

Contact

## The Argus System in **Contact**

- How many telescopes?
- How many channels?
- Channel Width?
- Sensitivity?

# ARGUS

131 telescopes                      pg. 63

Built by expanding the VLA

if similar antennas:  $\frac{131}{27} \sim 5 \times$  the area

Coverage:  $10^9$  channels                      pg. 56, 62

channel width  $< 1$  Hz                      pg. 56

$\Rightarrow \sim 10^9$  Hz if width = 1 Hz

Sensitivity: if assume better than VLA by 5,

5 Jy in 1 sec

$5 \times 10^{-26} \text{ W m}^{-2} \text{ Hz}^{-1}$

# The Signal

- Frequency at which it was first detected?
- Bandwidth?
- Polarization?
- Other frequencies?

# The Signal

First detected near 9 GHz      pg. 66

$\nu = 9.24176684$       }      pg. 72

$\Delta\nu = 430$  Hz      }

Linearly polarized      pg. 66

Later found at 1.420 GHz      H      pg. 78

1.667 GHz      OH

Bimodal pulses 179 and 174 Jy      pg. 72

## Source of Signal

- How was terrestrial interference ruled out?
- How was it determined to come from Vega?
- How do we know it was intended for us?
  - Rather than omnidirectional
  - BEFORE the message decoded

# The Signal

Not Terrestrial:

Moving Sidereally      pg. 66

Vega:

Interferometric Position      pg. 65

Proper Motion      pg. 78

Doppler Corrected      pg. 78

## What were the 4 Levels of information?

- How encoded (modulation method)?
- What was the purpose of each?

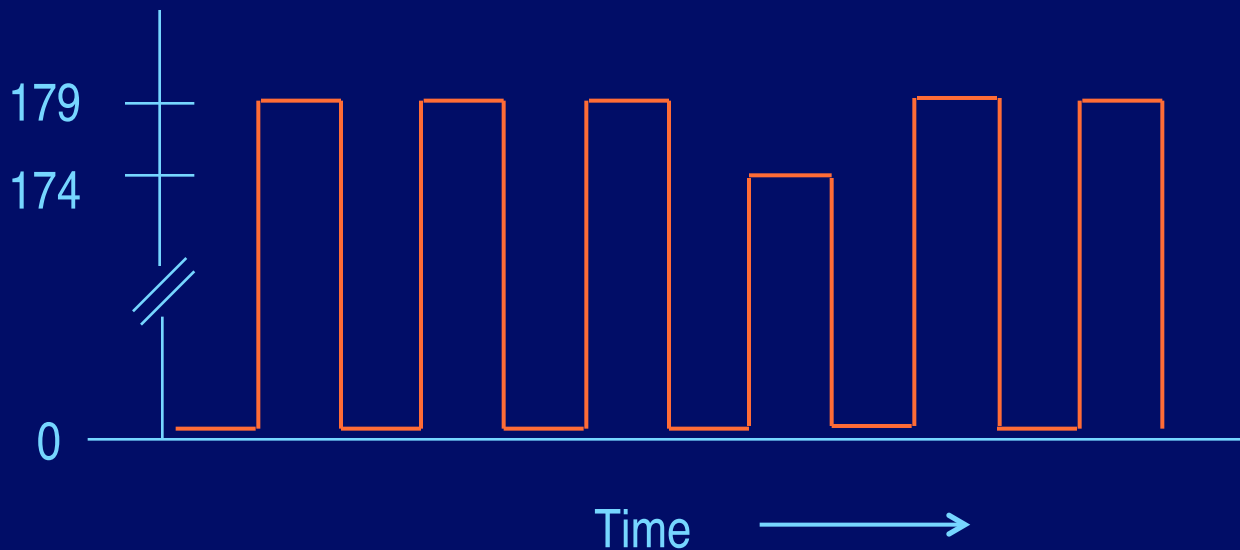


# The Prime Numbers

## Amplitude Modulation

- ("Strength is the Message")

