Radiation handler education and training

Class A

― Safe handling（topics）―

Points

１　Before handling　＞＞＞　Danger prediction

Understand the behavior of RI and radiation to handle

Estimate the exposure dose associated with radiation work

２　Under handling　＞＞＞　Reduce exposure dose

External exposure：Three principle protection（Distance・Time・Shield）

Exposure dose measure by radiation measurement

Internal exposure：Identification of using place

（Prevention of contamination expanding）

Wearing protective equipment (gloves, lab coat, mask)

３　After handling　＞＞＞　Decluttering

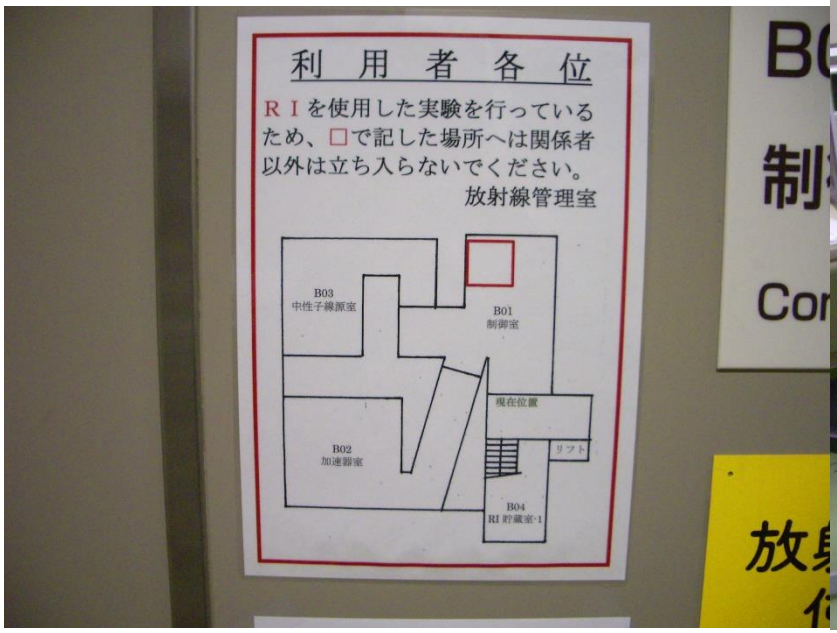
Storage of RI, shutdown of radiation generator

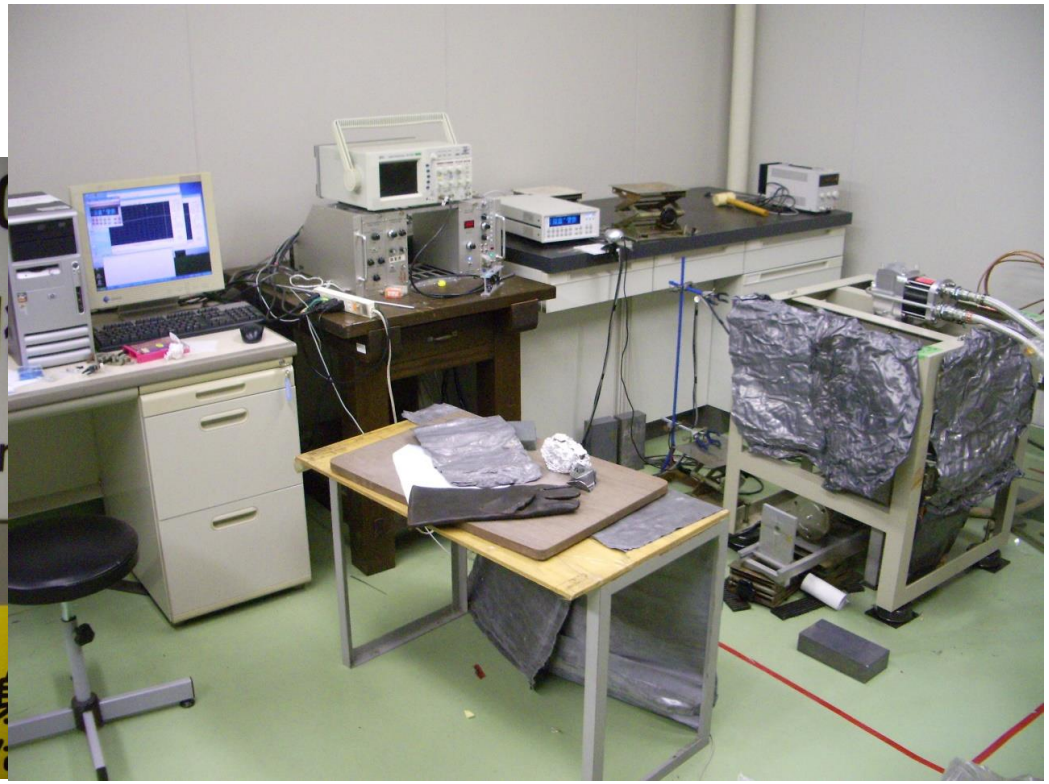
Decluttering the place of use (including contamination inspection)

