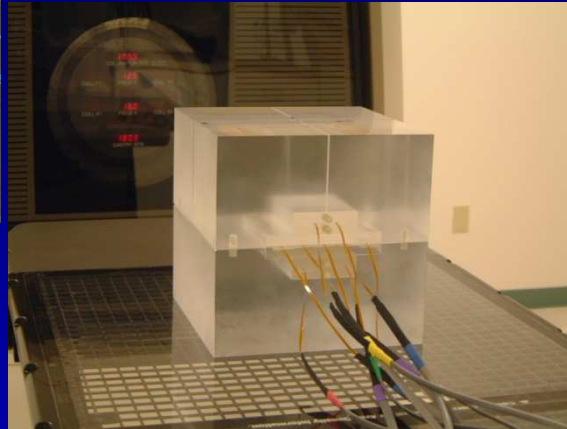
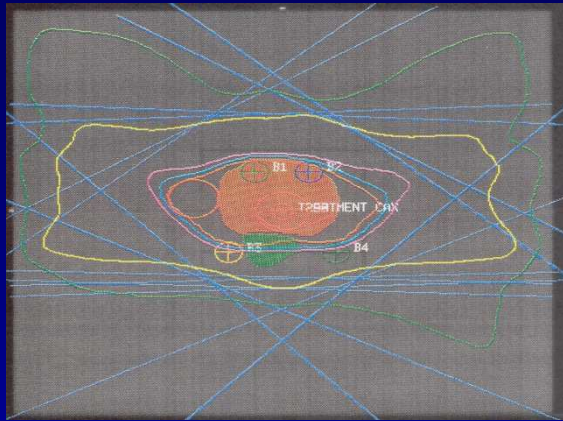
- Using CT images as a patient model
- Design the best radiation beam directions and intensities
- Based on the tumor location and prescription dose.

# An Example of Radiation Dose Distributions



77Gy, 70Gy, 66 Gy, 56 Gy, 50 Gy

# Patient Specific QA



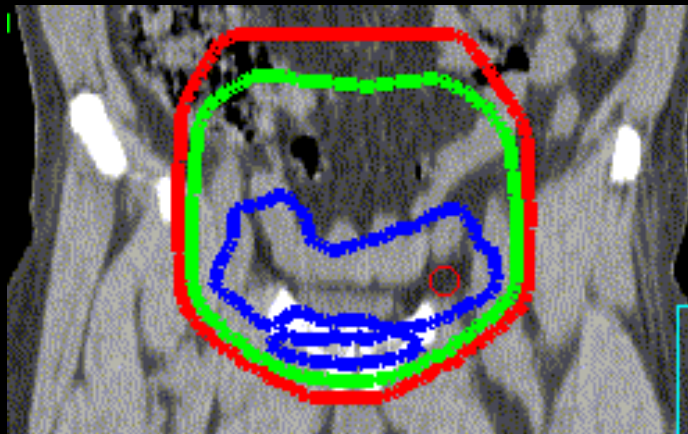
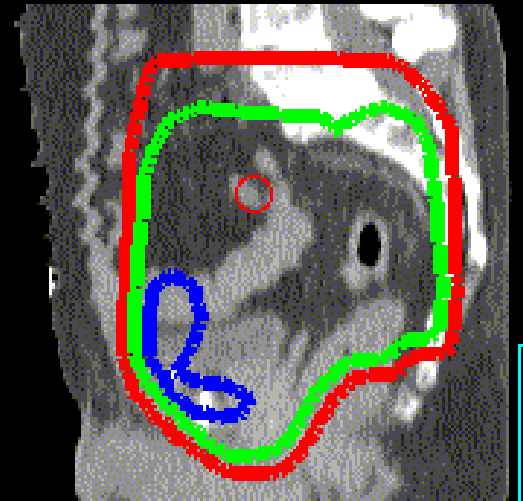
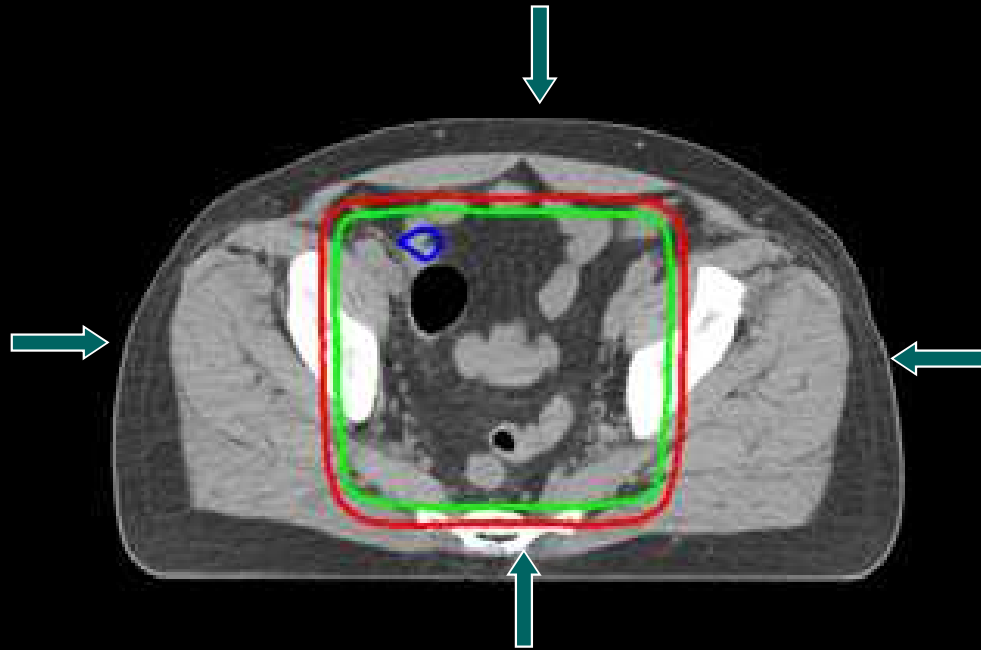
Point doses : RTP vs MOSFET (cGy)

