

Announcements

- Quiz 4 is available now and due at 11:59pm
 - Topic: Artificial Intelligence from Chapter 4 & lecture material; 50 pts possible
- Exploration paper 4 due **Mar 29**
 - Topic: Extraterrestrial Intelligence; see Canvas for details
- Quiz 5 coming up next Monday, Apr 1 (not a joke!)
 - Topic: chapter 5 & this week's lectures

Last time: Artificial Intelligence

- Asimov's Laws of Robotics
- Machine learning
 - Bayesian learning
 - Deep learning
- Ethics of Artificial Intelligence
 - If we do reach the singularity, will there be ethical implications for the treatment of AI?

Today: “Are We Alone in the Universe?

The search for extraterrestrial intelligence

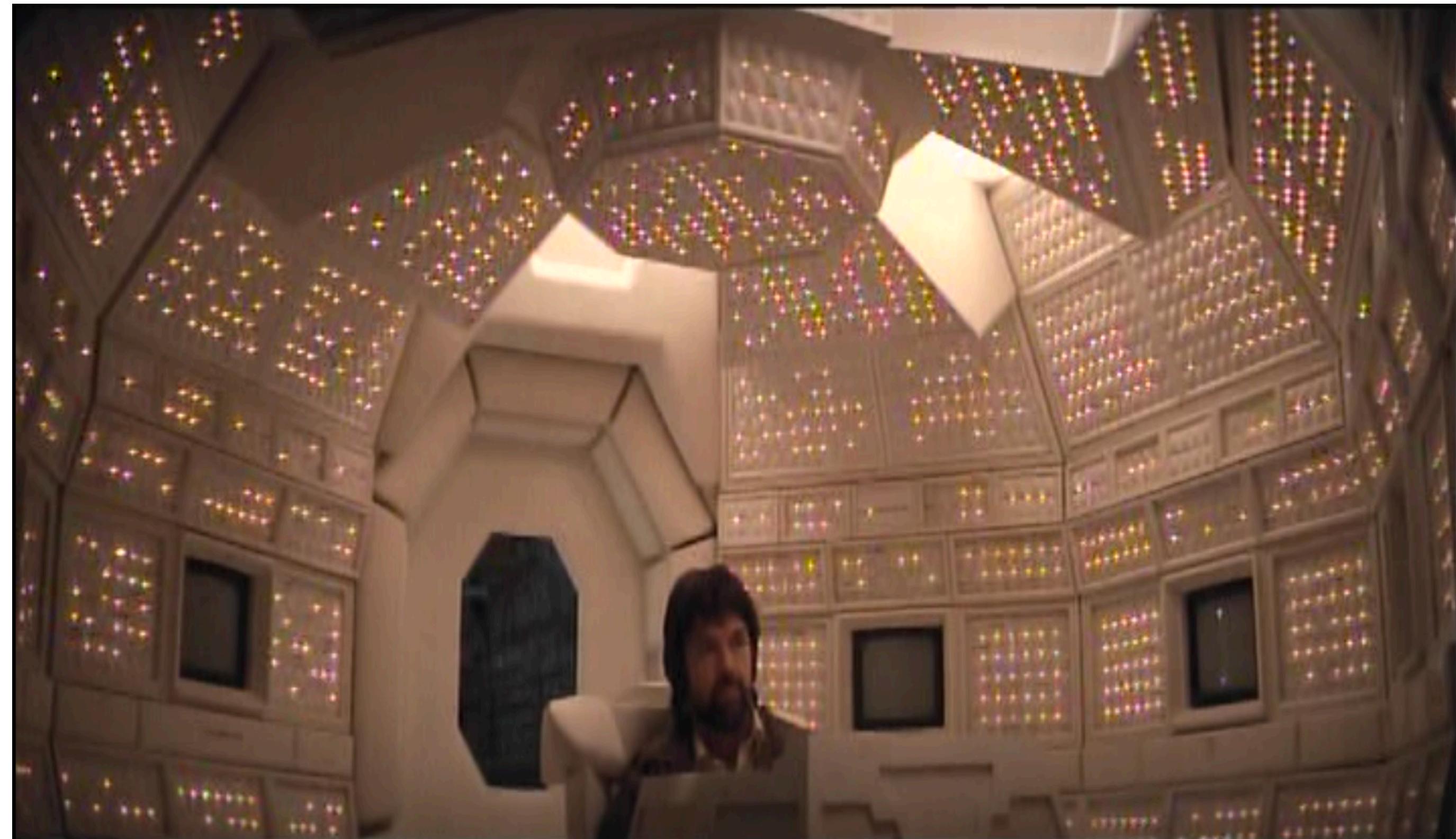
Who is funding the search?

