RADIATION SAFETY AND THE PROPER USE OF PPE

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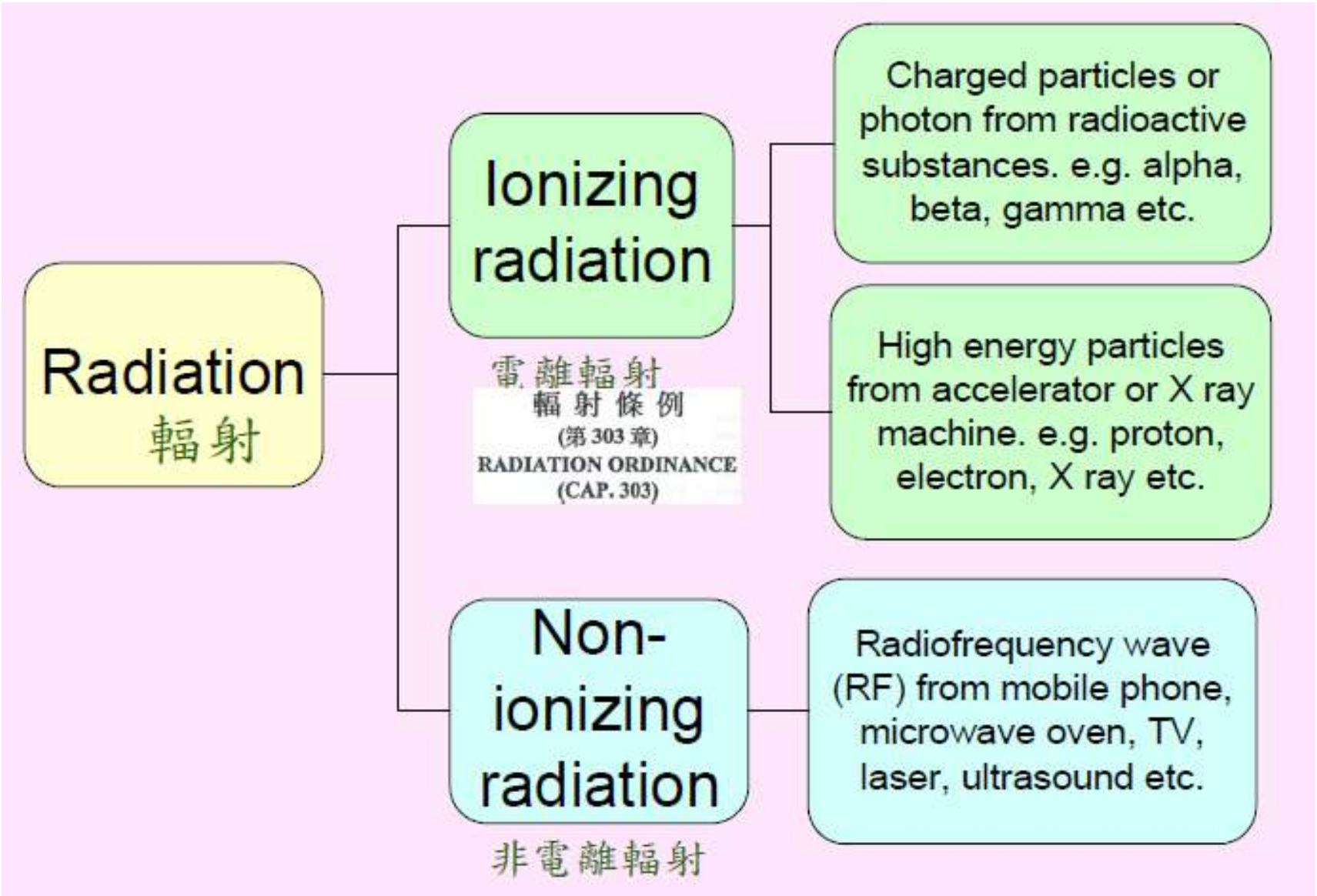
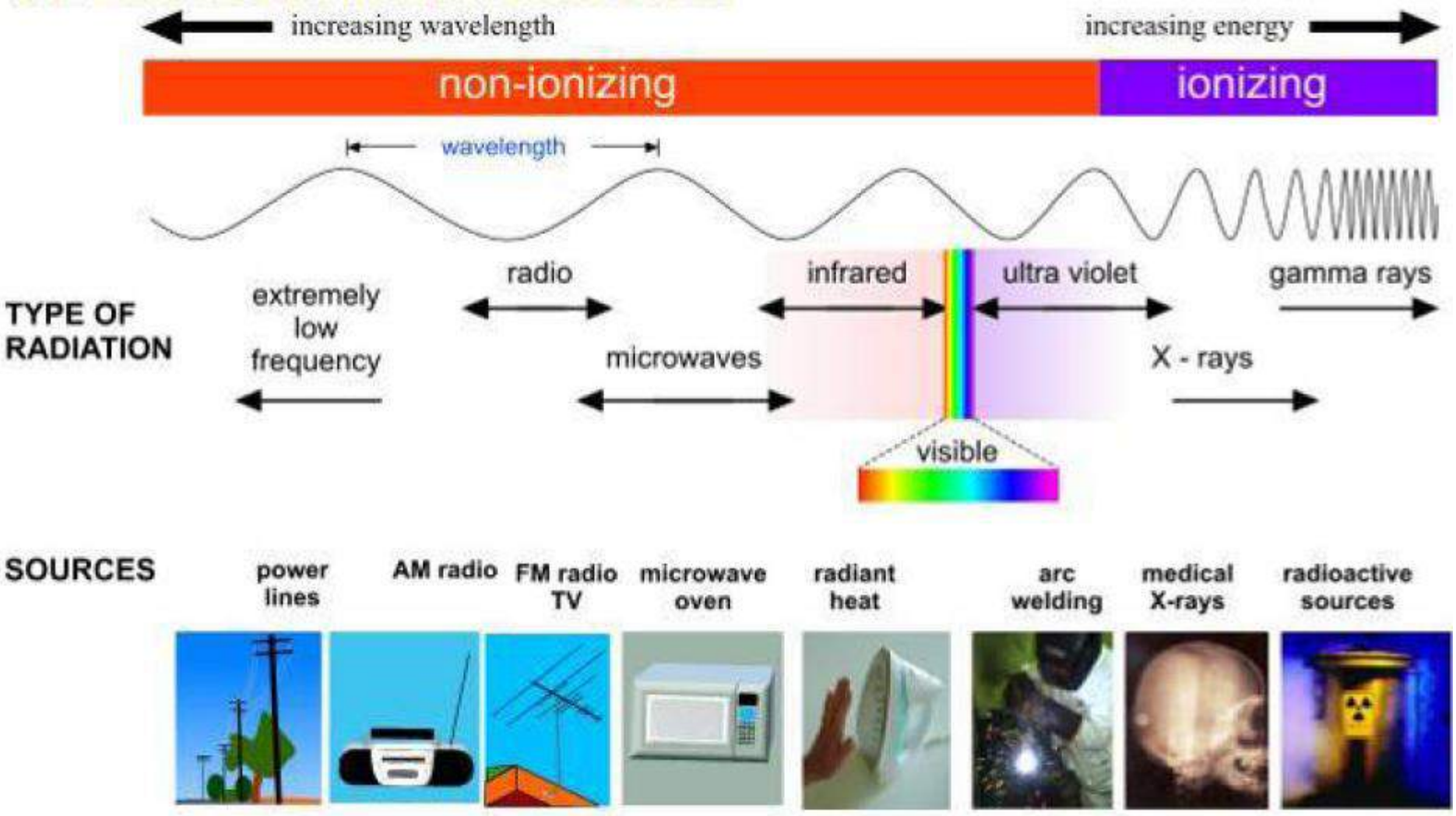
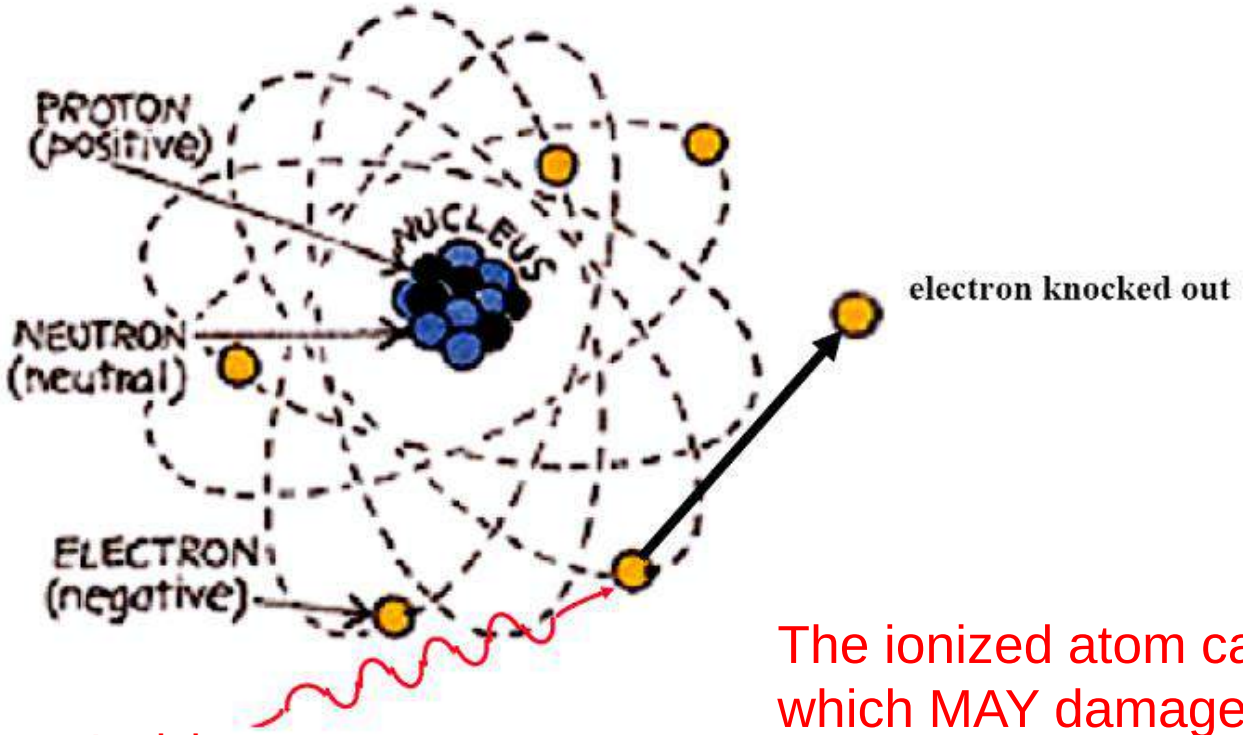
Radiation


