Chapter VI: Experiment dosimetry: Introduction

Types of measurements

- Detector for immediate (instantaneous) measurements → dose rate → **monitor** → called « dosimeter » (ex: ionization chamber)

- Detector for integrated (total) measurements on a time → **dosimeter** → called « integrating dosimeter » (ex: films, thermoluminescent dosimeters,…)

- Detector for the identification of incident particles → **spectroscopes**

Types of monitors or dosimeters

Effet	Instrument	milieu
Electrique	Chambre d'ionisation	Gaz
	Compteur proportionnel	Gaz
	Compteur Geiger	Gaz
	Chambre d'ionisation solide	Semiconducteur
Chimique	Film photographique	Emulsion photographique
	Dosimètre chimique	Solide ou Liquide
Lumière	Scintillateur	Cristal ou liquide
	Compteur Cerenkov	Cristal ou liquide
Thermoluminescence	Dosimètre thermoluminescent	Cristal
Luminescence stimulée optiquement	Dosimètre OSL	Cristal
Chaleur	Calorimètre	Solide ou Liquide

Types of integrating dosimeters

- Dosifilms (photographic films)
- Thermoluminescent dosimeters
- OSL dosimeters
- Calorimeters
- Chemical dosimeters
- Electronic dosimeters
- …

General characteristics of dosimeters

- Absoluteness
- Precision and accuracy
- Dose range
- Stability
- Energy dependence
- Miscellany

Absoluteness

- An absolute dosimeter allows a measurement of the absorbed dose without requiring calibration in a known field of radiation
- Some kind of calibration not involving radiation is possible (as electronic calibration)
- However a calibration is always useful to rely the measurement to a standard measurement→ in an absolute dosimeter an error may go undetected

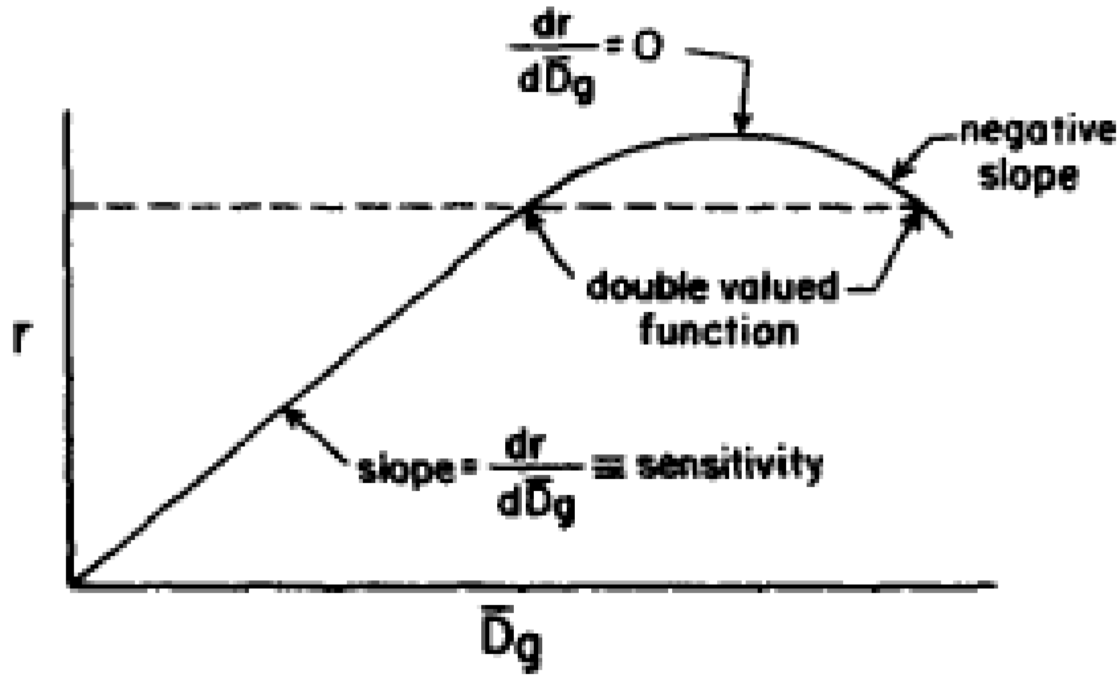
Precision and accuracy

- The precision depends on fluctuations in instrumental characteristics, on ambient conditions and on the stochastic nature of radiation fields
- The precision may be determined by repeated measurements → large precision ↔ small standard deviation
- The accuracy expresses the proximity of the value given by the dosimeter *r* (reading) and the true deposited dose D_g → impossible to evaluate the accuracy of data from data themselves → usefulness of calibration

Dose range

- Definition of the sensitivity of a dosimeter: $s = dr/dD_g$
- It is desirable to have a linear response (i.e. a constant sensitivity) throughout the dose range to be measured → $r \propto D_g$
- If nonlinear → it requires that a calibration be carried out at a multiplicity of doses
- Lower limit of the useful range of dose: background r_0 → $r = sD_g + r_0$ → r_0 has to subtracted from a dose reading
- Upper limit of the useful range of dose (inherent limit imposed by the dosimeter itself) → decrease in the dose sensitivity s (ultimately to a negative value)

