

ARCHMAT

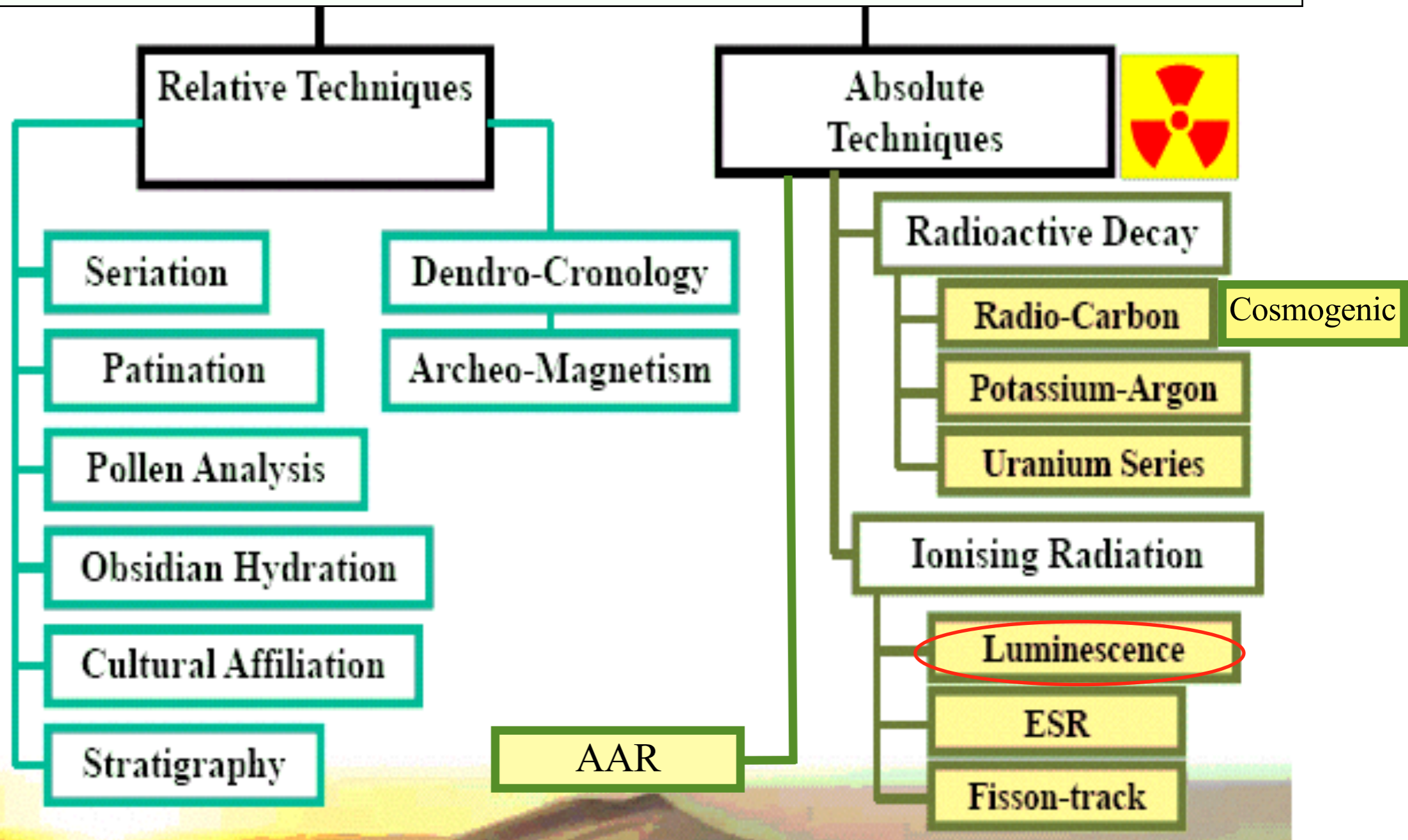
Advanced Analytical

Methods

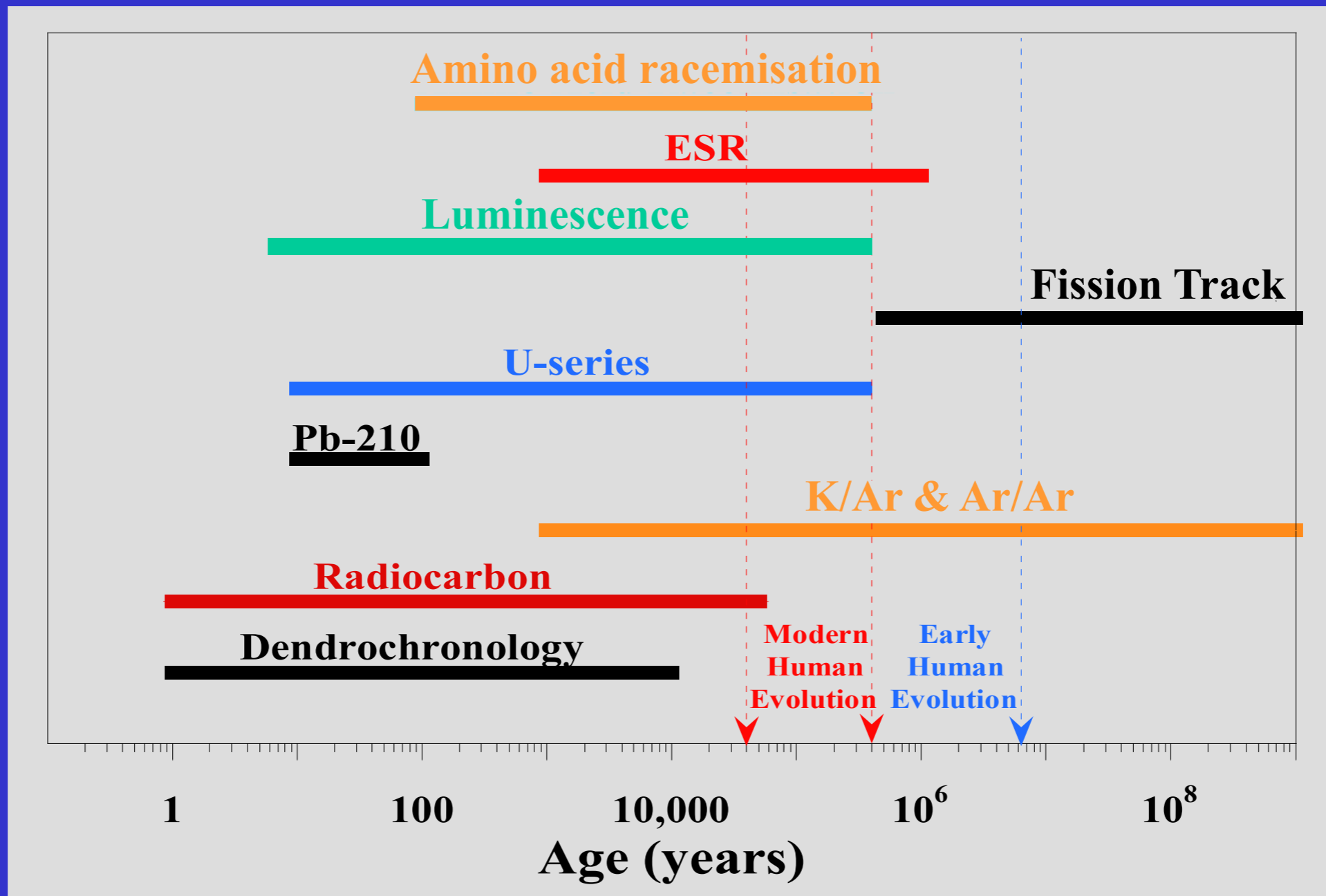
Claudio Tuniz

Luminescence Dating

