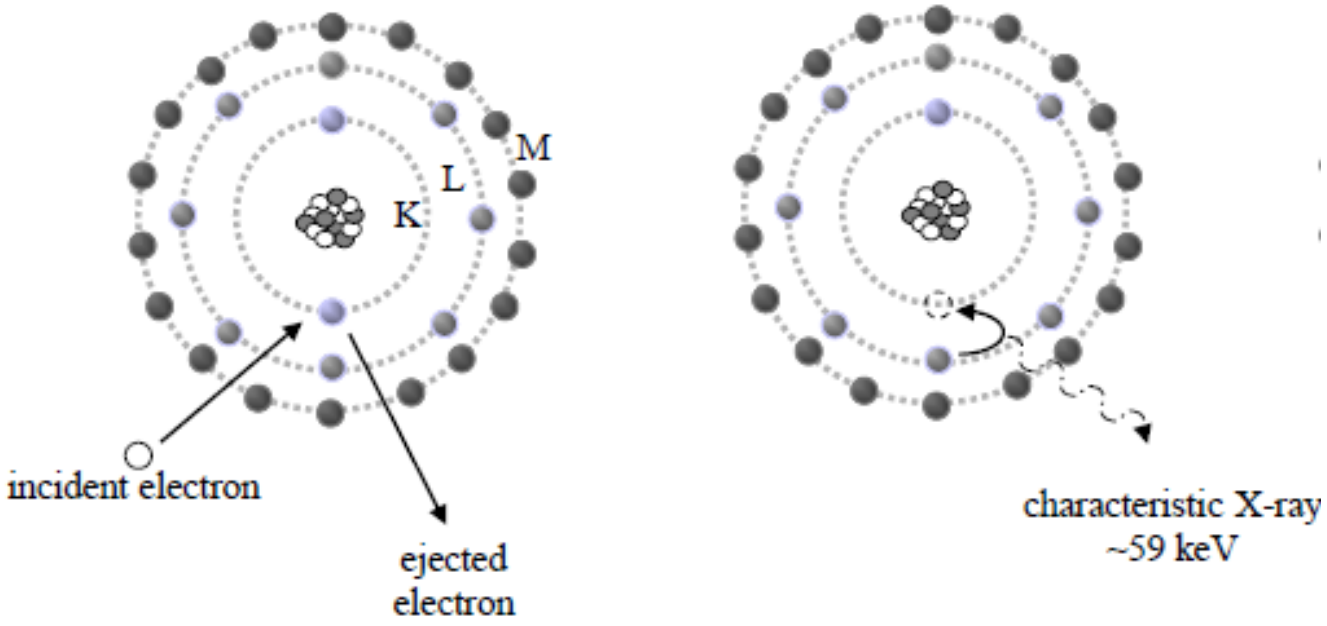
Lec 3: Generation of x-rays and X-ray tube

Characteristic x-rays: have specific energies



1. Electron from cathode knocks out an inner shell (K) electron from the anode
2. Another electron from a higher energy shell (L) in anode fills the vacancy
3. Energy given up by L $\rightarrow$ K transition is emitted as x-rays.

