Astronomy 330

This class (Lecture 27):
ICES and CHP Evals
Visitations

Next Class:
Final words

Music: Concerning the UFO Sighting Near Highland, Illinois– Sufjan Stevens

Final Papers

- You must turn final paper in with the graded rough draft.
- Unless you are happy with your rough draft grade as you final paper grade, then email me to keep the grade.
- Final paper is due on last day of class.

Final

- Take home exam.
- Must be dropped off no later than May 2nd (noon) in my mailbox in astro building.
- You are allowed 4 hours– must be typed.
- Will consist of
  - 7 short answer questions (5-10 points each, 1 short paragraph)
  - 2 short essays (15 points each, 2-3 paragraphs)
  - 2 large essay question (50 points each, 1-2 pages).
- A total of 210 points graded out of 200 points.
- A normal-sized sheet of paper with notes on both sides is allowed, but otherwise closed-book/lecture notes.

Outline

- ICES and CHP evals….. fun..
- Fermi's Paradox..
- UFOs?
- Facts from class.. where do they lead us?

The future:

May bring us closer to the speed of light

- Right now we can travel through space at about c/25,000
- Maybe fusion-powered crafts could in the near future reach 0.01c or maybe even 0.10c

http://www.jedisaber.com/SW/wallpaper/light%20speed.jpg

Issues and Incentives

- Assume there is intelligent life out there.
- Will they try to travel to us?
  - Is it worth it?
  - Exploration?
- If a civilization has been around for 1 million more years than ours…
- But interstellar travel is HARD!!!!
- Back to thinking about autonomous probes..

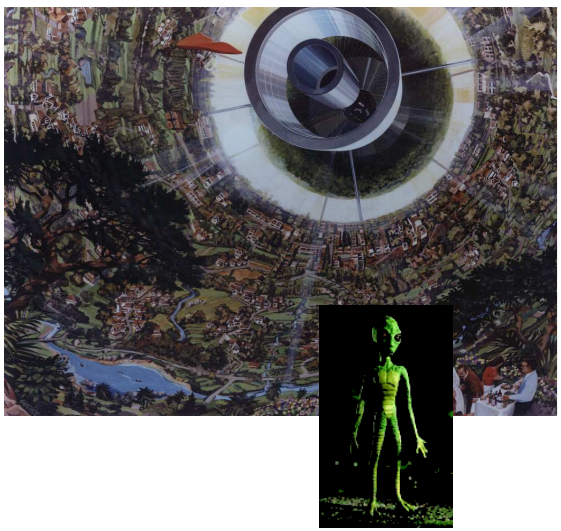
ET's Spacecraft?

- We really don't know yet how to get to the stars realistically, so we don't know what advanced civilizations might use.
- But it is
  - Smarter
  - Cheaper
  - Still very informative and
  - Realistic

  to send an unmanned probe into stars first
  - Lighter payload!
- Self-replicating probes?

Slow Long Haul Space Travel

- Spacecraft that we can envision easily would take a lifetime to get to the nearest star.
- Colonizing missions would have to be multi-generation missions.
- Space colonies with propulsion systems would slow down things, so maybe it would take 1000 yrs for each trip.
- How many of you would sign up today?



Nikolai Kardashev: Civilization Types

Type 0: Not in complete control of planet's energy
Understand the basic laws of physics
Chemical and nuclear propulsion, solar sails

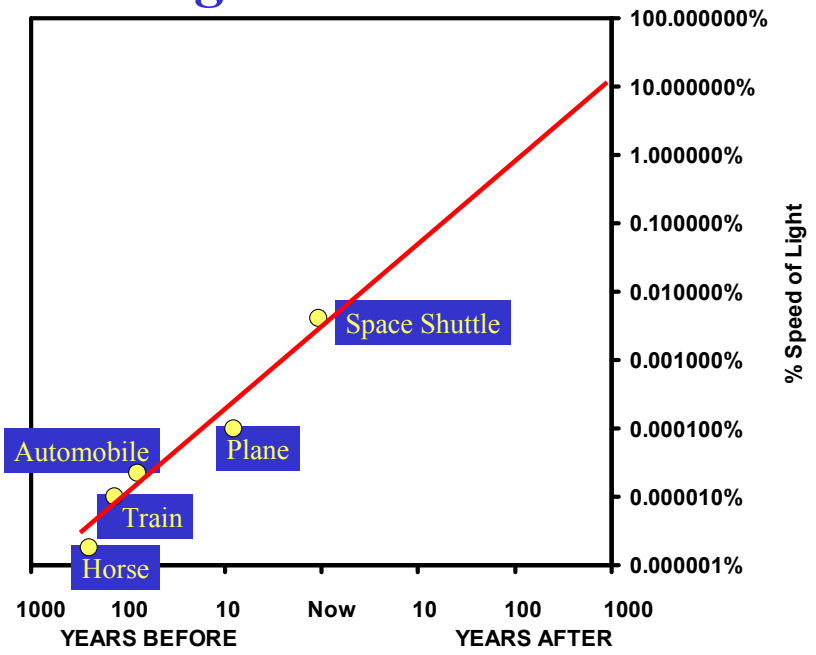
Type I: Harnesses energy output of an entire planet.
Laser sails.