Submission of usage record book

Strict adherence to reduce exposure dose

1　Check the bulletin board (various precautions).
2　Use an appropriate shield in consideration of the type, energy, and radioactivity of radiation.
3　Secure the distance from the radiation source.
4　Check the dose using a survey meter (Max 25μSv/h　(1mSv/W))
5　Check the exposure dose using a glass badge and an auxiliary dosimeter (pocket dosimeter)





Exposure dose estimation

●External exposure

【Question a】

Find the exposure dose for one year when working 40 hours a week at a place where the survey meter shows 0.5 (μSv / h).

【Answer】

Per a week : 0.5(μSv/h) ×40(h/w)＝20(μSv/w)

Per one year : 20(μSv/w) ×52(w/Y) ＝1040(μSv/Y)

＝1.04(mSv)

Exposure dose estimation

●External exposure

【Question b】

Find the effective dose rate at a distance of 1 m from the surface to which Cs-137 adhered 50000 (Bq).

1 cm dose equivalent constant of Cs-137 ;
0.0963(μSv・h^{-1}・MBq^{-1}・m^2)

【Answer】

$0.0963 \times 50000(Bq) \times 10^{-6} / 1^2(m) = 0.0048(\mu Sv/h)$

Exposure dose estimation

●External exposure

【Question c】

20000 (Bq / cm^2) adhered to the skin when it touched the sample contaminated by P-32. Find the absorbed dose rate of the skin.

The absorbed dose rate of the skin per 1 (Bq / cm^2) of P-32 is 1800 (nGy / h).