Radiation
輻射
Ionizing radiation
電離輻射
輻射條例
(第303章)
RADIATION ORDINANCE
(CAP. 303)
Charged particles or photon from radioactive substances. e.g. alpha, beta, gamma etc.
High energy particles from accelerator or X ray machine. e.g. proton, electron, X ray etc.
Non-ionizing radiation
非電離輻射
Radiofrequency wave (RF) from mobile phone, microwave oven, TV, laser, ultrasound etc.

Electromagnetic Spectrum

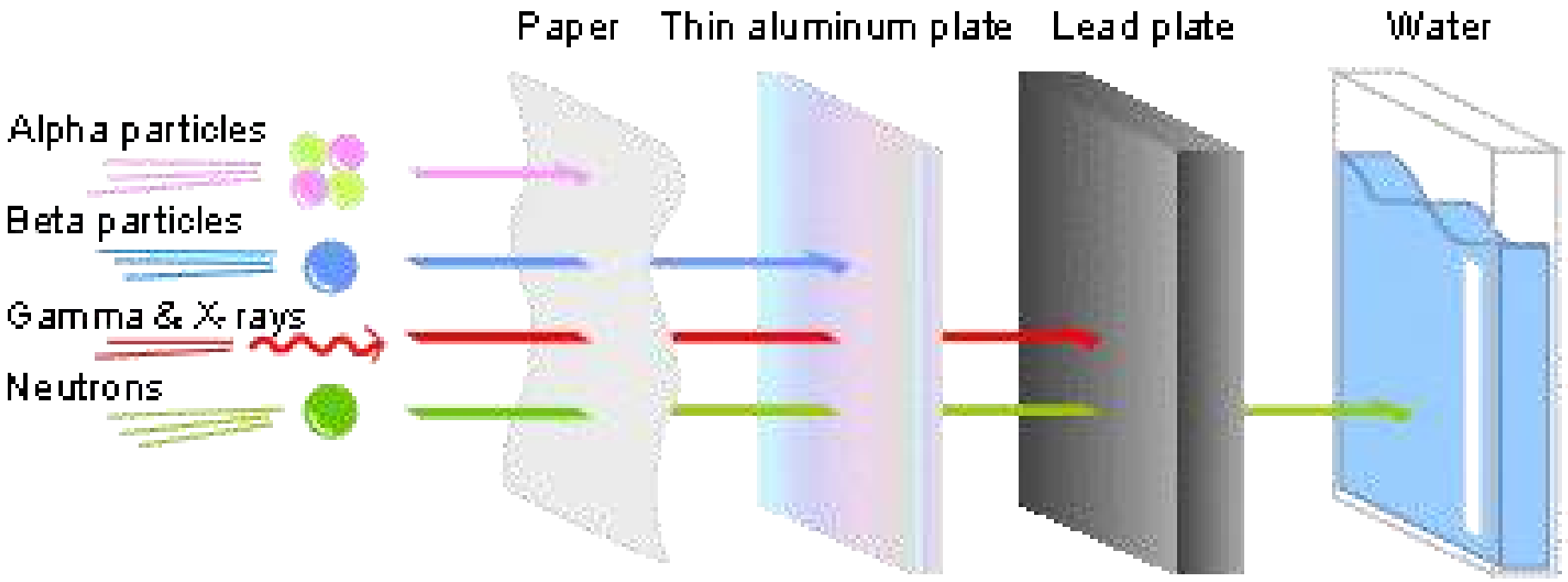


Ionizing Radiation

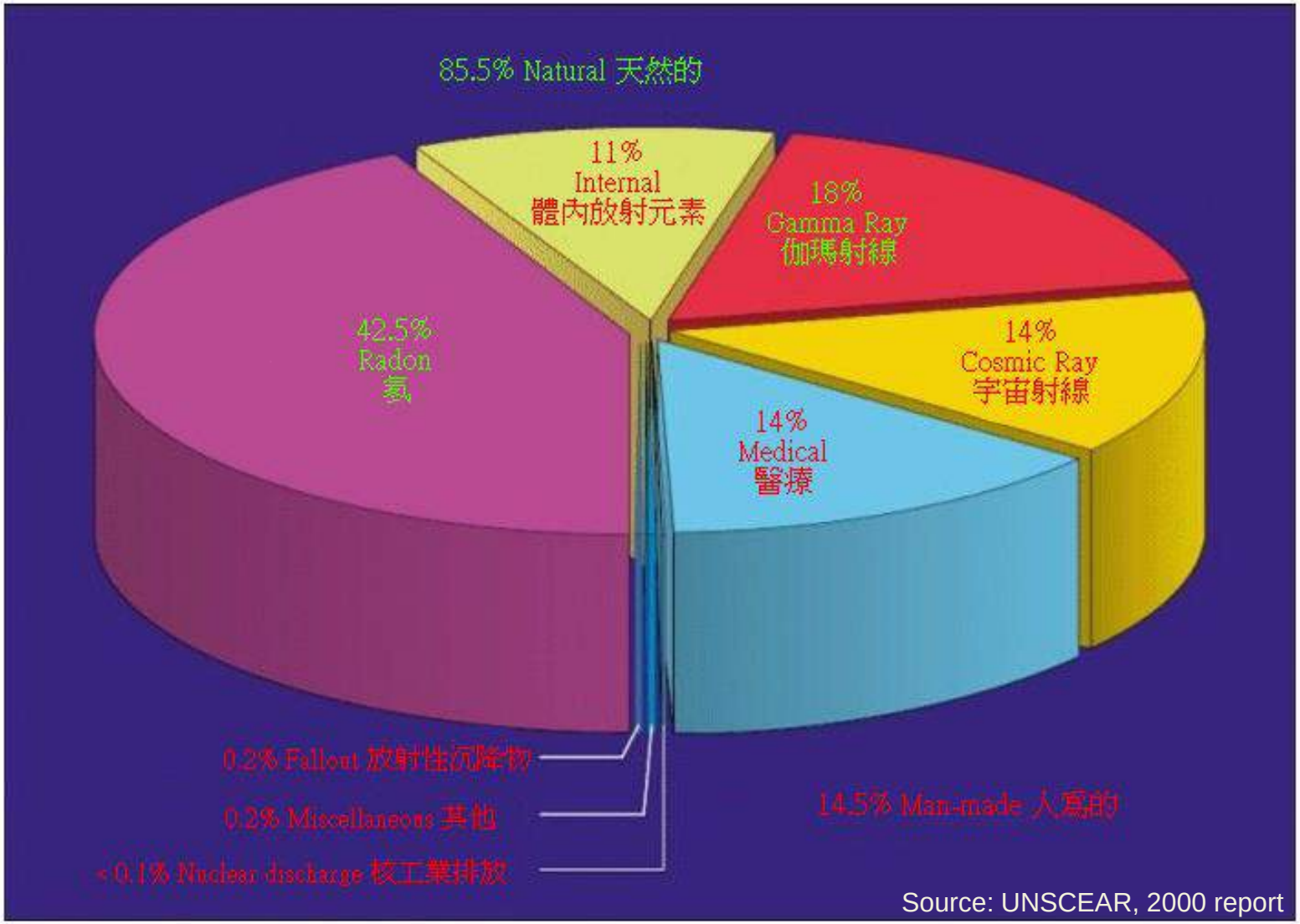


The ionized atom causes changes
which MAY damage cells
which MAY cause health effects

Penetration Power of Ionization Radiation



Sources of Radiation Exposure



Source: UNSCEAR, 2000 report

Radiation Units

Equivalent Dose (SI unit)

- The Unit indicate the biological damage from the radiation

- Sievert (Sv)
- Energy deposited, modified by radiation type and biological effect

1 Sv = 1000 mSv
1 mSv = 1000 µSv

Radiation Health Effects

(1) Stochastic Effects (Delayed)

- Examples: cancer induction, leukemia, genetic effects etc

(2) Deterministic Effects

- Examples: skin injury, cataract, visual impairment, permanent sterility, death

Radiation Protection

Objectives

- To prevent the occurrence of deterministic effects