Detectors -->	A1	A2	A3*	A4	A5	B1	B2	B3	B4
RTP-dose	81.7	82.0	99.4	96.8	82.0	102.6	101.9	91.5	90.2
MOSFET	81	82	97	99	82	102	102	94	93
%DIV	-0.9%	0.0%	-2.4%	-2.3%	0.0%	-0.6%	0.0%	2.7%	3.1%

# How Research Improves Clinical Care



# Conventional Dose Distributions

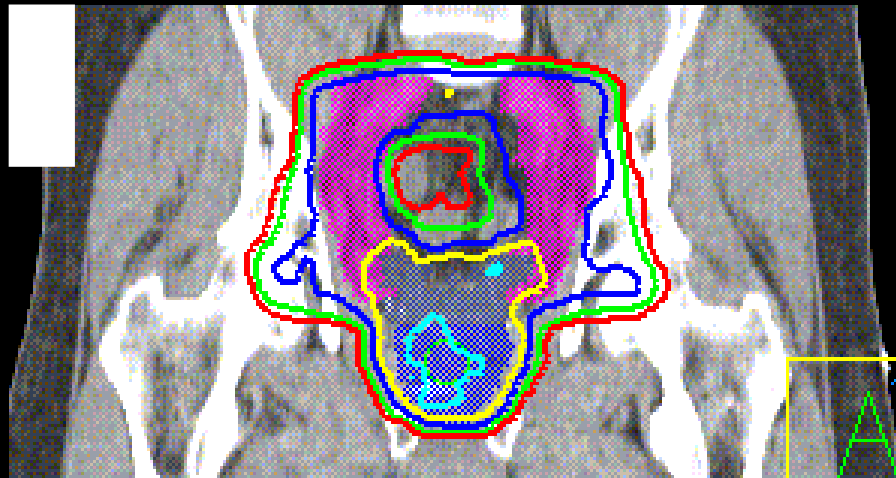
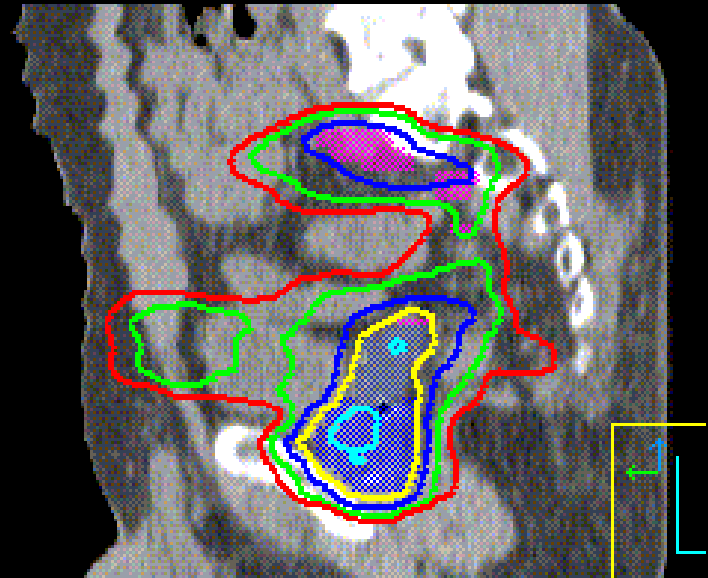