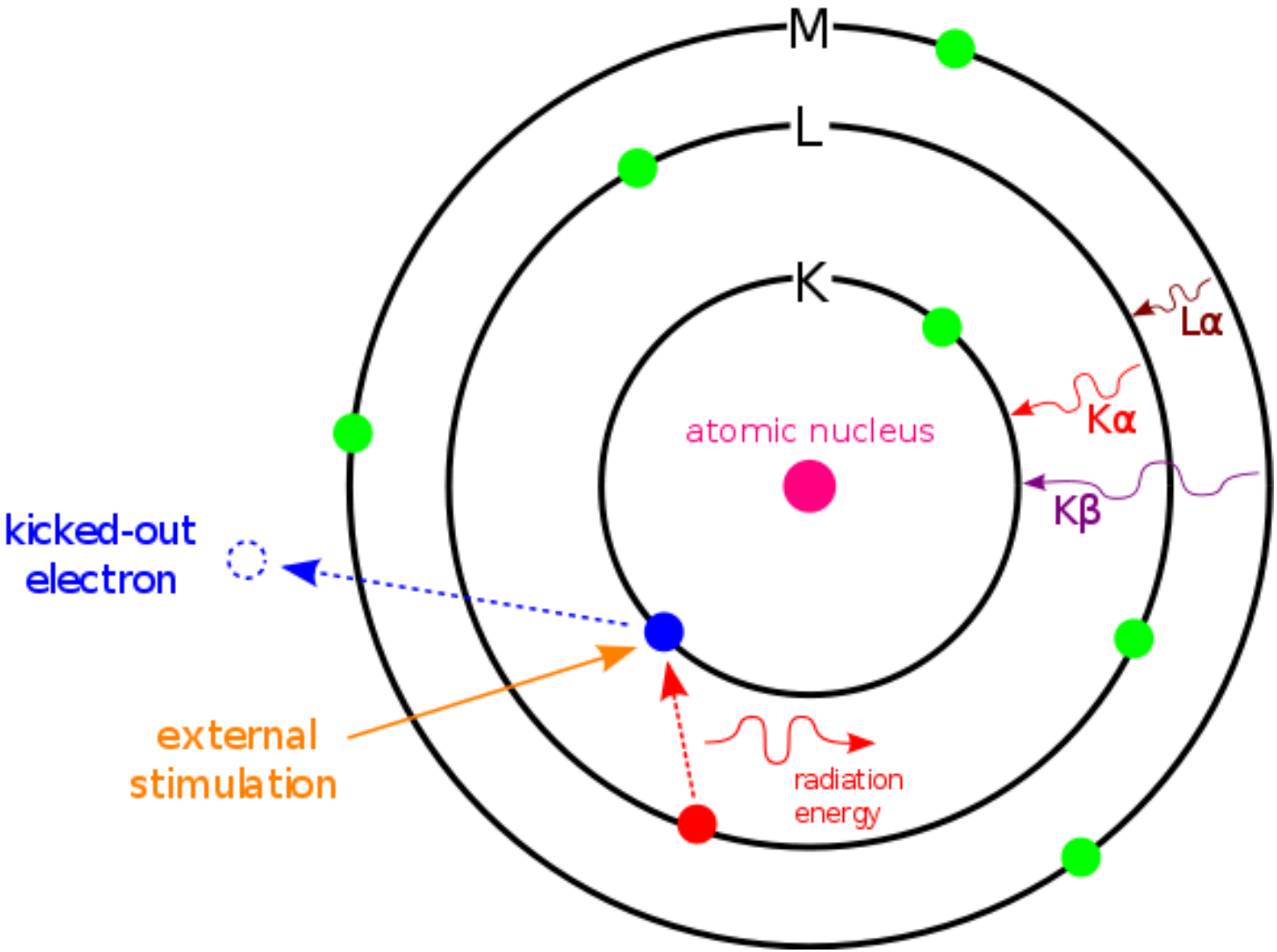
Wavelength and energy of X-rays

Shell	Tungsten (keV)	Molybdenum (keV)
K	69.5	20
L	10.2-12.1	2.5-2.8
M	1.9-2.8	0.4-0.5

Example: Calculate the wavelength range of characteristic x-rays emitted during a transition from M level to K level in Tungsten.

