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GEORGIAN TECHNICAL UNIVERSITY
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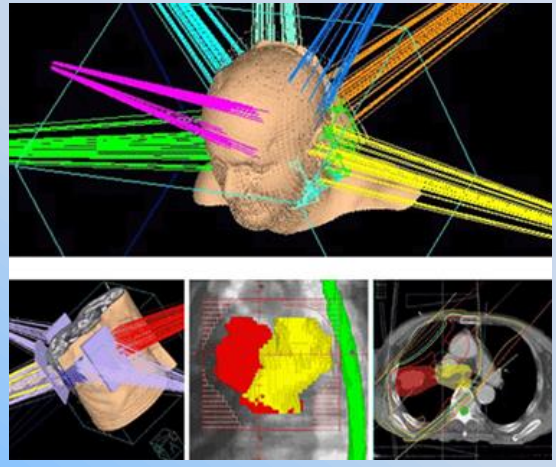
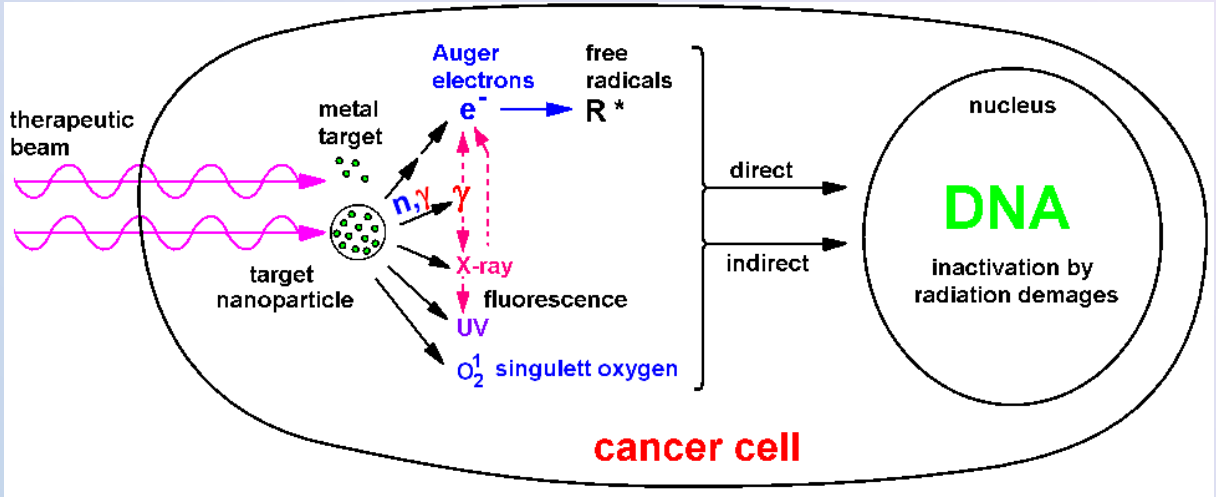
General aspects of Radiation Therapy





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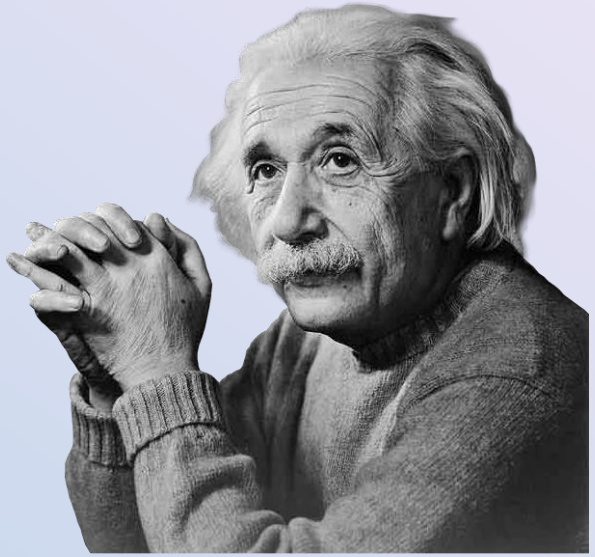
Basic Radiation Principles

