



HELICAL ANTENNA

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INTRODUCTION



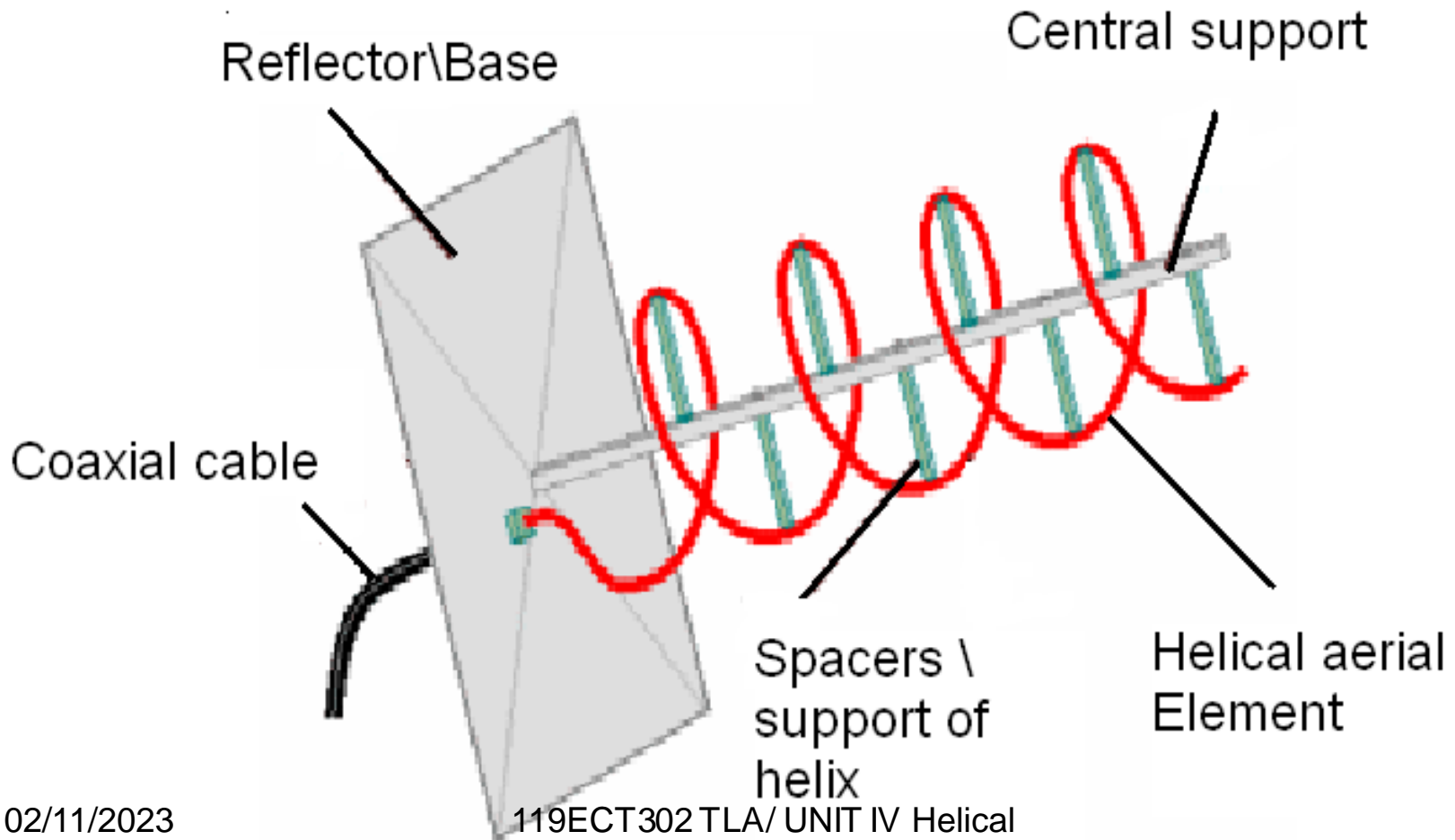
A helical antenna is a specialized antenna that emits and responds to with rotating (circular) polarization.

These antennas are commonly used at earth-based stations in satellite communications systems.

The center conductor of the cable is connected to the helical element, and the shield of the cable is connected to the reflector.