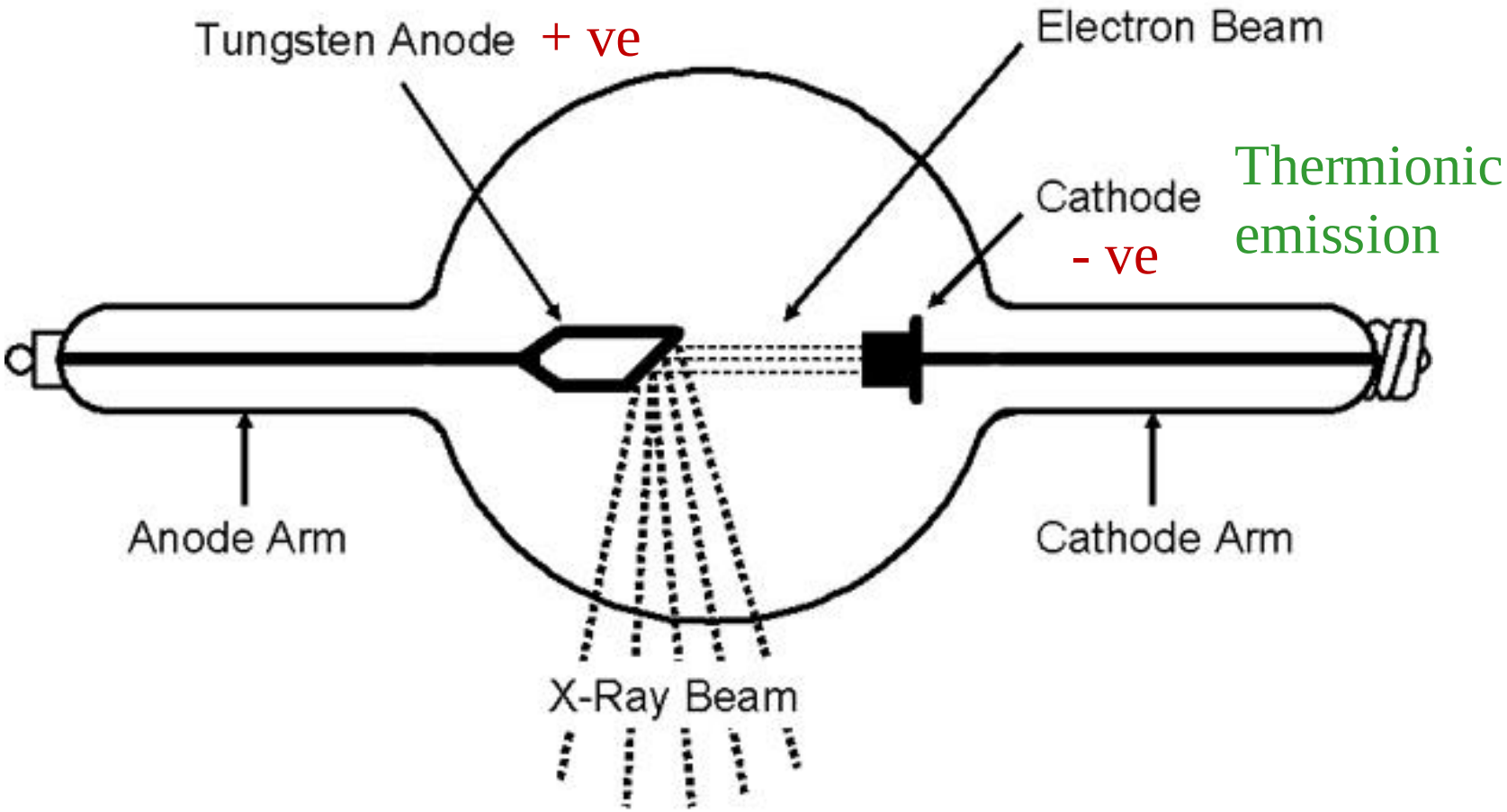
If, E in keV and λ in nm, then E (keV) = 1.24/ λ (nm)

