

Wave Propagation

①

Propagation of Radiowaves



Modes of wave propagation

Radio waves are propagated from T_x antenna to R_x antenna by various methods.

These methods are called mode of propagation.

These are given as \rightarrow

- ① Ground wave propagation or surface wave propagation (15 kHz to 2 MHz)
- ② Sky wave propagation (2 MHz to 30 MHz) (ionospheric propagation)
- ③ Space wave propagation (above 30 MHz)

Ground wave propagation

When the radio waves travel along the earth surface and reaches to receiver, it is known as Ground or surface wave propagation.

The necessary conditions for GWP.

- * frequency should be in the range of (15 kHz to 2 MHz)
i.e. VLF, LF & MF.
- * The radio waves should be vertically polarized. i.e. electric field component of the radio waves should be \perp to the earth's surface.

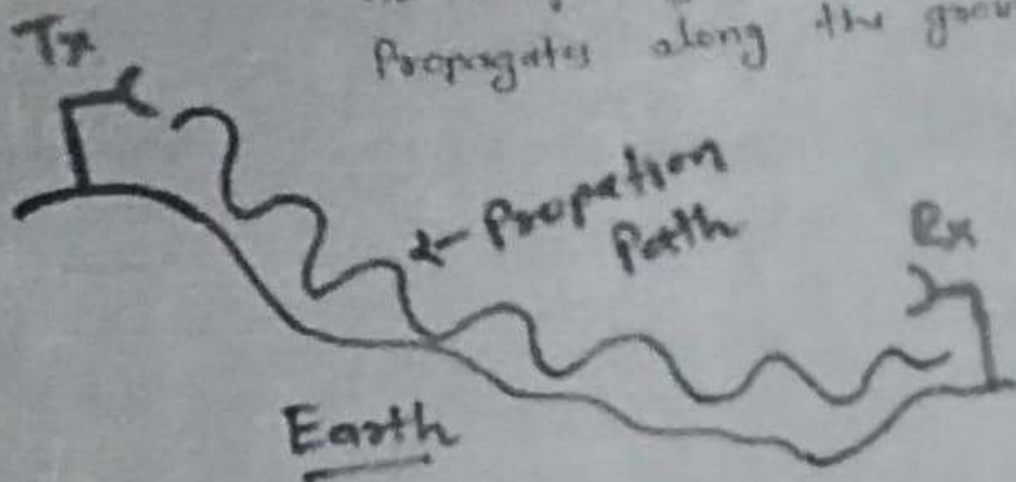
* if polarization is horizontal i.e. electric field is parallel to earth's surface, the electric field of the radio waves gets shunted due to earth conductivity.
- * Both T_x & R_x antennas should be close to the earth's surface. ~~ie~~

Applications \rightarrow $535\text{ kHz} \rightarrow 1605\text{ kHz}$
AM broadcast service

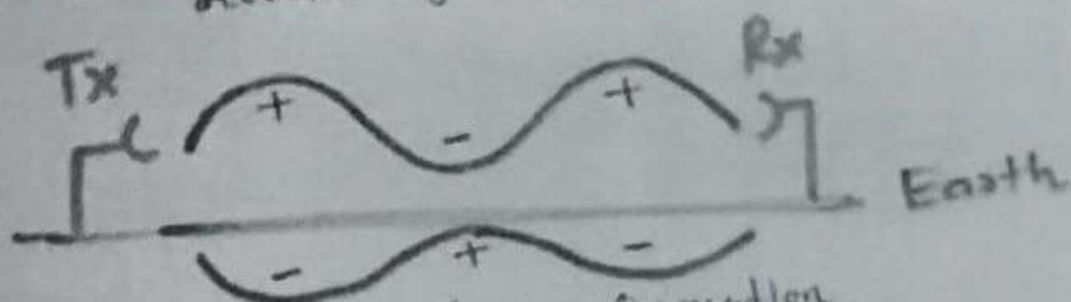


Ground wave propagation

- In this propagation signal (EM wave) propagates along the ground.