X-rays and gamma ray photons - part of the electromagnetic spectrum

Photon energy $E = hv$

plank constant h=6.62 × 10^{-34} J-sec



Albert Einstein
1879 – 1955

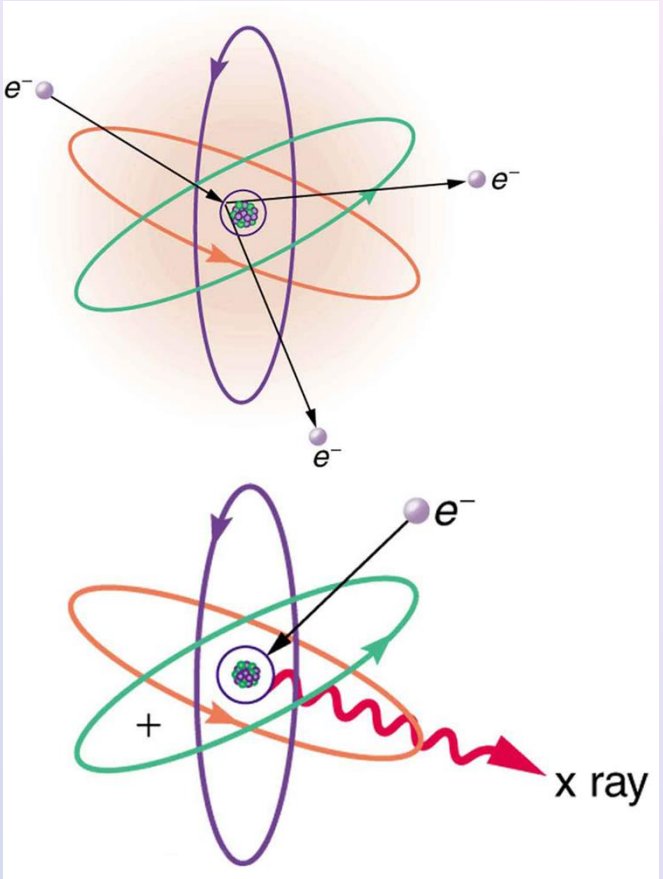
What is radiation?

Radiation - energy in motion

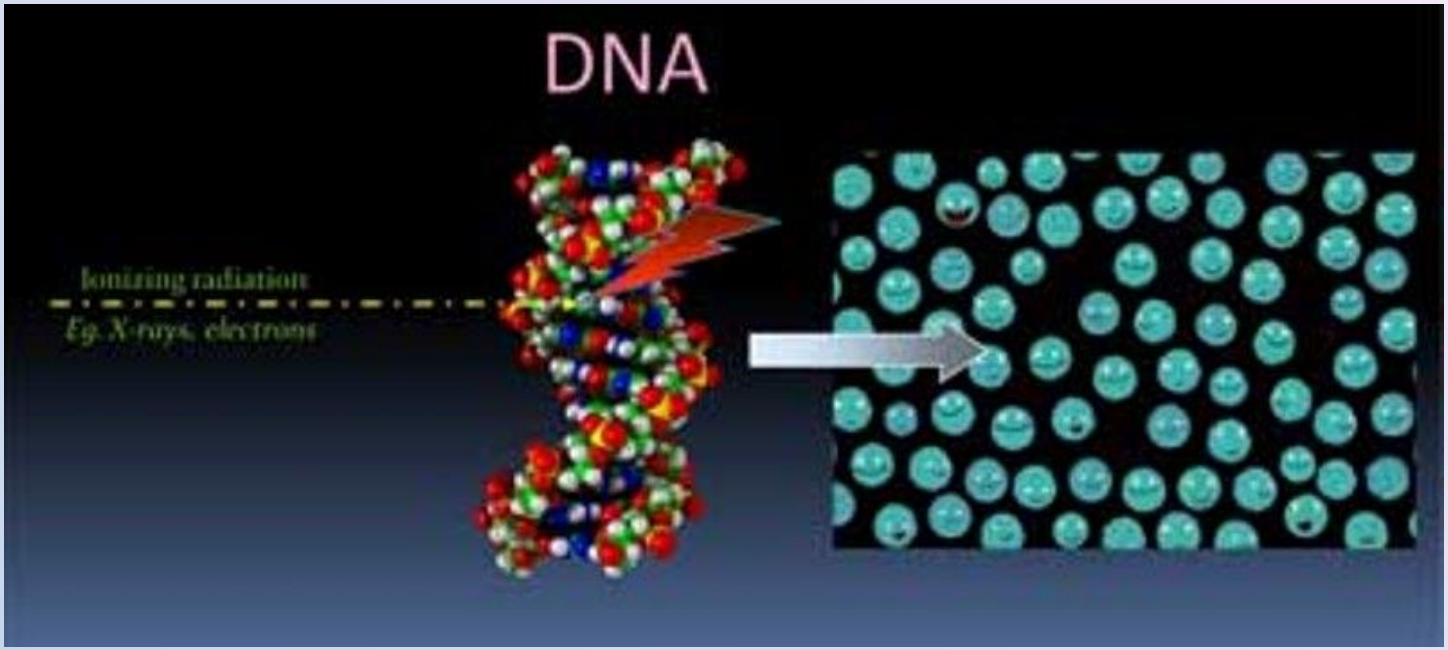
Radioactivity- spontaneous emission of radiation from the nucleolus of an unstable atom

Isotope – Atoms with the same number of protons, but different number of neutrons

Radioisotope – unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation.