Dating Techniques



Luminescence age range

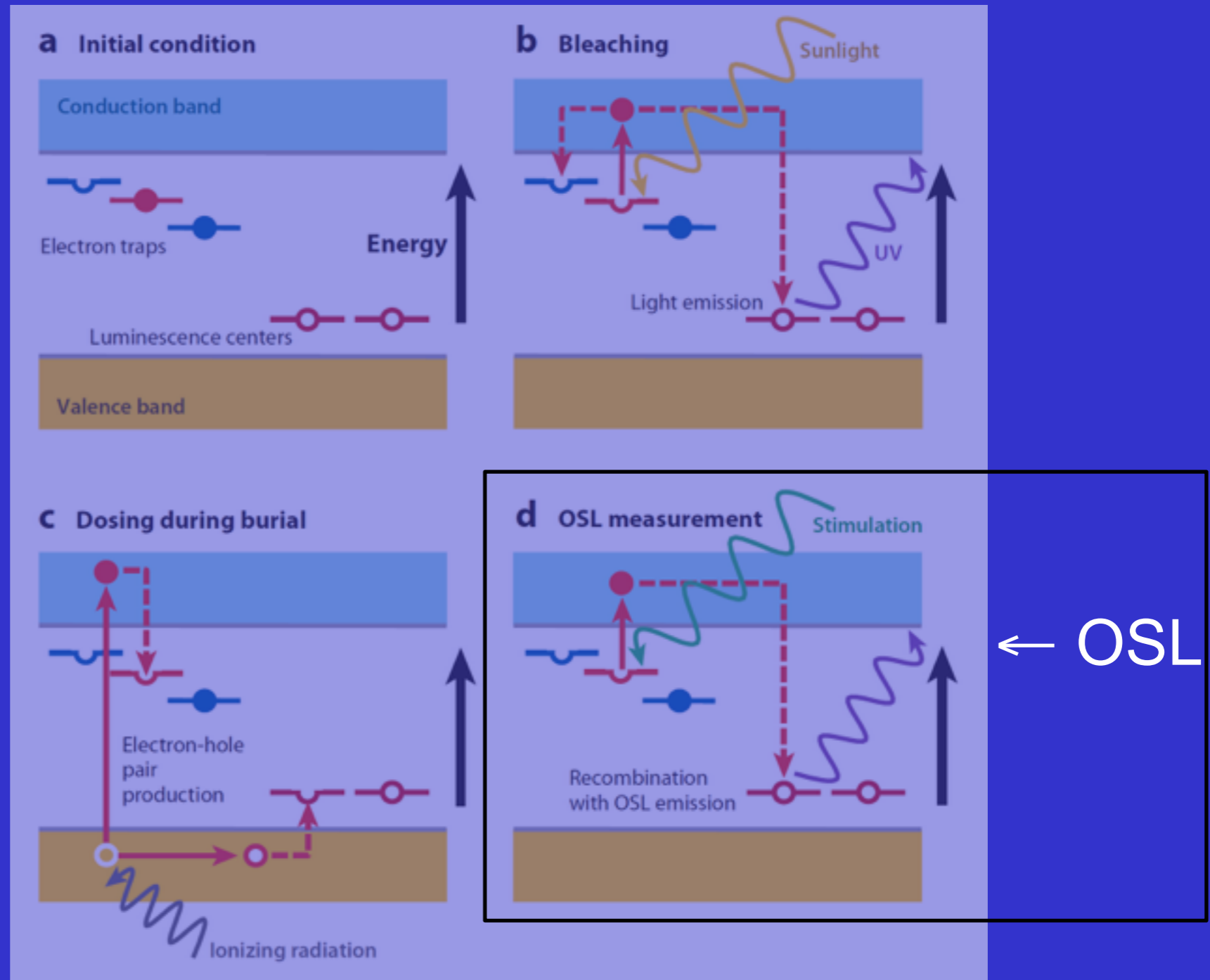


Energy band model

Excited state

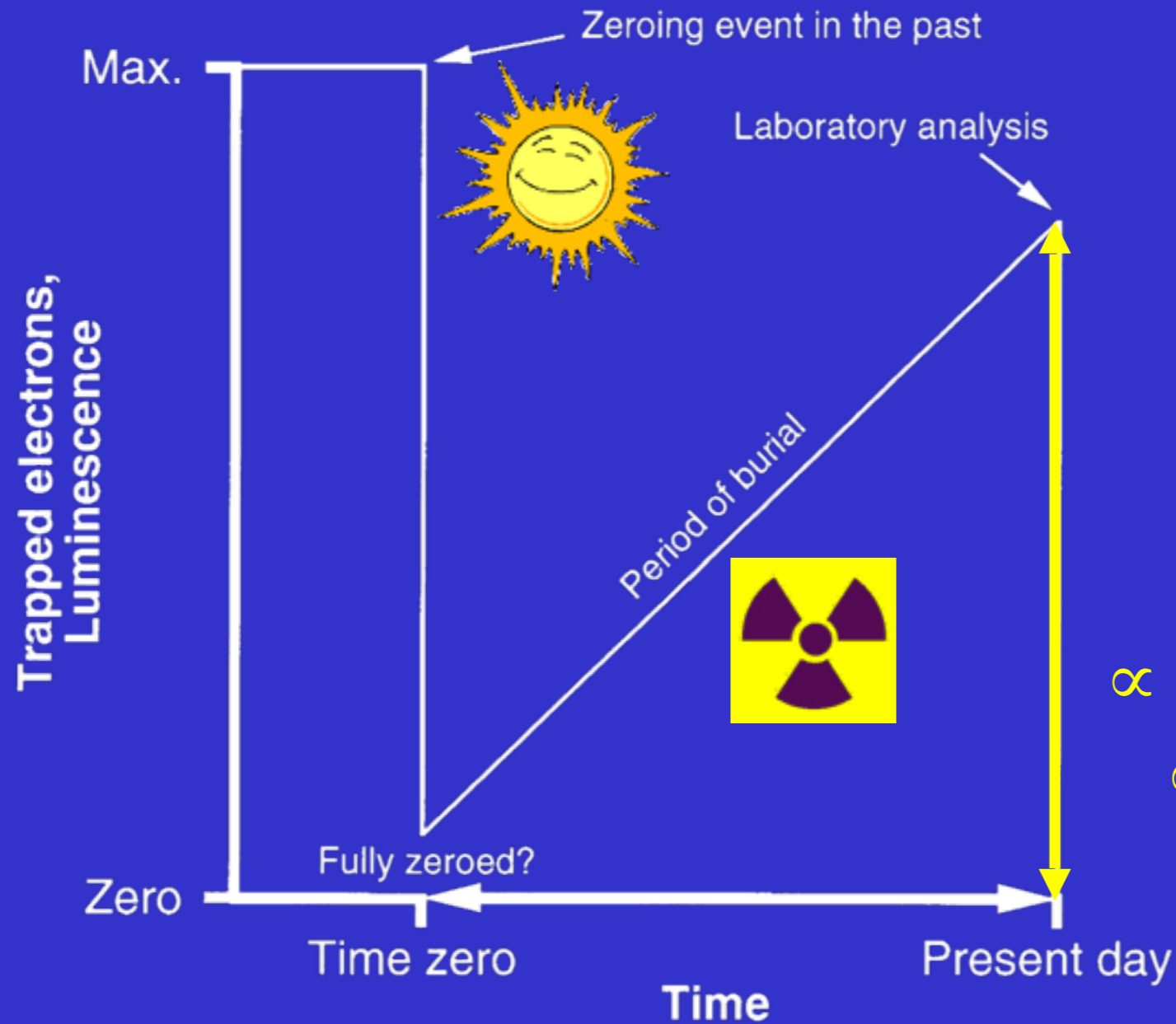