What should we be looking for?

How should we go about our search?

Where is the best place to look?

When did the search begin in earnest?



Alien

Directed:
Ridley Scott

20th Century Fox (1979)

Who is funding the search?

Government Funding vs Private Industry

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of commercial space flight orgs in 1979: 0

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Intuitive Machines launched a Lunar orbiter on Feb 15; unsuccessful landing

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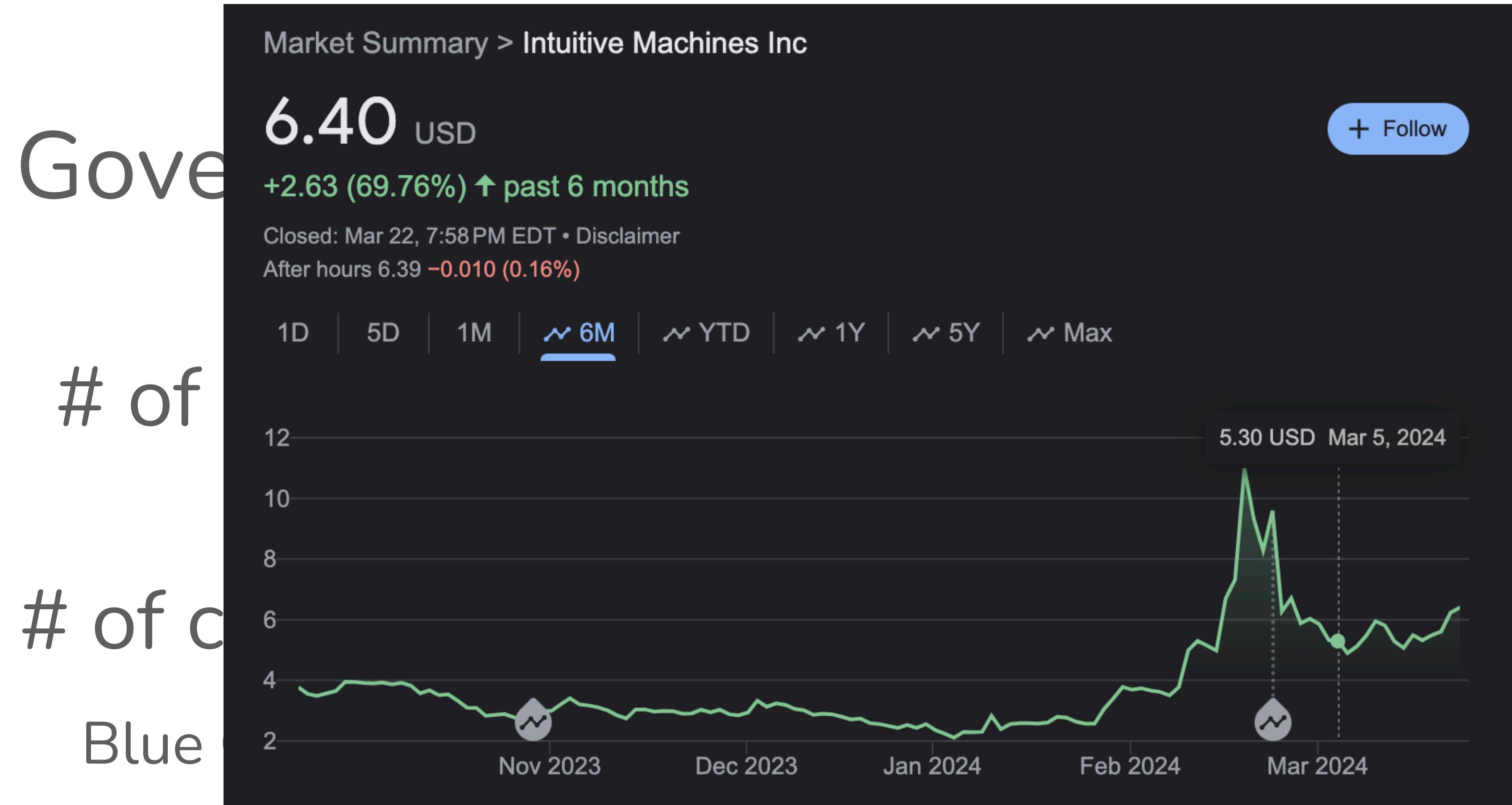
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Should contractors who are primarily driven by commercial profit be leading the SETI charge?