Type II: Harnesses entire output of their host star.
Dyson Sphere–can provide a trillion times more energy than we use on the Earth now. Antimatter drives?

Type III: Colonizes and harnesses output of an entire galaxy
Use a trillion times the energy of Type II civilizations
Use a trillion trillion times the energy of Type I civilizations

http://www.unm.edu/~astro1/ET109/types/types.html

Going Interstellar!

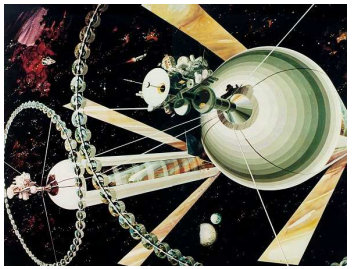


Problems to Overcome?

1. Space is Big.
   - Nothing we can probably do about this one.
2. Time.
   - Because of #1, interstellar travel would take a lot of time.
   - But arguably do-able.
     - Maybe lifetime is expanded, generation ships, suspended animation, or intelligent robots.
3. Cost
   - Right now, colossal budget of a few trillion dollars. Impossible now, but in the future?
   - Medieval blacksmiths could have made an oil tanker, but too costly. 500 years later, piece of cake.
   - In future, cost of interstellar travel may also go down.

1000 Years?

- So in 1000 years from now, we should be able to travel to other stars. But will we?
- It would be nuts to speculate on what will motivate our descendents (if any) 1000 years from now. But if interstellar travel really is easy and cheap, surely someone will give it a go?



Getting Out of Here

- Distances between stars are much greater than we can imagine– freaky big distances, plus difficult environment and time consuming makes interstellar travel hard to conceive.
- SciFi books and movies have dramatized space travel to make it seem possible
  - But, interstellar travel may never happen

Getting Out of Here

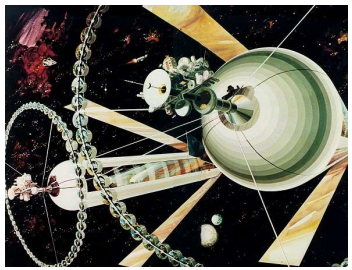
- Even the Voyager spacecraft (one of the fastest ever flown) travels at only 20 km/s through space - not even 1% of the speed of light. They would take 60,000 years to reach even the nearest star.
- In our discussions, we argue that with foreseeable technology 10% the speed of light is possible.
- Is that enough to expect to see aliens on Earth?

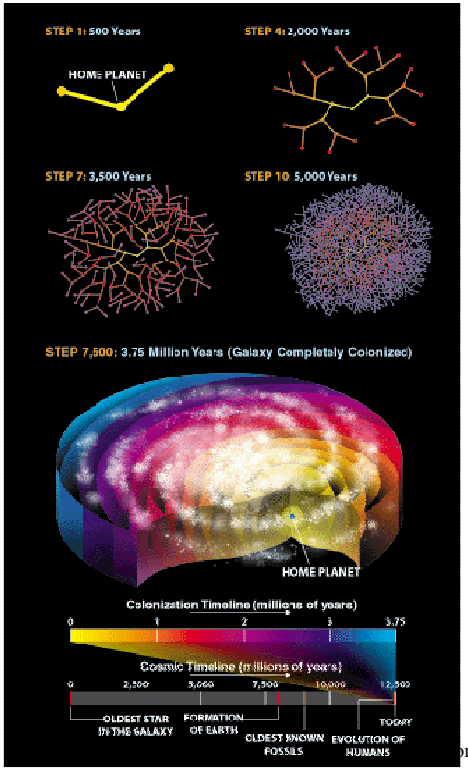
Galaxy Colonization

- If our Drake equation estimate is roughly right, there should be civilizations that are 1 billion years old!
- Think of the accomplishments.
- Even if interstellar travel is limited to 0.1c, civilizations with advanced telescopes could send colonizing craft to new "Earth-like" planets.
- That group regenerates for 500 yrs and sends out another craft.
- An advanced civilization could colonize the entire galaxy in maybe only 5 million yrs!