Bimodal amplitudes 174 & 179 Jy



Convention 17  
9 = 1 174 = 0

1 1 1 0 1 1

$2^5 + 2^4 + 2^3 + 0 + 2^1 + 1$

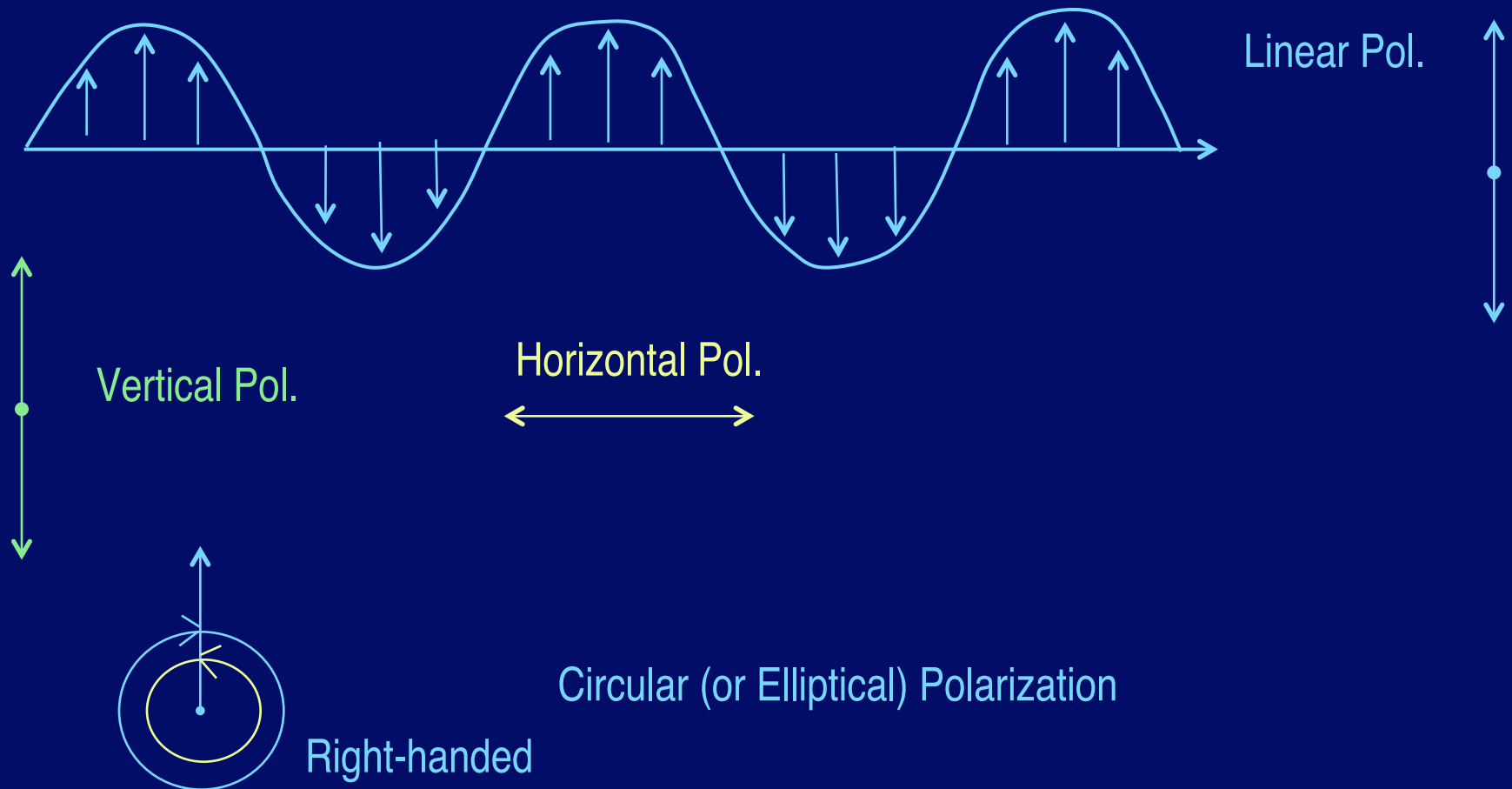
$32 + 16 + 8 + 0 + 2 + 1 = 59$

(pg. 68)

# The Movie (and the Instructions)

Polarization Modulation (pg. 83)

- ("Direction is the Message")



# Decoding the Movie

- Repeating pattern
- Tens of billions of bits
- Product of 3 prime numbers
- Guess 2D image and time, so movie
- Purpose?
  - They know about us...

# Machine Instructions

- Palimpsest (pg. 100)
- Under the movie (pg. 185)
- Polarization modulation
- Purpose:

## Suggestions for the Primer

- Sol Hadden made 5 suggestions for finding it
- What were they?
- Which was right?

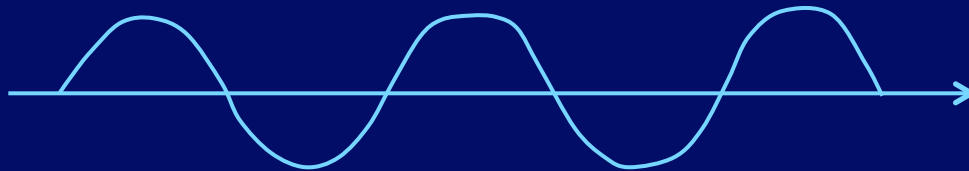
## Five Suggestions (pg. 220)

- Slower bit rate (e.g., 1 bit per hour)
- Faster bit rates (would require more BW)
- Occasional fast data dump
- Phase modulation
- Have to detect from space
  - e.g., around 5 mm, where O<sub>2</sub> blocks waves

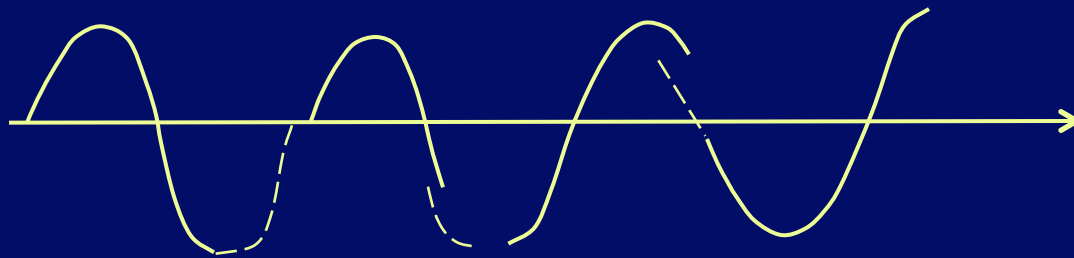
# The Primer

## Phase Modulation

- (“Timing is the Message”)



Steadily  
Increasing  
Phase



Rapid Changes  
in Phase

## How The Primer Works

1 A 1 B 2 Z	$1 + 1 = 2$	TRUE
1 A 2 B 3 Z	$1 + 2 = 3$	TRUE
1 A 2 B 4 Y	$1 + 2 = 4$	FALSE

⇒ A is +  
B is =  
Z is TRUE  
Y is FALSE