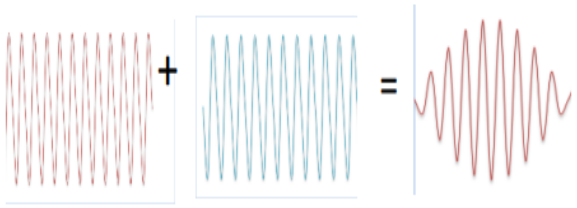
1A)

Wave packets



The superposition of two waves of very close frequency and propagation constant results in a wave packet, frequency $\omega + \Delta\omega$ and propagation constant $k + \Delta k$. Let y_1 be a sinusoidal wave with angular frequency ω and propagation constant k and y_2 be a wave with frequency $\omega + \Delta\omega$ and propagation constant k+Δk.

$y_1 = A\sin(\omega t + kx)$ and

$y_2 = A\sin\{(\omega + \Delta\omega)t + (k + \Delta k)x\}$

The superposition of the two waves gives a resultant

$$y = y_1 + y_2 = 2A\sin(wt + kx).\cos\left(\frac{\Delta wt + \Delta kx}{2}\right)$$

2A)

Phase velocity : The phase velocity of the waves is defined as the velocity of an arbitrary point marked on the wave (the high frequency component) as the wave propagates and is given by

$$v_p = \frac{w}{k}$$

Group velocity: The velocity of the wave packet is defined as the group velocity and is given by

$$v_g = \frac{dw}{dk}$$

The group velocity is the velocity with which the entire group of waves would travel.