How long to colonize the Galaxy?

- With 0.1c, we can travel 10 light years in 100 years
- We can reach the nearest star in 43 years
- Allow each new colony 500 years to duplicate the technology
- Colonies could spread out about 50 light years every 3,000 years





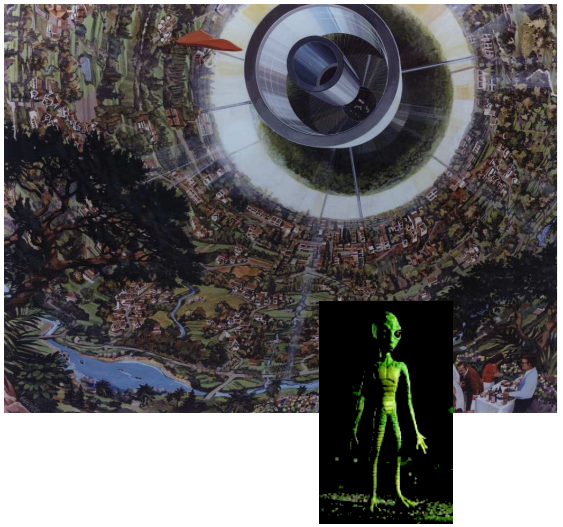
Optimistic

Every 500 years, the colonization craft makes it to the next suitable solar system– small delay.

Then, it only takes about 4 million years!

Slow Long Haul Space Travel

- Spacecraft that we can envision easily would take a lifetime to get to the nearest star.
- Colonizing missions would have to be multi-generation missions.
- Space colonies with propulsion systems would slow down things, so maybe it would take 1000 yrs for each trip.
- How many of you would sign up today?



Or how long to colonize slower?

Be even more pessimistic and use 100,000 years per 50 light years.

100,000 lyrs

Total time to cover the Galaxy:

1500 hops x 100,000 years = 150,000,000 years

The Fermi Paradox

The Drake Equation – Even for a few hundred technical civilizations.

Only 150 million years to colonize the Galaxy.

WHERE IS EVERYBODY?????

The Fermi Paradox

- Our estimate for communicable civilizations was around 13,300.
- Given such a large number, one of them must have developed earlier than we did.
- So "Where are they?"
- Even if interstellar travel is very slow and difficult, there has been a lot of time to do it.
- Furthermore, many of the objections to interstellar travel do not apply to artificial intelligence (intelligent robots.)

Life on Earth is of One Type?

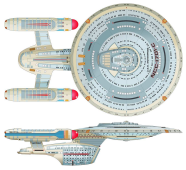
- Life got started on Earth pretty quickly. To some, this suggests that life forms easily, whenever conditions are right.
- So why are all creatures on Earth descended from the same microbe?
- You can tell from the similarities in our DNA and cells that all living things come from the same ancestors. Why?
- The average time needed to spread over the Earth was much less than the average time to evolve. Not true for the Galaxy.

Timescales

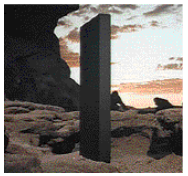
- For pessimist: 150 million years to colonize the Galaxy.
- For optimist: 4 million years to colonize the Galaxy.
- This may seem like forever, but it is actually pretty tiny compared to the time it takes evolution (about 0.1%).
- So, if we believe our condition, there should only be one intelligent family of species in our galaxy - whoever reached intelligence first should have spread everywhere before anyone else reaches intelligence.
- This is the main point of the Fermi Paradox.
- Where are they?

Limits

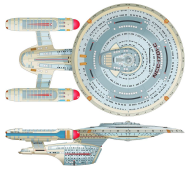
- So, if we go back to two alternatives - a galaxy packed with billions of intelligent life-forms, and a cold and lonely empty one, Fermi is suggesting that the truth lies closer to the second alternative.
- Does this seem reasonable?
- There may be a few (or a few hundred) intelligent species out there.
- But if there really were billions, we would have surely have been visited?