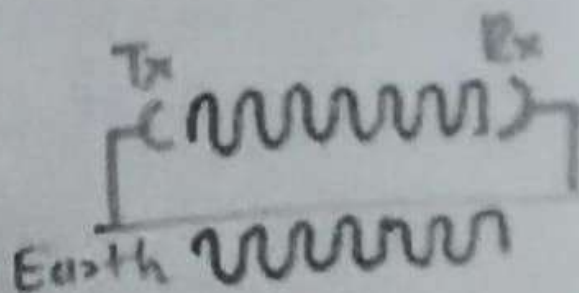
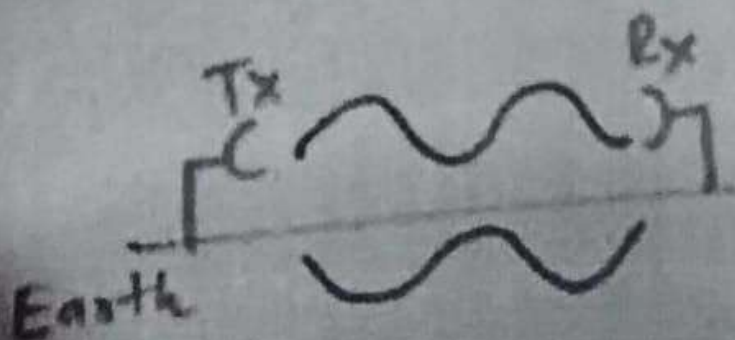
- It is utilized for short range communication.
- Induced wave by ground attenuate signal.
- As distance increases, magnitude of propagating signal decreases by large amount due attenuation by earth.



- It is used for Low freq. Operation.
- It is used up to 2MHz.

$$f = \frac{c}{\lambda}$$

- at lower wavelength attenuation by earth is high. (freq is high)

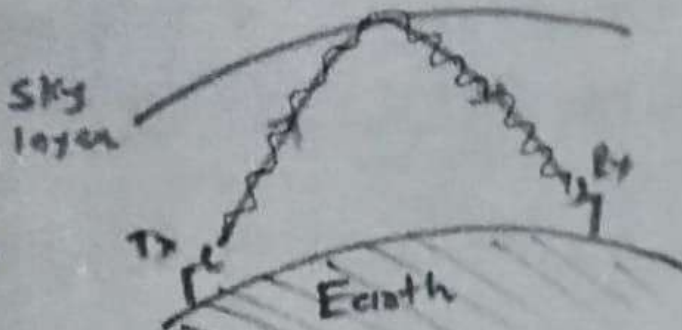


* Sky wave Propagation or ionospheric

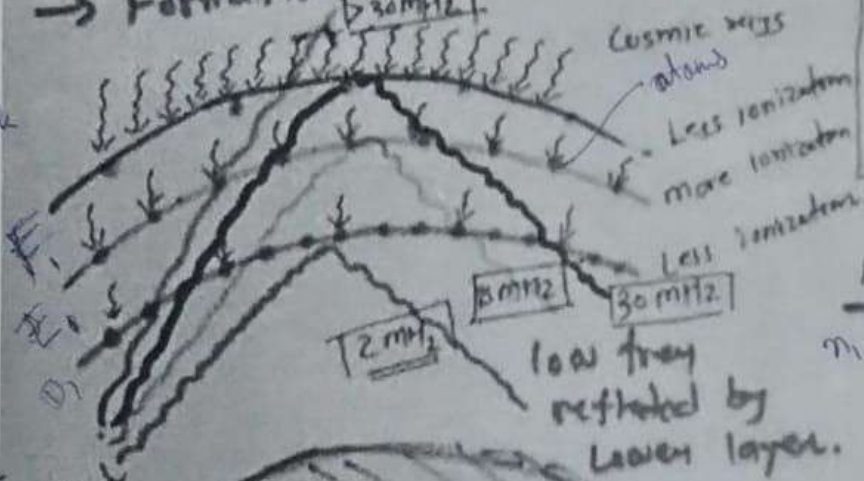
- Transmitted signal by Tx antenna reflected by ionospheric layer (sky) and received by Rx antenna is sky wave propagation or ionospheric wave propagation (2-30MHz)

→ For ground wave propagation range was limited so for long range we should go for sky wave propagation.