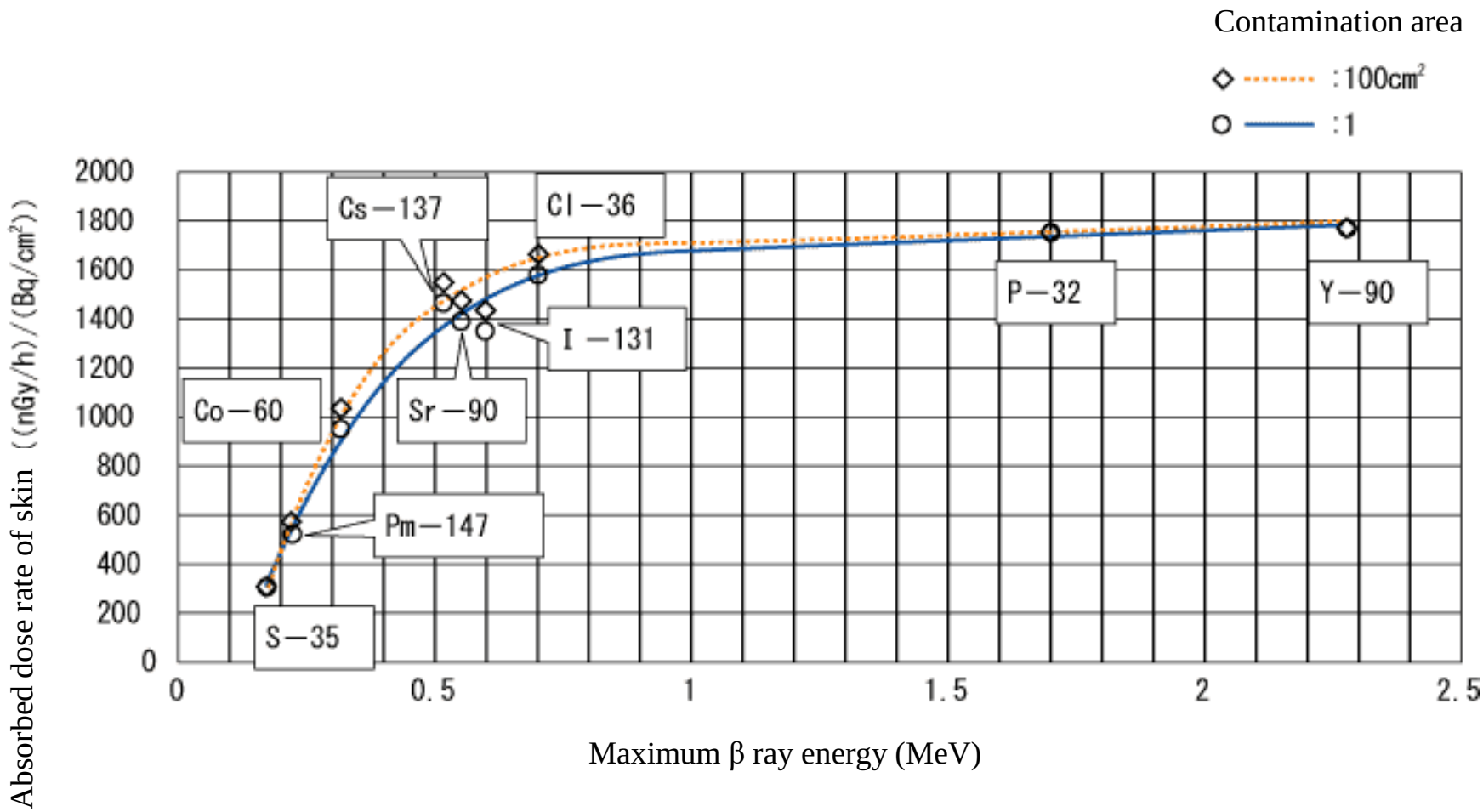
《β ray contribution》

$1800(nGy \cdot h^{-1} \cdot Bq^{-1} \cdot cm^2) \times 20000(Bq/cm^2) = 36(mGy/h)$

What is the equivalent dose rate for this skin?

β ray radiation load factor: From 1,

$28(mGy/h) \times 1 = 28(mSv/h)$



Relationship between maximum β-ray energy and skin absorbed dose rate

出展：緊急被ばく医療研修HP

Exposure dose estimation

●Internal exposure

【Question】

Find the effective dose when I-125 in the air is inhaled at 500 (Bq) per year.

Effective dose coefficient when I-125 is inhaled : 1.4×10^{-5}(mSv/Bq)

【Answer】

1.4×10^{-5}(mSv/Bq) $\times$ 500(Bq) $=7\times10^{-3}$(mSv)=7(μSv)

