IS ET LURKING
IN OUR COSMIC BACKYARD?

PROBES FROM PASSING STARS & A DRAKE EQUATION FOR ALIEN ARTIFACTS

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3 related papers

How Many Alien Probes Could Have Come From Stars Passing By Earth?

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Abstract

Stars come very close to our solar system frequently. About two stars per million years come within a light year. An extraterrestrial civilization that passes nearby can see there is an ecosystem here, due to the out-of-equilibrium atmosphere. They could send interstellar probes to investigate. We estimate how many probes could have come here from passing stars. And where would they be now? The Moon and the Earth Trojans have the greatest probability of success. Close inspection of bodies in these regions, which may hold primordial remnants of our early solar system, yields concrete astronomical research. This argues for a Search for Extraterrestrial Artifacts (SETA) strategy of exploring for alien artifacts near Earth.

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Looking for Lurkers: Co-orbiters as SETI Observables

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Abstract

A recently discovered group of nearby co-orbital objects is an attractive location for extraterrestrial intelligence (ETI) to locate a probe to observe Earth while not being easily seen. These near-Earth objects provide an ideal way to watch our world from a secure natural object. That provides resources an ETI might need: materials, a firm anchor, and concealment. These have been little studied by astronomy and not at all by the Search for Extraterrestrial Intelligence (SETI) or planetary radar observations. I describe the objects found thus far and propose both passive and active observations of them as possible sites for extraterrestrial (ET) probes.

Unified Astronomy Thesaurus concepts: Near-Earth objects (1092); Earth trojans (438); Trojan asteroids (1715)

A Drake Equation for Alien Artifacts

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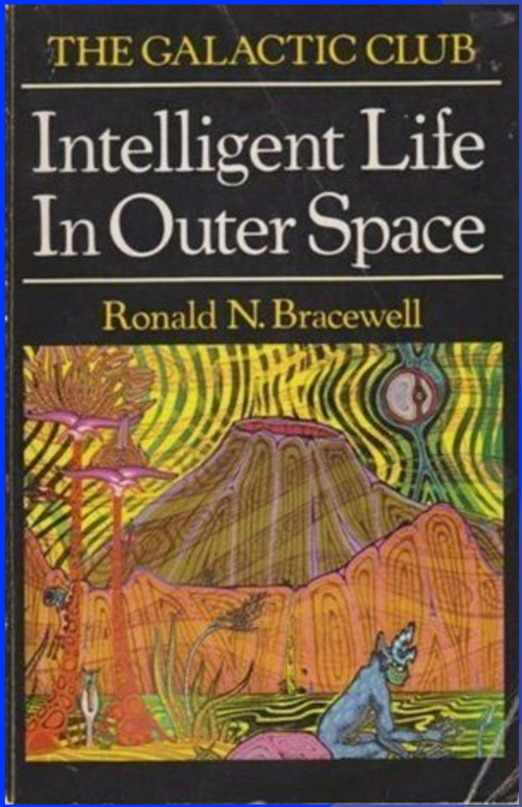
I propose a version of the Drake Equation to include searching for alien artifacts, which may be located on the Moon, Earth Trojans and Earth co-orbital objects. The virtue of searching for artifacts is their lingering endurance in space, long after they go dead. I compare a Search for Extraterrestrial Artifacts (SETA) strategy to the existing listening-to-stars Search for Extraterrestrial Intelligence (SETI) strategy. I construct a ratio of a SETA Drake equation for artifacts to the conventional Drake Equation, so that most terms cancel out. This ratio is a good way to debate efficacy of SETI vs. SETA. The ratio is the product of two terms: One is the ratio of the length of time probes from extraterrestrial (ET) civilizations could be present in the near-Earth region to the length of time ET civilizations transmit signals to the solar system. The second term is the ratio the respective 'origin volumes': the volume from which probes can come, which is affected by the long-term passage of stars nearby the Sun, to the volume of transmitting civilizations. Estimates presented here suggest that looking for alien artifacts near Earth is a credible alternative approach relative to listening-to-stars. This argues for emphasis on artifact searches, ET archeology. I suggest study of existing high-resolution images of the Moon, imaging of the Earth Trojans and Earth co-orbitals and for probe missions to the latter two. Close inspection in these near-Earth regions, which also may hold primordial remnants of the early solar system, yields concrete astronomical research.