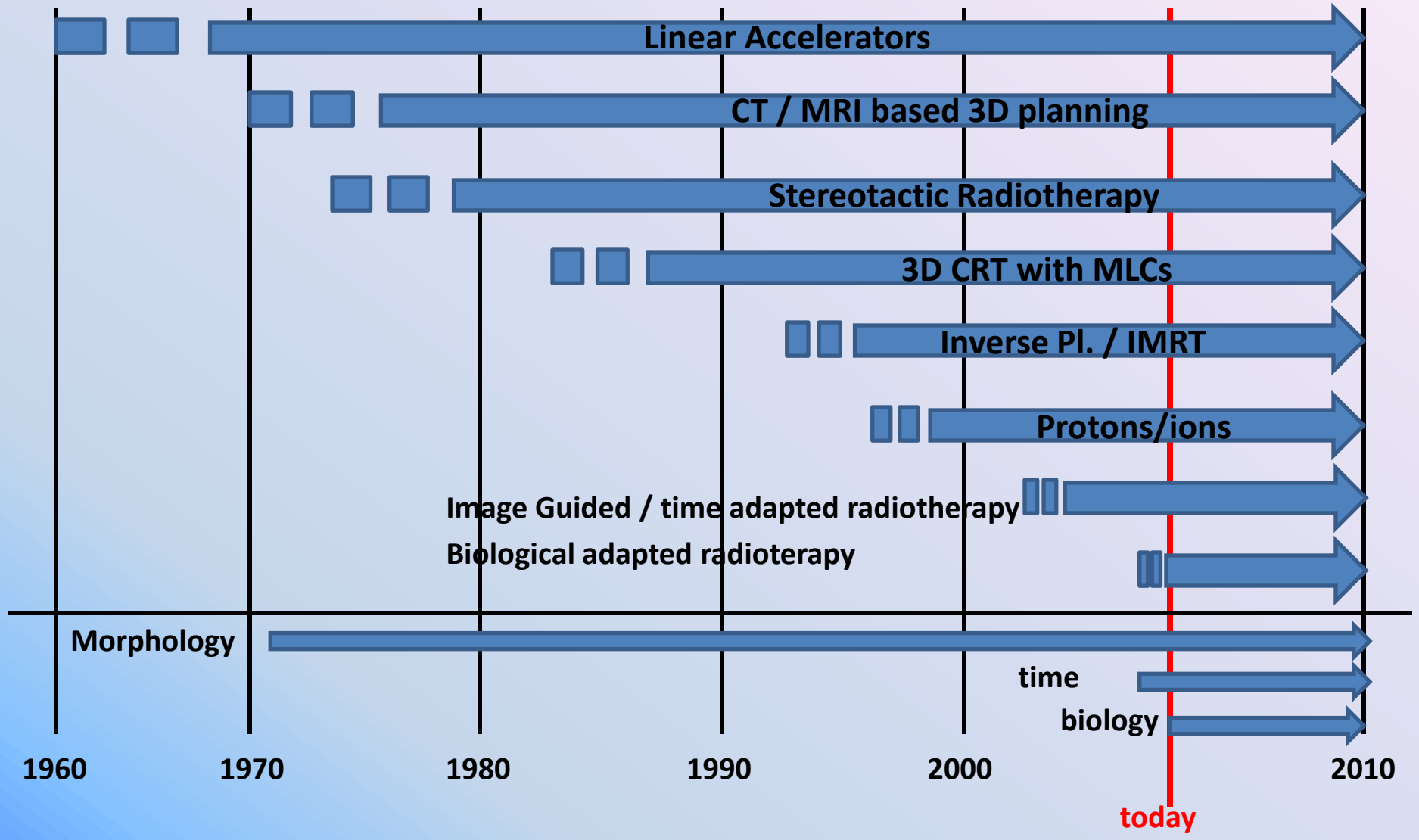


What is Radiotherapy and how radiation helps to kill cancer?