**49 Gy**

**45 Gy**

**35 Gy**

# A Typical Modern Plan



**59.0 Gy**

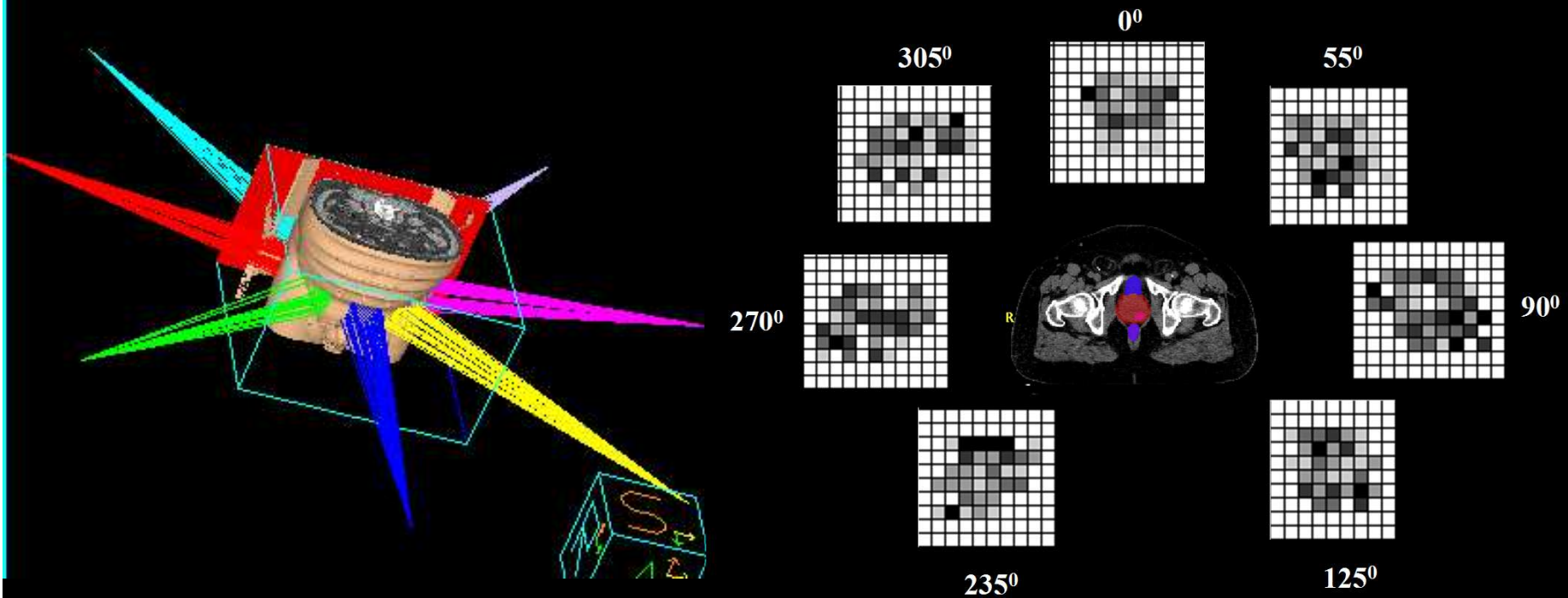
**54.0 Gy**

**48.6 Gy**

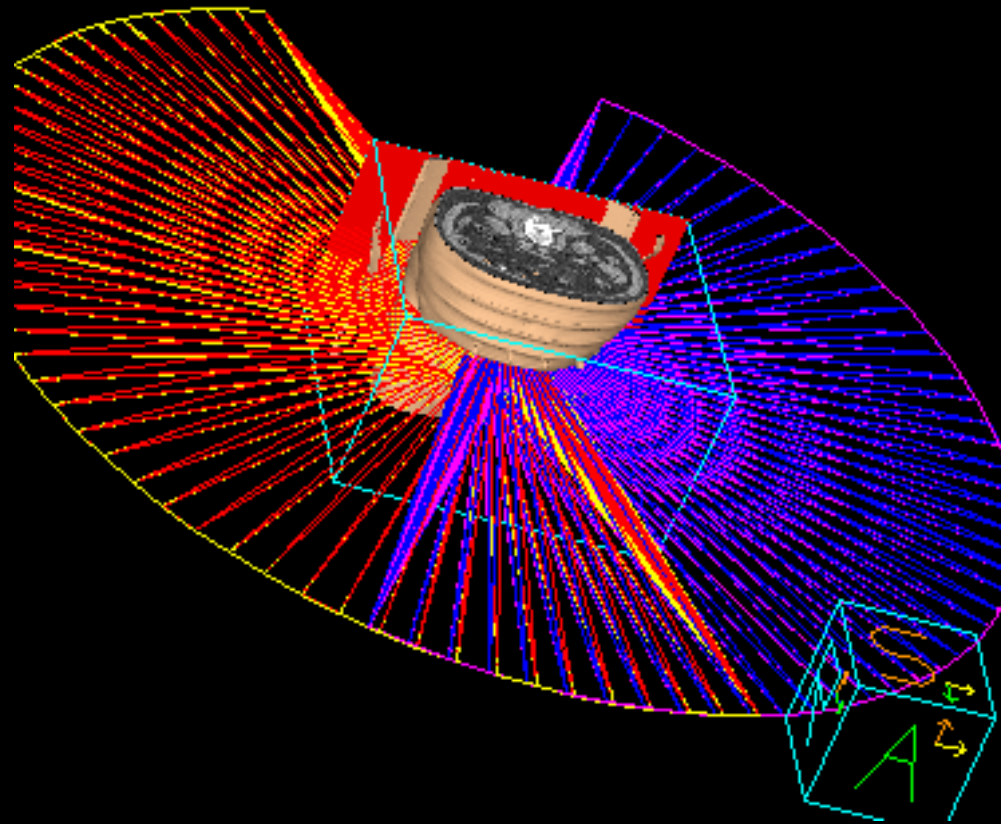
**45.0 Gy**

**35.0 Gy**

# Computer