

Modern Physics

Dual nature of light & matter

Sh → what is Modern physics?

Gn → Major revisions/disruptive
100 - 150 yrs ago.

Gn → Separated
Mech. Waves Thermodynamics

Sh → what are topics under Modern Phy.

Roadmap

Gm →

perception of light

particle wave

dual nature of light

PEE

Matter waves

X-rays

Atomic models

Quantum mech.

Nucleus

interference

Diffraction

Polarization

Scattering

Electromagnetic waves

Wave optics

Known → Unknown

waves & particles.

Gy → Give me some examples of waves & particles.

Sl → Sound, water wave,
wave in a string.
 e^- , p , n , gas molecule,
atoms, human being,
pen, charge.

Gy → what is the diff. b/w waves & particles.

Sh → waves need a medium.
motion & flow
waves don't need medium

Gy → 3 big differences.

① existential diff.

② The way they move/flow
& what they carry.

particles
carry mass

waves carry
disturbance.

③ How they combine → interference.

S14 → What do you know
about light

reflection refraction.

S14 → ① light travels in st. line.

② $i = r$, coplanar

$$n_1 \sin i = n_2 \sin r, \text{ coplanar}$$

Newton proposed

Corpuscles theory of
light.

Elastic collisions.

Newton → 1650

Somebody came →

1650

Huygens →

light may be a wave?