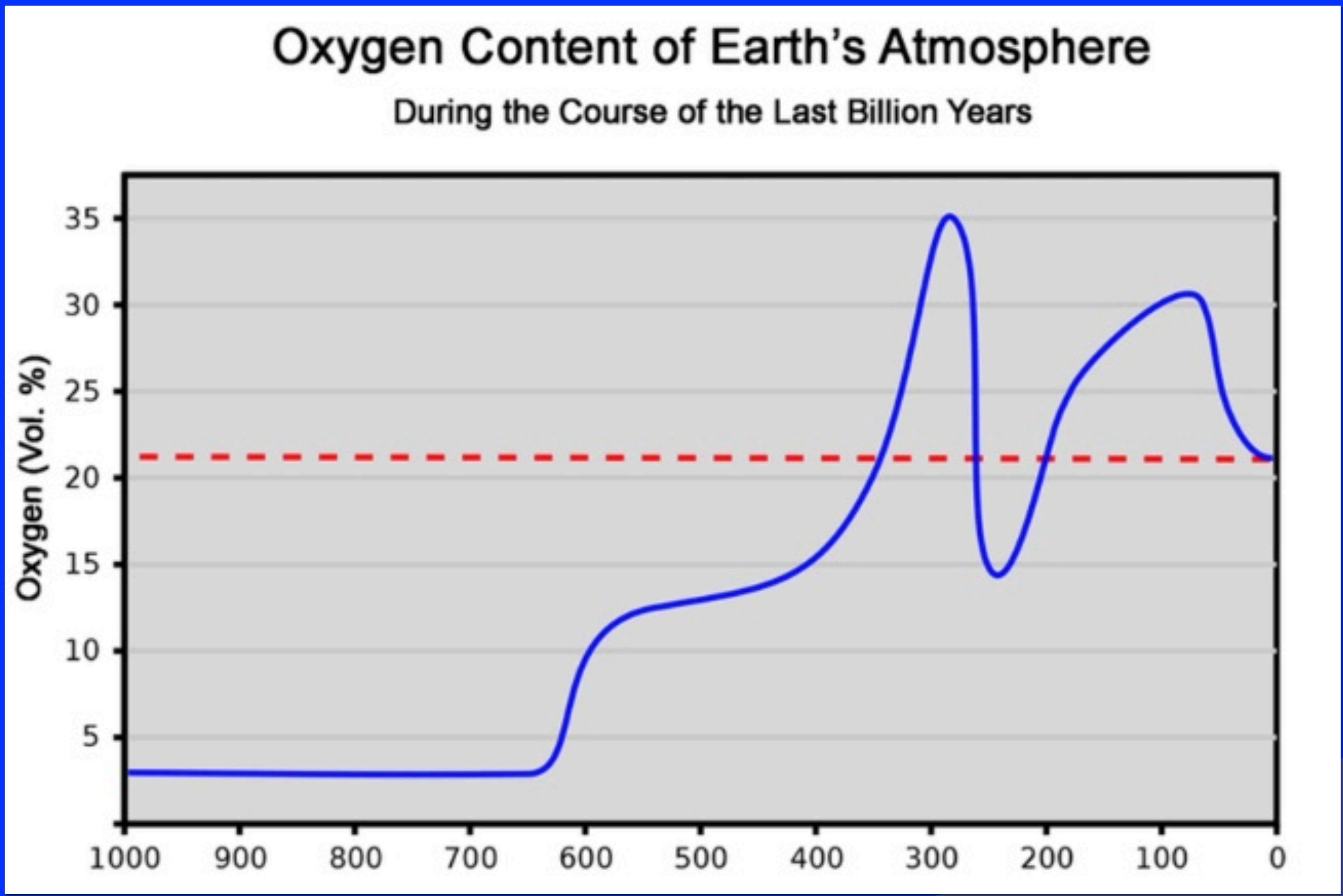
Bracewell's Lurker Hypothesis

- If advanced alien civilizations exist, they might place AI monitoring devices on or near the worlds of other evolving species to track their progress.
- Such a robotic sentinel might establish contact with a developing race once that race had reached a certain technological threshold, such as radio communication, interplanetary flight or *our finding them*.
- Co-orbitals are faint, hard to find, could provide materials, concealment.