  - All possible efforts should be made to keep doses received in a relatively short period of time below 500 mSv
- To lower the risk of stochastic effects to an acceptable level
  - Since stochastic effects have no threshold, protective actions aim at keeping the doses as low as reasonably achievable

What are the effects of exposure to radiation?

Indicative dose range (mSv)	Effects on human health (including unborn child)
Up to 10	No direct evidence of human health effects
10 - 1,000	No early effects; increased incidence of certain cancers in exposed populations at higher doses
1,000 - 10,000	Radiation sickness (risk of death); increased incidence of certain cancers in exposed populations
Above 10,000	Fatal always

United Nations Scientific Committee on the Effects of Atomic Radiation

Annual Dose Limits

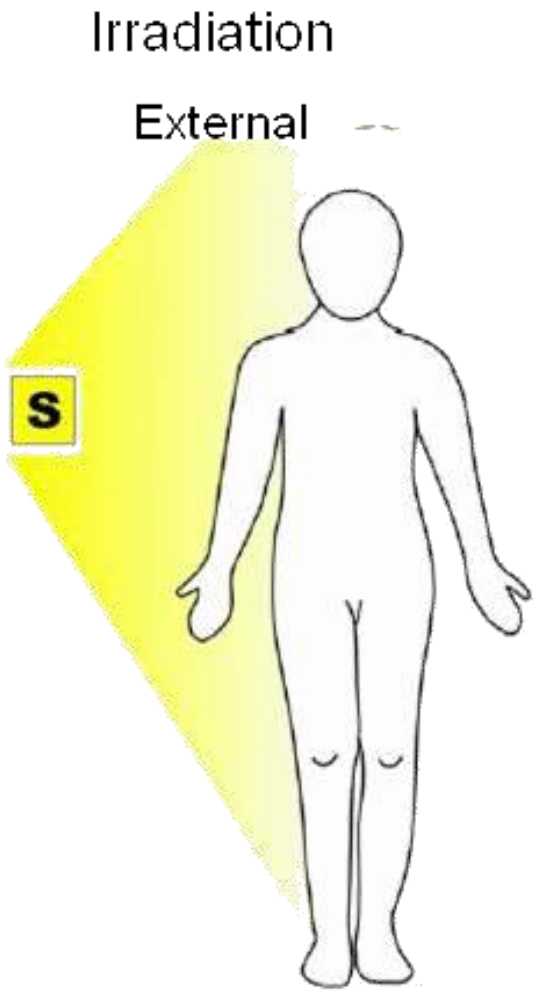
The annual dose limits stipulated in the Radiation Ordinance (Chapter 303)

Organs	Dose Limits	
	Occupational	Public
Whole body	20 mSv in any calendar year	1 mSv
Abdomen of a woman with reproductive capacity	5 mSv in any consecutive, 3 months interval	-
Abdomen of a pregnant woman	1mSv from declaration to delivery and intake radionuclides is limited to 1/20 ALI	-
Lens of eye	150 mSv	15 mSv
Skin, average over $1cm^2$	500 mSv	50 mSv
Other individual organs	500 mSv	-