Nomenclature of characteristic lines



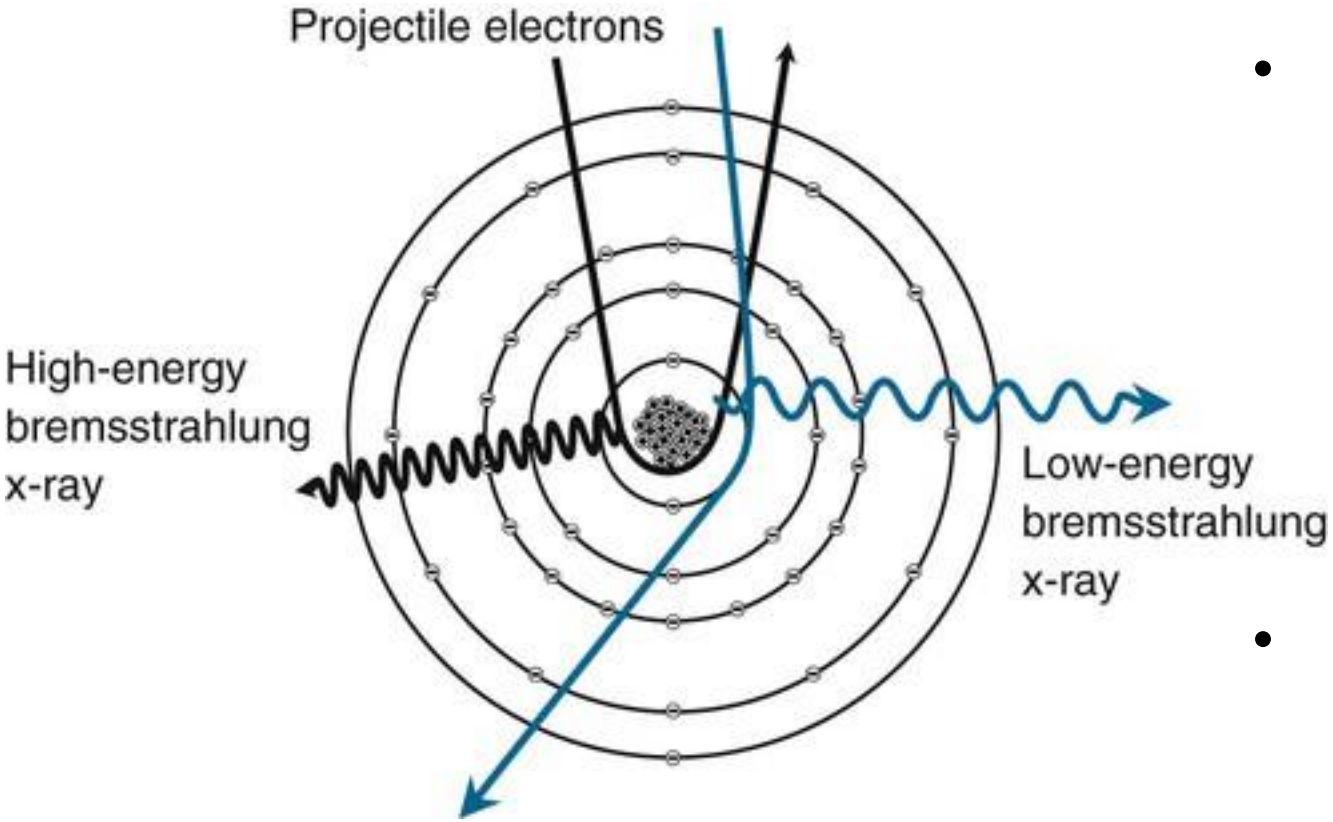
http://www.soest.hawaii.edu/HIGP/Faculty/sksharma/GG711/GG711Lec14EDS.pdf