Upper limit of the dose range



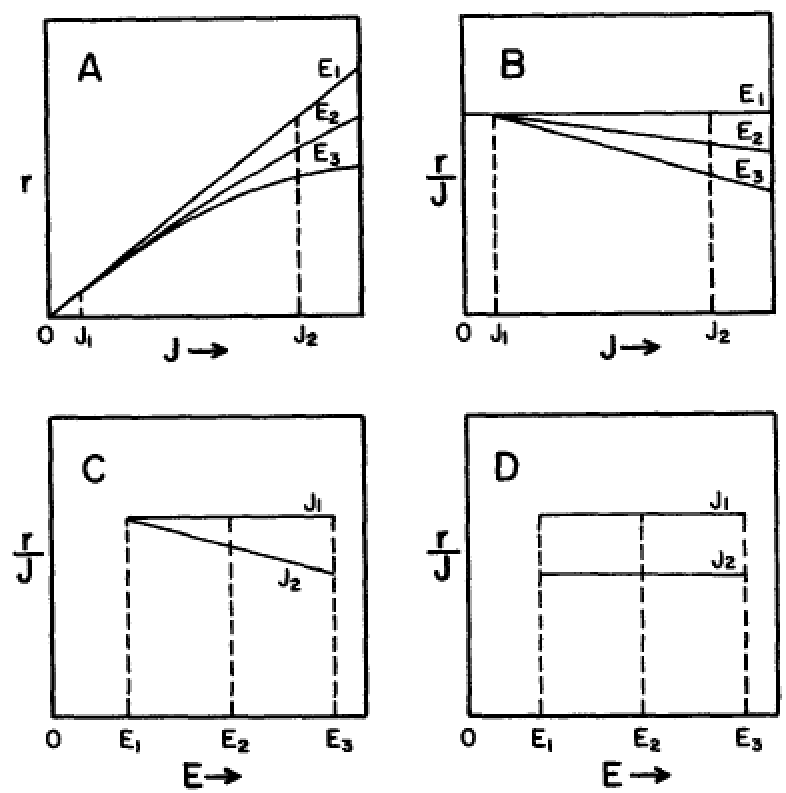
Stability

- Stability before irradiation → no modification of the properties before irradiation because of external conditions (temperature, humidity,…)

- Stability after irradiation → no modification of the reading in time (fading) → practically unavoidable → necessity of a measurements protocol to make them as reproducible as possible → standardization of the dosimeter reading

Energy dependence

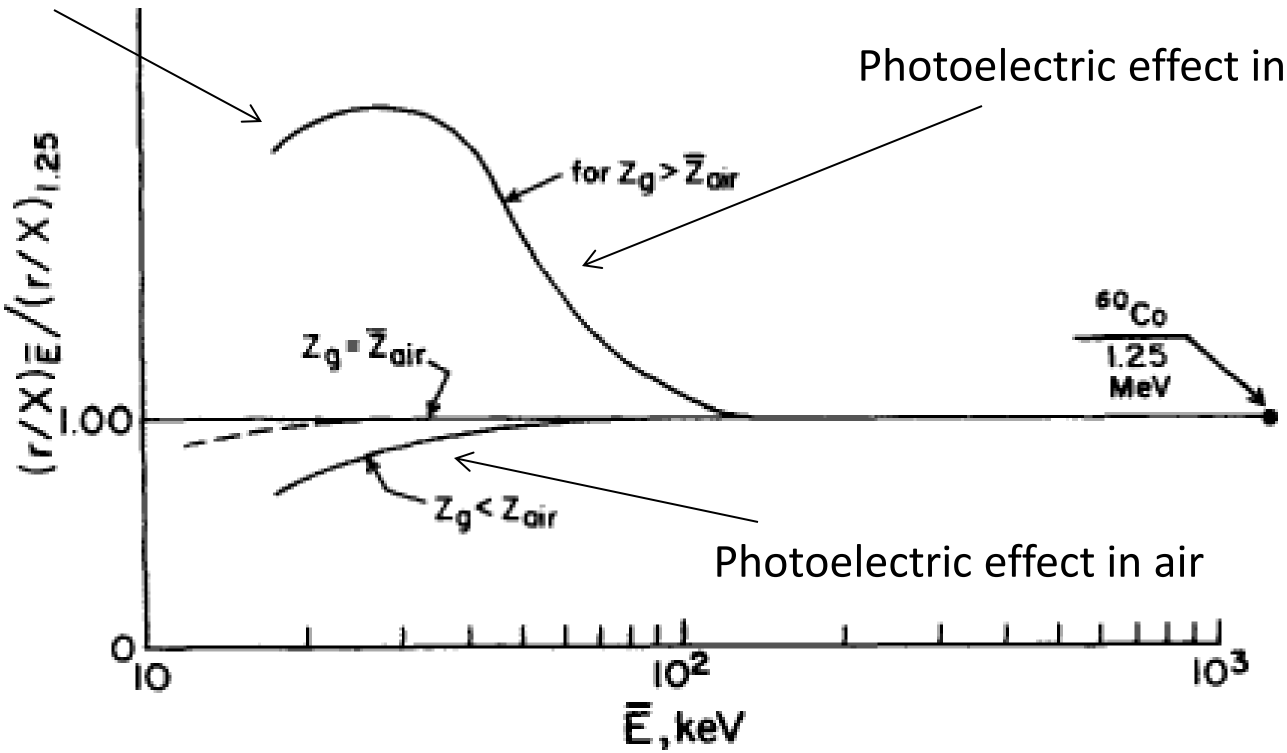
- The energy dependence of a dosimeter is the dependence of its reading *r* (per unit of the quantity to be measured *J* – dose, exposure) upon the energy *E* of the radiation



Example of energy dependence

Typical energy dependence curve in terms of the response per unit exposure (normalized to the response of ^{60}Co γ-rays) for a dosimeter made in a material g (Z_g)

Photoelectric effect in air and attenuation in g



Photoelectric effect in g

Photoelectric effect in air

Miscellany

- Geometric configuration
- Price
- Reusability
- Archival storage
- Control
- …