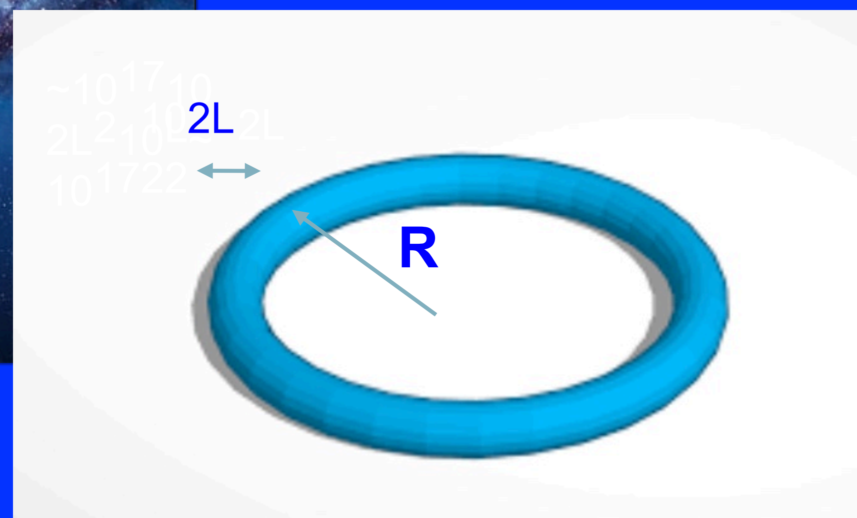


Alien Probes Could Have Come From Stars Passing By Earth

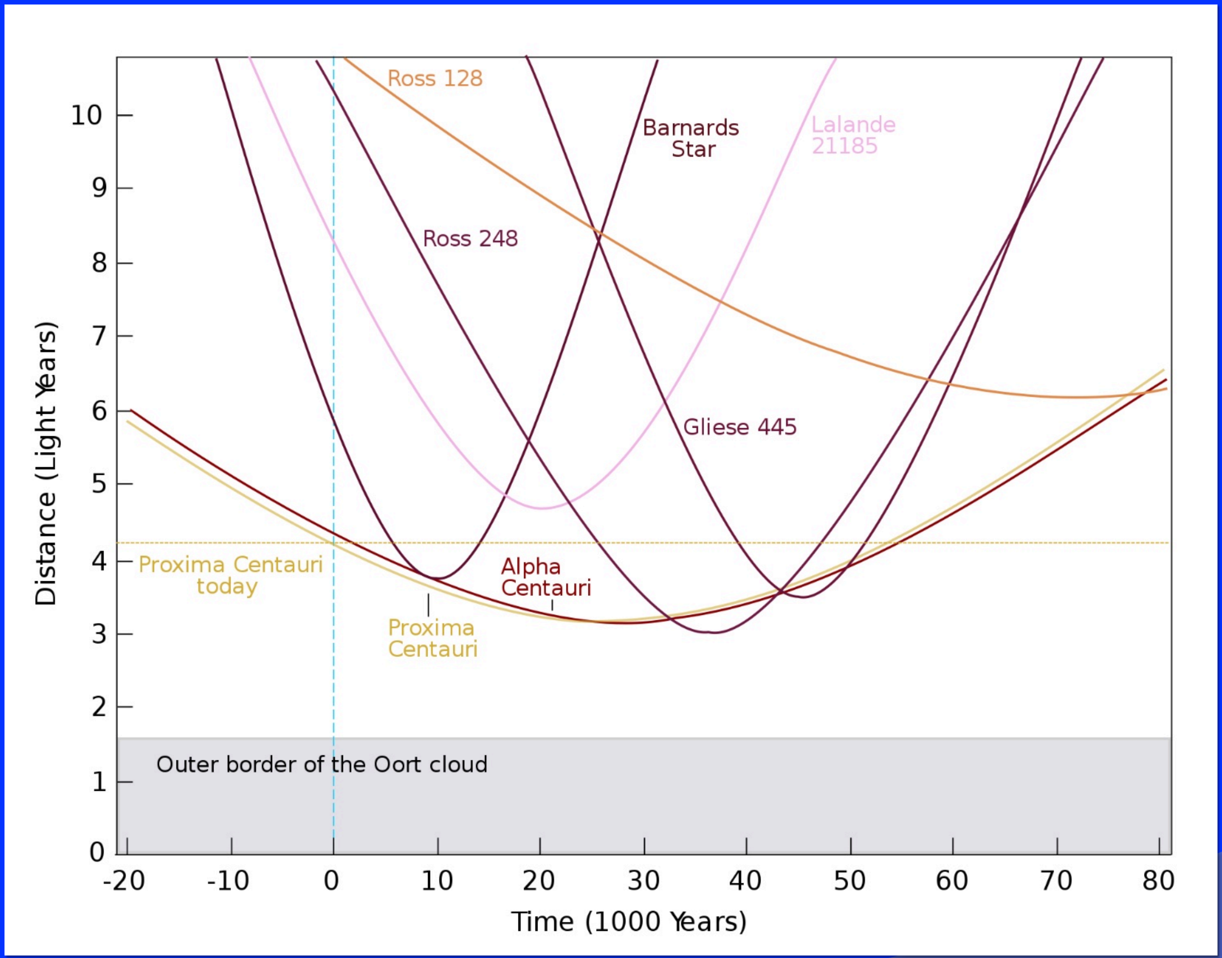
- Stars come very close to our solar system frequently. About two stars per million years come within a light year. In the 10,000-year timescale of our agricultural civilization, about two new stars have come within 10 ly.
- An extraterrestrial civilization that passes nearby can see there is an ecosystem here, due to the out-of-equilibrium atmosphere. *They could send interstellar probes to investigate.*
- This argues for a Search for Extraterrestrial Artifacts (SETA) strategy of exploring for alien artifacts near Earth.
- The Moon and the Earth Trojan(s) have the greatest probability of success. Close inspection of bodies in these regions, yields concrete astronomical research.


Oxygen Content of Earth's Atmosphere
During the Course of the Last Billion Years
Oxygen (Vol. %)
35
30
25
20
15
10
5
1000
900
800
700
600
500
400
300
200
100
0