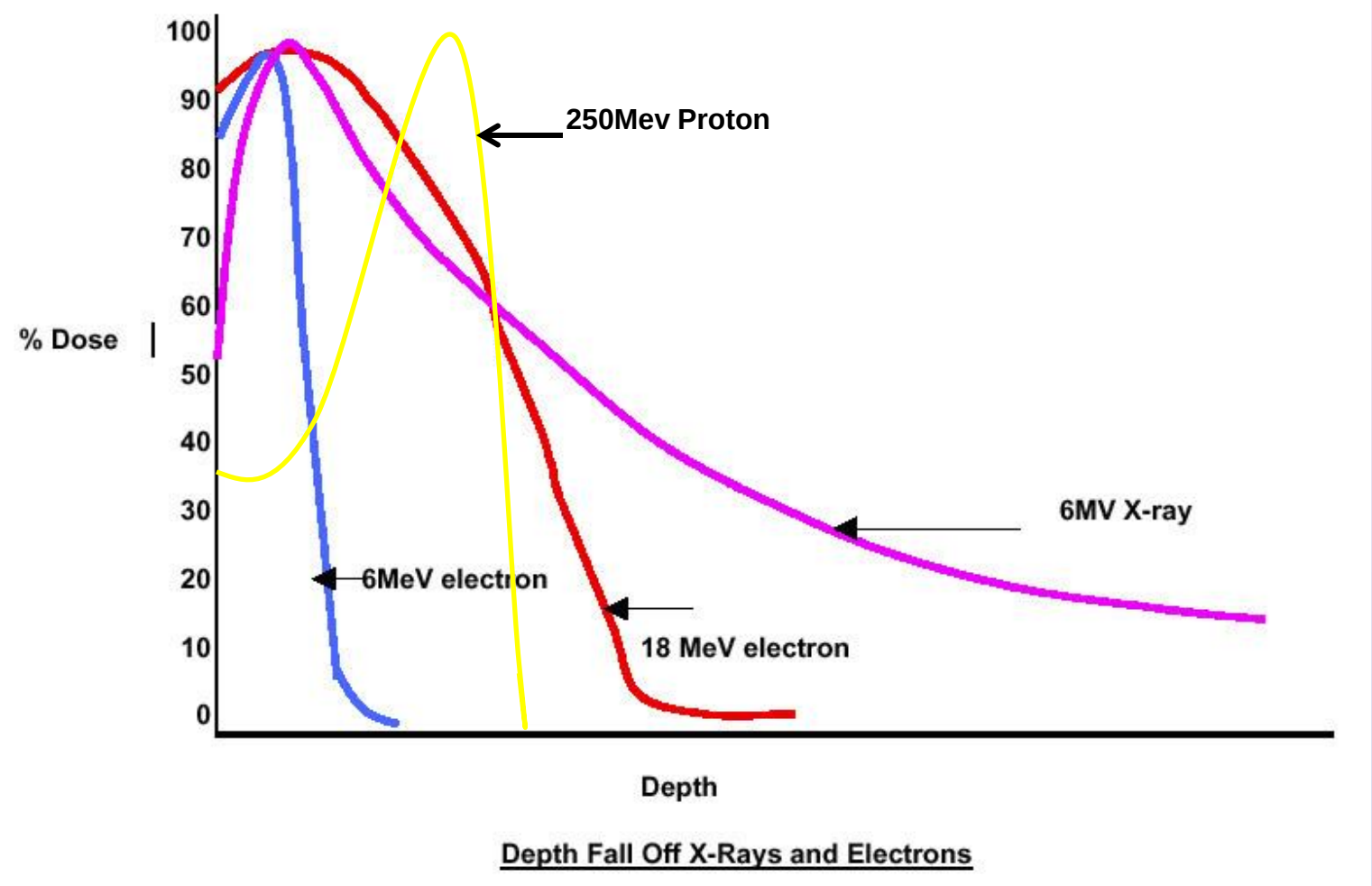


Radiotherapy is the use of ionizing radiation to kill cancer cells and shrink tumors

Innovations in Physics and technology for the benefit of cancer patients

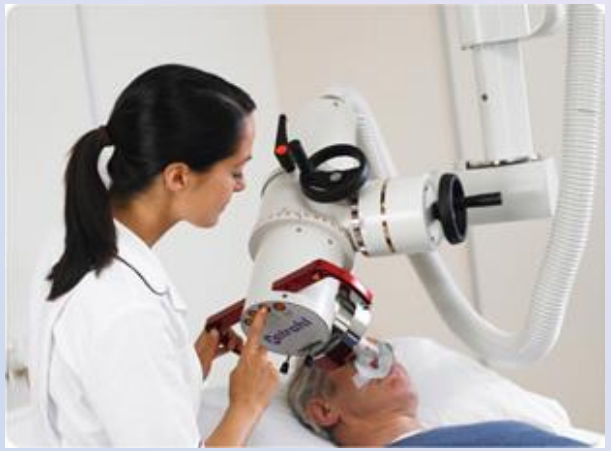


Variation of dose with depth (x-rays and electrons).



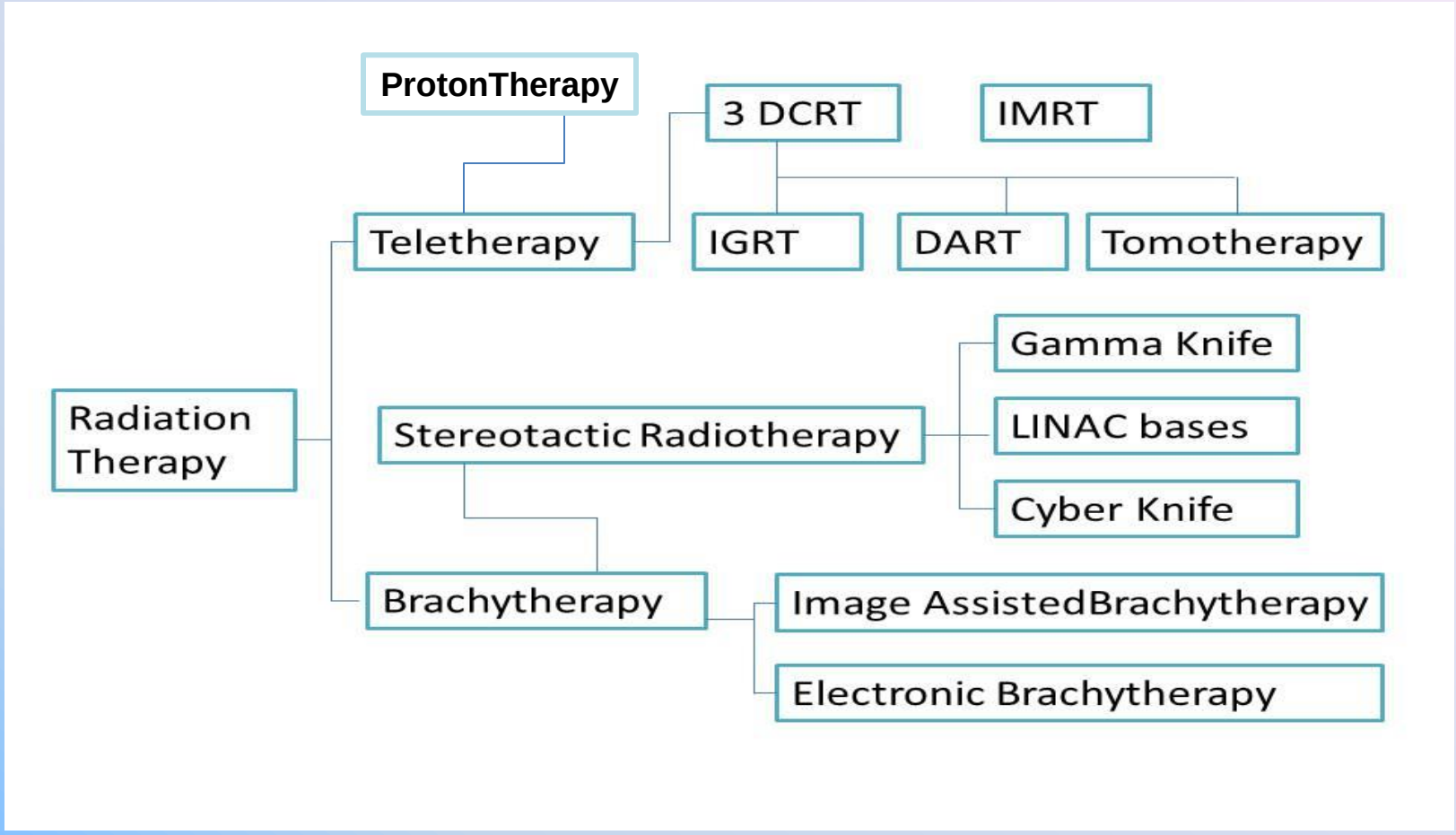
Different techniques used in Radiation Therapy