Where is Everyone?



- **They are around, but we can't tell yet**
  - They are too advanced or alien to recognize or detect
  - They don't bother with us (or traveling or broadcasting)
  - Do civilizations hide to avoid a "galactic scourge?"
  - They are keeping us "quarantined" (the "zoo" or prime directive hypothesis)
  - They've been here (or are here), and we don't know it
  - They are not "technical" in a way we can understand.



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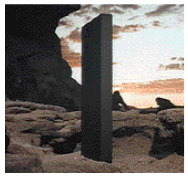


- **They are not around**
  - Some factors in Drake equation may be much smaller than we believe – life, or intelligent life, is very rare
  - They wipe themselves out too quickly
  - Other factors wipe them out too quickly
  - Life hardly ever develops technical civilizations
  - There is very little life out there
  - We are among the first to develop

Or…

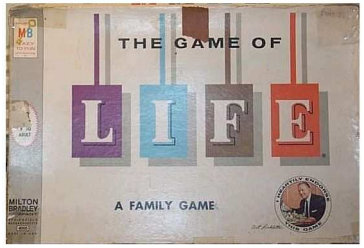
There is no ET life on Earth, so there may be 5 possible explanations (according to Michael Hart):

1. Space travel is not feasible.
2. Other civilizations have chosen not to colonize.
3. Other civilizations have not had time to colonize the Galaxy.
4. The Earth has been visited in the past, but we do not observe any visitors now.
5. There are no other advanced civilizations in the Galaxy.

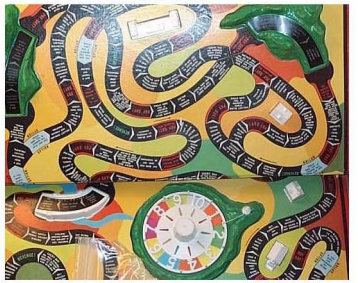
Hart argues against all but #5. He is saying that our Drake Equation result is wrong!

Maybe Life is Hard

1. Maybe colonization is much more difficult than we assume. Might expect robotic probes first, which slows down the process.
2. Maybe travelers prefer to explore more than colonize. Overpopulation is not the issue.
3. Are planets suitable for life? If one of the 20 amino acids is missing in that life system, food is a problem.
4. By colonization timescale, the space creatures may prefer to stay in space– weightlessness evolution. Comfy clothes.



1960 edition. Art Linkletter-endorsed. Shucks, that's all I need to see!



http://www.wesclark.com/am/life.jpg

Class Conclusions?

- There is no reliable evidence that leads us to believe that life exists somewhere else in the universe.
- As this class has shown, life is possible, but that is all we know now!
- May the future enlighten us!
- Still, let's use what we do know and see what sort of conclusions we can make.
- Is it possible that someone may see a UFO?

Fact 1

- It is possible that ETI life is abundant in our galaxy
  - With 300 billion stars and plenty of opportunities for life to develop.
  - Our estimate for civilizations was **13300** right now!
  - So, there are clearly arguments for common life.

Fact 2

- If ETI is abundant in our Galaxy, then we expect that, statistically, there exist or have existed ET civilizations that have achieved a technological capability greater than that which we now demonstrate– an advanced civilization!
  - The time to reach Type 0 status was about 4.5 billion years on Earth, but it could easily be only 3.5 billion years somewhere else
  - An intelligent civilization can do a lot in a billion years

Fact 3

- The distances and times associated with interstellar travel are great, but as far as we know, it is conceivably possible that a civilization conduct significant interstellar exploration, especially with enough time.
  - At very least, a more advanced civilization could have sent out nanoprobes across the Galaxy.

Fact 4

- It is possible therefore that an ET civilization has explored our region of the Galaxy, the Sun, and even our Earth at some point in its history
  - This is not pseudo-science but real logical consequences of abundant ETI.

Fact 5

- We have no reason to believe that this has not happened
  - We also have no reason to believe that it has.
  - It is an open question.

What are we left with?

- These are two distinct but still very significant claims
  - The Earth has been visited by ETs.
  - The Earth has not been visited by ETs.
- Neither of these statements has been validated.
- So, the only statement we can make is
  - We do not know whether or not the Earth has been visited by ETs.