Methods of Radiation Protection

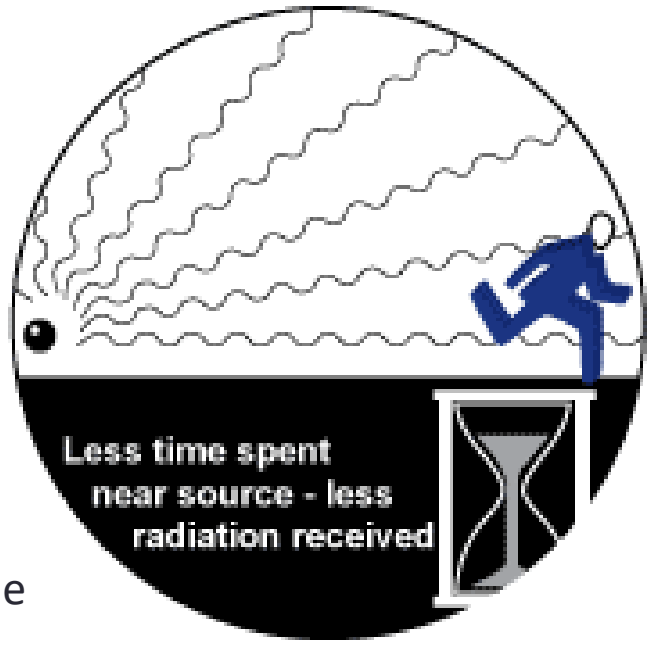
The three basic ways of controlling exposure to external irradiation are:

1. Limiting the time spent near a source of radiation
2. Increasing the distance away from the source
3. Using shielding to stop or reduce the level of radiation.



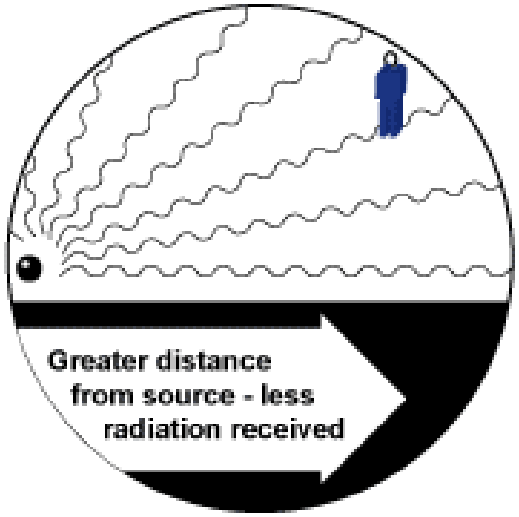
Time

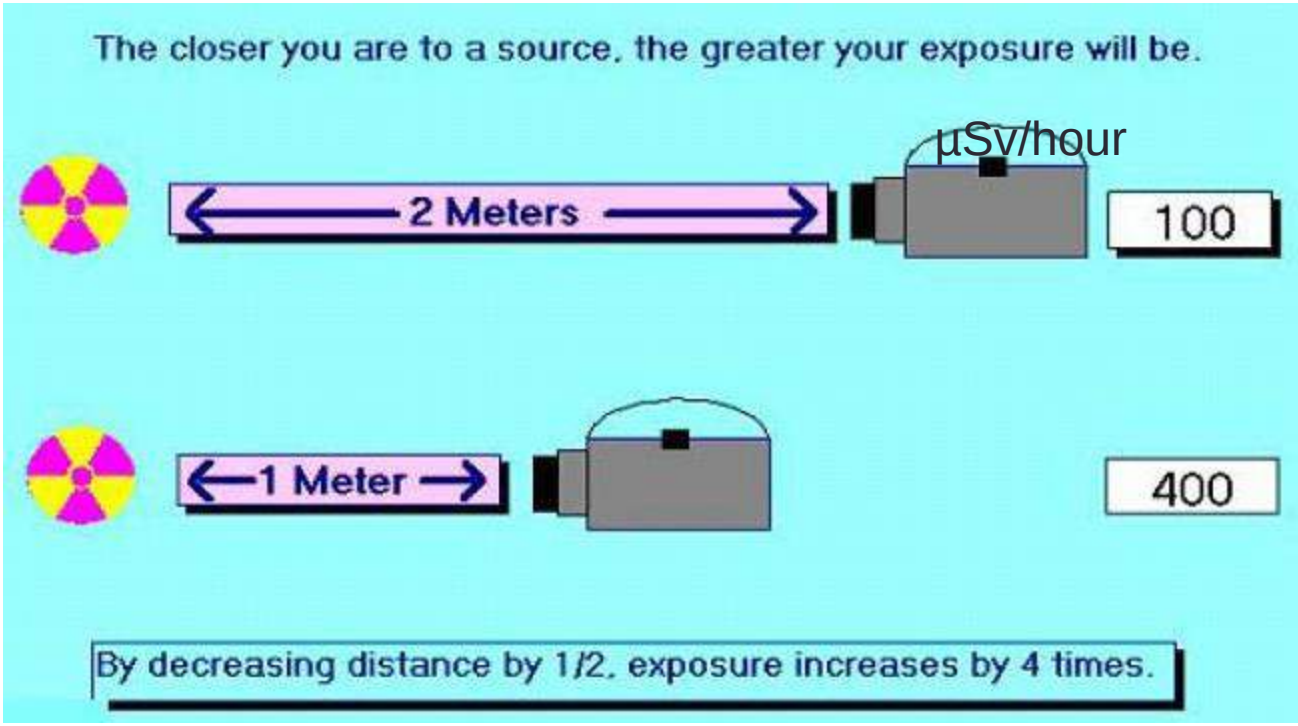
- Always remember that the longer the exposure, the greater the dose, which leads to greater amount of damage.
- Thus, your first protective measure should be to minimize the timee of exposure.



Equivalent dose = Equivalent dose rate x time

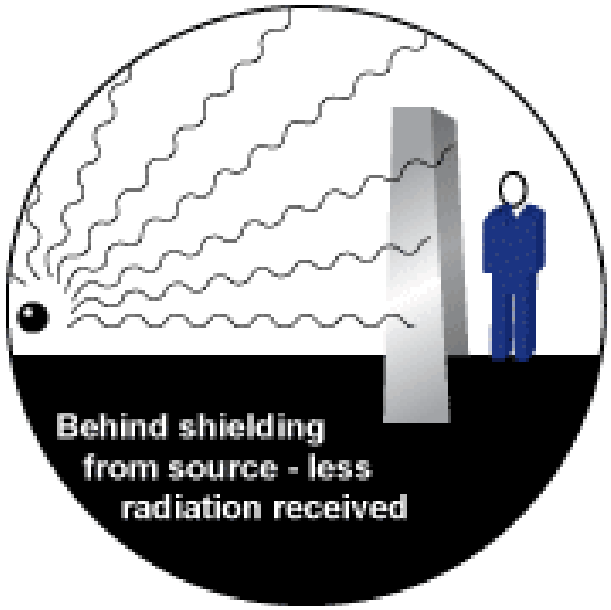
Distance





Distance: The more distance there is between you and the source of radiation, the less radiation you will receive. When exposure to radiation is not necessary, stay away from the sources, such as X-ray tubes, CT scanners, radioactive materials in nuclear medicine, linear accelerators, and nuclear power plant accidents.

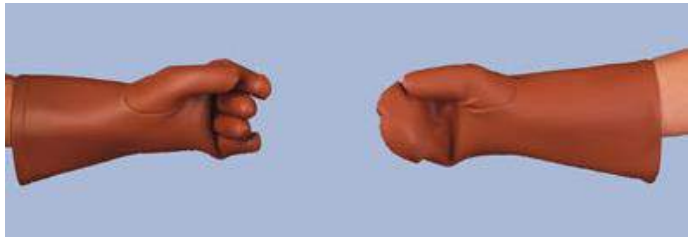
Shielding



- The third way to reduce exposure to radiation is to place something between you and the source of radiation. In general, the more dense the material the more shielding it will provide.