Stable state



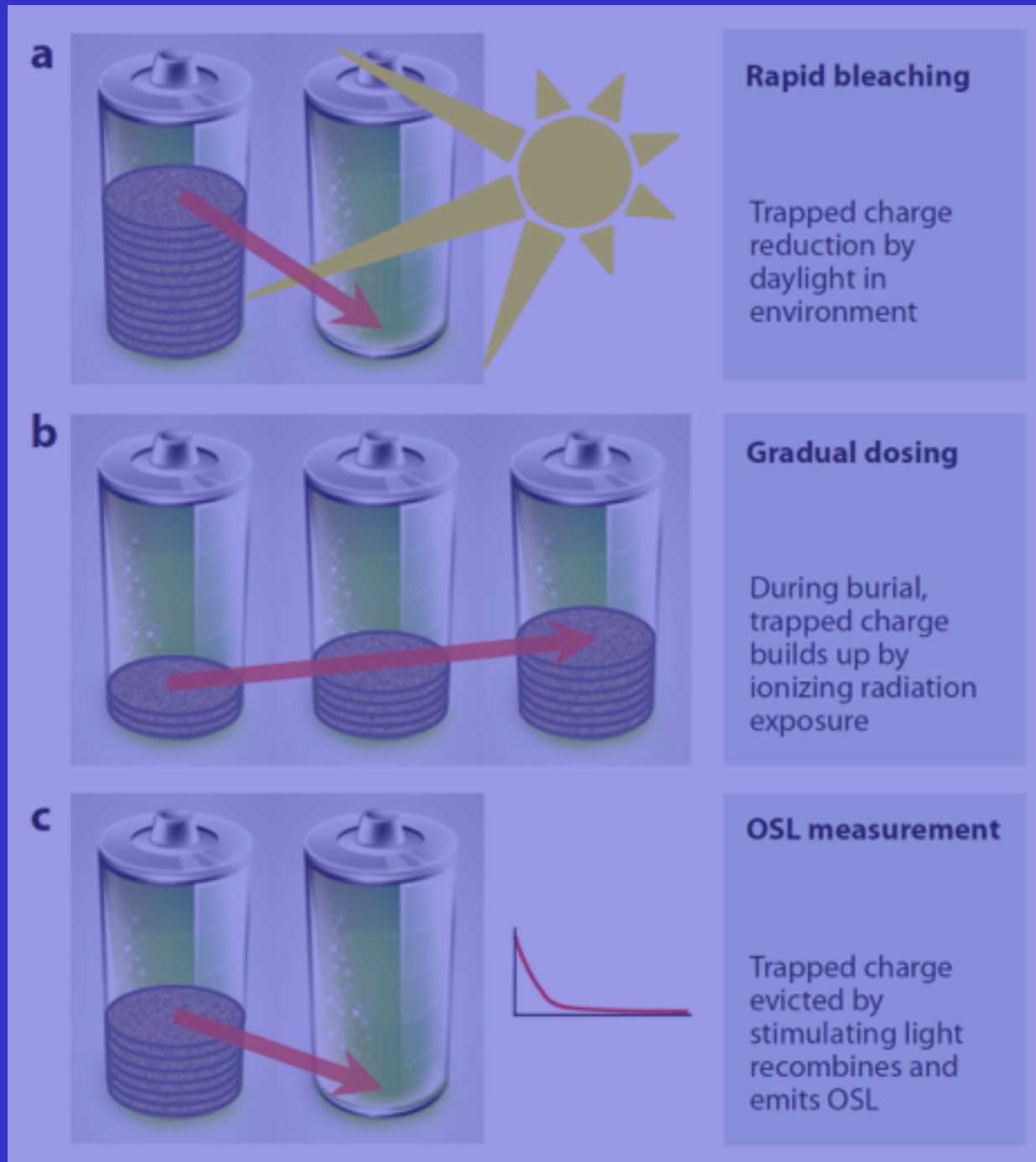
← OSL

Setting to zero



Luminescence
 \propto evicted
electrons
 \propto absorbed dose
 \propto time of burial