- Kilovoltage X-ray units
  1. Grenz rays/border x-rays (10kV to 20kV)
  2. Short distance or contact therapy (10kV to 60kV)
  3. Superficial therapy (50kV to 150kV)
  4. Intra Operative Radiotherapy (50 kV)
  5. Orthovoltage therapy or deep therapy (150kV to 400kV)



Different techniques used in Radiation Therapy

- Megavoltage Linear Accelerators, or Co-60 units



Different techniques used in Radiation Therapy

Brachytherapy

Gamma Knife

Tele-Gamma Therapy

Different techniques used in Radiation Therapy

TomoTherapy

Cyber Knife

Different techniques used in Radiation Therapy

Proton Therapy

Linear Accelerator - TrueBeam

Treatment Process

Consultation - review the history of patient illness and performing a physical examination

Simulation - to determine the treatment position

Immobilization – to ensure correct positioning

Skin Reference – tattoos on skin for correct field identification

Treatment Planning – calculating the radiation dose that will be delivered to the patient's tumor and the surrounding normal tissue

Verification – approval of the best treatment plan

Treatment Delivery - Irradiation

Key Staff Functions

	Key Staff	Supportive Staff
1. Clinical evaluation	Radiation Oncologist	
2. Therapeutic decision	Radiation oncologist	
3. Patient immobilization	RTT – MR	Rad.Oncologist
	Dosimetrist	**Physicist**
4. Target volume localization:		
Target volume determination	Radiation Oncologist	RTT-Sim
Sensitive critical organs	Radiation Oncologist	RTT-Sim
		Dosimetrist
Patient contour	RTT-TPS	**Physicist**
		RTT-Sim
		Dosimetrist

Key Staff Functions

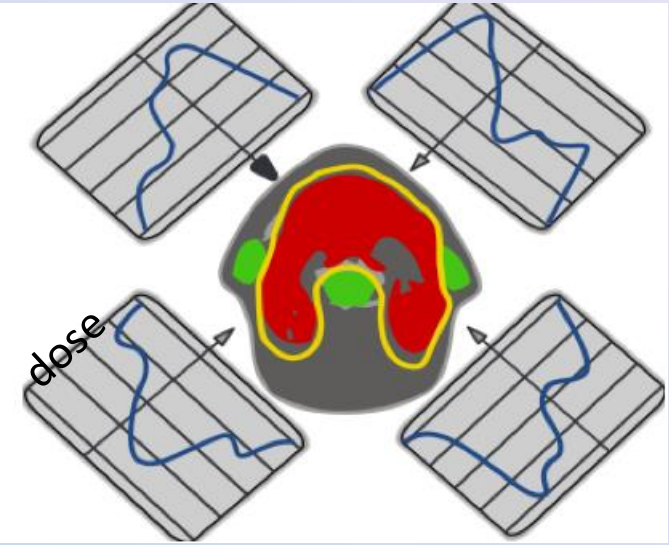
	Key Staff	Supportive Staff
5. Treatment Planning		
Beam data computerization	**Physicist**	
Computation of beams	**Physicist**	**Dosimetrist**
Shielding blocks, treatment aids, etc.	**Dosimetrist**	Rad. oncologist
	RTT-MR	**Physicist**
Analysis of alternative plans	Rad.Oncologist	**Dosimetrist**
	Physicist	RTT-TPS
Selection of treatment plan	Rad.Oncologist/	
	Physicist/Dosimetrist	
Beam-on time (MU) calculation	RTT-TPS	
	Dosimetrist	
	Physicist	

Key Staff Functions

	Key Staff	Supportive Staff
6. Simulation/verification	Rad.Oncologist	**Dosimetrist**
of treatment plan	RTT-Sim	**Physicist**
7. Treatment:		
First day set-up	Rad.Oncologist	**Dosimetrist**
	Dosimetrist	**Physicist**
	RTT	
Localization films	Rad.Oncologist	**Dosimetrist**
	RTT	**Physicist**
Daily treatment	RTT	
8. Evaluation during treatment	Rad.Oncologist	Social worker
	RTT	Dietician
9. Follow-up examination	Rad.Oncologist	Data manager,Dietic.
	Nurse	Social worker

Medical Radiation Physics

Deliver optimized high dose to all parts of the tumor while minimizing the dose to surrounding normal tissue.



