
5 MV PELLETRON TANDEM ACCELERATOR

RADIATION SAFETY

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Radiation Protection

“Maintain a working environment where levels of ionizing radiation pose minimal acceptance risk”

“how to safe use of radiation emitted instruments/devices for different kind of useful works”

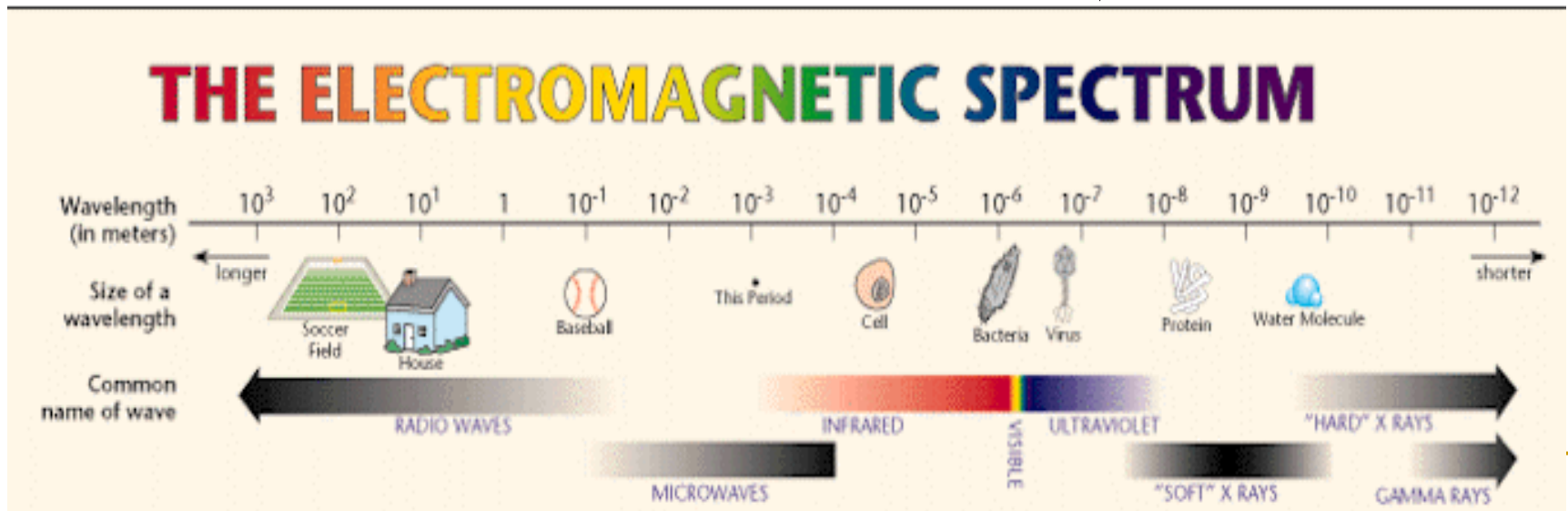
Types of Radiation

Radiations are of two types based on their nature and energy they carry.

- NON IONIZING Radiation
- IONIZING Radiation

Non-Ionizing

Ionizing



Non Ionizing Radiation

Definition:

“The radiation which do not produce any chemical or physical change in substances when pass through it”. They are less harmful biologically”.

Examples:

- Visible light
 - Radio Waves
 - Microwaves
 - Sound waves
 - LASER
 - Ultraviolet Light
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Ionizing Radiation

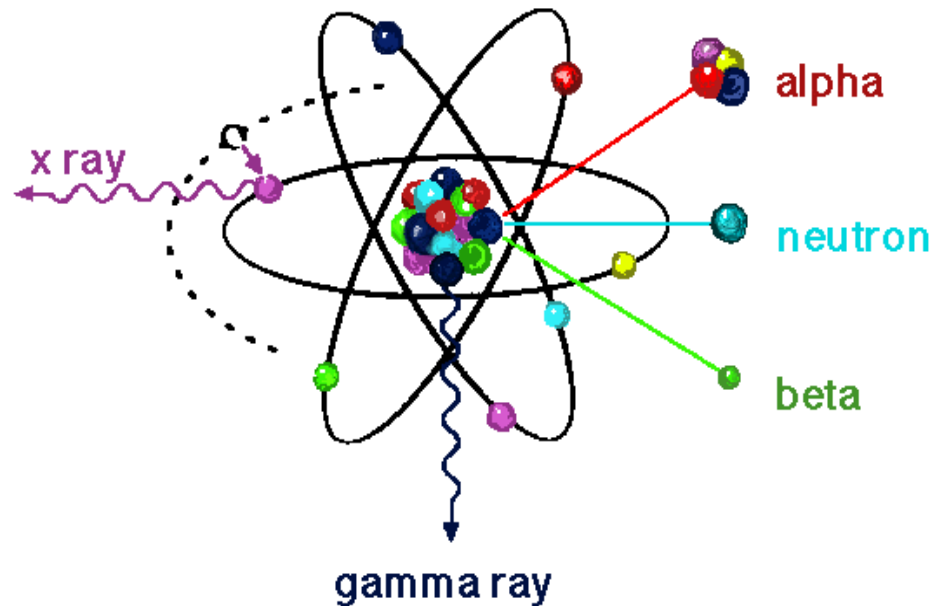
Definition:

“The radiation which produces any chemical or physical change in substances when passes through it”.

These are harmful biologically.

Examples:

- Alpha Particles
- Beta Particles
- Gamma Rays
- Neutrons
- X-Rays



Radiation Hazards

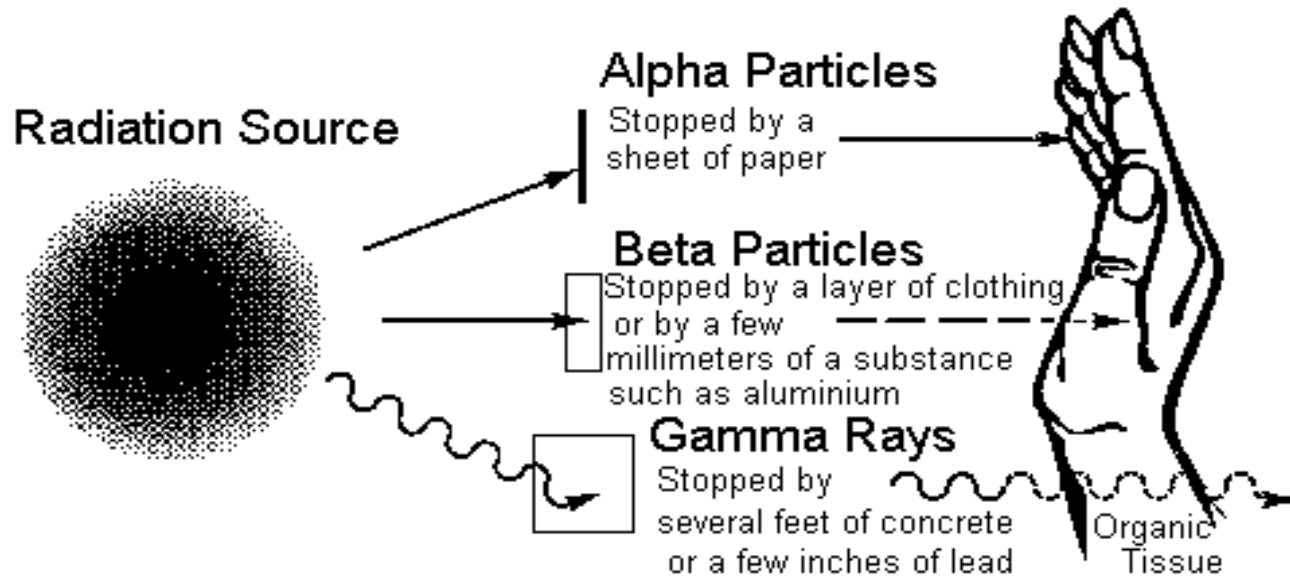
- Ionizing radiations can significantly alter the structure of material through which they pass.
 - Frequently exposure to ionizing radiations can destroy or mutate body cells. It can result in DNA damage in cell structure which transfer from one generation to other.
 - High intensity of ionizing radiations can cause severe burns even after few moments of exposure characterized by reddening of skin.
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Radiation Risks

- Cancer (leukemia, tumor)
 - Hereditary effects
 - Erythema (skin reddening)
 - Cataracts
 - Sterility
 - Epilation (hair loss)
 - Hematological
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Shielding of Ionizing Radiation

- **The Penetrating Powers of Alpha and Beta Particle and Gamma Rays.**



- Neutron high penetrating power, Shielding: water, paraffin wax and few feet concrete wall.