Personal Protective Equipment

- PPE: lead apron, vest, thyroid collar, lead glass eye shield, lead gloves, lead glass barrier etc.

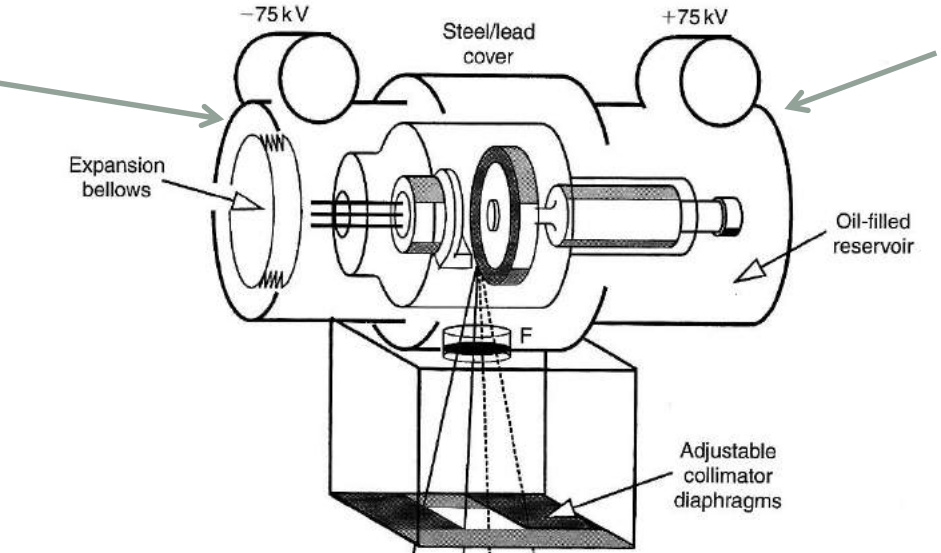


Radiation Shielding for CT Room

Warning Sign