Optimization in Treatment Planning



# Intensity Modulated Volumetric Arc Therapy



Increased beam directions from 7~9 to 90~180

# Image Guided Radiation Delivery

# On Board Imager (OBI)– KV-Cone Beam CT



Elekta KV-OBI



Varian KV-OBI

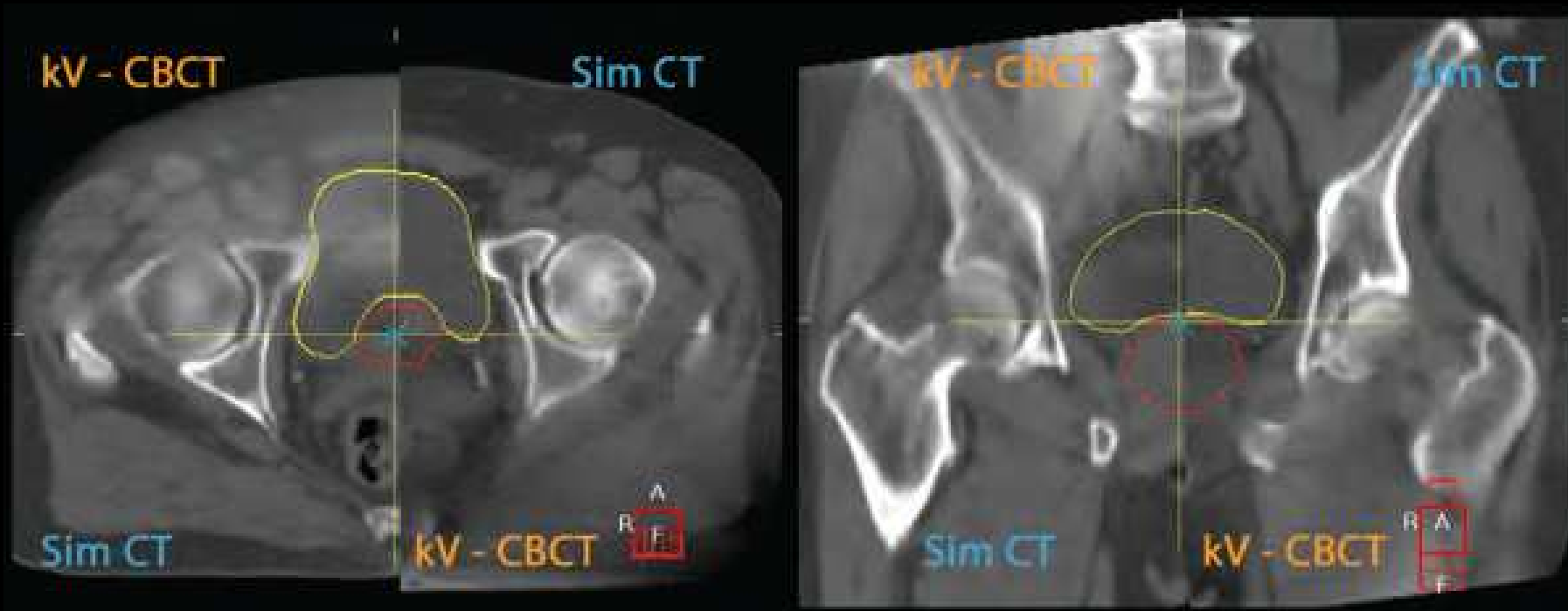
# CT on Rails



Siemens



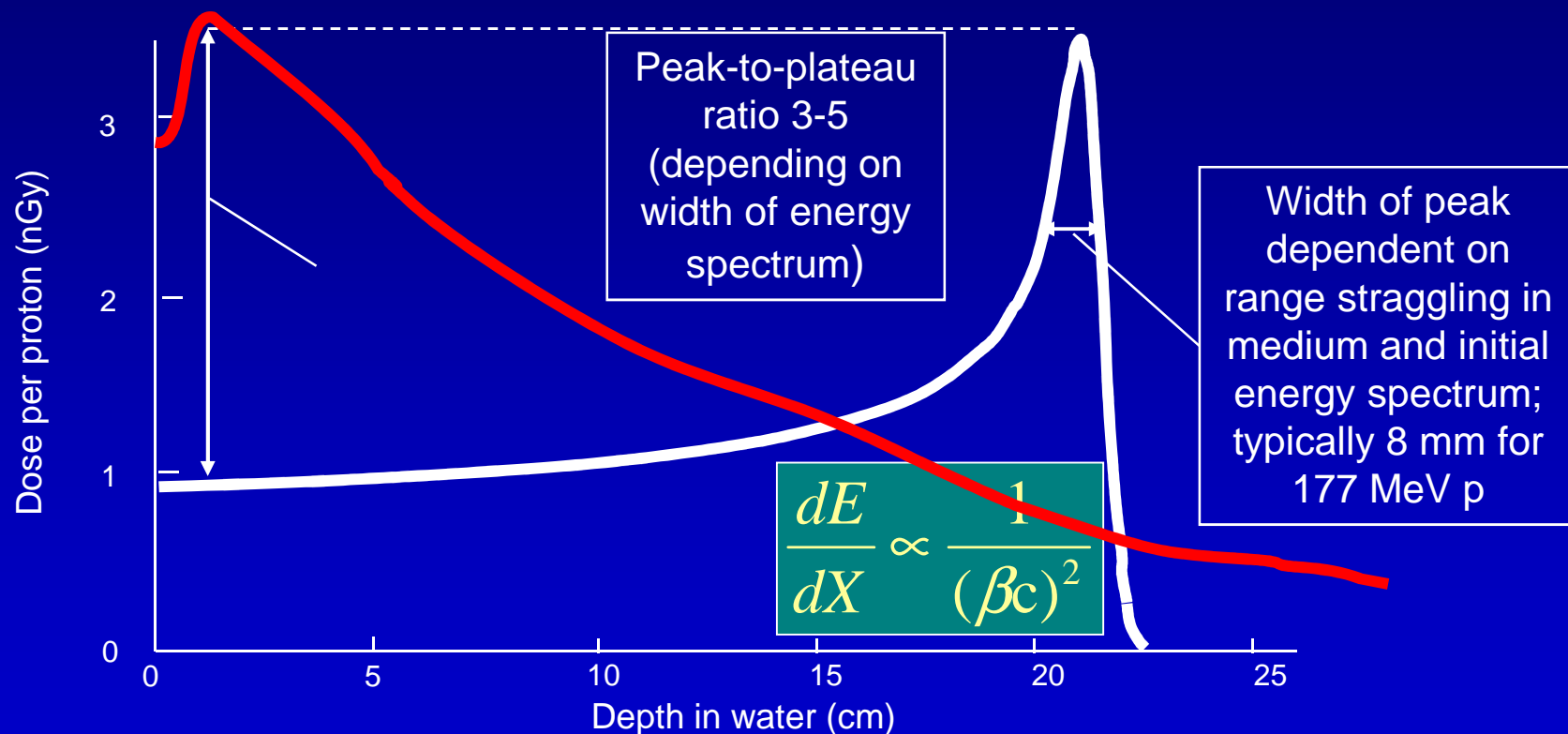
# Co-Registration Between Image of the day With Initial CT Images