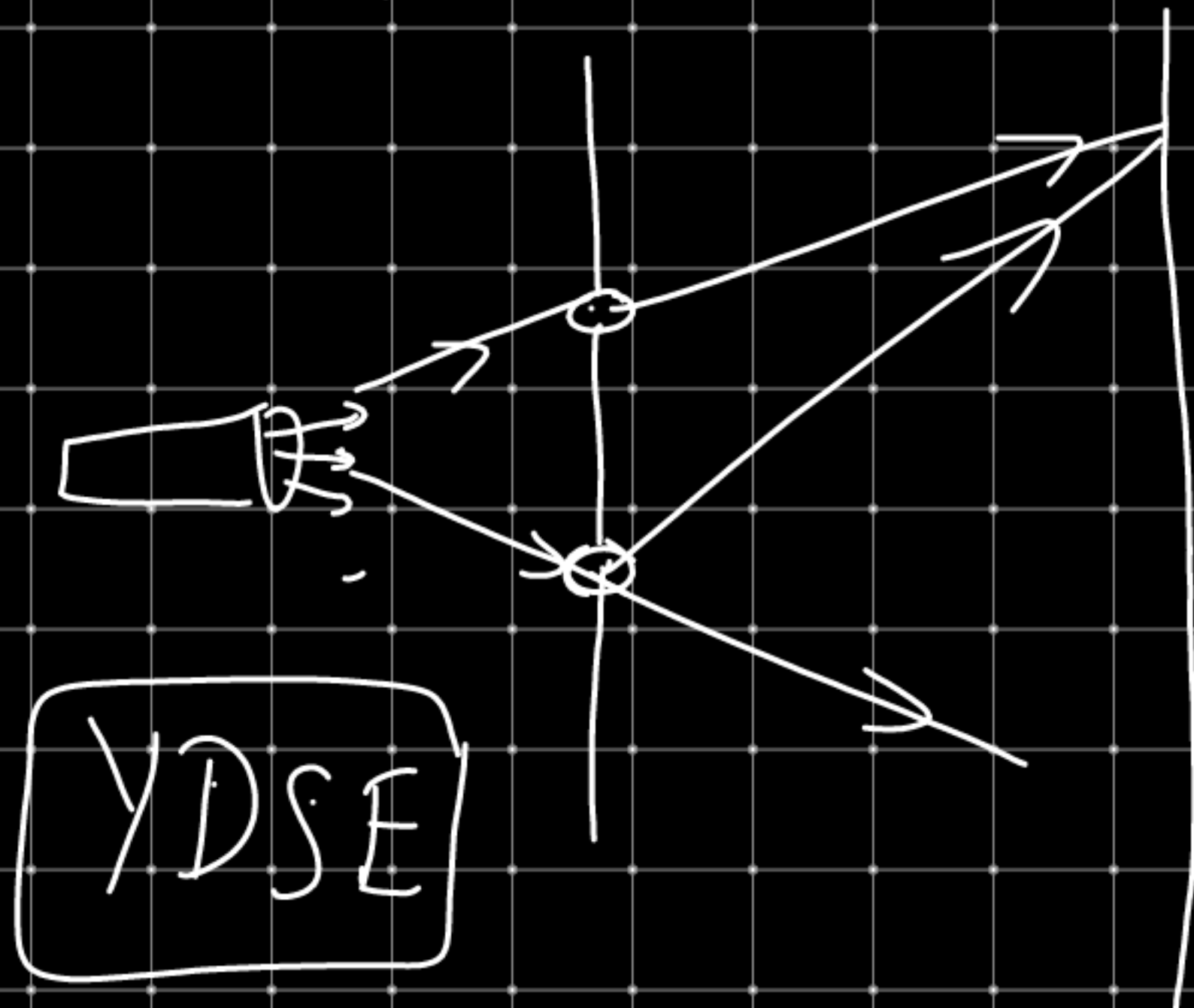
→ wavelength of light
may be small

350 nm — 750 nm

1 mm opening

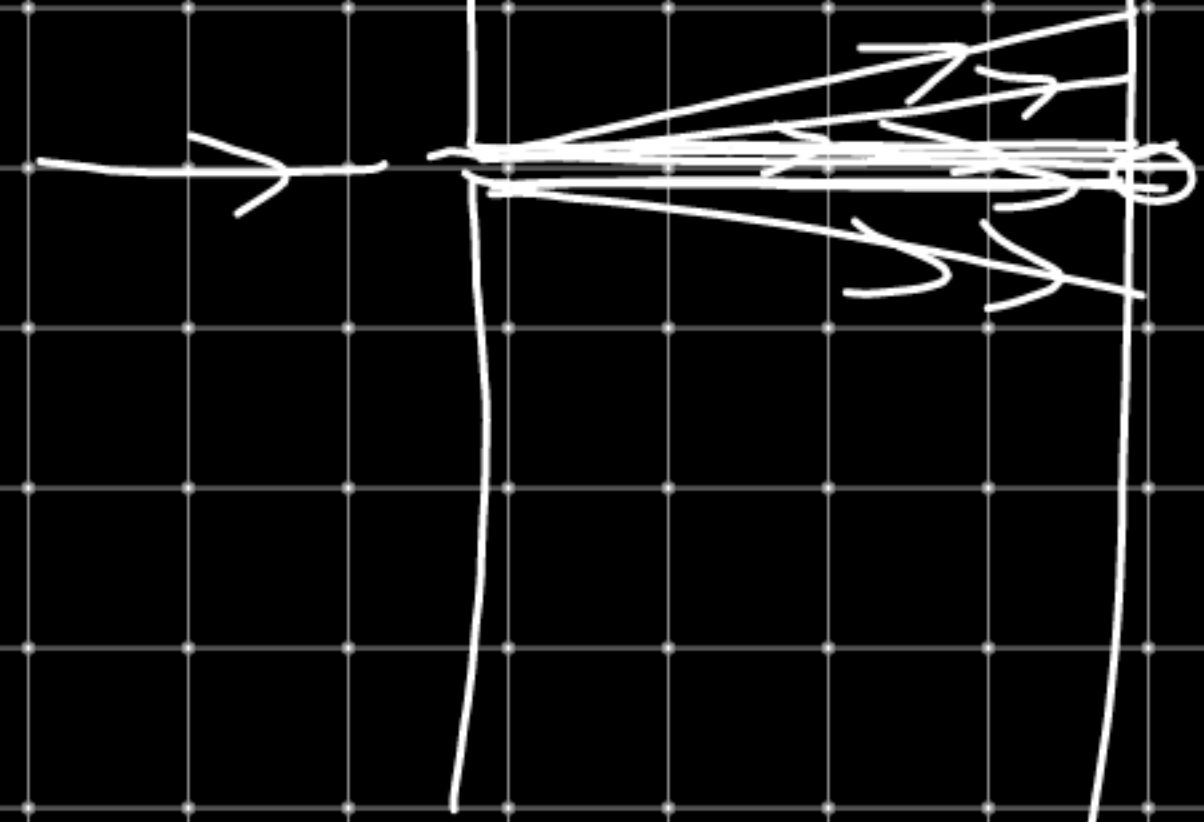
100 — 1000 times

Thomas Young
1801 → light → expt.



interference

Diffraction
Fresnel → 1820.



Screen

James Clerk Maxwell.

→ Electromagnetic theory
of waves (light).

$$\rightarrow E_0 \sin(\omega t - kn)$$

Electric field }
Magnetic field }
Light }

$$v = \frac{E_0}{B_0}$$

Maxwell - 1850

Gu → Light became a wave.

One day, e^- s coming out from a metal surface.

How? → if I give some energy to metal.

→ 4 ways.