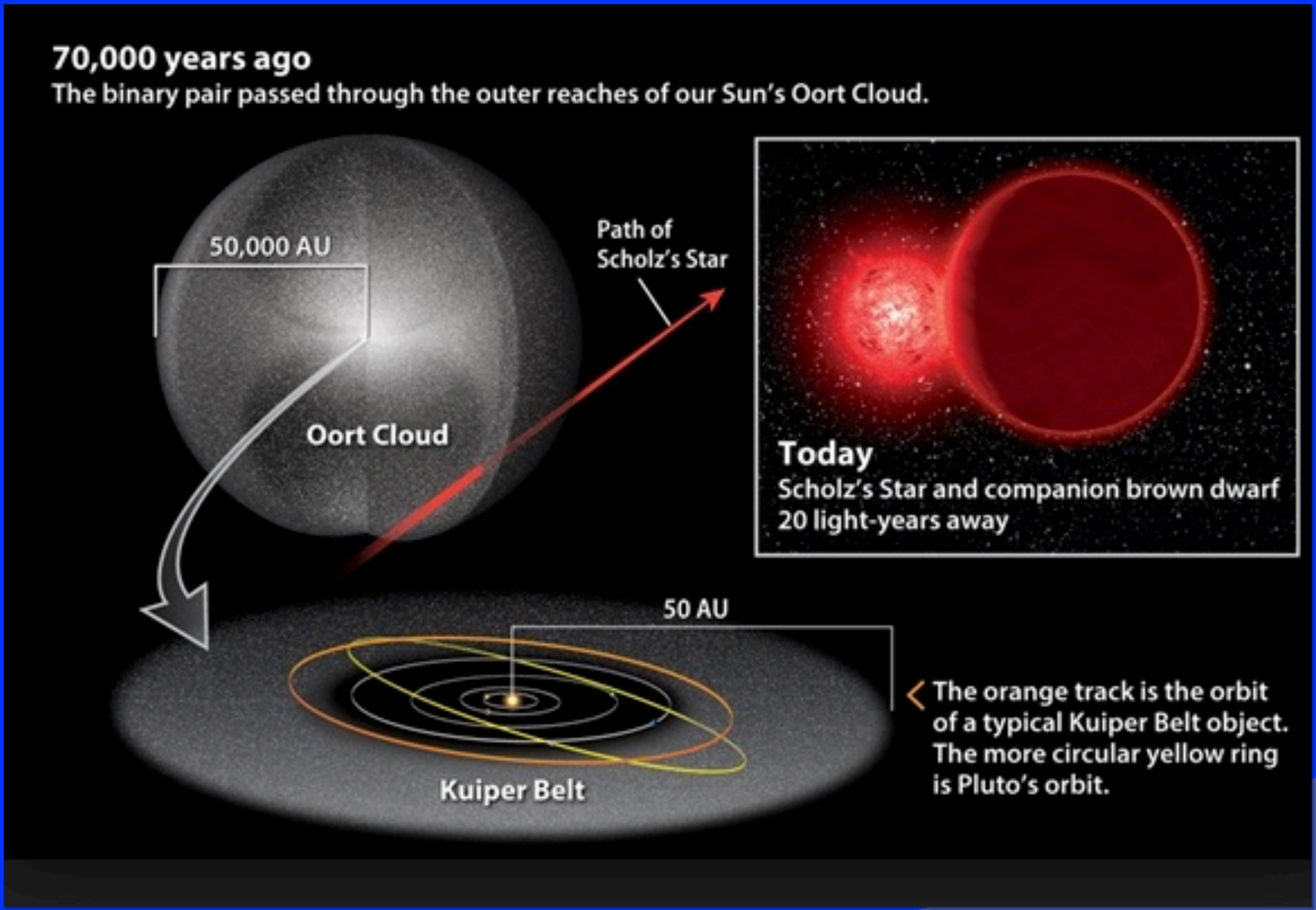
Earth moves around the galaxy in a torus in ~220 million years



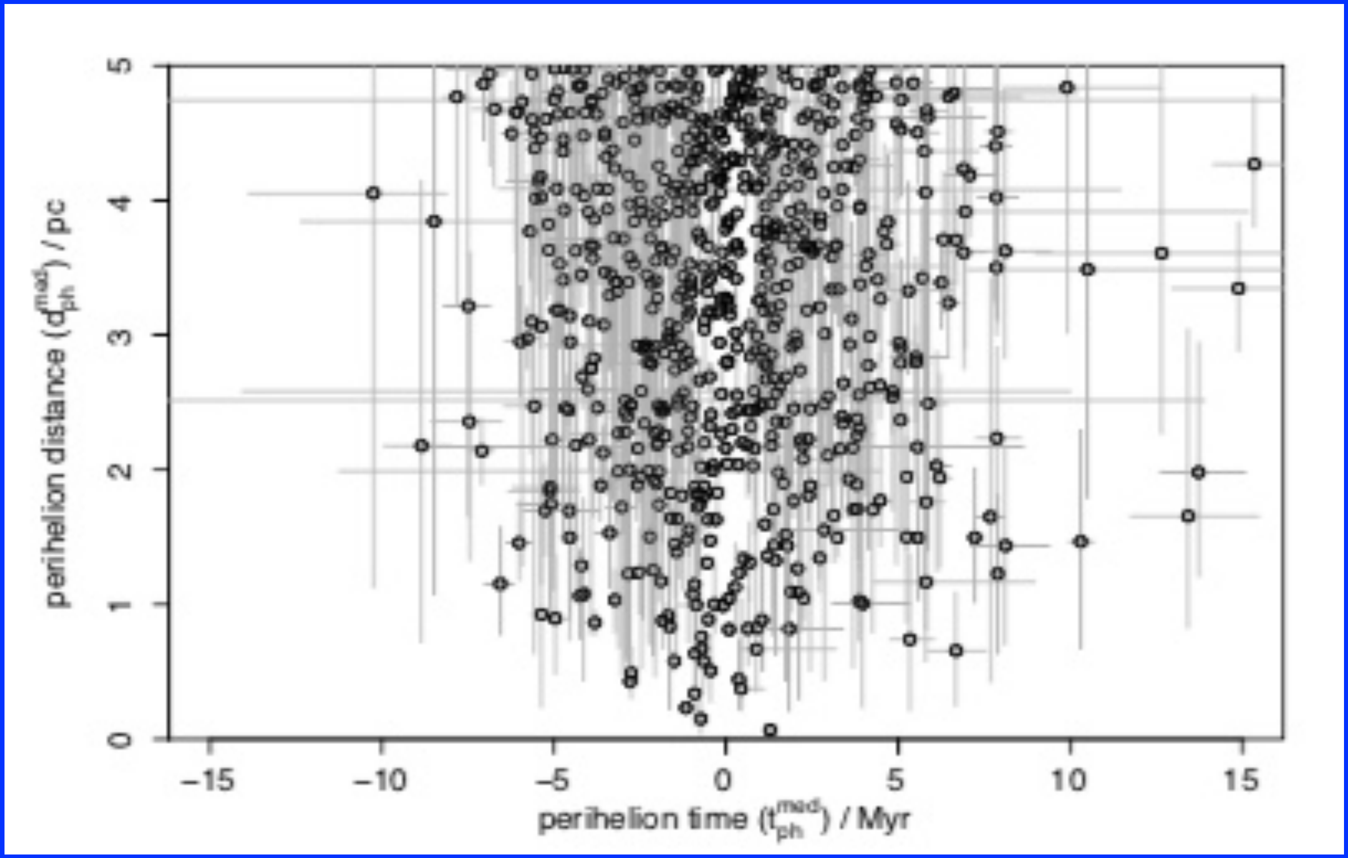
Stars move relative to the Sun. Stars come close to Earth frequently, ~2/Myr within 1 light year