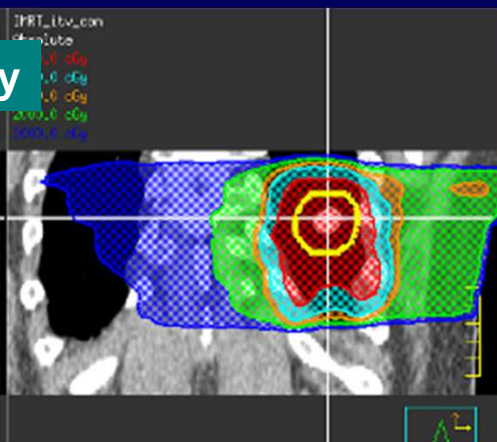
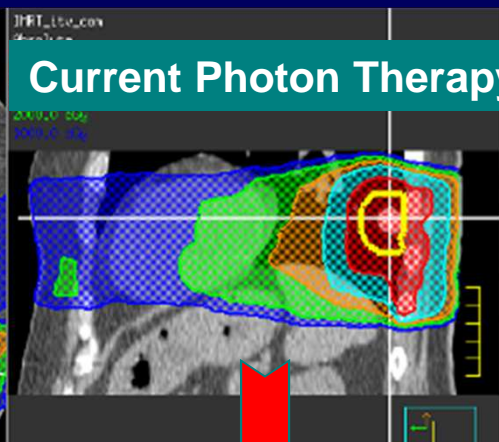
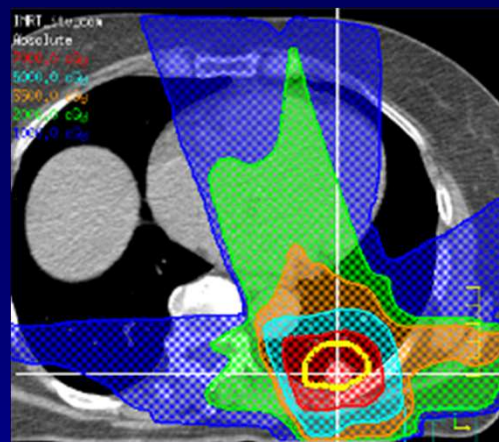
# On the Horizon