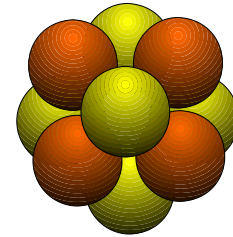
Radiation Sources

➤ **Radioactive material**

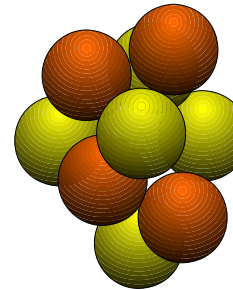
Any substance which contains or consists of radioactive nuclide (which emits ionizing radiation) ,naturally occurring or artificially produced is called radioactive material.

➤ **Radiation generator**

A device capable of generating Ionizing radiation is called radiation generator.



STABLE
NUCLEUS



UNSTABLE
NUCLEUS

Types Of Research Radiation Apparatus

Radiation Generators

There are numerous types of irradiating apparatus used in research.

Example

- XRD (to study material structure)
- XRF (For elemental analysis)
- Accelerators (e.g. cyclotron, linear acc., electrostatic acc. etc.)
- Reactors.

Unlike radioactive nuclides, these radiation generators will only emit radiation when high voltage is applied to it or when switched ON.

Safety Planning for Accelerator

- Radiation Training
 - General measurements for Personnel safety
 - Personnel monitoring
 - Medical Checkup
 - Area monitoring
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Personnel Training

Personnel protection comes 1st therefore three officers were trained at HPD, PINSTECH for two weeks ,One week in Personal radiation dosimetry lab. and one week in Applied health physics lab.

**All other Radiation Workers were trained by those officers
All radiation workers are fully trained in following topics.**

- **Health protection problem associated with exposure related to radioactive material or radiation.**
 - **Precaution or procedure to minimize exposure**
 - **Purpose and function of protective devices employed**
 - **Action to take in the event of an emergency**
 - **Worker's responsibility to promptly report any condition that lead to or cause a violation of regulation or cause an unnecessary exposure.**
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General measurements for Personnel safety

- Written Instructions are posted at the entrance of Accelerator hall for the guidance of radiation works /researchers/students.
 - Back door is Cordon off.
 - Hall entrance is Interlocked
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General measurements for Personnel safety

Warning lights and signs



Radiation area

No smoking



Accelerator and
beam ON lights

**ACCELERATOR
ON**

**BEAM
ON**

Personnel Monitoring (Methods)

To measure dose received by radiation workers

- **Three main methods**
 1. Film badge
 2. TLD (Thermoluminescence dosimeter)
 3. Pocket dosimeters
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Personnel Monitoring

- **Dosimeters at accelerator facility:**
 - Beta, Gamma and X-rays TLDS
 - Pocket dosimeters
 - Availing the services of Thermo-luminescent Dosimeters (TLD) from PINSTECH.
- **Monitoring period and permissible dose:-**
 - After every 10 weeks .
 - Permissible dose for workers=20mSv/year
 - =1.67mSv/month
 - =9.1uSv/hr

Medical Examination

- Medical examination of radiation workers on annual basis is an international practice
- In case of over exposure or any mishap, it is necessary to conduct medical examination of radiation workers.
- Medical examination depends on types and extent of exposure . Normally a following tests are taken
 - blood CP,
 - chest X-rays
 - urine test
 - Lungs function
 - Audiometric test.