Organs at Risk

Target

Uniting physics, biology and medicine for better healthcare

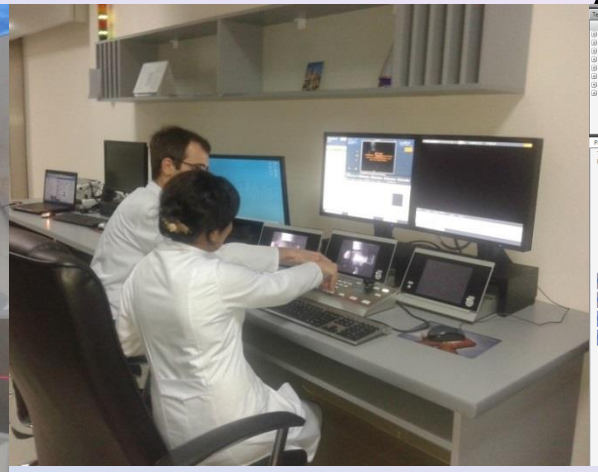
Things to be done and responsibilities

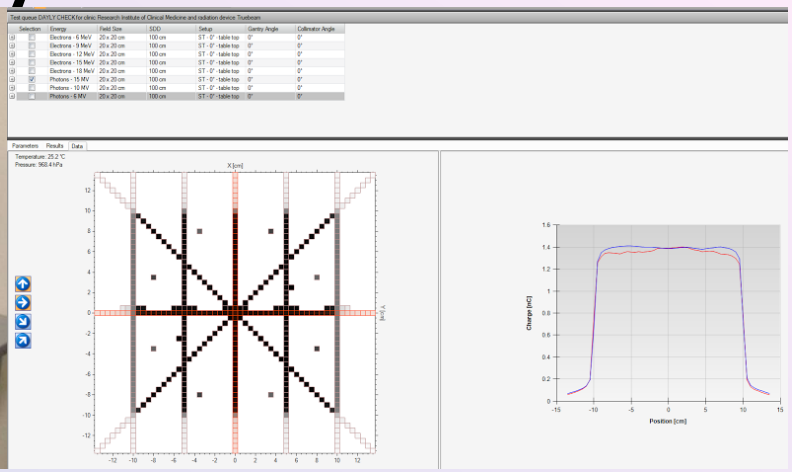
- Ensuring the correct calibration of treatment units both during commissioning and on a regular basis;
- Ensuring the correctness and accuracy in patient dose calculations, both computerized and manual;
- Designing, implementing and supervising quality assurance procedures;
- Participating in the continuing review of the radiotherapy practice's resources (including budget, equipment and staffing), operations, policies and procedures;
- Planning, in conjunction with the radiotherapy physician and the RPO, the facilities for radiotherapy practice;

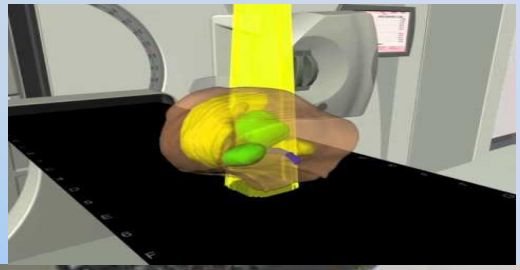
Things to be done and responsibilities

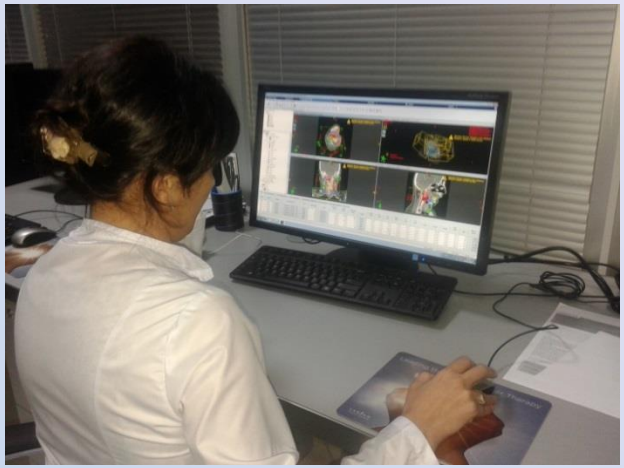
- Preparing performance specifications for equipment with regard to radiation protection;
- Ensuring the establishment and maintenance of a radiation protection programme for the safety of staff and the public;
- Test equipment for acceptance, commission equipment for clinical use and supervise equipment maintenance;
- Participating in the investigation and evaluation of incidents and accidents;
- Contributing to the radiation protection training programme.