CONSTRUCTION DIAGRAM





3.2 HELICAL ANTENNAS

Geometry of Helical Antennas

Geometry
Of Helical
Antenna

Diameter of ground
plane at least $3\lambda/4$

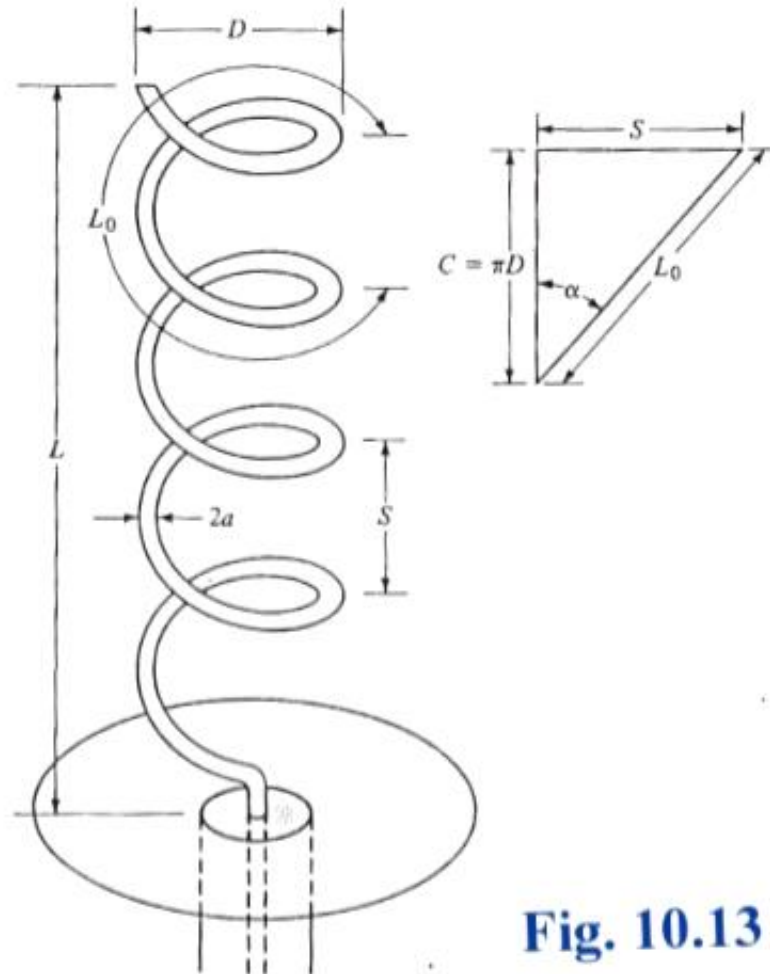


Fig. 10.13



HELICAL ANTENNAS (CONT'D..)

Modes of Operation:

- **Normal** (Broadside)
- **Axial** (End-fire) – Most practical
 - Circular polarization can be achieved over a wider bandwidth (usually 2:1)
 - More efficient