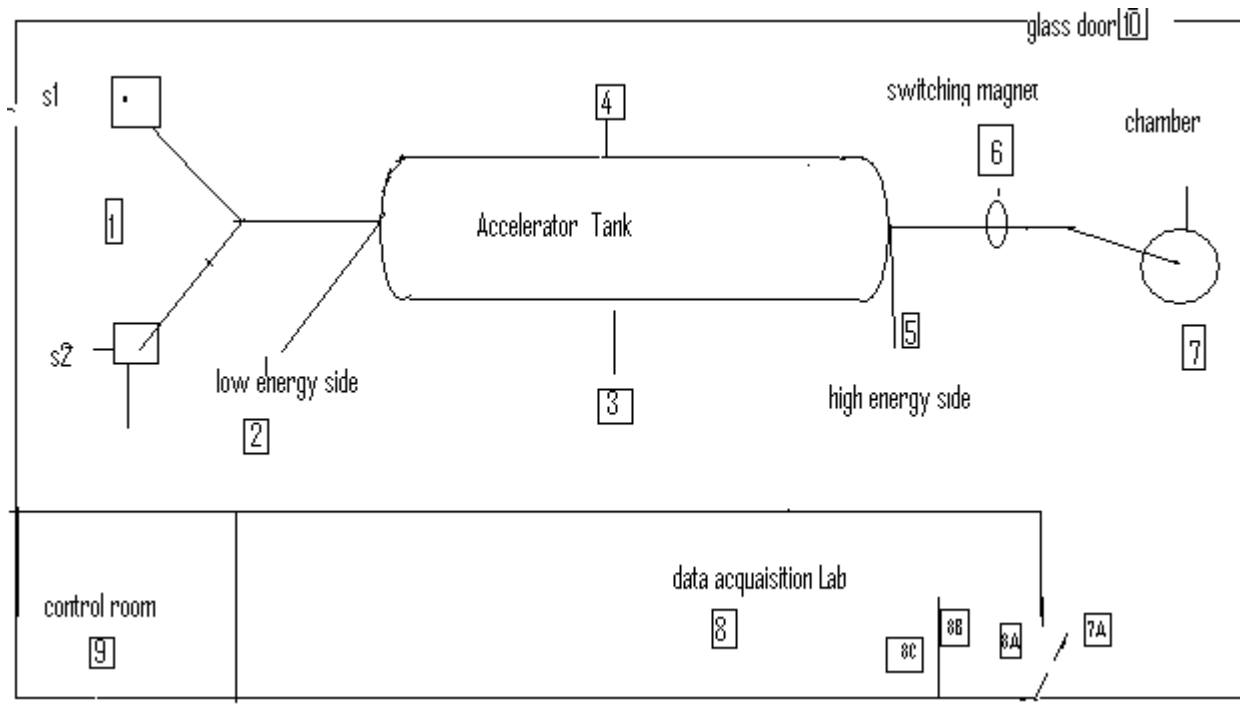


Area Monitoring

- Classification of radiation area.
 - Radiation area survey
 - Contamination Monitoring
- To evaluate presence of undesirable radioactive substances
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Area Monitoring

Classification of radiation area



Area Monitoring

■ Radiation detectors

we use two type of radiation detectors

➤ **Beta ,Gamma and X-rays radiation detector**

Name:	Detection Unit
Effective range (for gamma)	0.1uGy/hr-10mGy/hr
For low sensitivity range	0.1uGy/hr-150uGy/hr
For low sensitivity range	150uGy/hr-10mGy/hr

Neutron Detector

Name:	Detection Unit
Effective range	0.1uSv/hr-100mSv/hr
Energy range	0.02ev-10 MeV
Detector type	Scintillation Detector

