Superposition of wave

The Superposition of wave in optics is a fundamental concept ~~is~~ ~~one~~ " How light waves interact when they meet in the same space. In states that when two or more light waves (electromagnetic waves) the resultant disturbance (electric field vector) at any point is the algebraic sum of the disturbances produced by the individual wave

Fudamental priciples ——

(a) Vactar addition → For light, the superposition is vacter addition of electric field vectors ($E = E_1 + E_2 + \cdots$).

(b) Intensity Relationship →: Intensity I is proportional to the square of amplitude ($I \propto A^2$), The resulting intensity is ~~the~~ ~~sum~~ includes an ~~intensities~~ interference term. $I = I_1 + I_2 + 2\sqrt{I_1 I_2}\cos\phi$ where ϕ is the phase difference.

(c) linearity →: This principle holds strictly for linear media when light intensity is not high enough to change

the properties of the medium.

⟹ Types of Superposition (Interference) ⟶:
Based on the phase difference (ϕ) between the waves superposition cause -

(a) Constructive Interference (Maximum Intensity) -
⟶ Occurs when waves are in phase ($\phi = 0, 2\pi, 4\pi \dots$) The resultant amplitude is $A = a_1 + a_2$, leading to bright fringes $\left[I_{max} = \left(\sqrt{I_1} + \sqrt{I_2}\right)^2\right]$

(b) Destructive Interference (Minimum Intensity)
⟶ Occurs when waves are out of phase ($\phi = \pi, 3\pi, 5\pi$) The resultant amplitude is $A = |a_1 - a_2|$ leading to dark fringes $\left[I_{min} = \left(\sqrt{I_1} - \sqrt{I_2}\right)^2\right]$