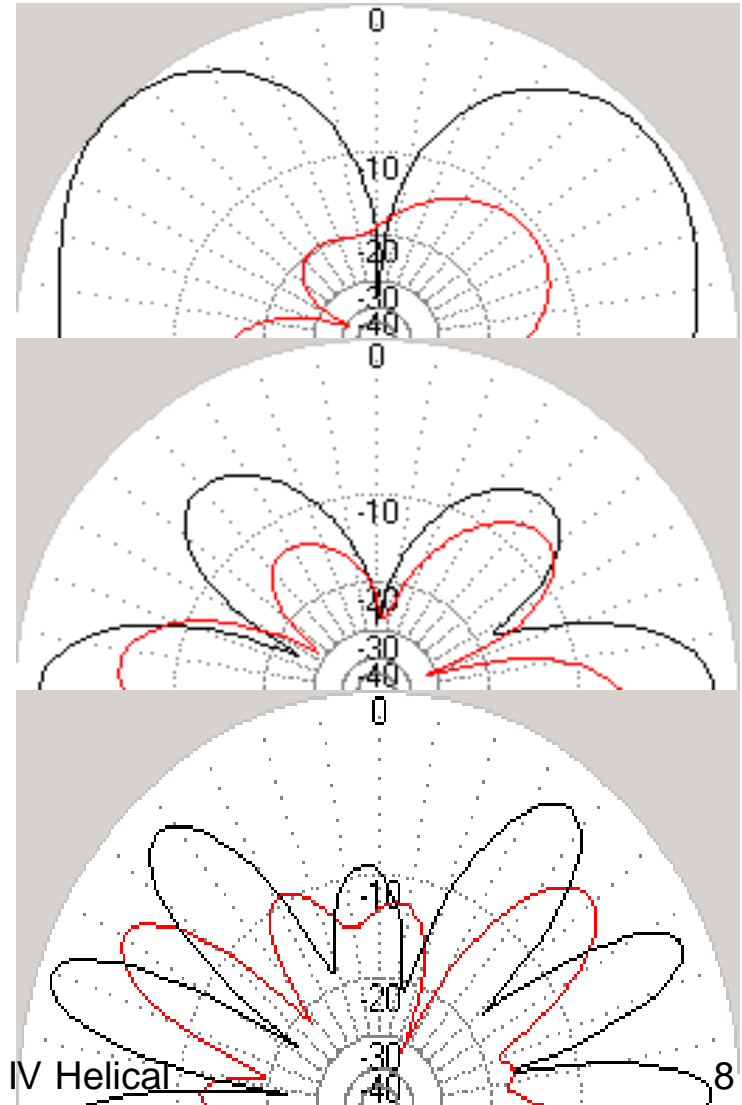
WORKING OF HELICAL ANTENNA

- A helical antenna is an antenna consisting of conducting wire wound in the form of a helix.
- this antenna can operate in one of two principle modes,
 1. **NORMAL MODE**
 2. **AXIAL MODE**



NORMAL MODE

In this modes the dimension of helix are small compare with the wavelength this antenna typically used mobile communication