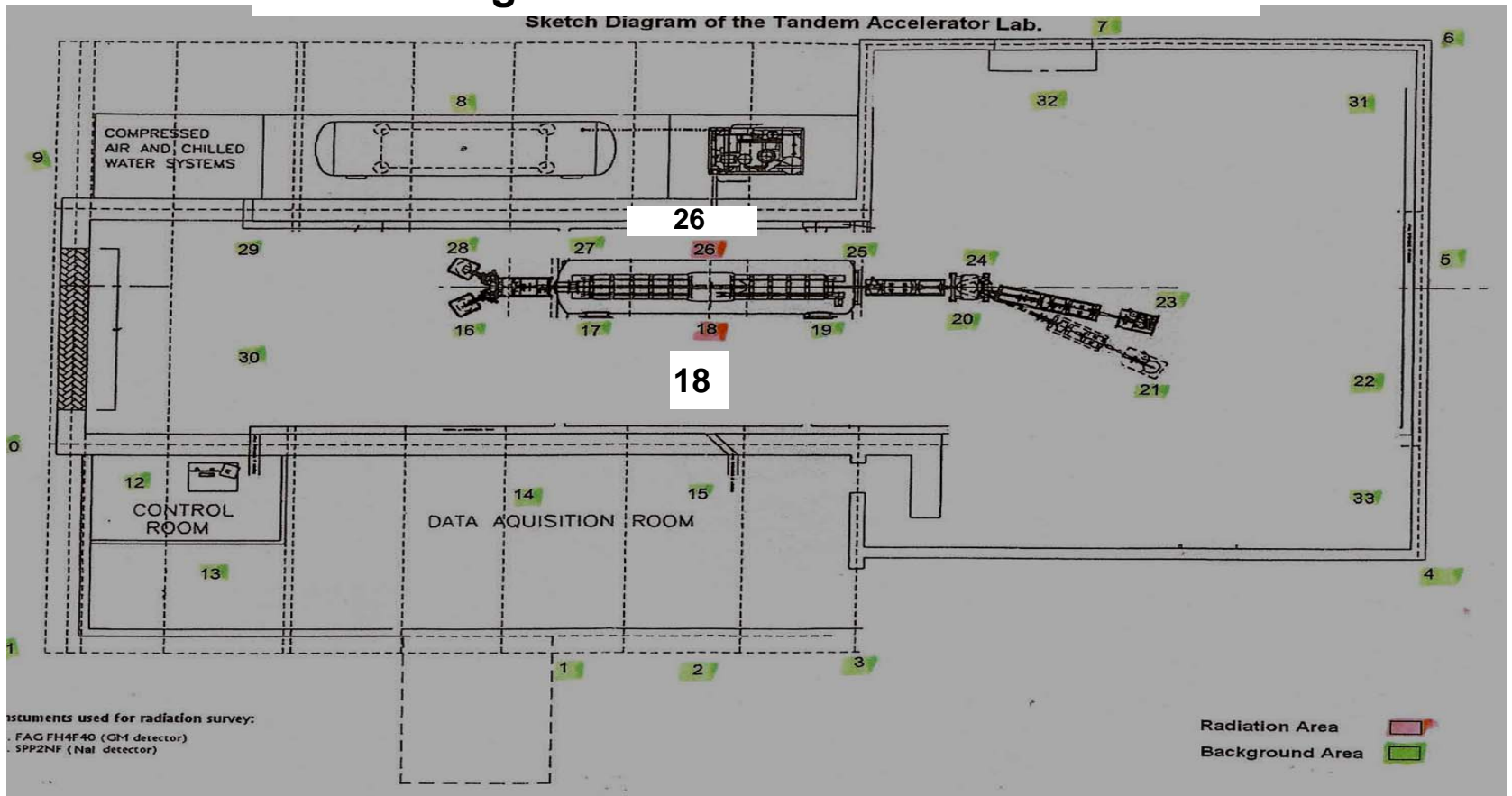


Dose Record

Name	Designation	Dose (27-10-08 to 27-01-09) mSv/hr	Dose (27-01-09 To 14-04-09) mSv/hr	Dose (14-04-09 To 25-08-09) mSv/hr	Dose (25-08-09 To 20-11-09) mSv/hr	Total Dose mSv/hr
Dr.Aqeel Ahsan Khuram	Manager	0.43	0.64	0.52	0.24	1.83
Mr.Ishfaq Ahmad	manager	0.4	0.77	0.58	0.36	2.11
Mr.Turab Ali	manager	0.72	0.46	0.76	0.35	2.29
Mr.Kamran Nawaz	Tech-III	0.57	0.52	0.73	0.39	2.21

Survey Report (PINSTECH)

Sketch Diagram of the Tandem Accelerator Lab



Survey Report (PINSTECH)

Table 1: **Radiation level for different terminal voltage and current (Point no. 18 and 26)**

S. No	Terminal Voltage (MV)	He ⁺⁺ Current (nA)	Radiation Level ($\mu\text{Sv.h}^{-1}$)	
			Point No. 18	Point No. 26
1.	1.5	0	Background	Background
2.	2.0	0	Background	Background
3.	2.5	0	Background	Background
4.	3.0	0	Background	Background
5.	3.5	0	Background	Background
6.	3.5	170	25	52
7.	3.5	40	6.24	8.62
8.	3.0	70	5.3	6.0
9.	2.5	70	2.0	2.64
10.	2.0	35	1.9	2.55
11.	1.5	45	1.01	1.2

Radiation Survey Report for Accelerator Hall

Reading Points	Ion Beam Energy								Remarks
	6 MeV		7 MeV		8 MeV		9 MeV		
	Neutron uSv/h	Gamma uSv/h	Neutron uSv/h	Gamma uSv/h	Neutron uSv/h	Gamma uSv/h	Neutron uSv/h	Gamma uSv/h	
1	0.082	0.186	0.041	0.122	0.256	0.156	0.286	0.141	Last FC close
2	0.061	0.418	0.061	0.221	0.490	0.240	0.633	0.211	Last FC close
3	0.224	4.988	0.163	1.340	3.225	2.484	2.341	2.308	Last FC close
4	0.347	3.873	0.102	1.241	4.572	1.891	1.388	1.629	Last FC close
5	1.653	0.404	1.020	0.164	9.932	0.493	7.763	0.480	Last FC close
6	0.204	0.133	0.265	0.136	0.612	0.146	2.872	0.232	Last FC close
7							32.34	-	Last FC close
8							0.60	0.127	Last FC open
9							0.20	0.114	Last FC open

Thank You
