Mirror Lab Tour - Wed

Wear closed toe shoes
Meet in courtyard – walk over @ 10
ε Lyrae - Double Double Star

Epsilon Lyrae

SEP 4, 2006 - 07:45 UT
SkyView Pro 6LT EQ - 6" f/8 Newtonian
10 mm Sirius Plössl + 2X Barlow: 240X / 12' FOV
Sketch by Jeremy Perez
1932: Detects radio waves (20.7 MHz) from space
Grote Reber

1938: Amateur ham radio operator maps Jansky’s emission (160 MHz)
Grote Reber
Grote Reber

Fig. 7—Contours of constant intensity at 160 MHz and 480 MHz, taken at Wheaton, Illinois.
Ewen & Purcell

1951: Detects HI (1420 MHz)
Penzias & Wilson (& Dicke)

1965: Detection of Cosmic Microwave Background
Jodrell Bank

1957: First truly steerable dish – 250 foot
Arecibo
Largest telescope in the world – 305m diameter
America's most powerful radio telescope IS... ZAPPED!

... by hostile space aliens!

Before ▲ After ▼

Space aliens zapped the enormous radio telescope at Green Bank, W. Va., with a powerful laser to keep scientists from monitoring their activities in the northern hemisphere!

That's the claim of Swiss astronomer Peter Vissar, who says the destruction of November 13 qualifies as the boldest act of extraterrestrial aggression in the history of the world.

"We know that extraterrestrial threats have shut down plants and induced panic but this is the first time they have been brave enough to destroy a permanent research facility," the expert told newsweek.

By KAGAN DUNN

The shockwaves throughout the world's scientific community but the handful of men who can talk about the Green Bank authority refused to describe the incident as anything more than 'a mystery.'

There is no doubt that the instrument—which could be a threat to objects almost anywhere in the universe—was involved in the events.

"Suddenly it collapses in the midst of a strike. There is no other rational explanation for such a strike as this," Dr. Vissar's report states.

"Any other explanation defies logic," he continued. "The telescope had been in operation since 1949 and was zapped by extraterrestrials who wanted to keep their activities from mankind," Dr. Vissar said.

"Then we can take whatever steps are necessary to prevent things like this from happening in the future..."
Green Bank Telescope

Largest fully steerable telescope in the world – 100m
Radio Telescope

Frontend

Backend

distant celestial radio source

primary parabolic reflector surface (dish)

incoming radio waves

subreflector

feed horn

cables (for carrying the signal to the control room for processing)

video display

display and analysis system

magnetic tape

computer and recording devices

receiver and amplifier
Antenna Power Pattern

\[ \theta = 1.2 \frac{\lambda}{D} \quad \text{FWHM of main lobe} \]

Example: Arecibo D = 305m \( \lambda = 3 \text{ cm} \)

\[ \theta = 1.2 \frac{\lambda}{D} = 1.2 \times \frac{0.03}{305} \times 206265 = 24" \]
1 Jansky = $10^{-23}$ ergs s$^{-1}$ cm$^{-2}$ Hz$^{-1}$

$F_\nu = \int_{\Omega_s} I_\nu(\theta, \phi) P(\theta, \phi) \cos \theta d\Omega$

$10^{-23}$ erg s$^{-1}$!! Implies we need to amplify signals to detect them.
Bolometers
Local Oscillator Frequency: $f_{\text{LO}}$

Mixer

$\nu_{\text{sky}}$

$\nu_{\text{sky}} - f_{\text{LO}}$
Example

245 GHz → 250 GHz USB

240 GHz LSB

5 GHz
Interferometry

\[ \tau_g = B \cdot \frac{s}{c} \]

\[ v_1 \cos 2\pi v (t - \tau_g) \]

\[ v_2 \cos 2\pi v t \]

Voltage Multiplier

Integrator

correlator

\[ v_1 \cdot v_2 \cos 2\pi v \tau_g \]
N = 27  25m antennas

$N_{\text{baselines}} = \frac{N(N-1)}{2} = 351$
Light: Double Slit

![Diagram showing light propagation, coherent sunlight, destructive interference, barrier with double slits, screen, and intensity distribution of fringes.](image-url)
VLA 6cm Center of Milky Way
Very Long Baseline Interferometry

\[ B = 8434 \text{ km} \quad \text{and} \quad \lambda = 7 \text{mm} \]

\[ \theta = \frac{\lambda}{B} = \frac{206265 \times 0.007}{8.434 \times 10^6} \]

\[ = 172 \mu\text{as} \]
Next Generation: ALMA
64 12m antennas @ 16,500 ft. Chile