Tickling the traps



Rapid bleaching

Trapped charge reduction by daylight in environment

← exposure to sunlight

Gradual dosing

During burial, trapped charge builds up by ionizing radiation exposure

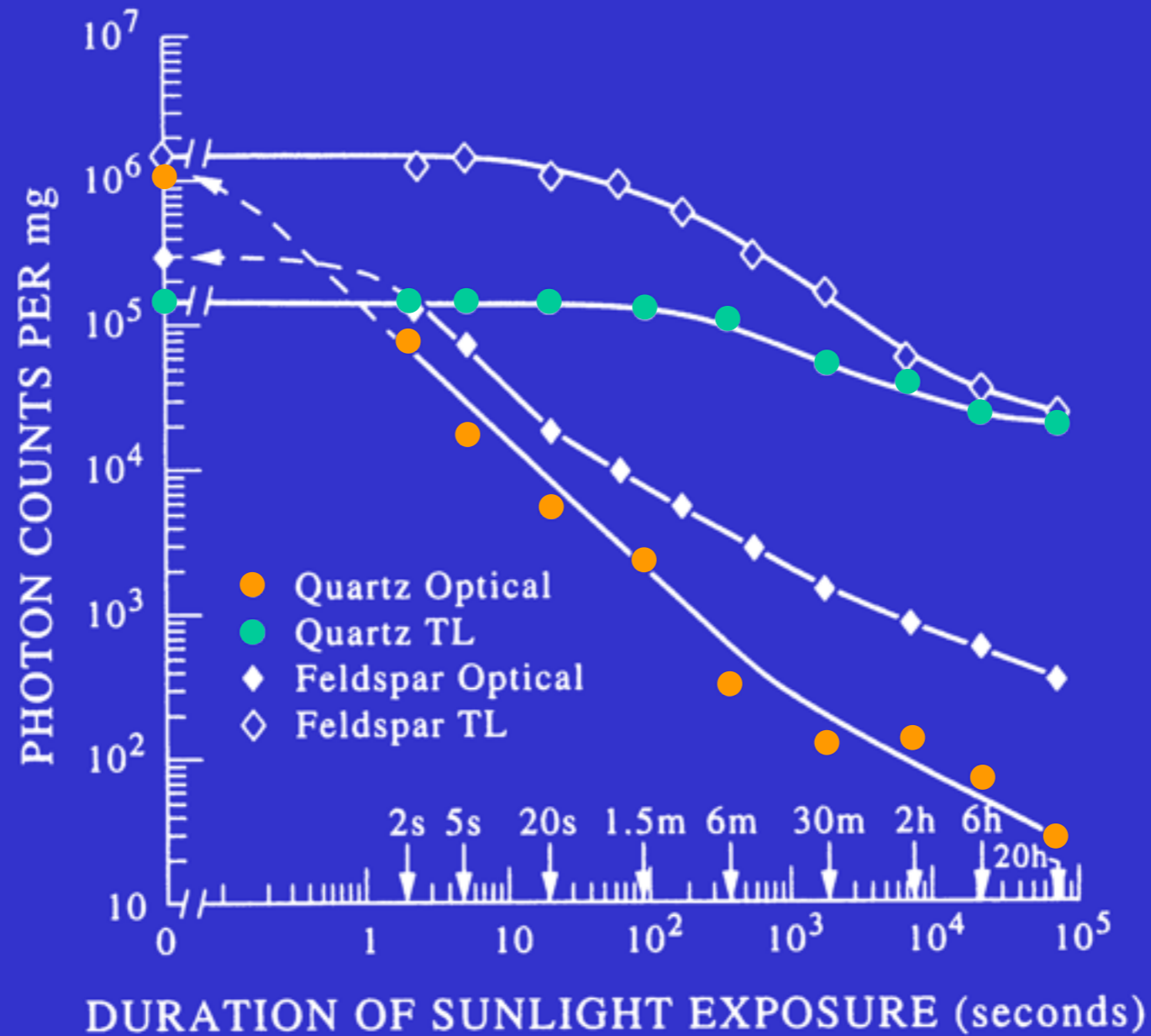
← exposure to radioactivity

OSL measurement

Trapped charge evicted by stimulating light recombines and emits OSL

← exposure to light in the lab

Sunlight bleaching rates

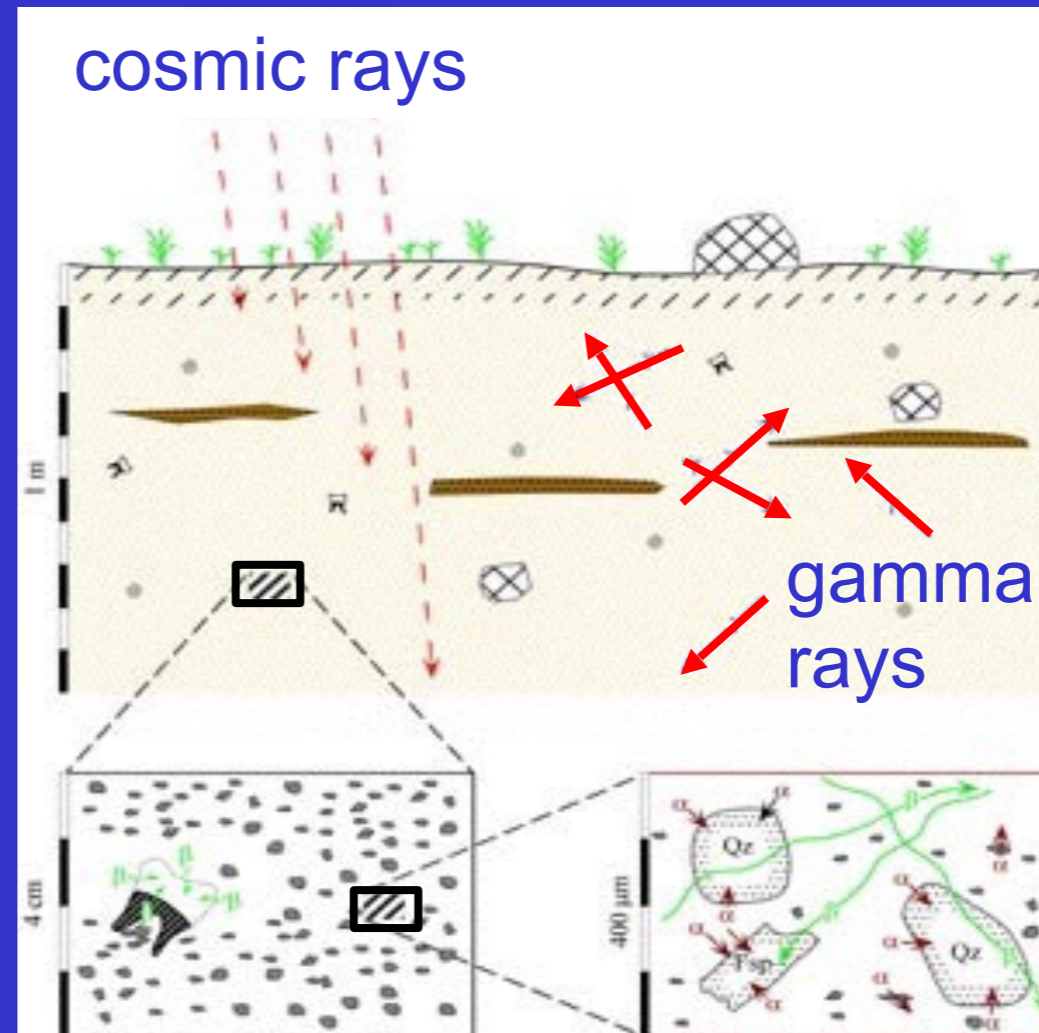


The age equation

