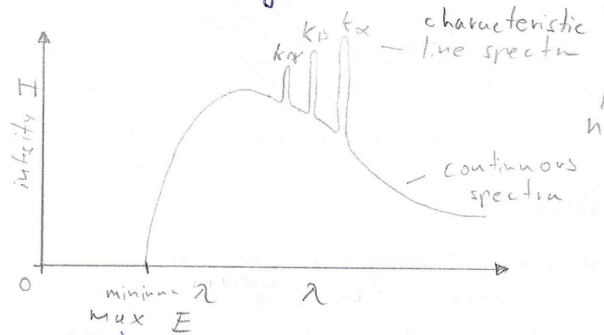
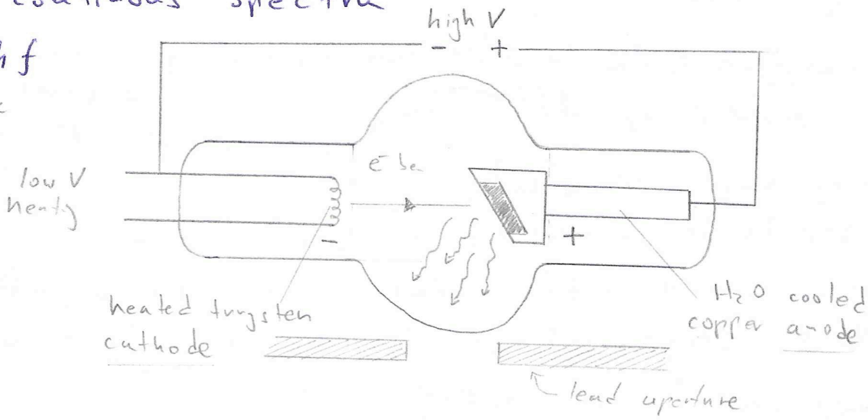
X rays

- produced when e^- are accelerated and collide with a heavy metal target. The kE of the e^- is converted into the E of an X ray photon

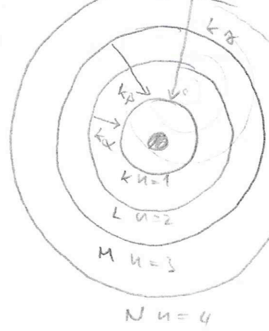
- breaking radiation (Brensstrahlung) are x rays produced by the collisions. Since E is consered there is a range of frequencies which the photon can have giving a continous spectrum

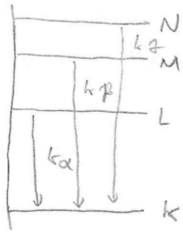
$kE = eV \qquad E_\gamma = hf \qquad eV = hf$





- in addition also certain linear spectra are produced these are characteristic to the eleent of the metal target
- the line spectra are produced when the e^- from beam penetrate into the target atom and knock out an e^- so e^-s from higher orbitals transition down to fill in the spot and emit X ray γ
- the lines have letters k, L, M, N corresponding to the energy level to which the e^- transition and subscript α, β, γ ... according to how many levels they fall
- the $k\alpha$ is the closest so e^- are most likely to transition for thee $\therefore$ highest peak

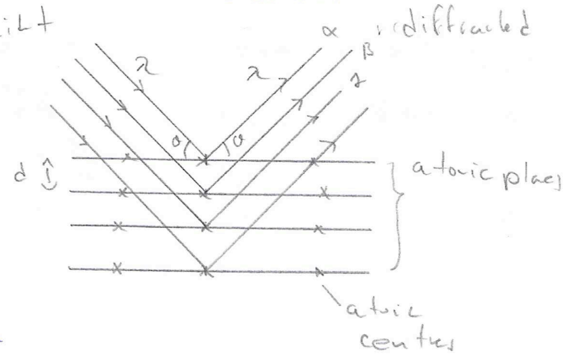




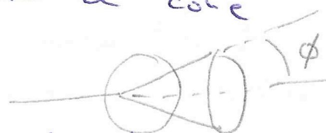
- Moseleys law
  ↳ discovered that f of $k\alpha$ is related to atomic number of target elements
  even used it to predict and calculate Z
  ↳ explained by applying Bohr theory and calculating ΔE
  similar to Balmer series but difficult due to effects of all e^- and structure of atom. it is $(Z-1)$ since the charge of nucleus is Ze and charge of e^- is $-1e$ so together $(Z-1)e$

$f = 2.5 \times 10^{15} (Z-1)^2$

- X ray cristallography
  - ↳ Xray λ are similar to distances between atoms in solid matter so crystals can be used as a diffraction grating producing a diffraction pattern which can be used to investigate the structure
  - ↳ most usefull is usually Braggs reflection in which monochromatic Xrays strike crystal lattice and by Hyugen Fresnel principle lines of maxima and minima are produced which overall give a reflection pattern hence the name



  - ↳ results similar to reflection but it is caused by diffraction and only occours at specific Θ
- using single crystal
  - ↳ has to be rotated, at places where the source, atomic planes and detector allign so Braggs reflection is visible we get maximum so it is recorded
    spots are produced
- using powder of crystal
  - ↳ contains particles with atomic planes at all orientations so it doesnt have to be rotated
  - ↳ planes for which Bragg reflection angle is ϕ create a cone of half angle ϕ so series of lines are produced



- now use the spots or lines and Bragg formula to work out the geometry of the crystall lattice

- hard X rays have $\downarrow\lambda, \uparrow f$ so $\uparrow E$