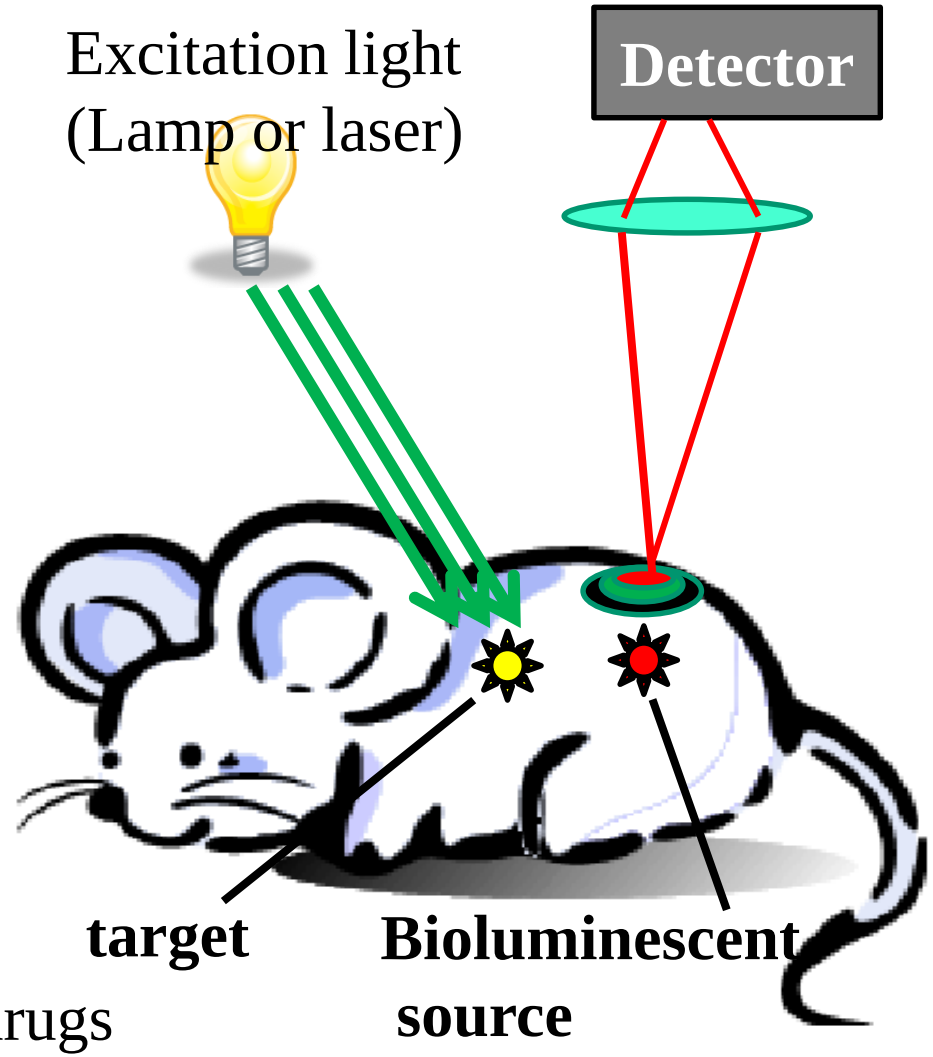
IVIS：In Vivo Imaging System

XENOGEN (PerkinElmer)