Scholz's Star came within 0.82 light-years from the Sun about 70,000 years ago.



Stars passing by Earth: Perihelion times and closest distances for 694 observed stars.

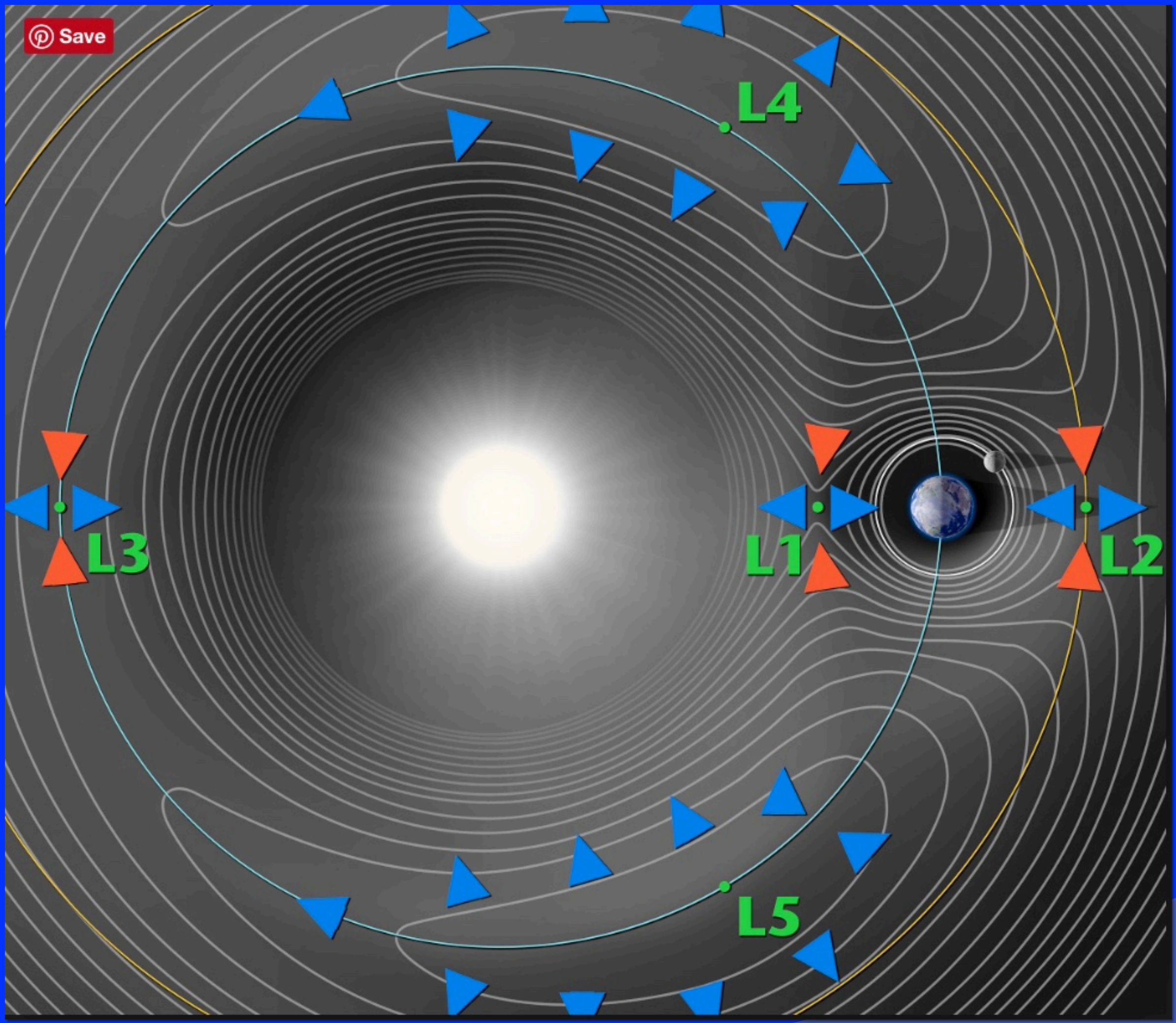


Rate Stars Pass Within R of Sun

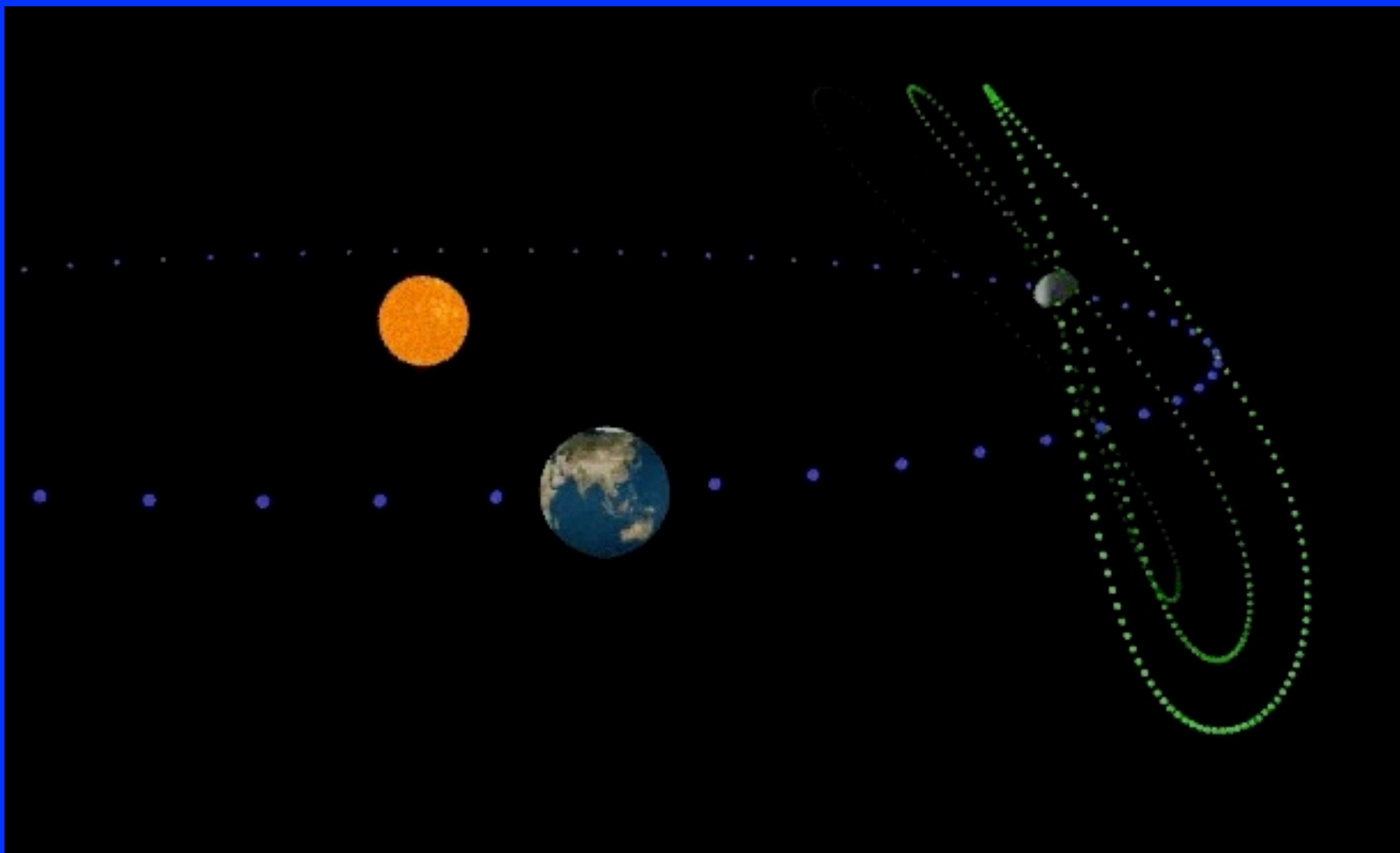
- $dN_S(R)/dt = 2\ 10^{-6}\ R^2$ stars/year = $2\ R^2\ (ly^2)$ stars/ Myear
- Number of Lurkers that could arrive and now be found:
- $\boxed{N_L = f_{ip}\ T_L\ [dN_S\ (R)/dt]}$
- $f_{ip:}$ fraction of civilizations that develop interstellar probe
- T_L: the orbital lifetime of the object upon which the Lurker is resident

