Lecture 2
Introduction to x-rays

Reading material for x-ray production

1. Smith and Webb: Chap. 2, pages 34 - 42.
2. Hendee: Chap. 2 (pages 12 - 16) for atomic physics concepts; Chap. 5 for x-ray production

Attempt the worked out problems in each chapter.

X-rays

www.wikipedia.org

- The oldest diagnostic imaging technique (image taken in 1895).
- Led to the first Nobel prize in physics in 1901

For the interesting story behind the discovery, read: https://www.nobelprize.org/prizes/physics/1901/perspectives/

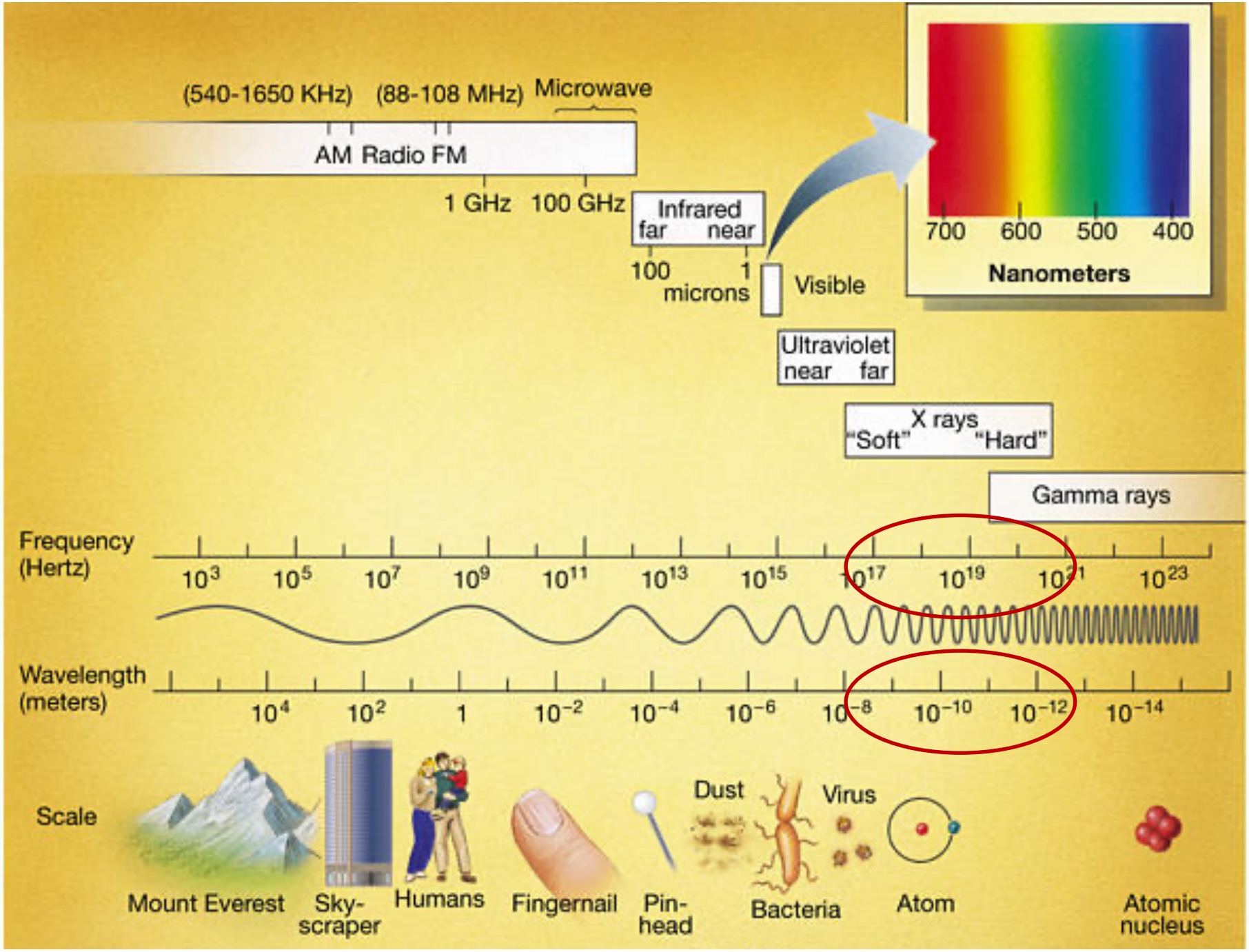
What are x-rays?

- Made of photons with no mass or charge. Can't be deflected by electric or magnetic fields.

- Travels in vacuum with a speed of ~ 3 x 10^8 m/s.

- Energy (E) = $h\nu = hc/\lambda$;

  h: Planck's constant (6.626×10^{-34} Joule-sec)



How are x-rays generated?

