Search for Extraterrestrial Intelligence (SETI) – Part II

Life in the Universe - Astrobiology
Dr. R. L. Hudson (Spring, 2018)

Need Search Strategies

1. Promising Stars
2. Extrasolar Planets
3. Chemistry and Biology (Life)
4. Civilizations

Factors to Consider

Drake Equation (ca. 1961)

\[ N = R \cdot f_p \cdot n_{\text{earth}} \cdot f_{\text{life}} \cdot f_{\text{int}} \cdot f_{\text{civ}} \cdot L \]

Helps to organize our thinking.

Next Problem - Communication

How to Establish Contact?

Transmit Information
Travel

Consider

Long wavelengths “cut” through the dust
Nature Provides A Clue

How Many Channels?

1638 MHz = 1,638,000,000 Hz
1420 MHz = 1,420,000,000 Hz

0.1 Hz / channel

(1,638,000,000 – 1,420,000,000) / 0.1
≈ 2 billion channels

And finally,

Is it better to give ...

... or receive?

Project Ozma, 1960

National Radio Astronomical Observatory
Green Bank, West Virginia
Two Stars Observed During One Month

Today

National Radio Astronomical Observatory
Green Bank, West Virginia
Same Observations in Under 1 Sec

Math

~ 2 billion radio channels

Modern computers measure
~ 250 million channels at once

Examine each channel for 1 sec
... need 8 seconds for total coverage of one star
More Math

~2 billion radio channels in the Cosmic Water Hole

Each star needs ~8 seconds for coverage.

For ~2 billion stars will need about 500 years for total coverage!

A Way Forward

Scientist
Physical Chemist
Infrared Spectroscopist

Co-founder of Intel Corp. (1968)
Gordon Moore

Computing Power Doubles in ~18 Months

Moore’s Law

In ~15 years can study all candidate stars in ~5 years, not 500 years!

Radio Wave Receivers

Arecibo Observatory, Puerto Rico
Is it better to give or receive?

Signal Sent in 1974 by the Arecibo Telescope
M13
A Globular Cluster
3 minutes

Message Sent to M13

Leaked Signals vs. Directed Signals
Weak Radio Leakage for ~100 years
Weak TV Leakage for ~60 years

Footnotes
How about optical SETI?
Need a way to attract attention to our signals

What Will Be Learned?
Our Neighbors
Signal Location
Signal Strength
Signal Wavelength
Doppler Fluctuation of Signal?
What is Expected?

Signal of Abnormal Behavior

Codes – Prime Numbers, Patterns

Another Approach
... Just Go There!

Space Travel

Planets and the Solar System

NASA's Pioneer 10 and 11 Spacecraft, 1972 and 1973

Pioneer Satire
Yet More Pioneer Satire

NASA’s Voyager I and II Spacecraft, 1977

1977 - Voyager I and II

1973 1979

Io Europa Ganymede Callisto Titan Mimas
Uranus and Oberon

Neptune and Triton

Each Voyager spacecraft carried a Pioneer-like plaque and a record.

The Voyager Record

Languages
Earth Sounds
Photographs
Data

Stars

Speed × Time = Distance

Trillions of miles (and more)
Stellar Distances

Trillions of miles (and more)

Example/ Alpha Centauri star system

= 4 light years = 4 \times 10^{13} \text{ km}

(Pluto is about 6 \times 10^9 \text{ km})

How Much Time?

\text{Speed} \times \text{Time} = \text{Distance}

\text{Speed} \times \text{Time} = 4 \times 10^{13} \text{ km}

But what speeds are available?

Technology gives about 12 \text{ km} / \text{sec}

Sources of Material

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