$$\text{Age (years)} = \frac{\text{Equivalent dose, } D_e \text{ (grays)}}{\text{Environmental dose rate (grays / year)}}$$

Environmental dose rate:

- cosmic rays (m)
- gamma rays (cm)
- beta particles (mm)
- alpha particles (μm)



alpha particles

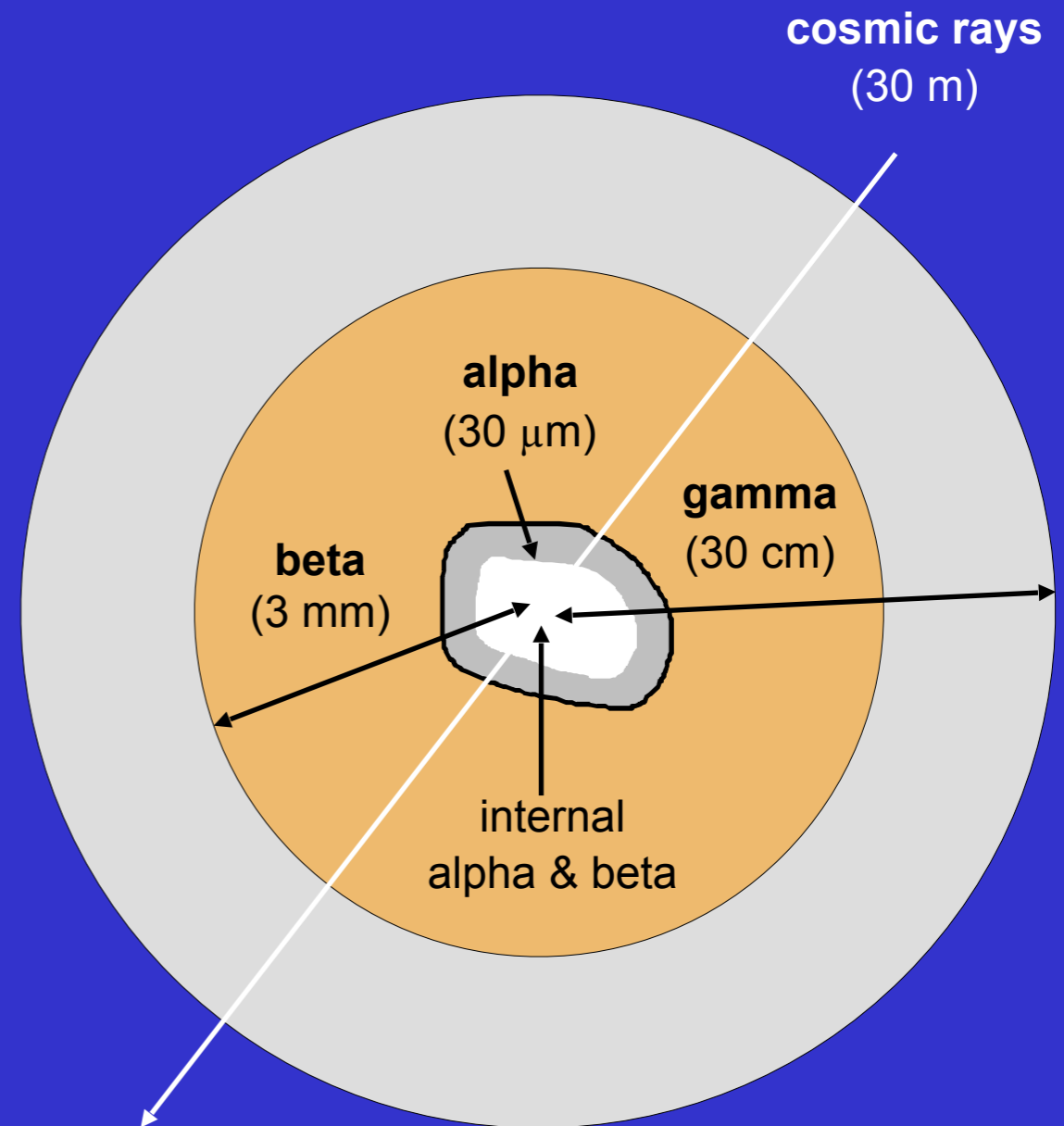
Dose rate contributions

➤ External

- cosmic rays
- gamma rays (U, Th, K)
- beta particles (U, Th, K)
- alpha particles (U, Th)

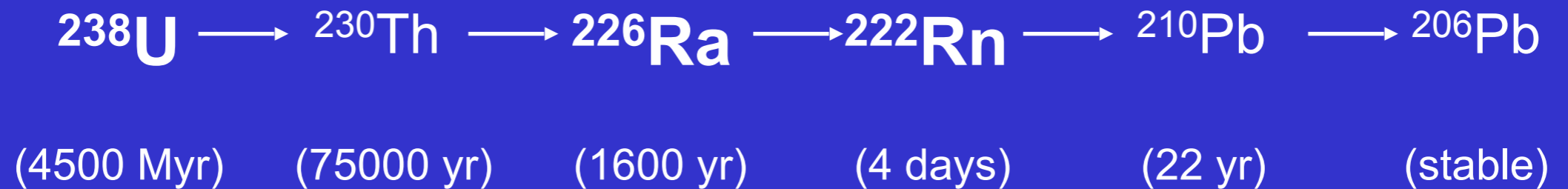
➤ Internal

- beta particles (U, Th, K)
- alpha particles (U, Th)