Do contracts like the one invoked in Alien currently exist in commercial spaceflight?

What should we be looking for?



“She has intercepted a transmission of unknown origin ... repeats over intervals of 12 seconds”

More on this in a later lecture

How should we go about the search?



Star Trek (Original)

“The Devil in the Dark”

Written:

Joseph Penney

Paramount (1967)

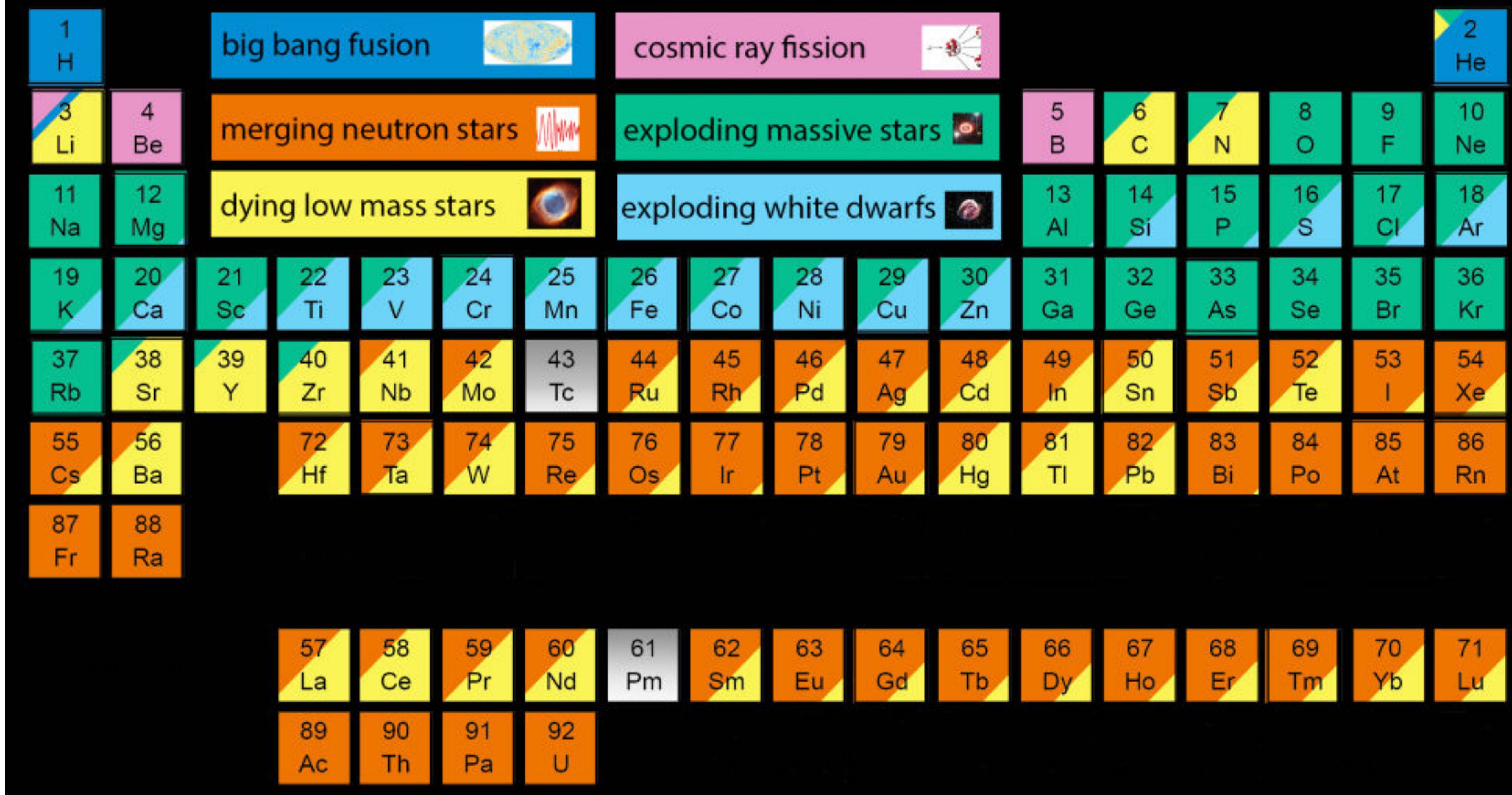
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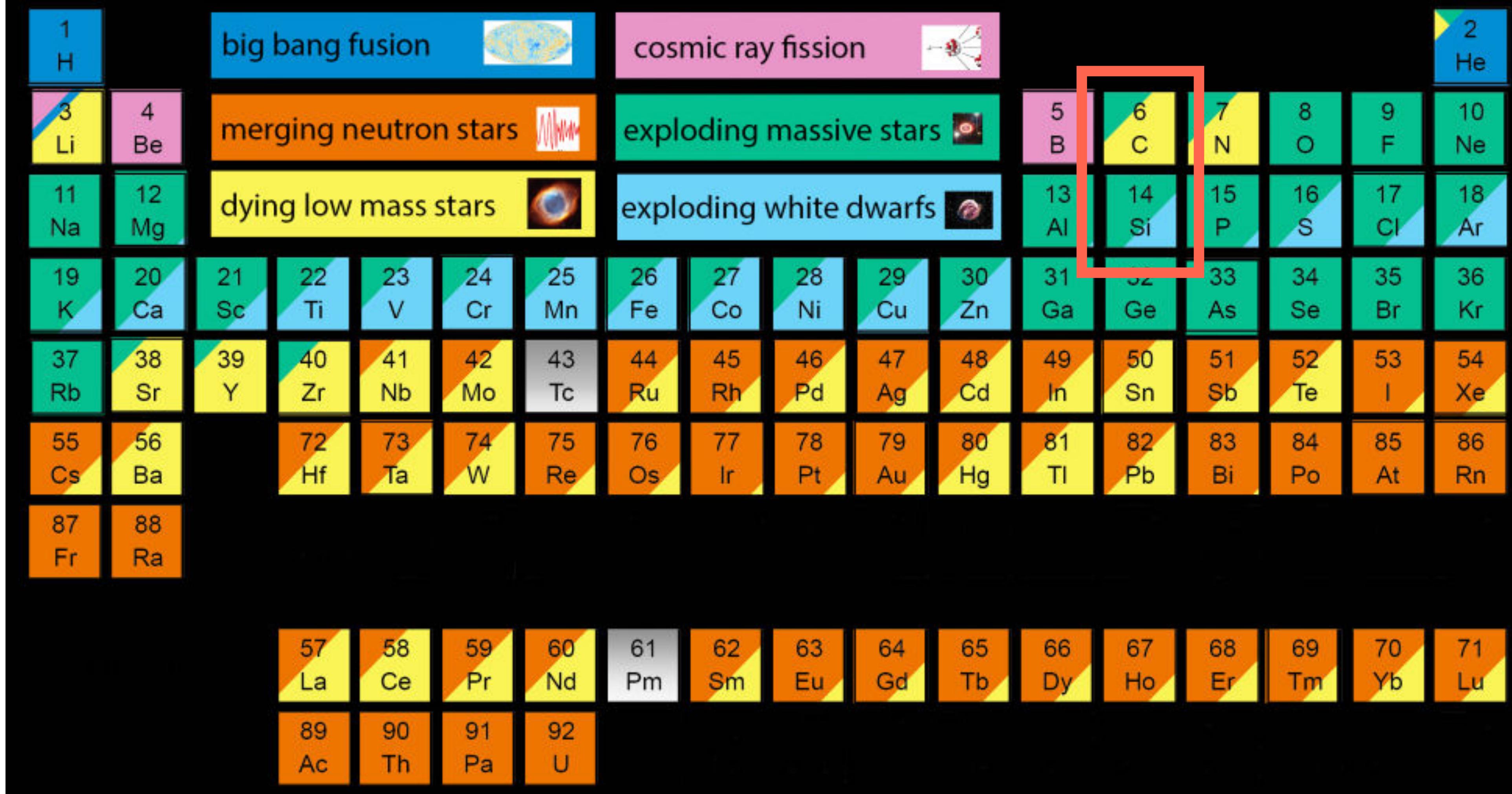
Is there a reason to
search only for life as
we know it?