# Promise of Proton Radiotherapy

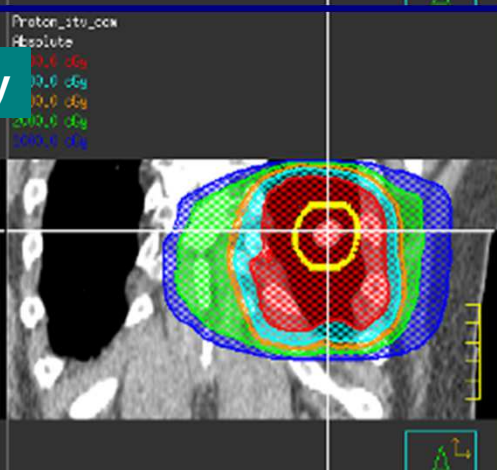
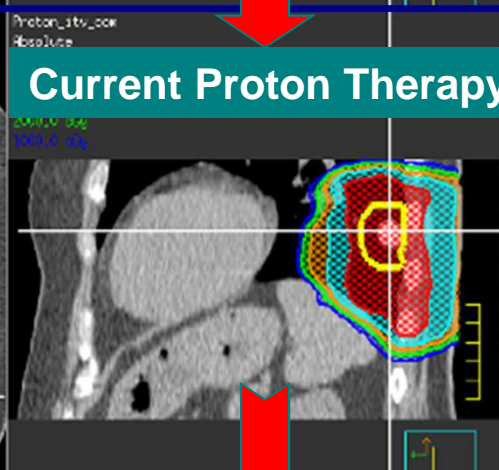
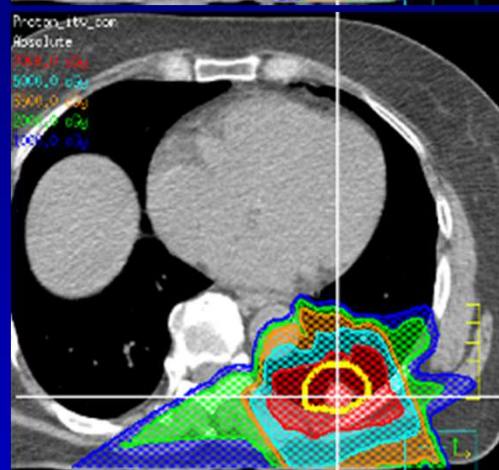


Depth-dose curve for 177 MeV protons

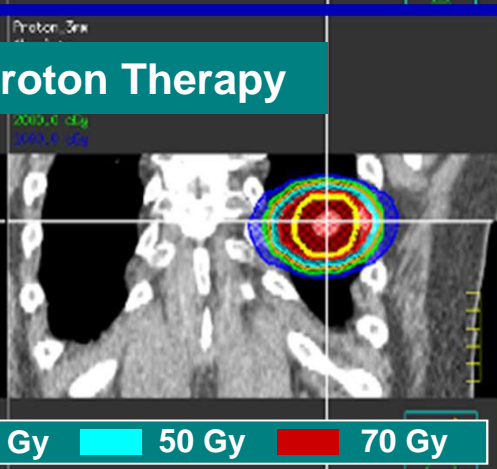
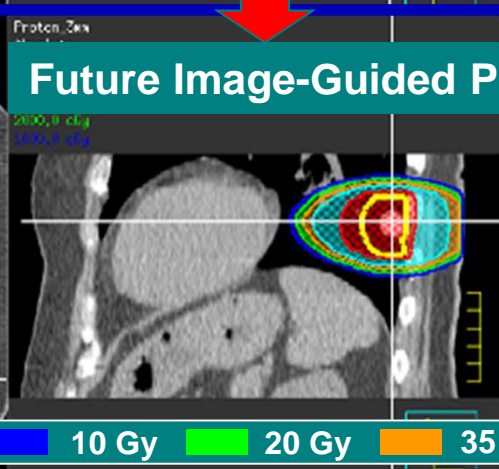
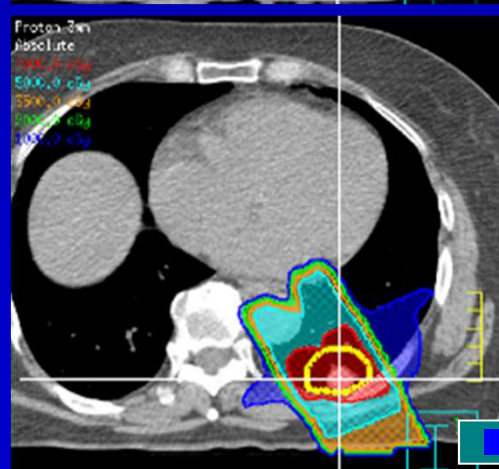
# Research Driven Patient Care



Current Photon Therapy



Current Proton Therapy



Future Image-Guided Proton Therapy



# Summary

# Radiation Therapy Is Effective

- Radiation therapy is a local treatment.
- Radiation is a universal treatment that can treat most solid tumors effectively.
- About 50% of all cancer patients receive some type of radiation therapy sometime during the course of their treatment.

# Responsibilities Of A Medical Physicist

- Assure the safe and effective delivery of radiation
- A qualified medical physicist
  - Obtains a MS or Ph.D. degree
  - Receives clinical training and passes a specific board exam.