X-ray production: Coolidge tube

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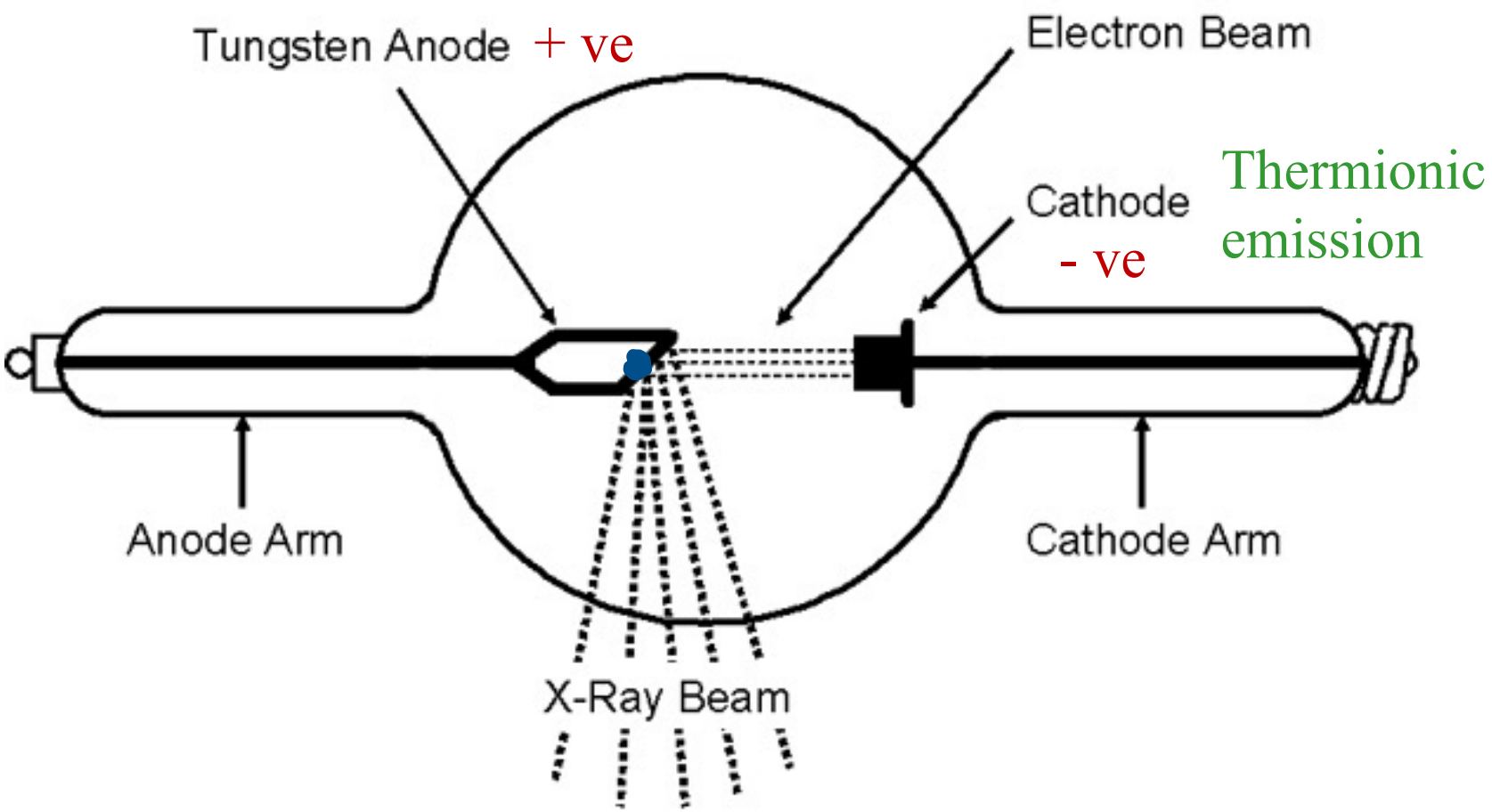


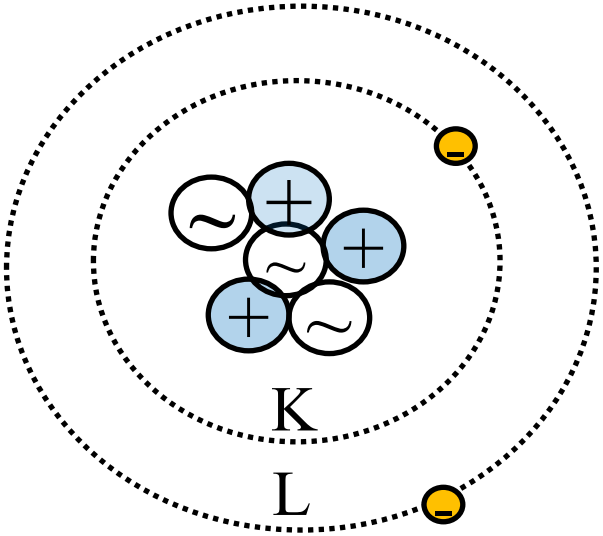
Some of the kinetic energy of electrons hitting the target is converted into x-ray photons; the rest is dissipated as heat.

X-rays are of two kinds

1. Characteristic X-rays
2. Bremsstrahlung (translates in English as “braking radiation”)

What happens inside the target (anode)?

- Electrons have discrete energy levels
- Binding energy: energy input needed to remove electron from atom. Higher binding energy for electrons in inner shells.
- Electron will release energy when it moves from higher to lower energy level.



Shells: K, L,...