Why not non-
carbon-based
lifeforms as well?

The Origin of the Solar System Elements



The Origin of the Solar System Elements



Why not silicon-based life instead of carbon?

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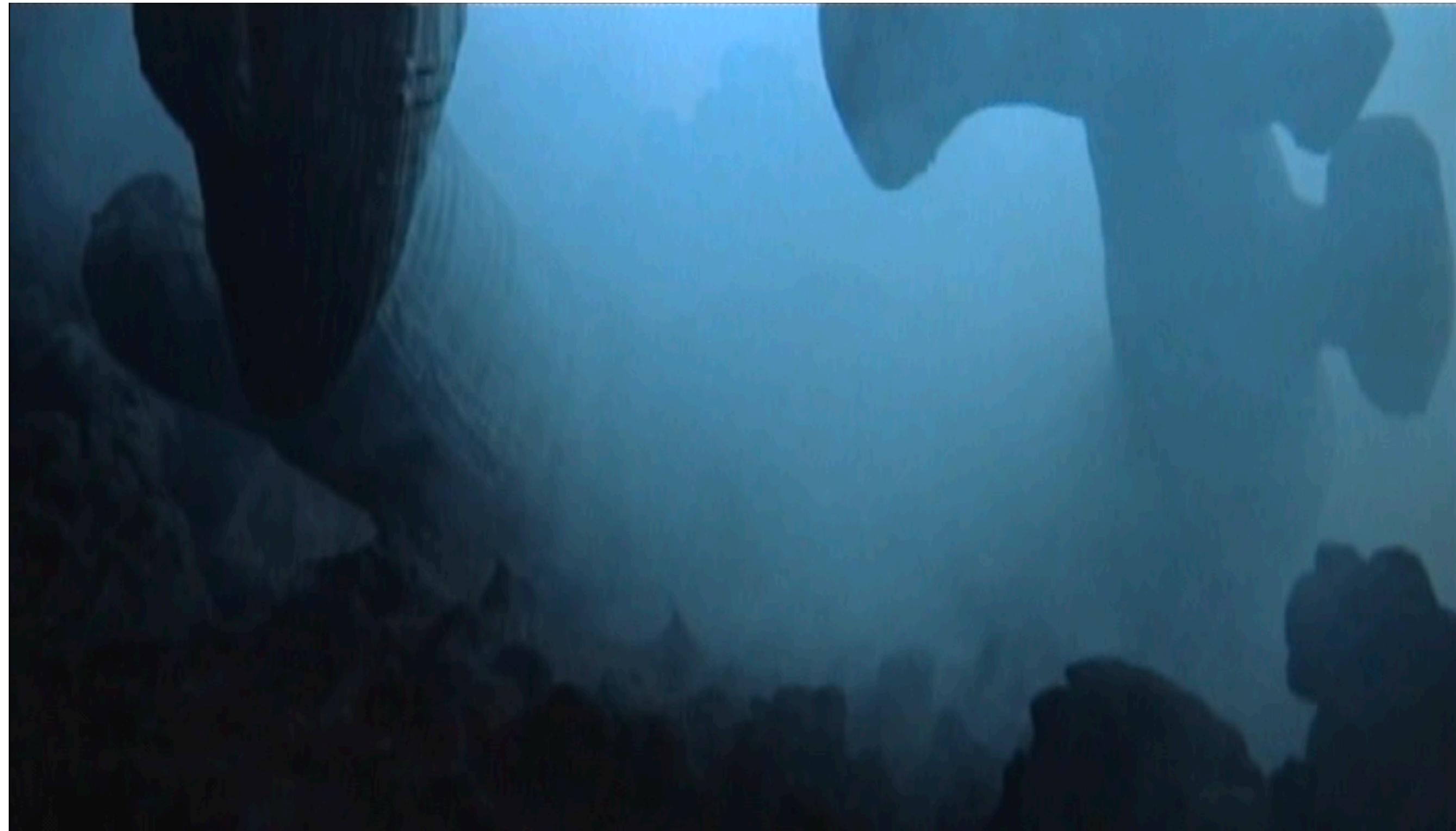
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At “room temperature” CO_2 is a gas while SiO_2 is a solid

Carbon bonds easily with itself and does not dissolve in water, while silicon bonds break apart easily in water

How should we go about the search?

