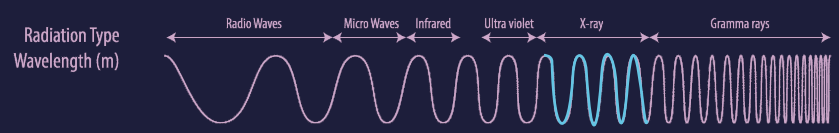
How do X-rays work?

Physics facts in Medical X-rays

What is X-ray?

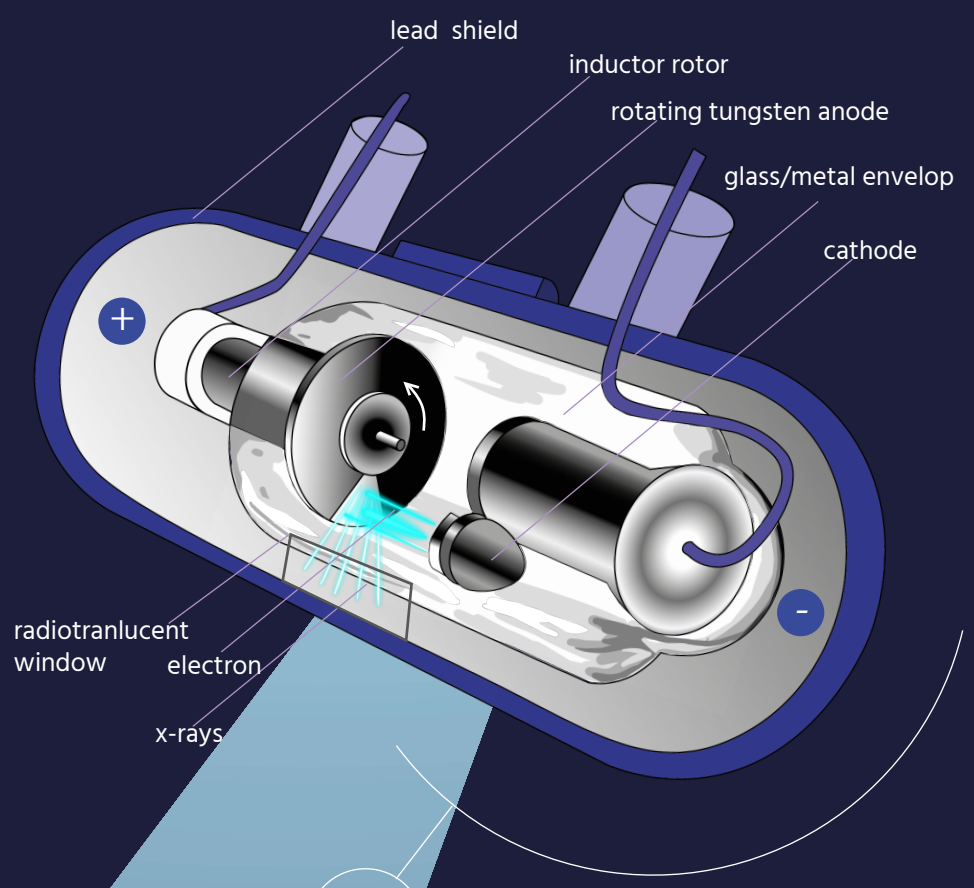
The nature of X-rays, like the visible light we see, are electromagnetic waves. However, the wavelength of X-ray is much smaller than that of visible light, which is 10~nm, as shown in the figure.



How does X-rays work for body parts that does not contain metal elements?

We have “Barium meal” and “Contrast agent containing iodine” for these body parts to increase the possibility of photoelectric effect (light area on films). Because the occurrence probability of the photoelectric effect is proportional to the third power of the atomic number of the medium according to the formula below.

($\propto Z^3$, Z:atomic number)



1

The emmiter emmit the X-rays:

The basic principle is that we pressurize the cathode and emit electron beams to bombard the anode (usually tungsten, rhodium and other metals). The electrons slow down in the anode, and the lost kinetic energy is converted into photons. When the voltage on the cathode is high (in kV), the photon energy we obtain reaches the X-ray wavelength range. X-ray GET!