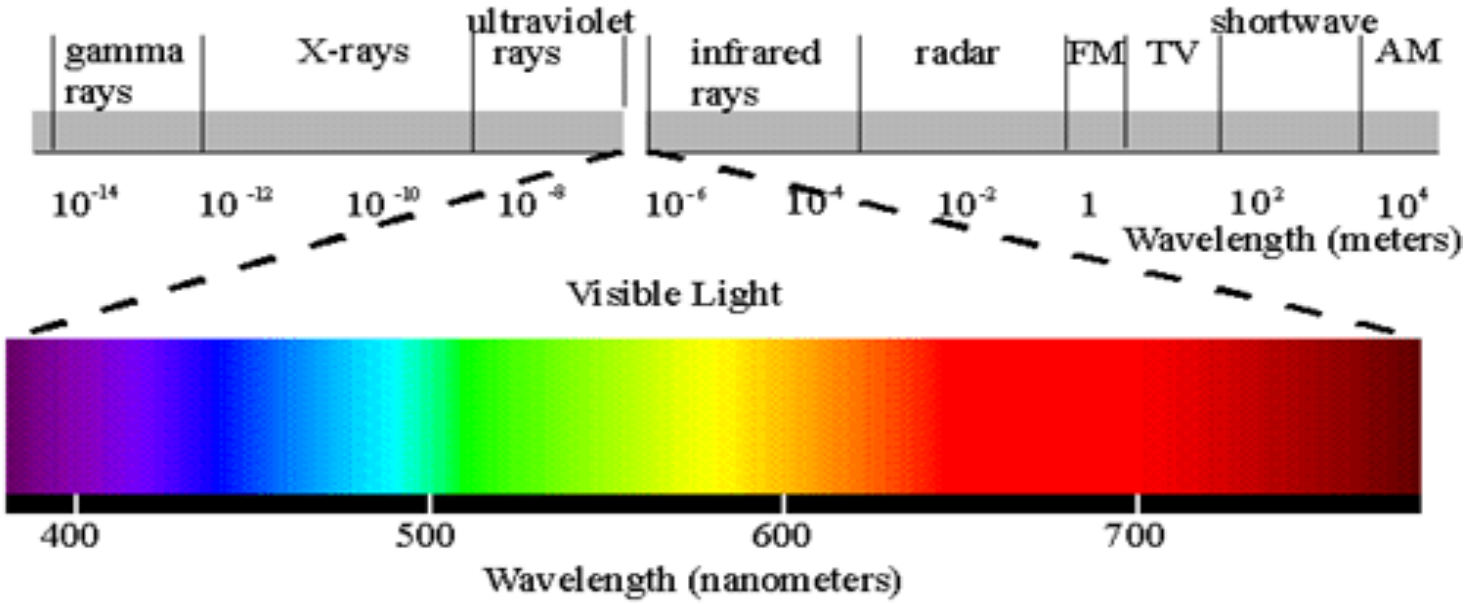
- Ultra-sensitive low noise cooling CCD camera
  - 27×27mm square CCD, 2048×2048 pixels
- Imaging system for small animals
  - Fluorescence, light emission, Cherenkov light
  - Anesthesia system
  - Heating stage
- Software(Living Image)

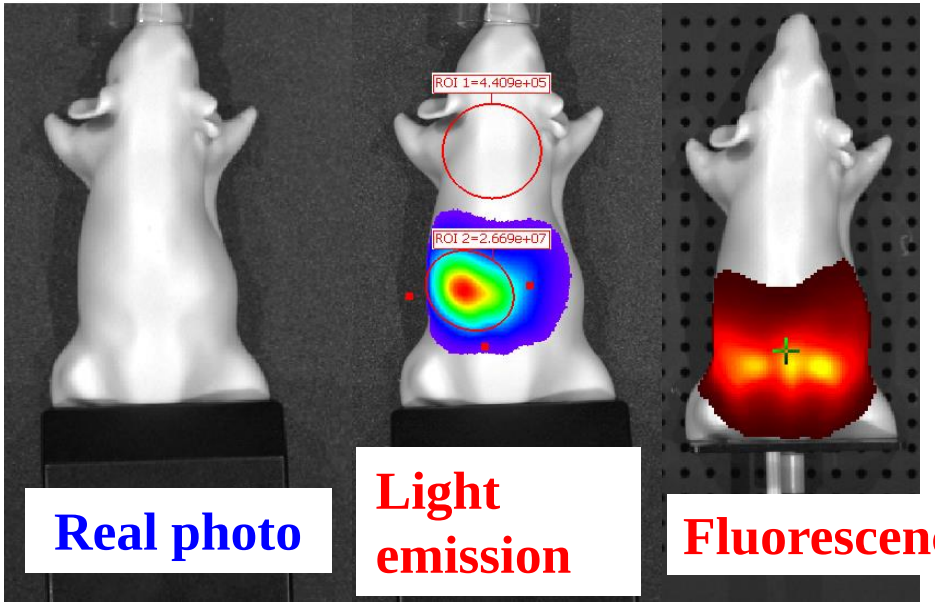
in vivo imaging method

- **Fluorescence**
  - Use fluorescent proteins such as GFP and fluorescent probes
- **light emission**
  - Use luciferase, etc.
  - The luminescence has high tissue permeability, high sensitivity and excellent quantification.
- **Cherenkov light**
  - Imaging of charged particles
  - Animal testing of radioactive drugs



Wavelength in the visible light region





- **700-900nm is called Medical Spectrum Window and is a wavelength of light suitable for in vivo imaging.**
- **Red light (> 600 nm) easily passes through tissue**