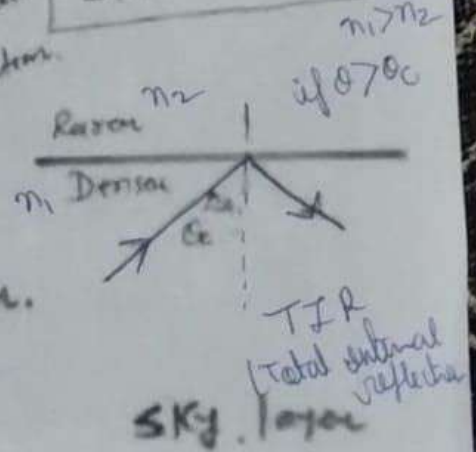
→ We use 3 MHz to 30 MHz for sky wave propagation.



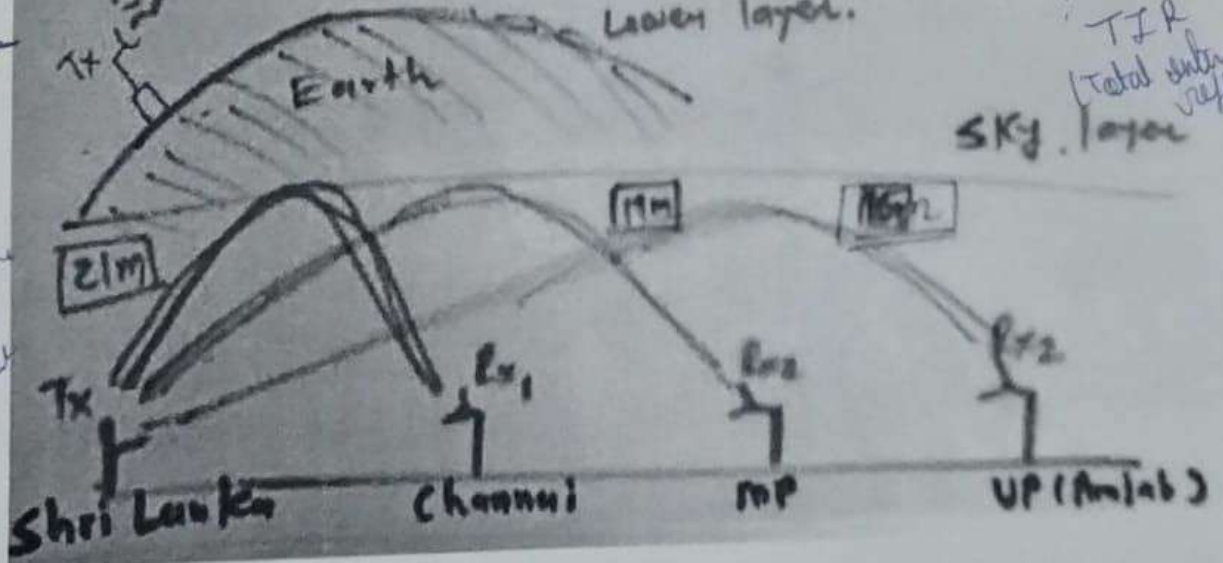
→ Formation ionospheric layer



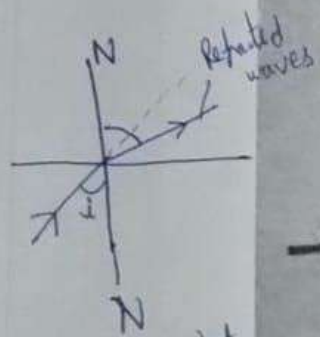
Cosmic rays
• Electrons are released
- Formation ions.



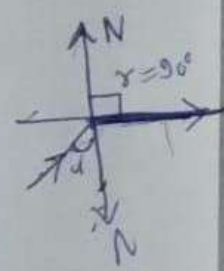
low freq reflected by lower layer.



Ionospheric



$\sin i = \sin r$
refraction angle



i is known as angle of incidence