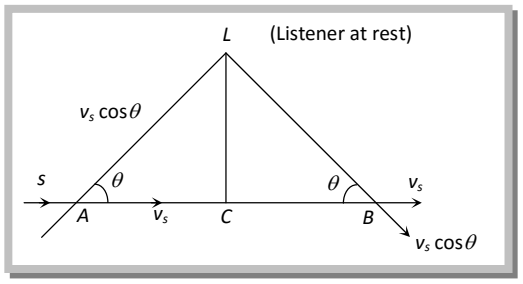
Some Typical Features of Doppler's Effect in Sound.

(1) When a source is moving in a direction making an angle θ w.r.t. the listener: The apparent frequency heard by listener L at rest



When source is at point A is $n' = \dfrac{nv}{v - v_s \cos\theta}$

As source moves along AB, value of θ increases, cosθ decreases, n' goes on decreasing.

At point C, $\theta = 90^o$, $\cos\theta = \cos 90^o = 0$, $n' = n$.

At point B, the apparent frequency of sound becomes $n'' = \dfrac{nv}{v + v_s \cos\theta}$

(2) When a source of sound approaches a high wall or a hill with a constant velocity v_s, the reflected sound propagates in a direction opposite to that of direct sound. We can assume that the source and observer are approaching each other with same velocity i.e. $v_s = v_L$

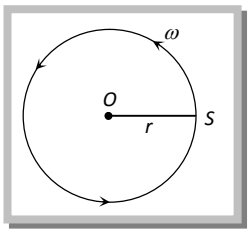
$\therefore \quad n' = \left(\dfrac{v + v_L}{v - v_s}\right) n$

(3) When a listener moves between two distant sound sources: Let v_L be the velocity of listener away from S_1 and towards S_2. Apparent frequency from S_1 is $n' = \dfrac{(v - v_L)n}{v}$

and apparent frequency heard from S_L is $n'' = \dfrac{(v + v_L)n}{v}$

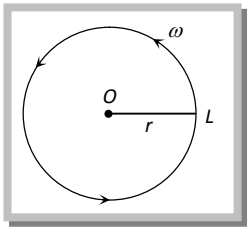
$\therefore$ Beat frequency $= n'' - n' = \dfrac{2nv_L}{v}$

(4) When source is revolving in a circle and listener L is on one side



$v_s = r\omega$ so $n_{\max} = \dfrac{nv}{v - v_s}$ and $n_{\min} = \dfrac{nv}{v + v_s}$

(5) When listener L is moving in a circle and the source is on one side



$v_L = r\omega$ so $n_{\max} = \dfrac{(v + v_L)n}{v}$ and $n_{\min} = \dfrac{(v - v_L)n}{v}$

(6) There will be no change in frequency of sound heard, if the source is situated at the centre of the circle along which listener is moving.

(7) Conditions for no Doppler effect:

(i) When source (S) and listener (L) both are at rest.

(ii) When medium alone is moving.

(iii) When S and L move in such a way that distance between S and L remains constant.

(iv) When source S and listener L, are moving in mutually perpendicular directions.