X-ray production: Coolidge tube



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

Continuous energy x-rays: Bremsstrahlung



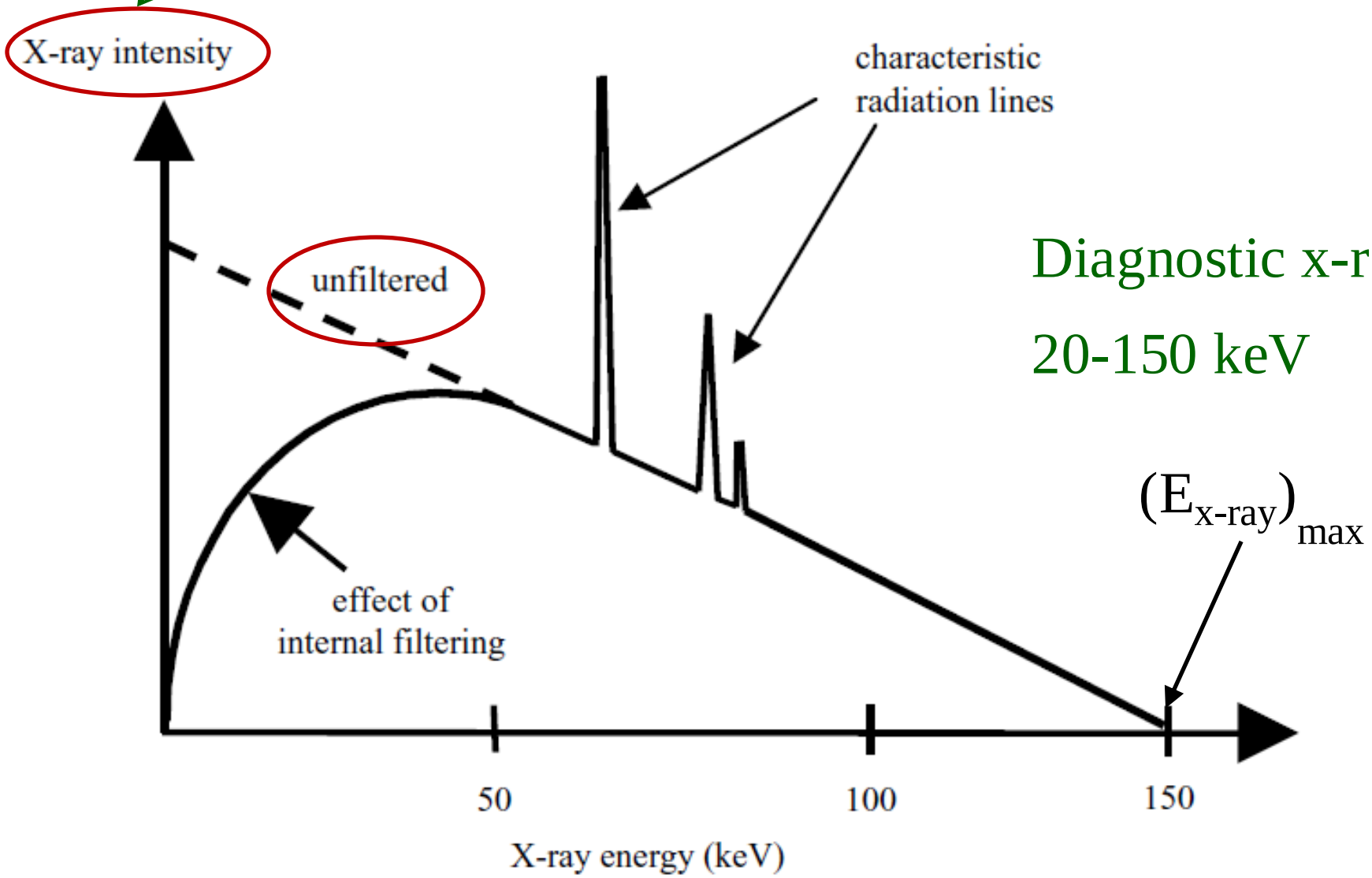
- Instead of knocking off an electron in the anode, electron from cathode changes its direction
- X-rays are emitted with <u>continuous</u> energies.

http://physicsopenlab.org/2017/08/02/bremsstrahlung-radiation/

$$E_{x\text{-}ray} = E_{incident} - E_{final}$$

X-ray spectrum

of photons in the beam



Diagnostic x-rays:

20-150 keV