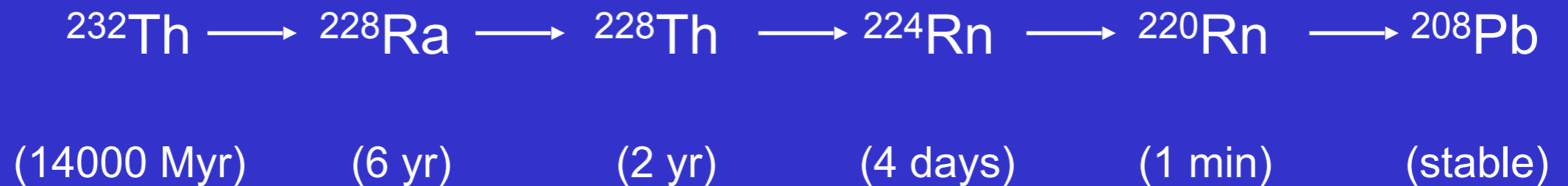


Radioactive decay chains

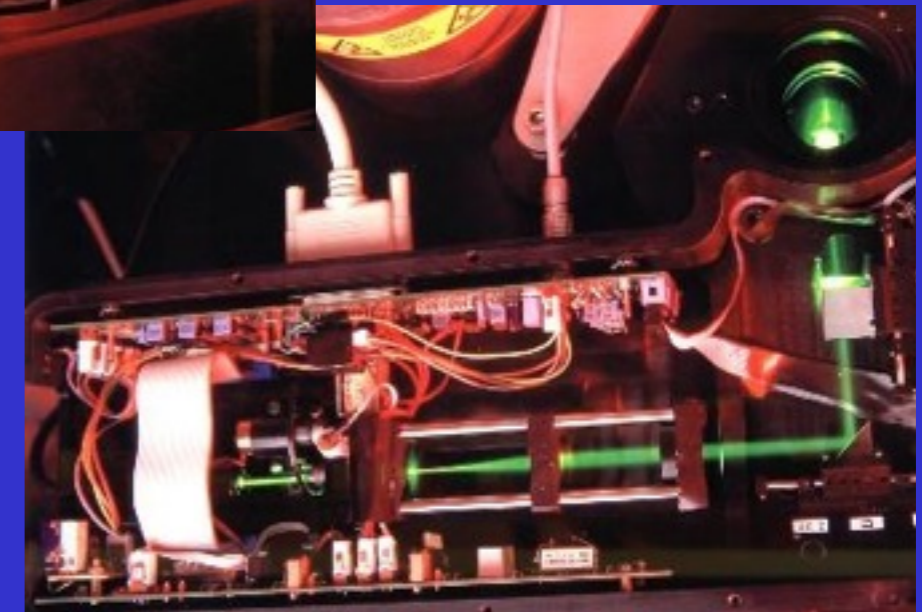
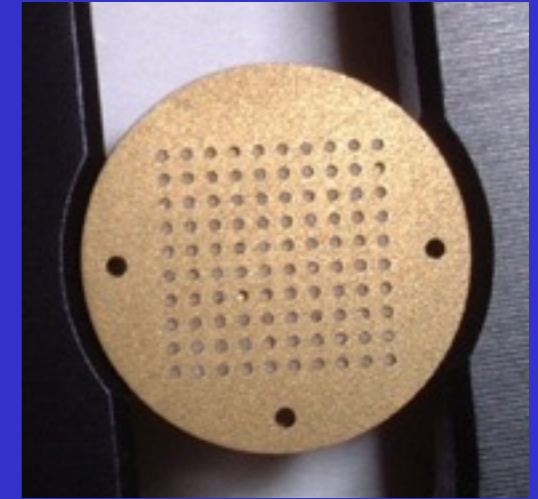
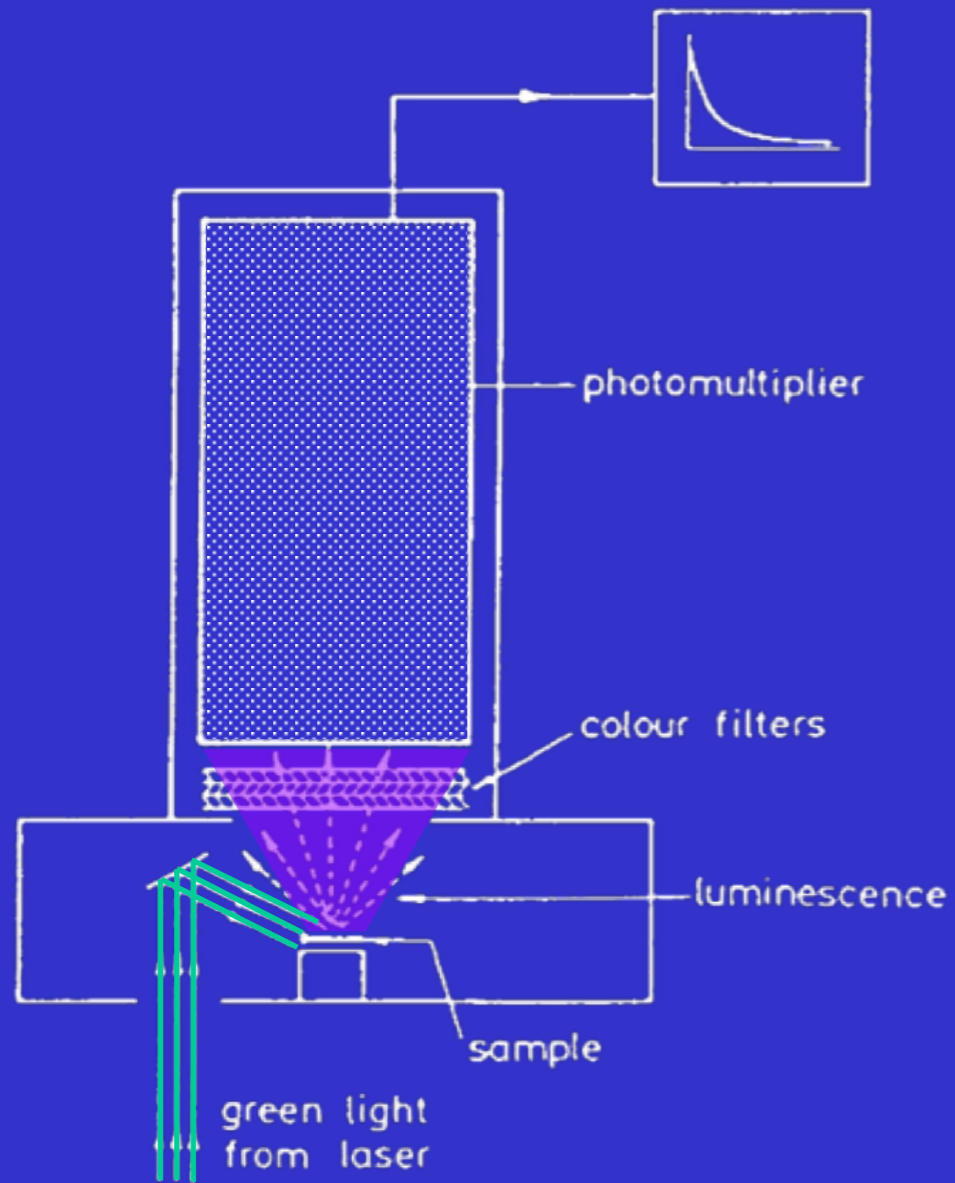
Uranium series