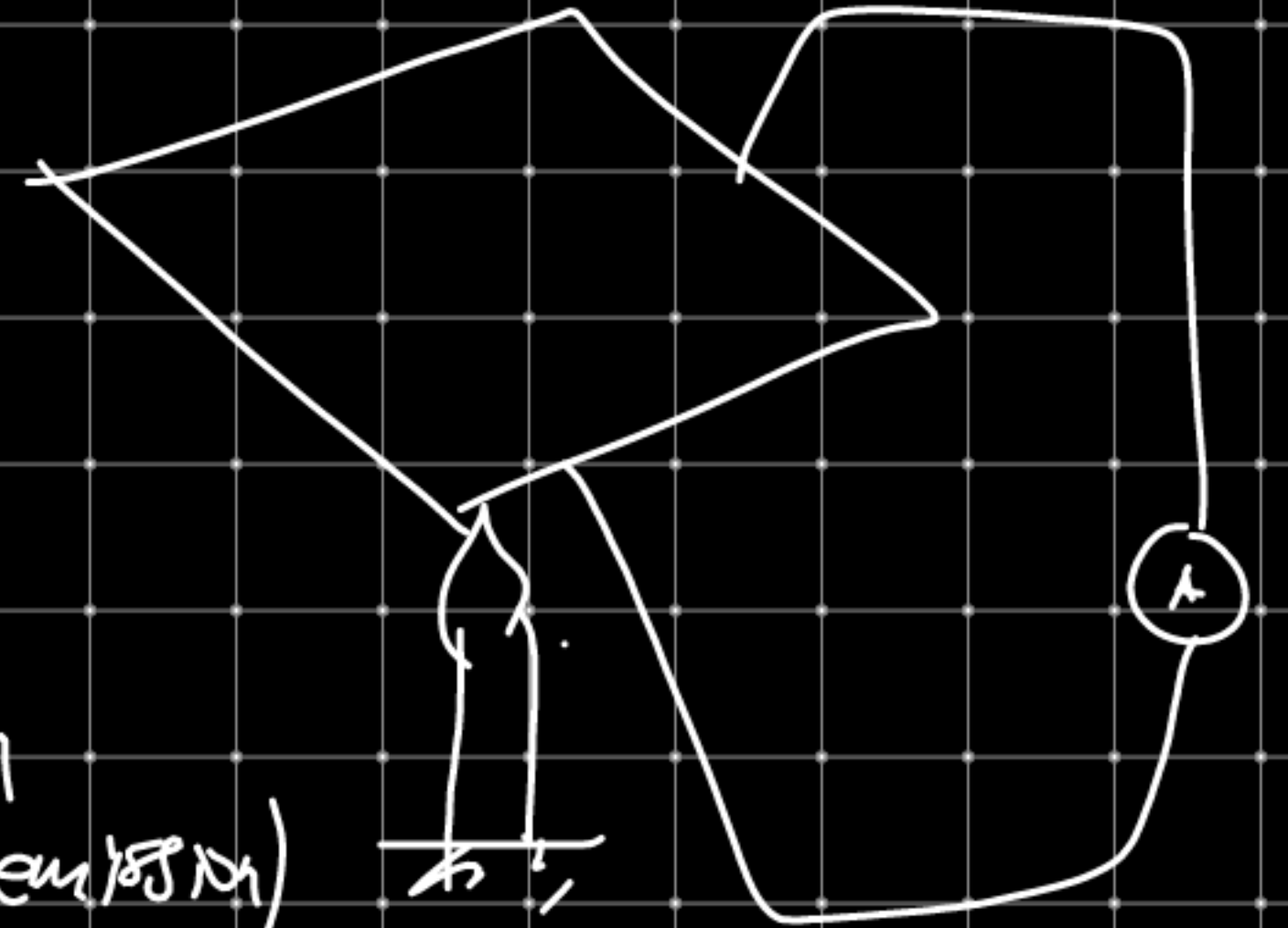
thermionic emission

collision (secondary emission)

electric field (field \rightarrow -)

