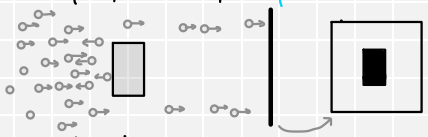
NEWTON'S CORPUSCULAR THEORY OF LIGHT

Starting in 1672, there was a 180 year debate as to the nature of light

Newton - Corpuscular Theory

1672 - 'New Theory of Light and Colour' published
- → white light made up of 7 distinct colours (ROYGBIV)
- → each colour was a different (tennis ball like) particle

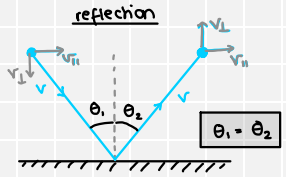
1704 - 'Opticks' published (By now Huygen and Hooke were dead)
- → Newton's new comprehensive theory of light (corpuscular theory)
- → light 'particles' now referred to as corpuscles
  - → tiny, weightless particles that travelled in straight lines.
- → theory accounted for formation of sharp shadows.



corpuscles would collide with object and bounce back or were stopped resulting in only corpuscles around object reaching screen

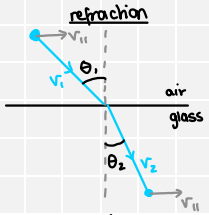
- → dispersion was explained by different coloured corpuscles travelling at different speeds in glass.
- → Newton used his laws of motion to explain reflection and refraction.

reflection



- corpuscular velocity components parallel to mirror unchanged.
  $v\sin\theta_1 = v\sin\theta_2$
- velocity component perpendicular to mirror reversed.
  ∴ mirror exerts repulsive force on corpuscle.

refraction



- as with reflection, there is no change in parallel components
  $v_1 \sin\theta_1 = v_2 \sin\theta_2$
- since $\theta_1 > \theta_2$, Newton concluded that light travelled faster in glass ← contradiction!

Huygen - Wave Theory

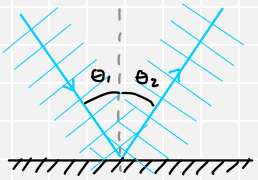
1672 - Robert Hooke's experiments on light pointed to a wave theory of light (particles could not account for diffraction)

1678 - Christiaan Huygen hypothesises that light is a longitudinal wave
- → propagates through an 'ether'
- → Huygen used a geometrical construction of a wave front to predict behaviour of light.

wave front : line/surface on which a wave disturbance has the same phase.

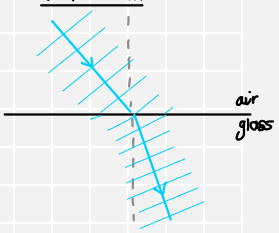
- → like Newton's theory, Huygen could explain reflection/refraction

reflection



- wave front made correctly predicted
  $\theta_1 = \theta_2$

refraction



- model predicted a decrease in wavelength in glass
- This would result in a decrease in the speed of light in glass

- → Huygen's theory could not explain sharp shadows (due to diffraction of light/sound waves.

Rejection : despite being able to explain narrow slit diffraction (where Newton could not) Huygen's inability to explain sharp shadows, coupled with Newton's existing reputation meant this theory was disregarded but most for the next 100 years!

Further Evidence

- Young Double Slit Experiment - 1801
  - → Newton's theory predicted just two bright fringes
  - → Huygen's theory predicted a series of fringes ← observed outcome!

- Fizeau and Foucault - 1849
  - → measured speed of light in air and water (see next lesson)
  - → demonstrated light traveled slower in water ← predicted by Huygen!

] ← led to the disregarding of Newton's corpuscular theory and acceptance of wave theory