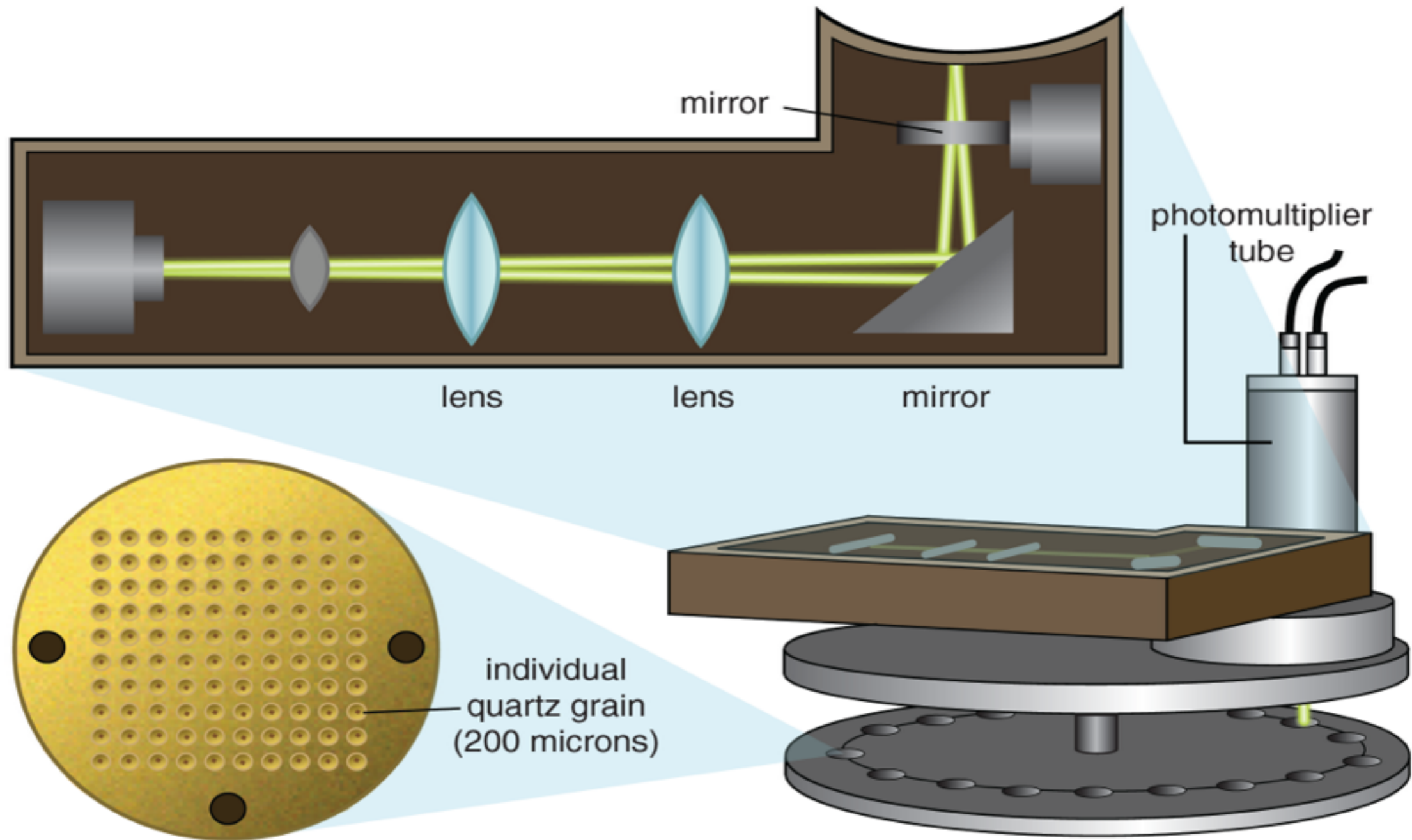
Thorium series



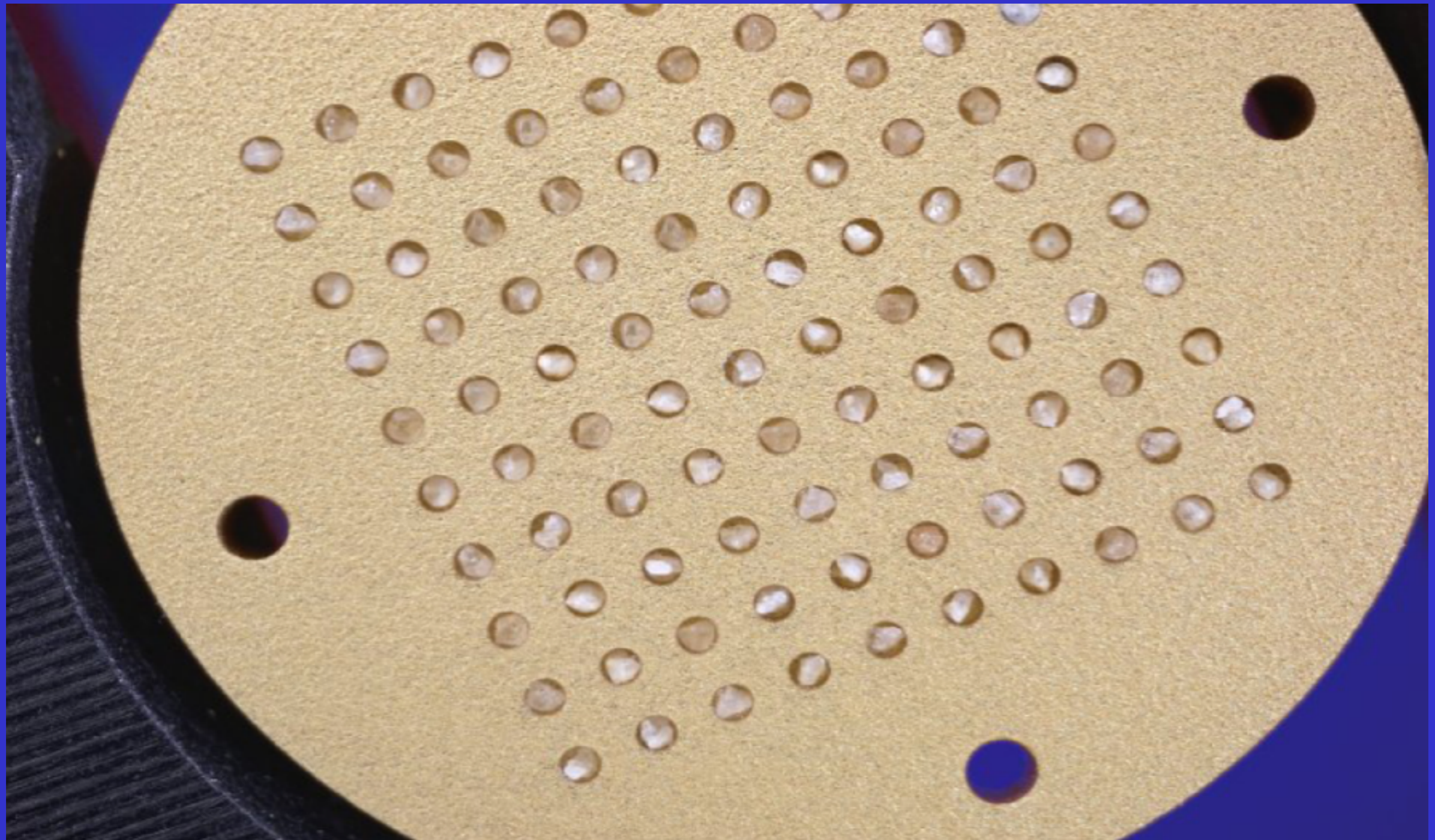
TL / OSL equipment

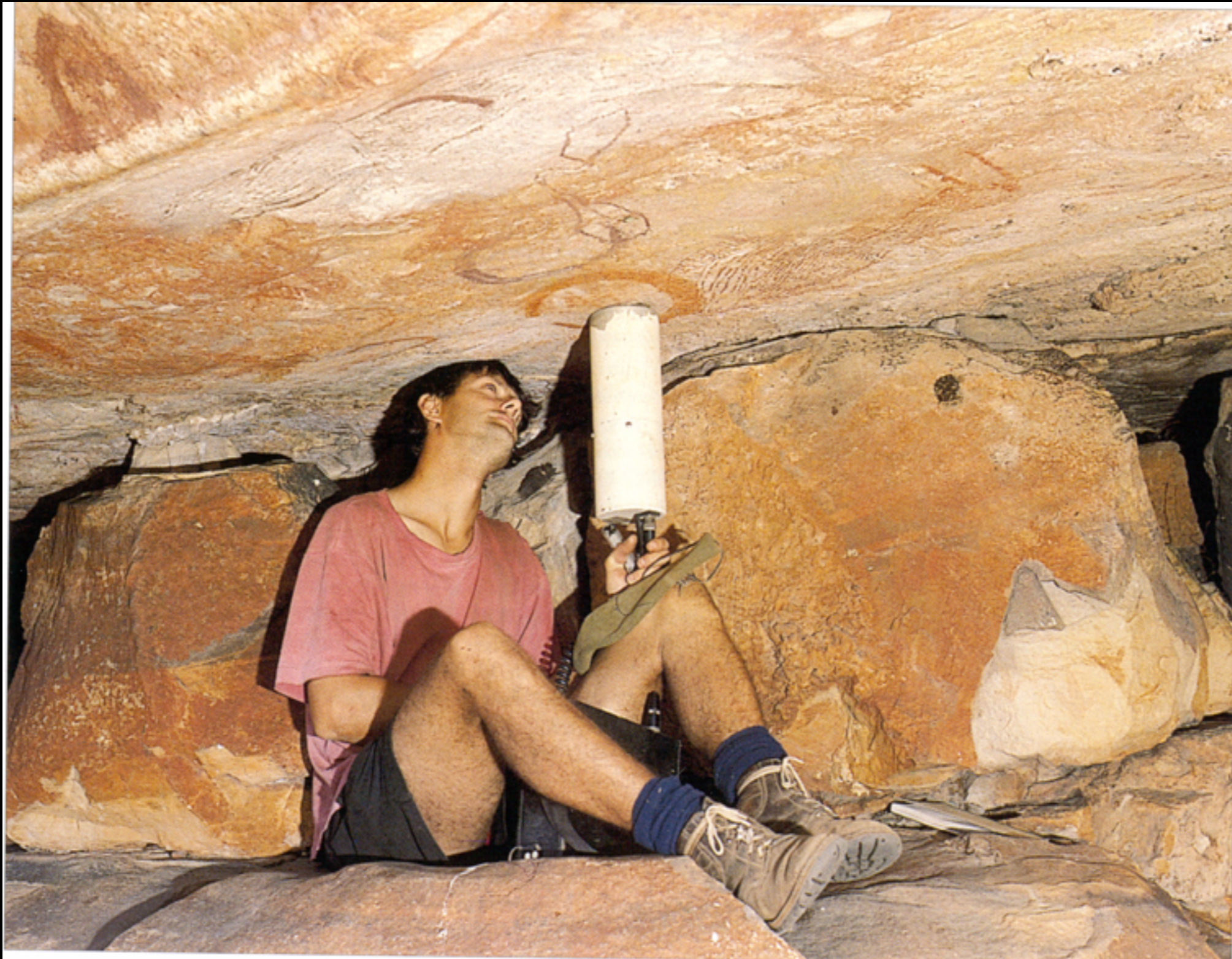


Laser stimulation of single grains



OSL dating of single grains of quartz





R. Roberts ...M. Morwood ... C. Tuniz, ...

Nature 387(1997)696.B

Mud-wasp nests & rockart (Bradshaw)

[Roberts, Walsh, Murray, Olley, Jones, Morwood, Tuniz, Lawson, Macphail, Bowdery, Nauman, Nature, 1997]

OSL and ^{14}C
dating



Mud-dauber
Wasp



Southern Africa 70,000 yr BP

First evidence of symbolic thinking



Bifacial points

Scrapers

Henshilwood et al.
Science 2004