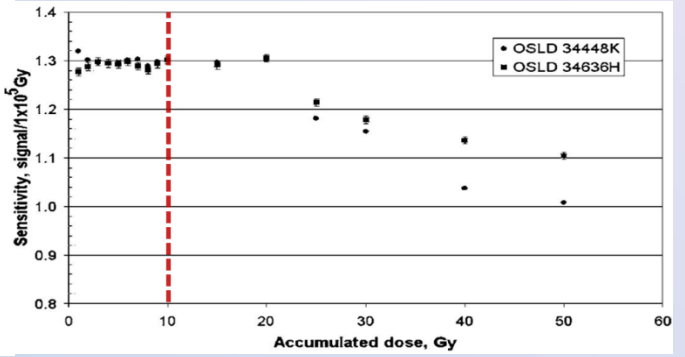
Medical Physics











Quality Assurance vs. Quality Control

Quality Assurance

An overall management plan to guarantee the integrity of data (The “system”)

Quality Control

A series of analytical measurements used to assess the quality of the analytical data (The “tools”)

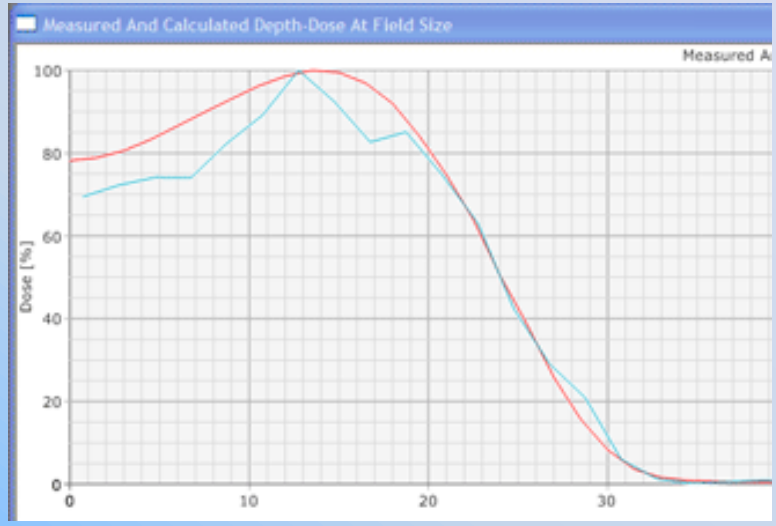
True Value vs. Measured Value

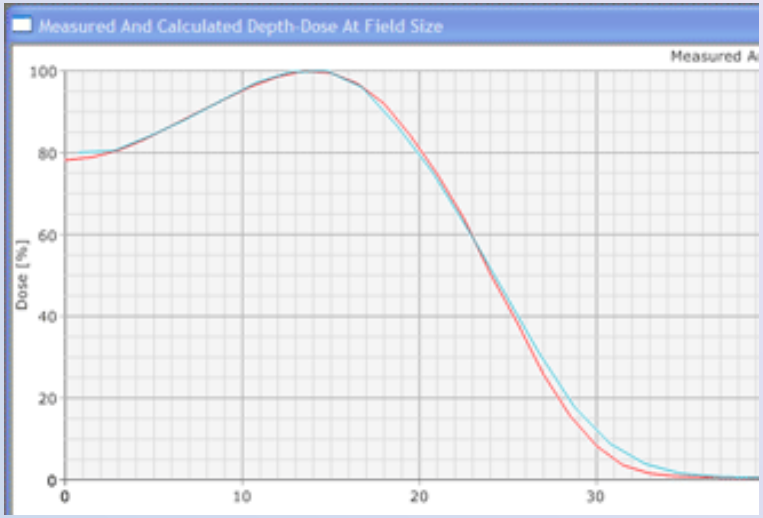
True Value

The known, accepted value of a quantifiable property

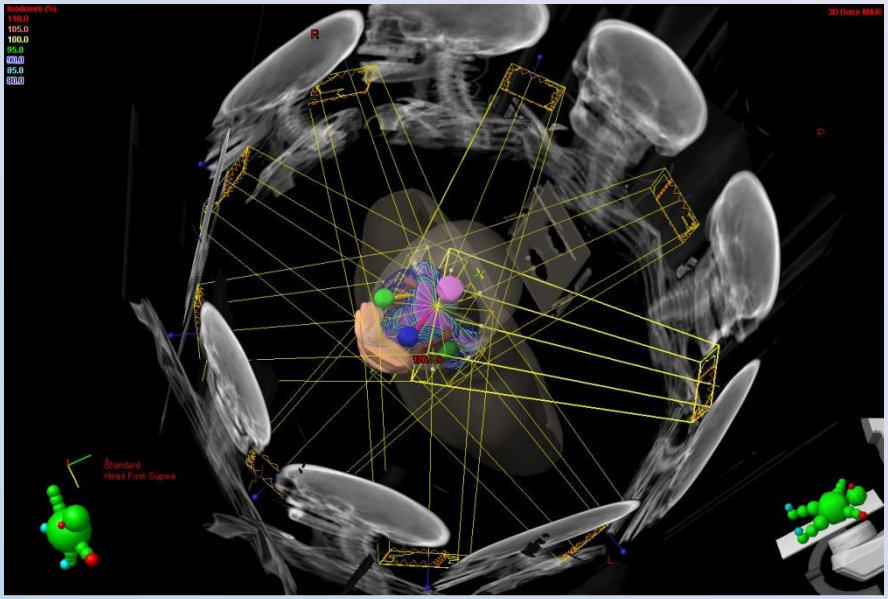
Measured Value

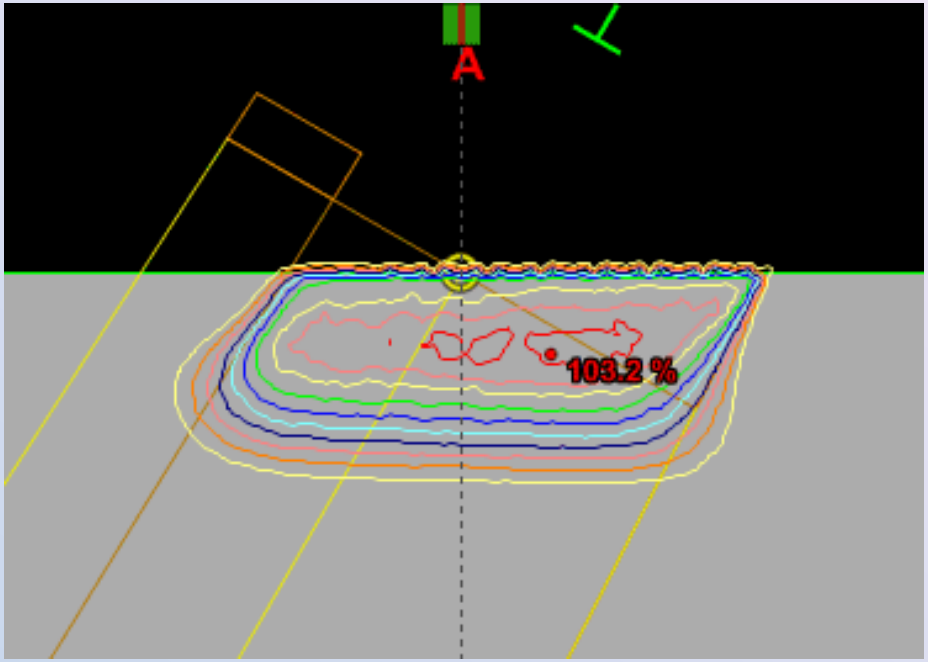