Apollo 17 Site

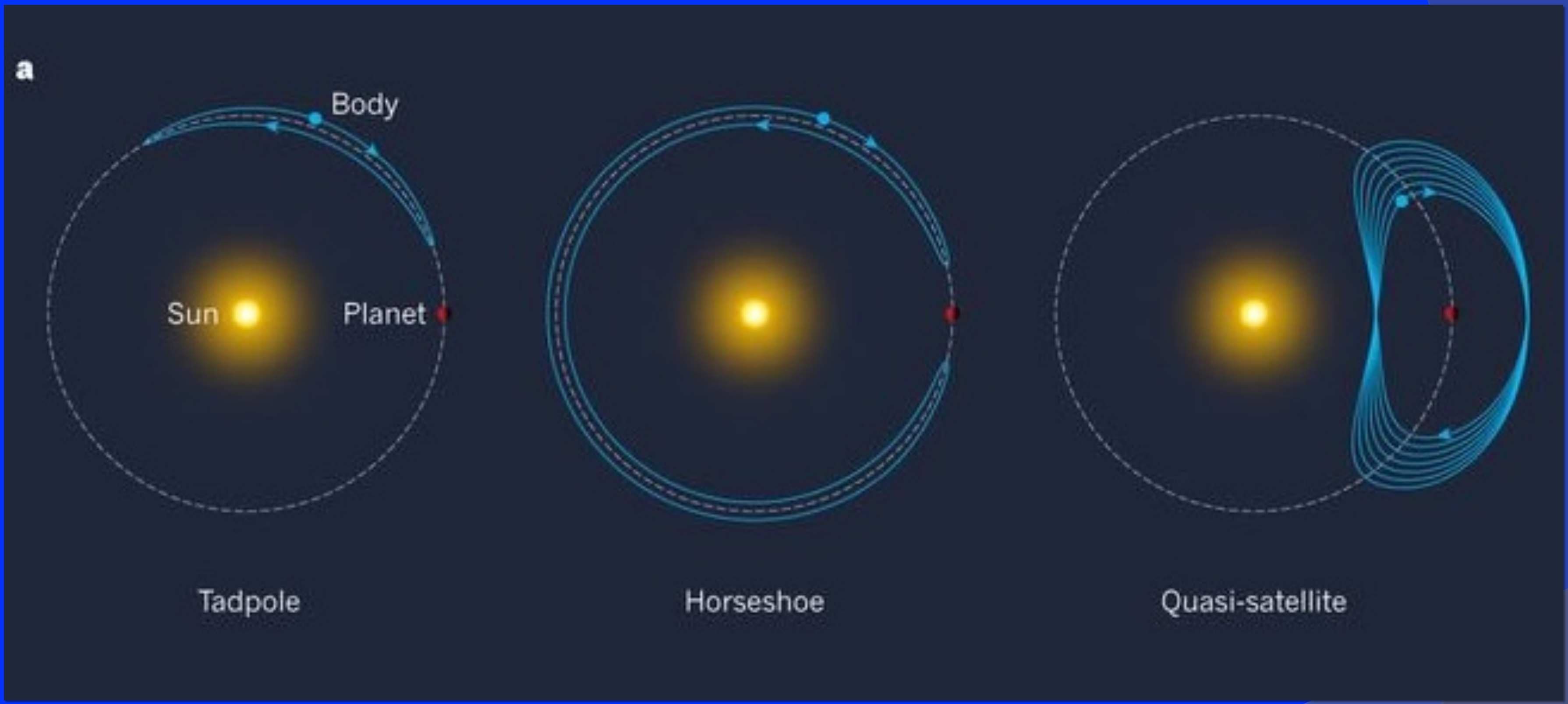
Lagrange Points



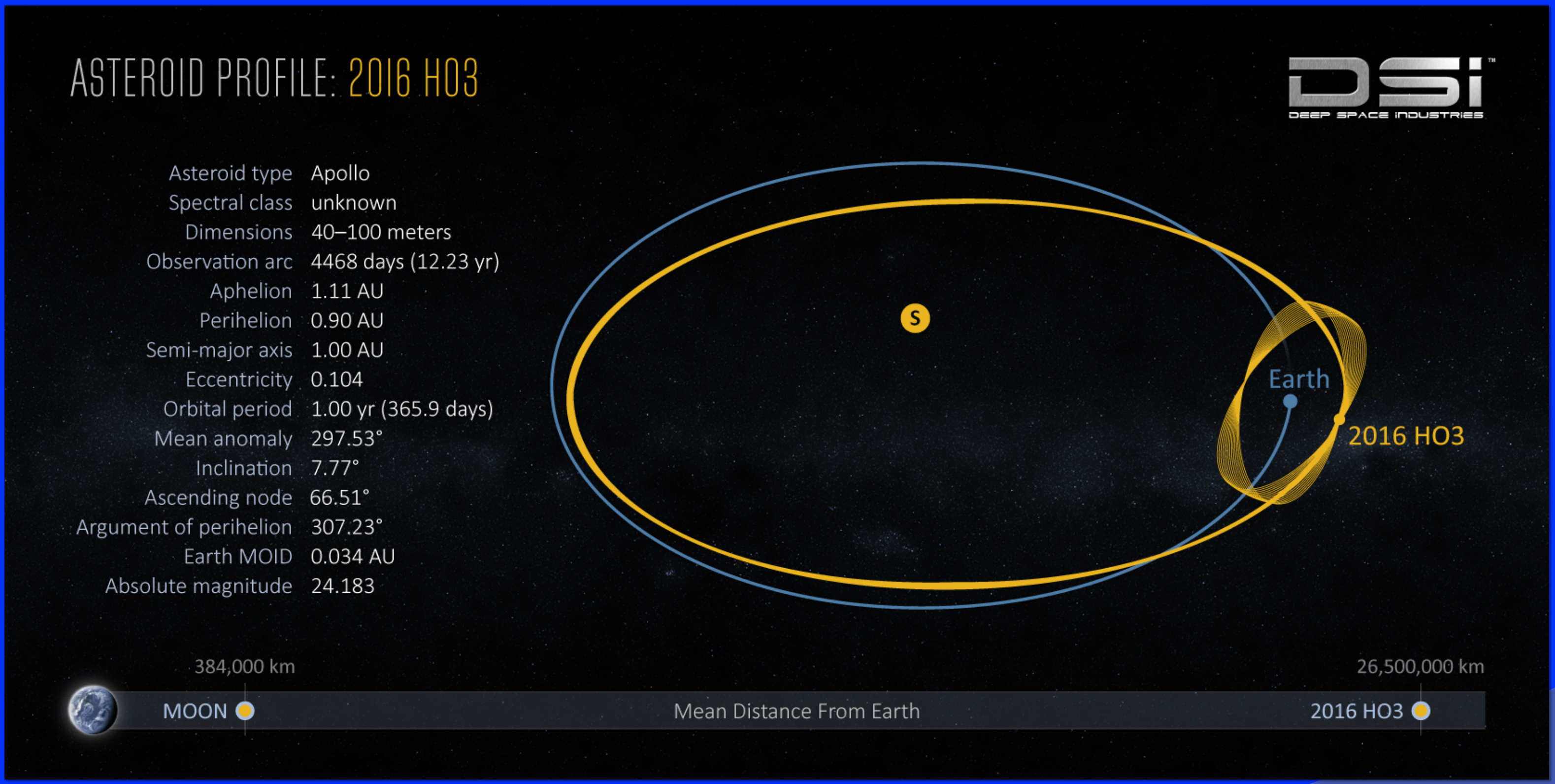
Earth Trojan orbit [2010 TK_7]



3 Types of Co-orbital Orbits



Orbit of 2016 HO_3 around Earth



Research for Finding Alien Artifacts

I advocate a sequence of tasks:

- Develop an AI for searching for alien artifacts in the millions of sites that Lunar Reconnaissance Orbiter has photographed, about 1.6 million at high resolution. The vast majority of the photos have not been inspected by the human eye.
- Conduct passive SETI observations of these nearer-Earth objects in the microwave, infrared and optical.
- Use active planetary radar to investigate the properties of these objects.
- Conduct *active* simultaneous planetary radar 'painting' and SETI listening of these objects.
- Launch robotic probes to conduct inspections, take samples of Earth Trojans and the co-orbitals.

Drake Equations for SETI & SETA (Search for ET Artifacts)

$$\frac{N_L}{N_C} = \left(\frac{N}{N}\frac{R}{R}\frac{f_p}{f_p}\frac{n_e}{n_e}\frac{f_l}{f_l}\frac{f_i}{f_l}\frac{f_c}{f_c}\right)\left[\frac{f_{ip}}{f_R}\frac{T_L}{T_R}\right]$$

$$\frac{N_L}{N_C} = \frac{f_{ip}}{f_R}\frac{\mathrm{T}_L}{T_R}$$

The ratio of Eqs means:

- *This is a 'Success Ratio' of searching for artifacts compared to listening to stars. It allows us to <u>quantitatively</u> evaluate their relative merits.*

- *The two strategies, SETA and SETI, are competitive.*

- *The Moon and the Earth Trojans have a greater probability of success than the co-orbitals.*

SETA Searches of near-Earth objects-1

- Plan a multiyear program of observations by radio and optical telescopes and planetary radars around the world.
  - discern their size, shape, rotation periods, and optical properties, such as spectra. We would need to discern their optical spectra out to at least J-band (to 1.2 μ).
- Conduct passive SETI observations of these nearer-Earth objects.

SETA Searches of near-Earth objects-2

- Use *active* planetary radar to investigate the properties of these objects.
- Conduct *active* simultaneous planetary radar 'painting' and SETI listening of these objects.
- Launch robotic probes to conduct inspections, take samples. For example, 2016 HO_3 at close approach has a relative velocity of 3-5 km/sec, so is within present capability. (China already doing this.)

Costs & Benefits

What Does it Cost?

- Resources such as time on telescopes, radio and optical. And volunteers. Costs start small, then grow.

What do we gain?

1. We would be studying the Moon and newly found objects, which could well be interesting astronomy. Little is known, other than orbital calculations and faint images. We know almost nothing about co-orbitals and the Earth Trojan.
2. *We do something new, an active fresh front in SETI research.*