→ photoelectric emission

Heitz - 1887



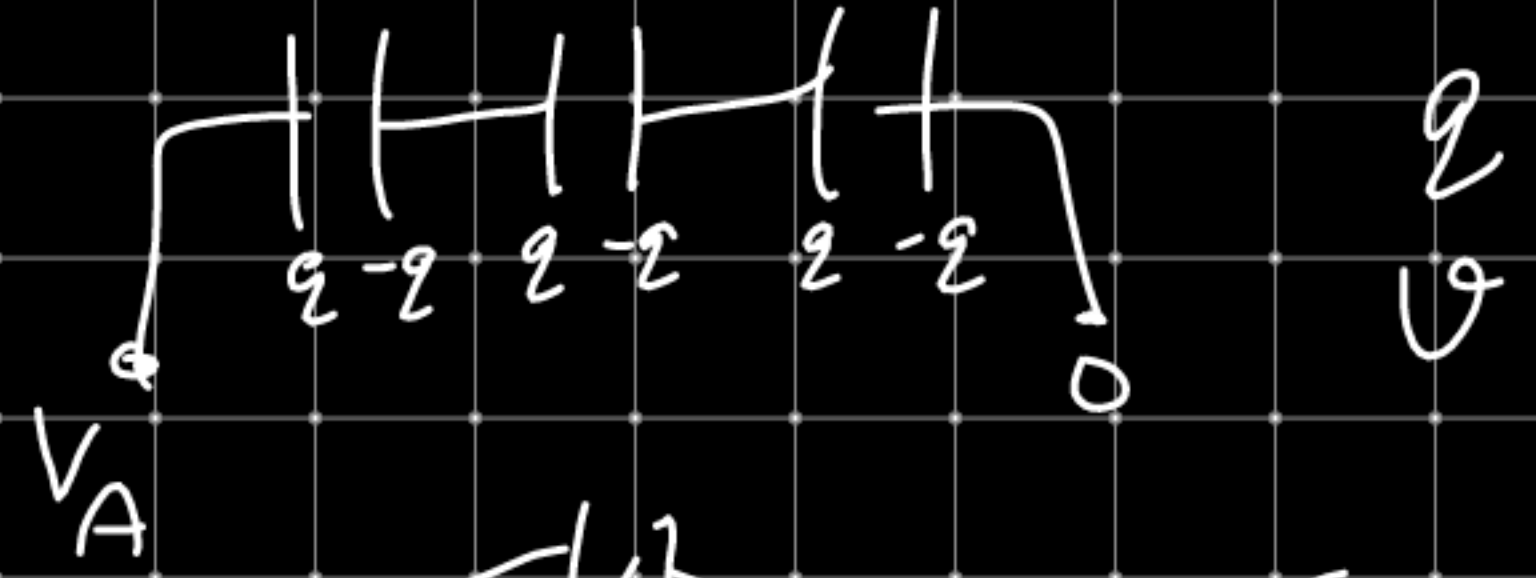
$$q = CV$$

$$V_A - \frac{q}{C_1} - \frac{q}{C_2} - \frac{q}{C_3} = 0$$

$$V_A = q \left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \right)$$

$$q = \frac{1}{\left(\frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3} \right)} V_A$$

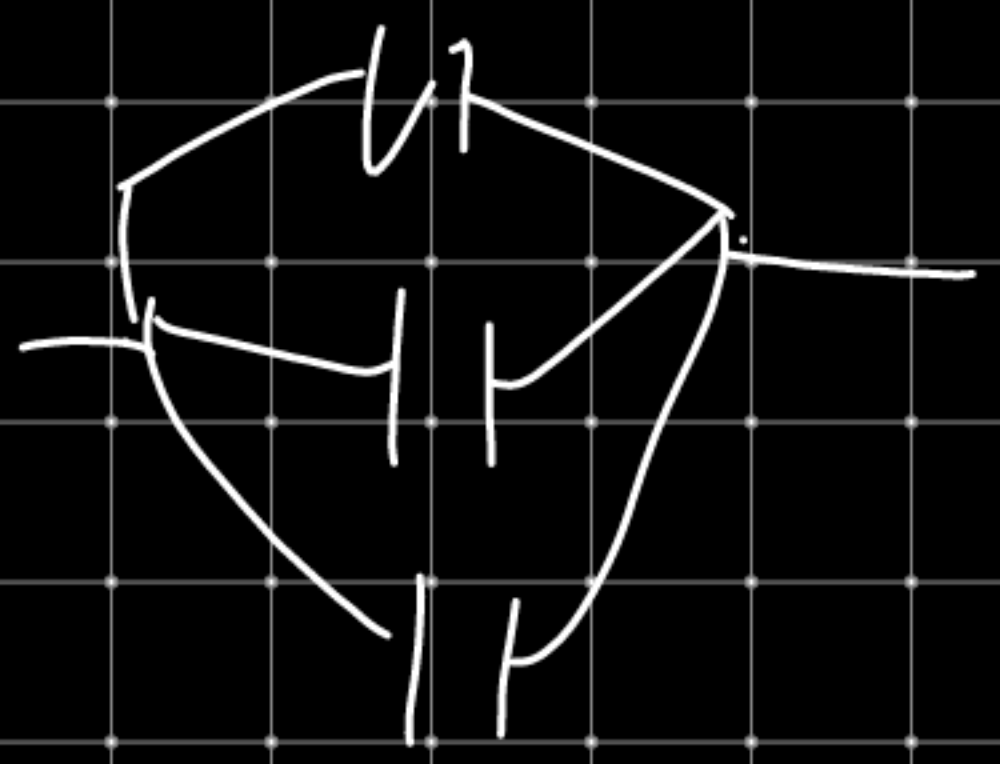
- 3 mF
- 4 mF
- 6 mF



$$q = C_{eq} V_A$$

$$\frac{1}{C_{eq}} = \frac{1}{C_1} + \frac{1}{C_2} + \frac{1}{C_3}$$

series
par



$$C_{eq} = C_1 + C_2 + C_3$$