The result of an individual's measurement of a quantifiable property





True Value vs. Measured Value





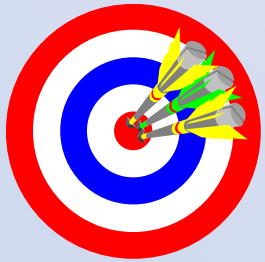
Accuracy vs. Precision

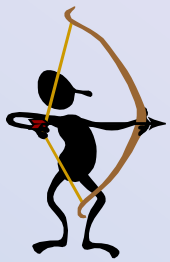
Accuracy

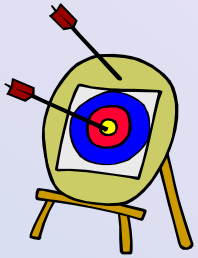
How well a measurement agrees with an accepted value

Precision

How well a series of measurements agree with each other

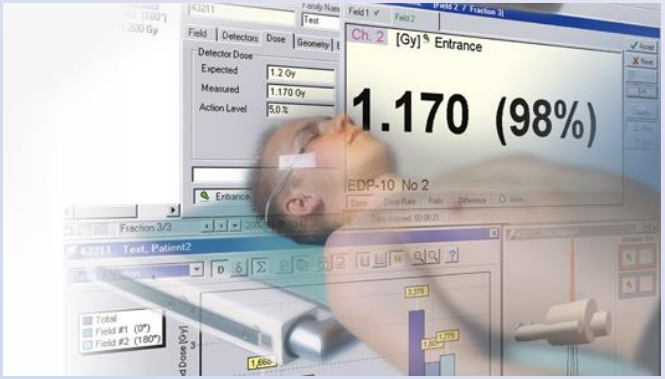


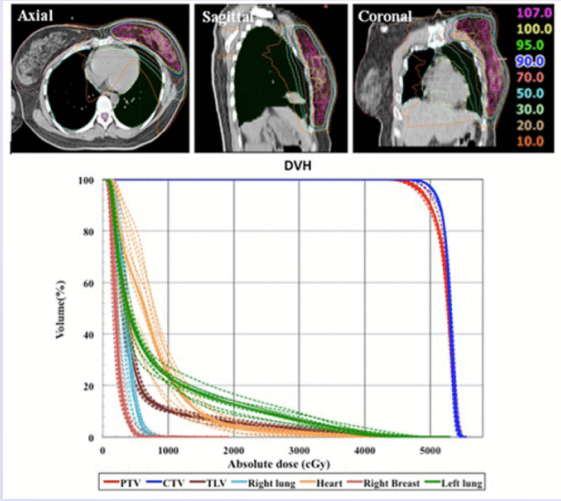




To give priority to healthy life

- Radiation Safety of Patient





- Radiation Safety of Staff

Thanks for your attention!

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