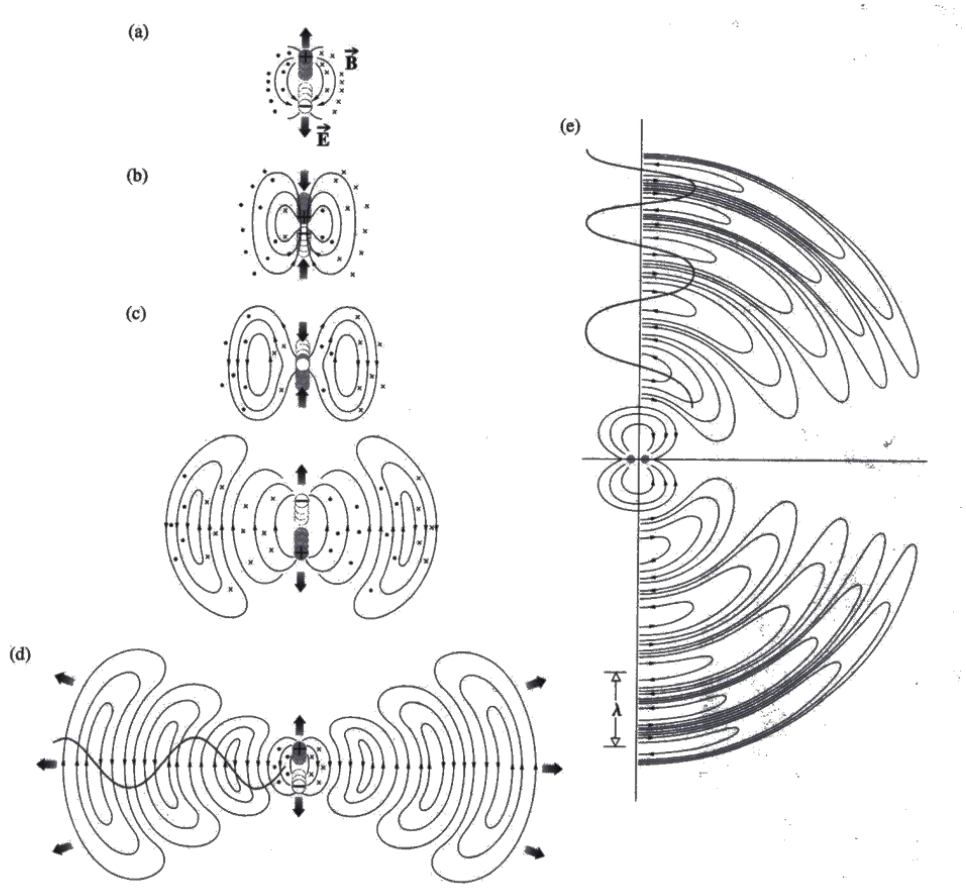
PARTICLE PROPERTIES OF WAVES

1. Electromagnetic Waves.
2. Blackbody Radiation.
3. Photoelectric Effect.
4. What is Light?
5. X-Rays.
6. X-ray Diffraction.
7. Compton Effect.
8. Pair Production.
9. Photons and Gravity.

X-RAY DIFFRACTION

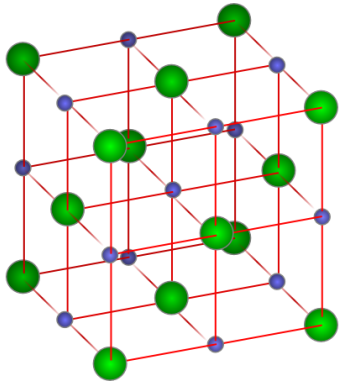
How is light scattered?



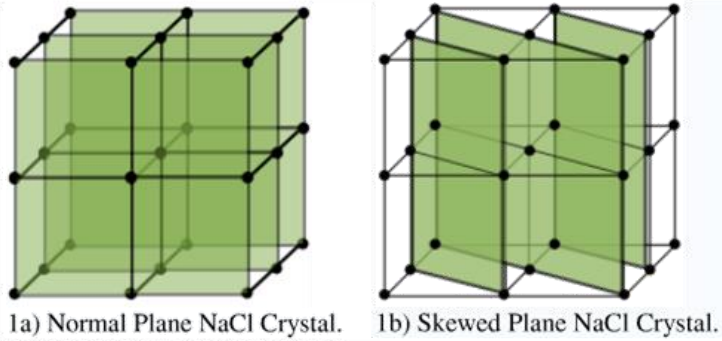
Scattering: atoms absorb incident plane waves and reemit spherical wave (all directions) of the same frequency.

X-RAY DIFFRACTION

How is light scattered off crystals?



- Monochromatic X-ray beam falling on a crystal will be scattered in all direction inside it.
- Due to the atoms regular arrangement, the scattered light will interfere constructively in some places and destructively in others.
- The atoms in the crystals can be thought of as families of parallel planes. ← with a characteristic separation between its component planes.