2

When the x-rays HIT bodies:

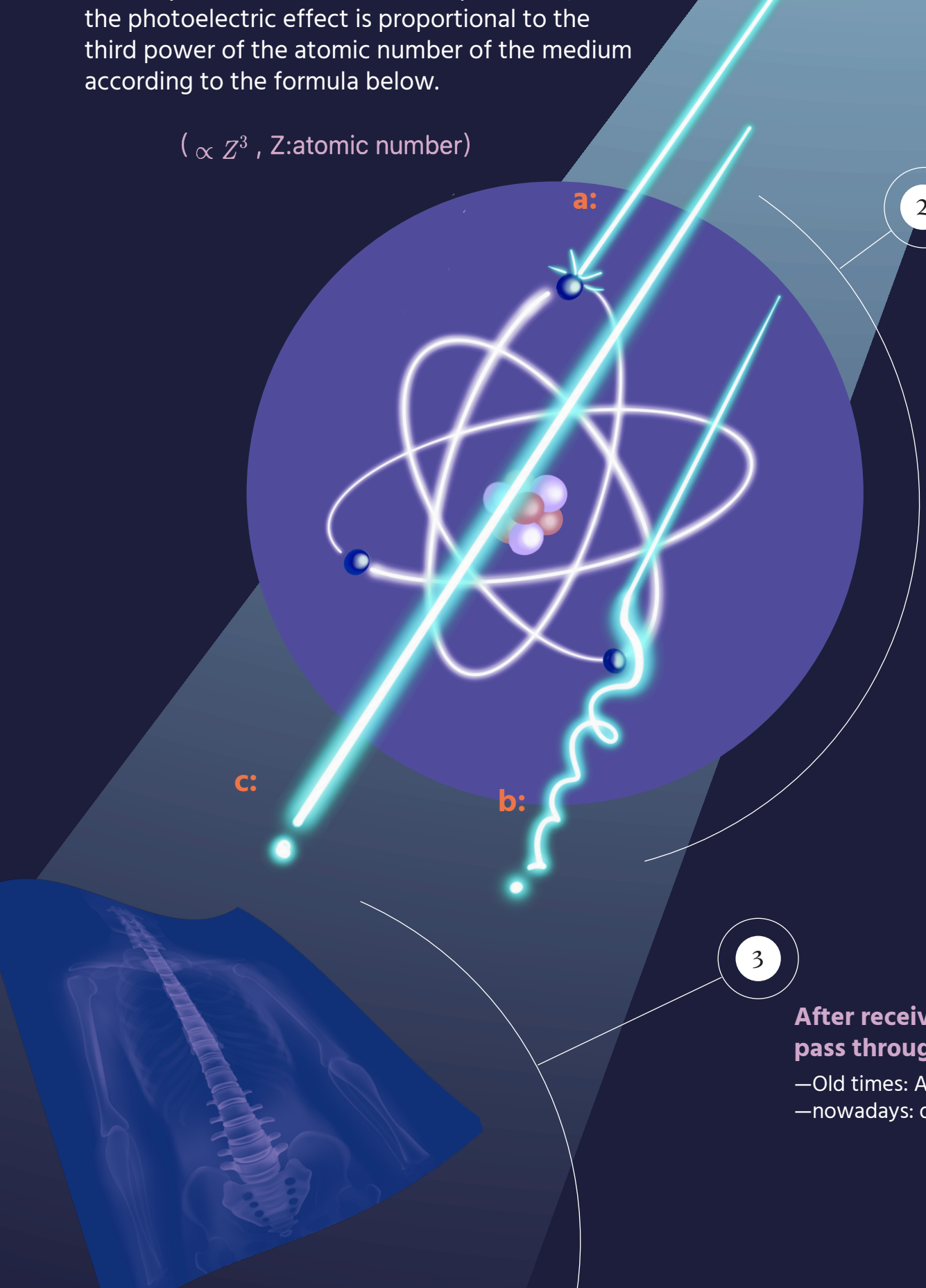
CASE a: Photoelectric effect
(causing photons to be absorbed)
—LIGHT AREA ON THE FILM

The photoelectric effect refers to the interaction of photons with the inner electrons of atoms, and the photons are absorbed. The photoelectric effect is more obvious on metals, and photoelectrons can even converge into photocurrent.

CASE b: Compton scattering
(resulting in the scattering of photons)
—NOISE ON THE FILM

Compton scattering refers to the interaction of photons with the outer electrons of the atom, which causes the energy of the photon to weaken and change the direction of movement (scattering), and at the same time excite the outer electrons.

CASE c: No reaction
—DARK AREA ON THE FILM



3

After receiver receives the X-ray that pass through the body:

—Old times: A x-ray film of your body produced
—nowadays: digital photo produced