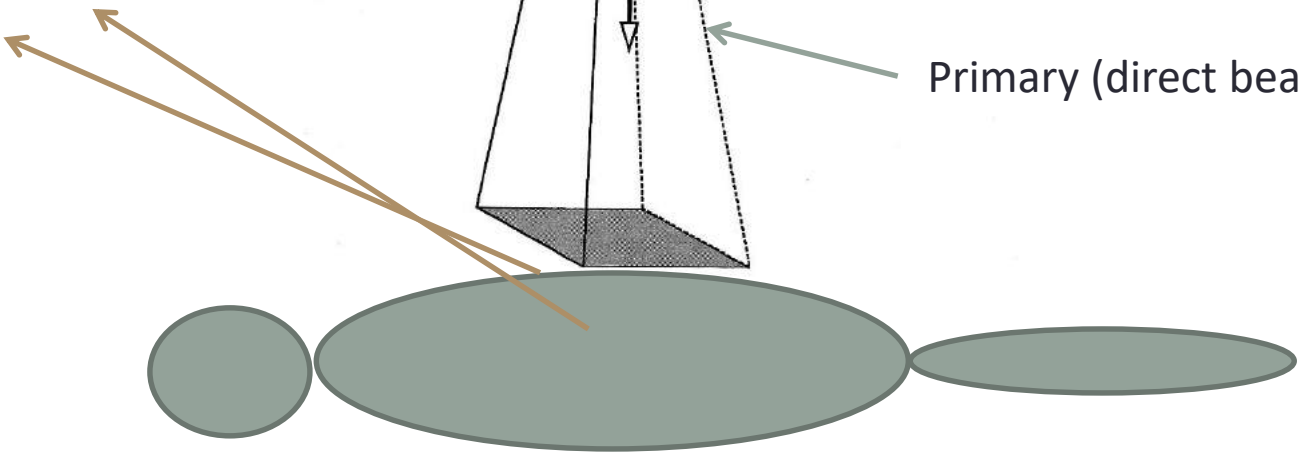
Tube housing

Leakage radiation is minimized by tube housing

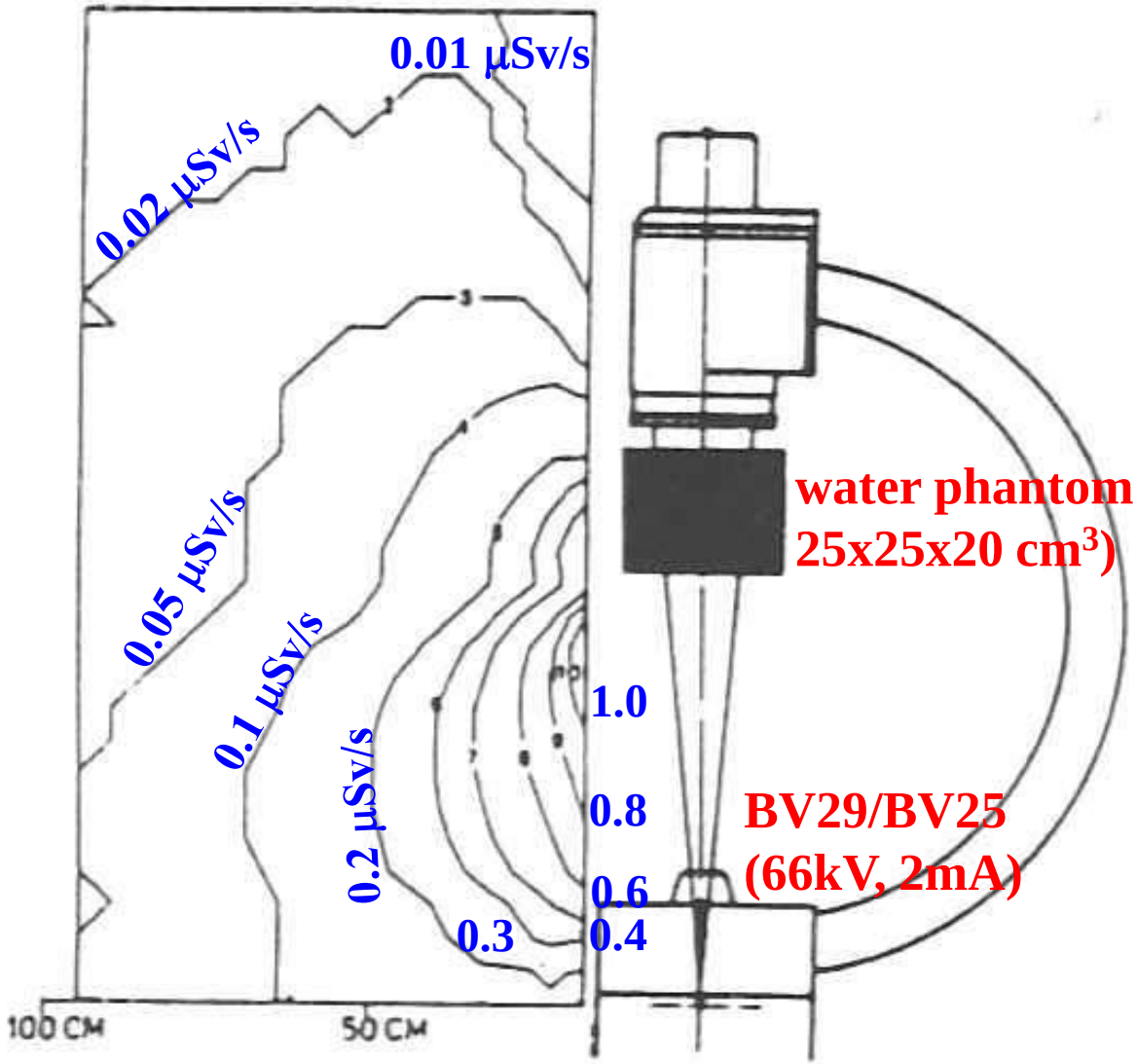


Scattered Radiation

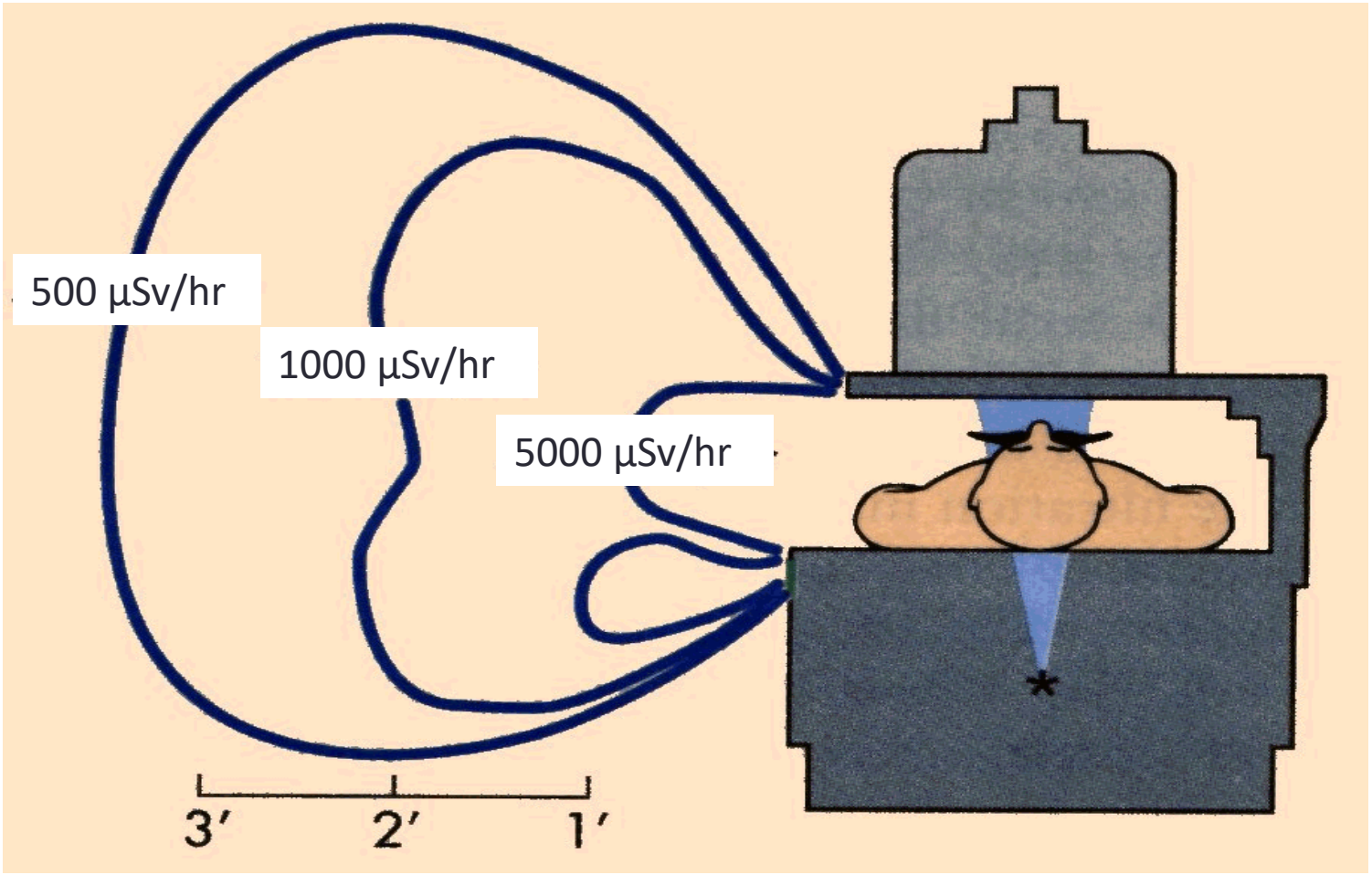
Primary (direct beam)