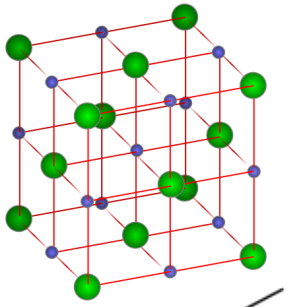


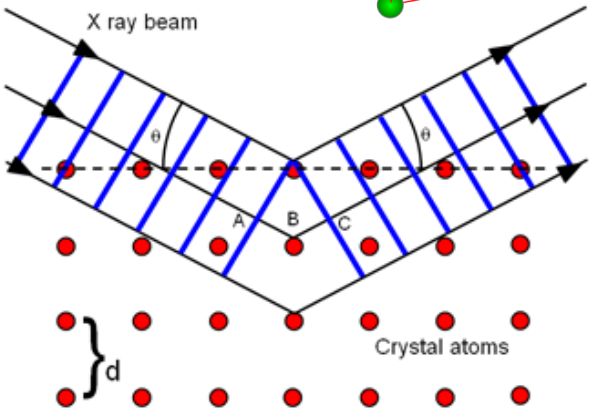
1a) Normal Plane NaCl Crystal. 1b) Skewed Plane NaCl Crystal.

Bragg planes

X-RAY DIFFRACTION

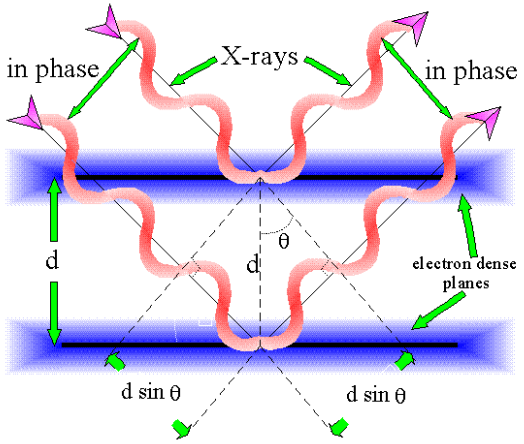
What are the conditions of constructive and destructive interference?





- The spacing between Bragg planes is d.
- The X-rays have wavelength λ.
- Angle of incidence θ.
- Let us look at the two scattered rays.
- Constructive interference:
  - Parallel rays with path difference λ, 2 λ, 3 λ, … → n λ.
- The path difference = 2d sin θ.

$$2d\sin\theta = n\lambda$$



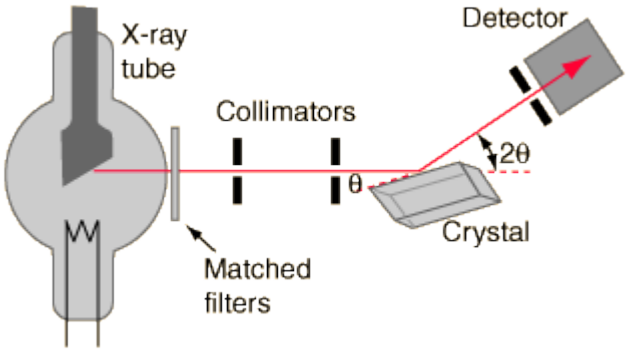
- n is the order of the scattered beam.

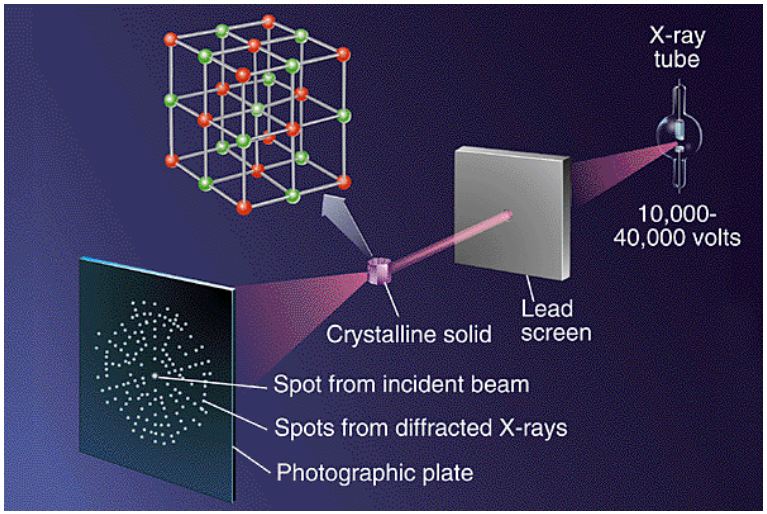
X-RAY DIFFRACTION

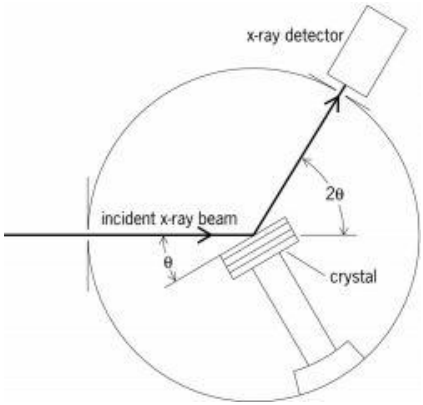
What does an X-ray spectrometer looks like?

As θ is varied, the detector will record intensity peaks corresponding to the orders predicted by the equation:

$$2d \sin\theta = n\lambda$$







X-RAY DIFFRACTION

Remember….

X-rays diffraction can be used to determine the X-ray wavelength or the lattice spacing…