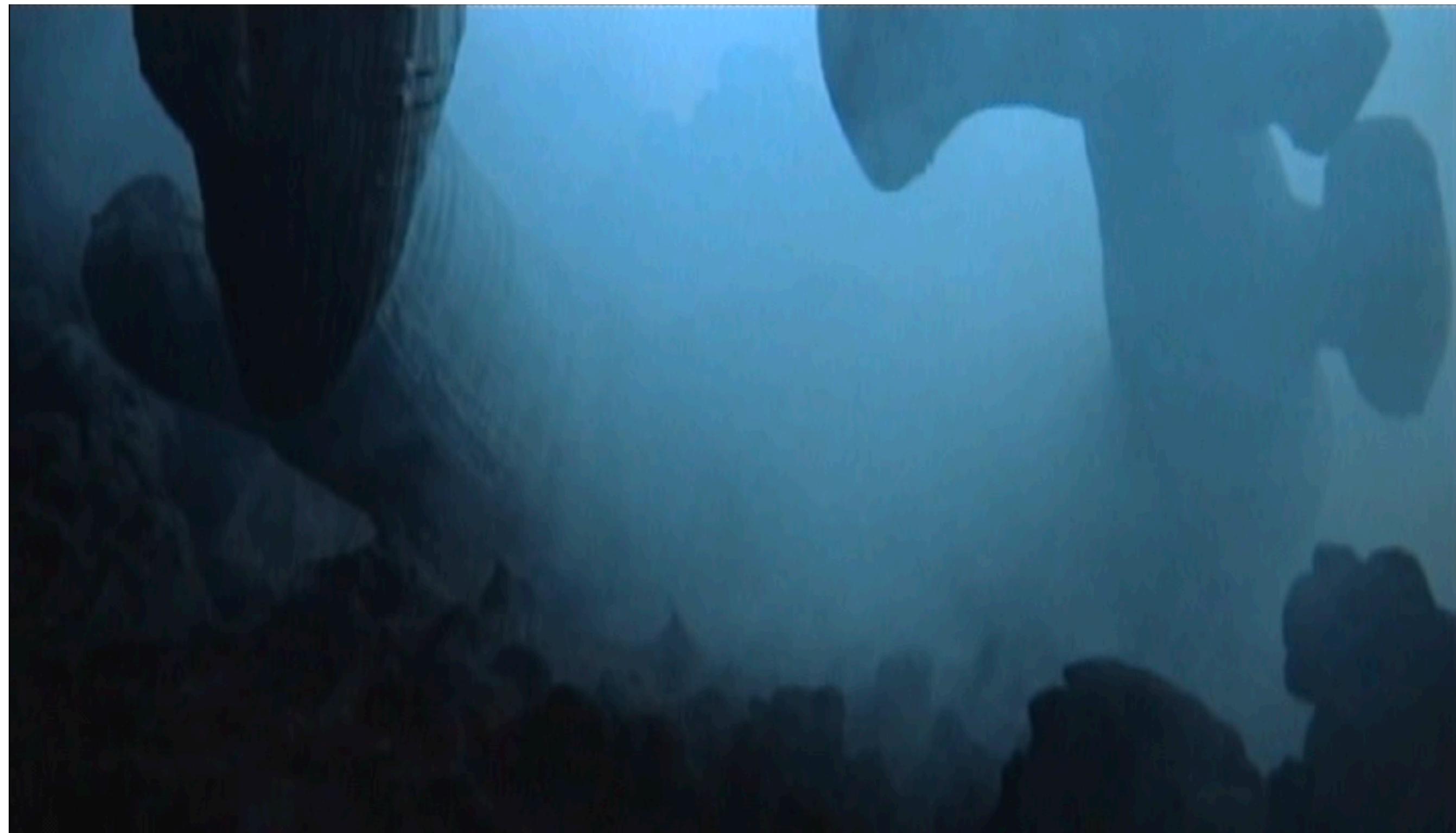


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How should we go about the search?



Maybe going out to find extraterrestrial life is not the way to go!

Other options include broadcasting our existence or looking/listening from home

When did the search begin?



1959: Nature paper led by Giuseppe Cocconi & Philip Morrison propose radio searches for extraterrestrial transmission

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1960: Project Ozma led by Frank Drake at NRAO in Green Bank, WV

The Drake Equation

$$N = R^{\star} \times f_p \times n_E \times f_l \times f_i \times f_c \times L$$

R^{\star} : average star formation rate in the Galaxy

f_p : fraction of stars with planets

n_E : number of Earth-like planets per star

f_l : fraction of Earth-like planets with life

f_i : fraction of life sustaining planets with intelligent life

f_c : fraction of intelligent civilizations capable of communication

L : average lifetime of radio-communicating civilization

The Drake Equation

$$N = R^\star \times f_p \times n_E \times f_l \times f_i \times f_c \times L$$

R^\star : average star formation rate in the Galaxy (assumed $10 M_\odot/\text{yr}$)

f_p : fraction of stars with planets (assumed < 1)

n_E : number of Earth-like planets per star (assumed > 1)

f_l : fraction of Earth-like planets with life (assumed ~ 1)

f_i : fraction of life sustaining planets with intelligent life (assumed ~ 1)

f_c : fraction of intelligent civilizations capable of communication (assumed ~ 1)

L : average lifetime of radio-communicating civilization (assumed 10^4 yr)

Next time: the
search for extrasolar
planets & conditions
for habitability