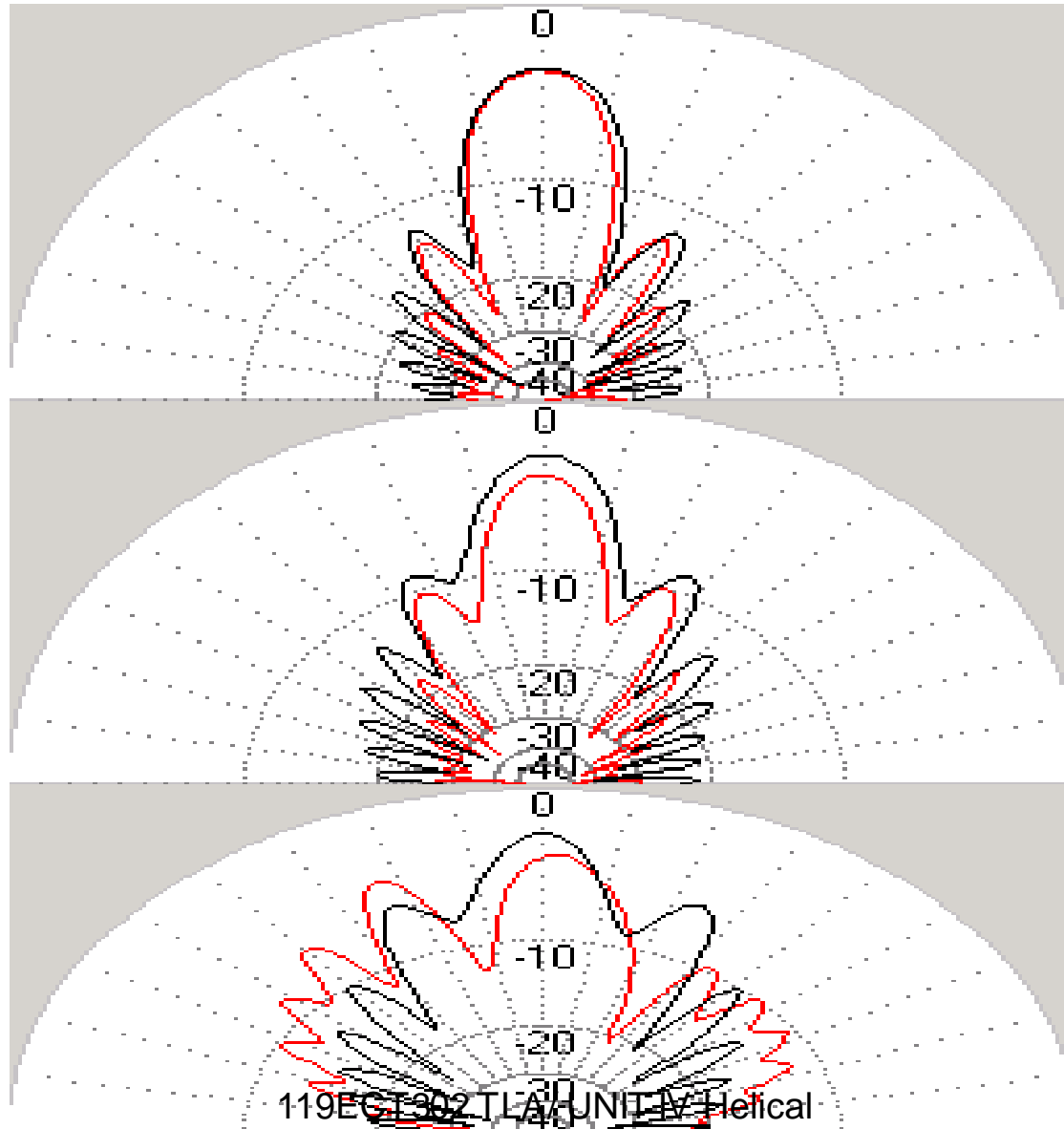


AXIAL MODE

- In this modes the helix dimensions are at above the Wavelength of Operation.
- The antenna the falls under the class of waveguide antenna and produces True circular polarization.
- These antenna are best suited for space communication



AXIAL MODE





HELICAL ANTENNAS (CONT'D..)

Important Parameters

$$\alpha = \tan^{-1}\left(\frac{S}{\pi D}\right) = \tan^{-1}\left(\frac{S}{C}\right) \quad (10.24)$$

$$\alpha = 0^\circ \text{ (flat loop)}$$

$$\alpha = 90^\circ \text{ (linear wire)}$$

$$L_0 = \sqrt{S^2 + C^2} = \text{single turn}$$

$$L_n = NL_0 = N\sqrt{S^2 + C^2}$$



HELICAL ANTENNAS (CONT'D..)

Normal Mode ($NL_0 \ll \lambda$)

Dipole:

$$E_{\theta} = j\eta \frac{k_o I_0 S e^{-jk_o r}}{4\pi r} \sin \theta \quad (4-26a) \quad (10.25)$$

Loop:

$$E_{\phi} = \eta \frac{k_o^2 \left(\frac{D}{2}\right)^2 I_0 e^{-jk_o r}}{4r} \sin \theta \quad (5-27b) \quad (10.26)$$

$$\Delta\varphi = j = 90^\circ$$

$$AR = \frac{|E_{\theta}|}{|E_{\phi}|} = \frac{4S}{\pi k_o D^2} = \frac{2\lambda_0 S}{(\pi D)^2}$$



HELICAL ANTENNAS (CONT'D..)

For this special case,

$$AR = \frac{2\lambda_0 S}{(\pi D)^2} = 1 \quad \Rightarrow \quad \pi D = C = \sqrt{2\lambda_0 S} \quad (10.28)$$

$$1) \quad C = \sqrt{2\lambda_0 S} \quad (10.28a)$$

$$2) \quad \tan \alpha = \frac{S}{\pi D} = \frac{S}{\sqrt{2\lambda_0 S}} = \sqrt{\frac{S}{2\lambda_0}} = \frac{\pi D}{2\lambda_0} \quad (10.29)$$

The radiated field is circularly polarized in all directions other than $\theta = 0^\circ$



HELICAL ANTENNAS (CONT'D..)

End-fire Mode

- 1) $12^\circ < \alpha < 14^\circ$
- 2) $\frac{3}{4}\lambda_0 < C < \frac{4}{3}\lambda_0$ (C $\approx \lambda_0$ near optimum)
- 3) $N > 3$

Parameters for End-fire Mode

$$R \approx 140 \left(\frac{C}{\lambda_0} \right) \quad \text{Accuracy } (\pm 20\%) \quad (10.30)$$

$$HPBW \approx \frac{52\lambda_0^{3/2}}{C\sqrt{NS}} \quad (10.31)$$



HELICAL ANTENNAS (CONT'D..)

Parameters for End-fire Mode (cont)

$$FNBW(\text{deg}) \approx \frac{115\lambda_0^{3/2}}{C\sqrt{NS}} \quad (10.32)$$

$$D_o \approx 15N \frac{C^2 S}{\lambda_0^3} \quad (\text{Dimensionless}) \quad (10.33)$$

$$AR = \frac{2N + 1}{2N} \quad (10.34)$$



ADVANTAGES

- Greater Bandwidth (range 400MHz to 900MHz, 14dB)
- greater gain
- more flexibility
- Uni-directional antenna
- crystal clear transmission



APPLICATION

- High Gain
- RH Circular Polarization
- Adjustable Tilt Stainless Steel Bracket
- Type N Female Connector
- DC Grounded for lightening protection
- Rugged, Lightweight and Waterproof