Isodose lines of mobile X ray machine

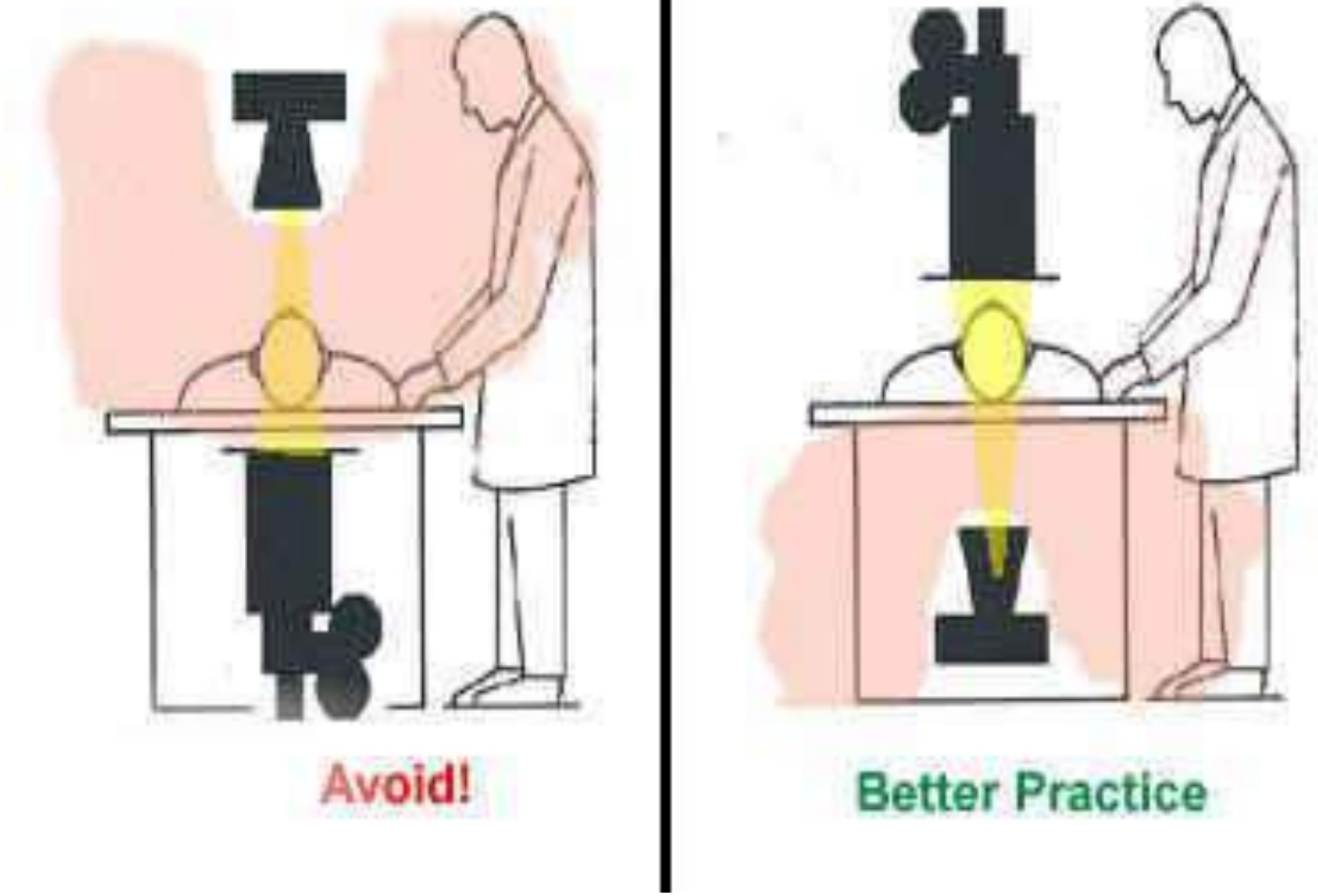


Isodose lines of fluoroscopy unit



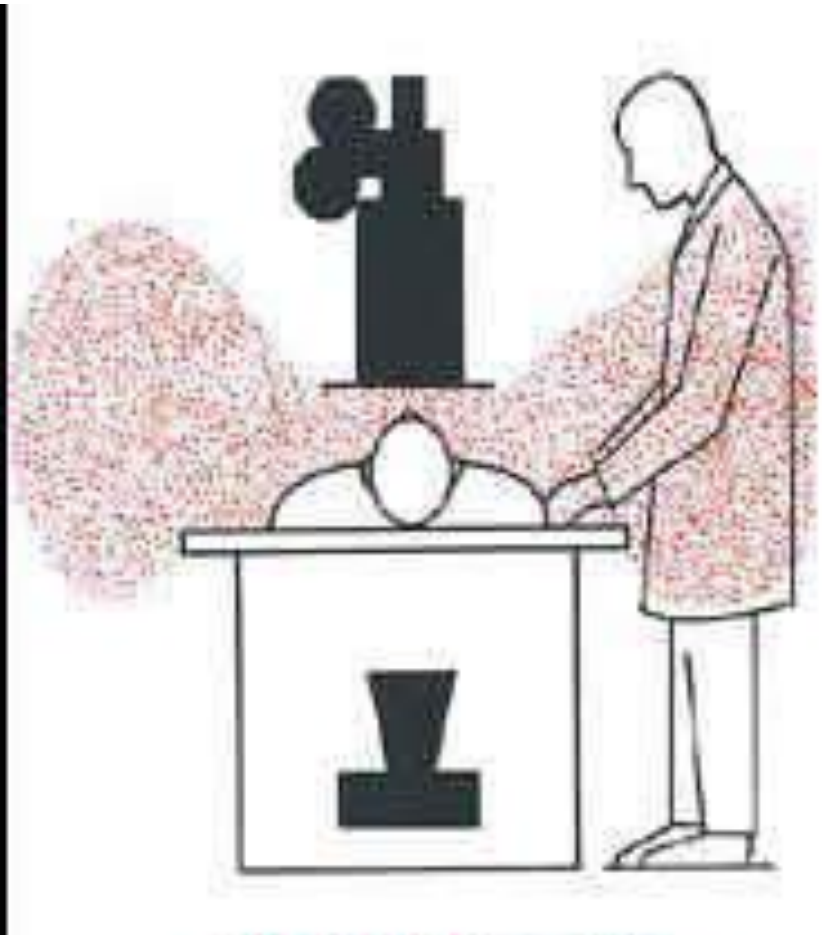
Fluoroscopy Exposures

Benefit of Under-Couch Position



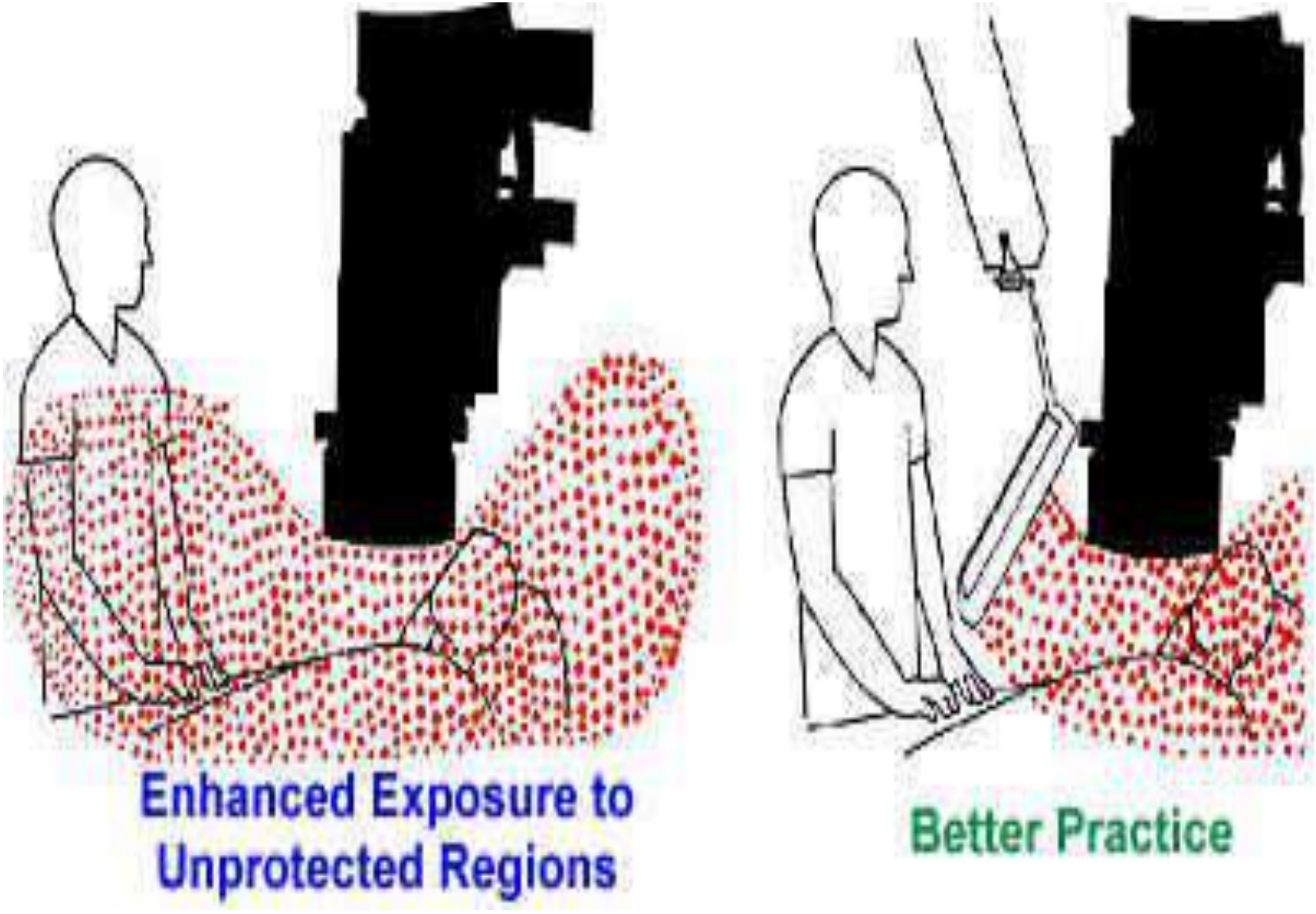
Benefit of Reducing the Air Gap

Enhanced Exposure
More Noise from Scatter



Better Practice

Benefit of Hanging Shield



Personal Radiation Monitoring

- Thermoluminescent dosimeters (TLDs)
  - Measure cumulative exposure to ionizing radiation for periods of approximately one month
  - Maintain cumulative records of an individual's exposure to radiation over an extended period of time

Wear the TLD badges - mandatory for classified radiation workers

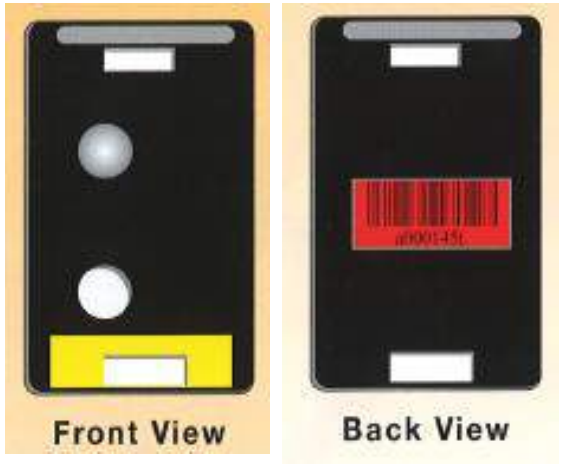
This side faces towards your body

Wear it facing out on the trunk at chest or waist height and under the lead apron, if any

Note the correct name label

Proper use of TLD badges

- Wear TLD badge while on duty.
- Keep TLD badge away from radiation area when not performing radiation work.
- Must return TLD badge to Radiation Health Unit (RHU) on or before 15th of each month. Arrange with your supervisor when taking long leave. Otherwise, the dose of that month will be missed out in your TLD report.



Proper use of TLD badges

- Report any loss or damage to RHU as soon as possible.
- Make any necessary arrangement with RHU when you transfer to another department or hospital.
- Return your TLD badge and inform RHU when you quit your job or permanently cease working with radiation.
- For classified radiation workers only: Copy the annual H[10] or H_p[10] reading (i.e., a deep-sited dose) from your TLD record to a report form prior to medical examination.

Proper use of TLD badges

- Don’t vandalize TLD badge.
- Don’t try to open TLD badge.
- Don’t put TLD badge above the lead apron or in the unshielded outer pocket of the lead apron.
- Don’t expose TLD badge to excess heat.
- Don’t bring along your TLD badge on air travel.
- Don’t put on your TLD for personal X-ray or CT examination.
- Don’t take your TLD away from the workplace.

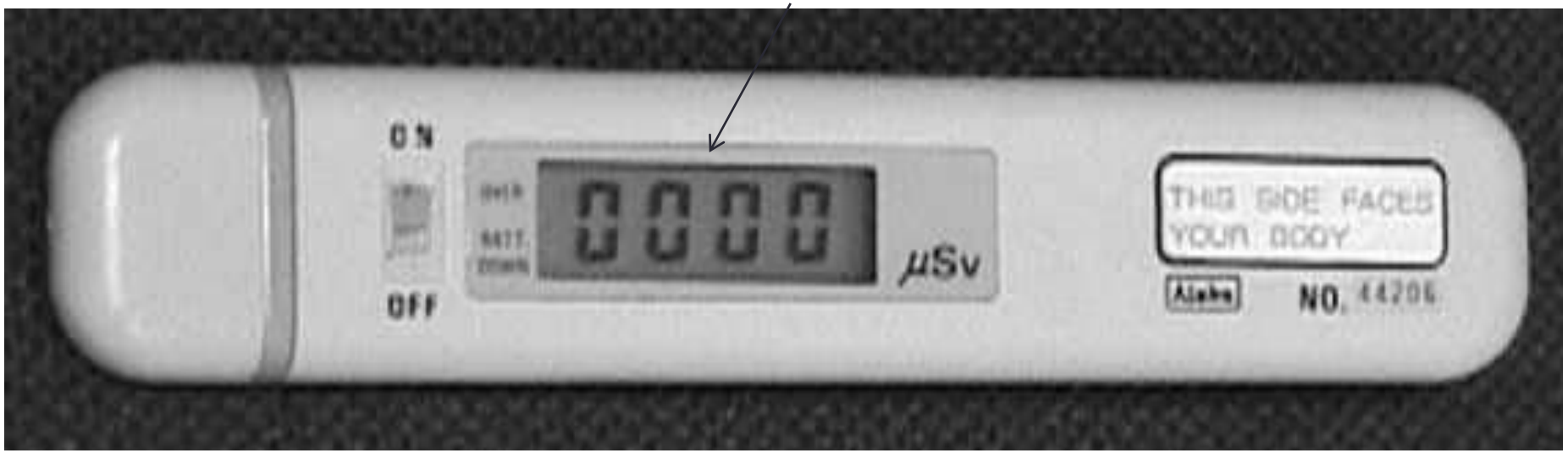
Dose Report

- Available at http://www.erls.gov.hk

Monitoring Period		Dose (mSv) for period	
From	To	H[0.07] Dose equivalent at 7 mm tissue depth	H[10] Dose equivalent at 10 mm tissue depth
01/06/2012	30/06/2012	BRL	BRL
01/06/2012	30/06/2012	not returned	
01/06/2012	30/06/2012	BRL	BRL
01/06/2012	30/06/2012	BRL	BRL
01/06/2012	30/06/2012	BRL	BRL
01/06/2012	30/06/2012	BRL	BRL
01/06/2012	30/06/2012	not returned	

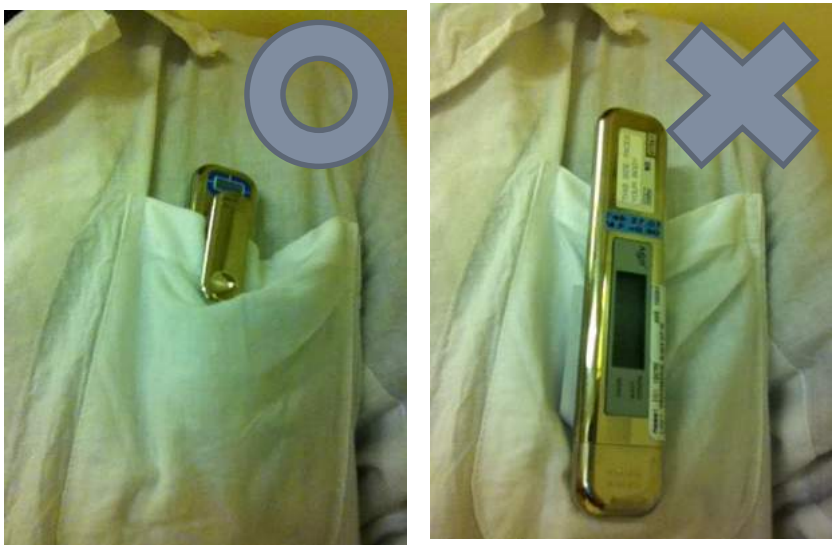
Electronic Personal Pocket Dosimeter

- Direct reading of personal dose.
- To be used by staff and carers working with the patient.
- Daily dose should not exceed 80 μSv. HK BKG is about 3-6 μSv/day



Proper use of Pocket Dosimeter

- Wear pocket dosimeter according to instructions shown.
- Don’t put pocket dosimeter near to mobile phone.



Thank you!