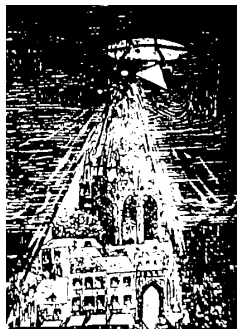
http://www.cgl.uwaterloo.ca/~csk/washington/graphics/logos/validated.gif

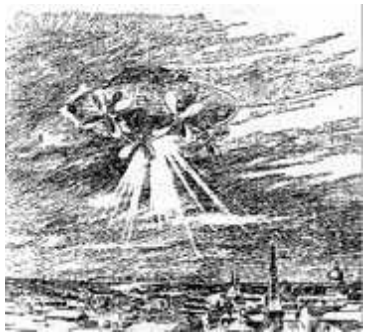
The ET Visitor Hypothesis

- So far no reliable evidence exists for ET visitation
- But, the idea that we have been visited and traces exist somewhere is a valid THEORY
  - Maybe improbable but still valid
- *Don't expect people to believe your theory unless it is substantiated with reliable evidence*

UFO Before

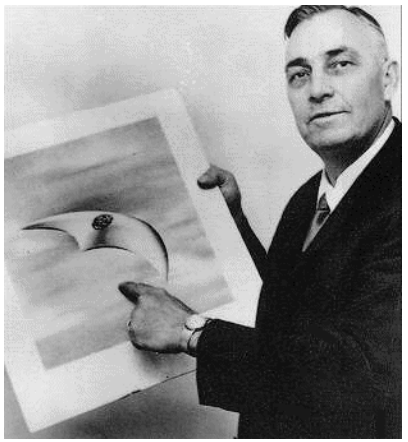
- First idealized UFOs around 1900.
- In Sacramento in 1896
- In England in 1906
- Blimp-like objects with search lights.





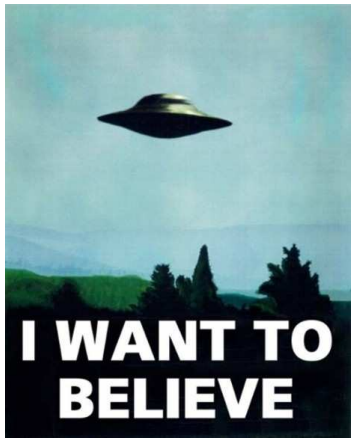
Flying Saucer

- Modern sighting phenomenon from Kenneth Arnold in 1947 who told reporters that while flying a private airplane near Mount Rainier, he saw nine objects that moved like "a saucer skipping across the water."
- He actually thought they were government projects.
- Picked up by the pulps, and the number of sightings jumped.



UFOed

- The popularity is not very surprising
  - Jet planes first introduced at the end of World War II
  - Public aware of fast-moving aircrafts
- 50% of the public believe in the existence of UFOs as aliens visiting Earth.
  - Where there's smoke…
  - Not all of them can be wrong…



UFOs

- What is a UFO?
- Can all/any of these sightings be traced to ETIs?
- Stands for **U**nidentified **F**lying **O**bject.
- Was introduced as neutral bureaucratese term to replace the emotionally charged term "flying saucer"
- Originally, the term UFO did not have anything to do with extraterrestrials.
- Scheme did not work, and now UFO has all of the connotations that "flying saucer" originally carried.

http://www.screensavershot.com/misc/ufo-02a.jpg

Close Encounters?

Scientific approach– you gotta classify

Carl Jung

1. Nocturnal lights: bright lights
2. Daylight lights: usually cigar or disk-like shaped.
3. Radar-visual: those detected by radar
4. Close encounters of the 1st kind: visual sighting of an unidentified object.
5. Close encounters of the 2nd kind: visual sightings plus physical effects on animate or inanimate objects
6. Close encounters of the 3rd kind: sightings of occupants in or around a UFO.

UFO Study Problems

- Why are UFO sightings hard to explain?
- Sightings must be explained "after the fact" without complete information.
- Sightings are based on eyewitness accounts, which are notoriously unreliable.
- Inconsistencies are often ignored.
- Humans seem to have a psychological need to believe in superior beings (→religion?).
- Failure to find a "normal" explanation is not evidence for alien visits.

Occam's Razor

– *Pluralitas non est ponenda sine necessitate* [Latin]
– Given two equally predictive theories, choose the simpler.

Or

– *The simplest explanation is usually the best.*

We Need Hard Evidence?

- A probe or remains of a probe somewhere on our planet or in our solar system
- The remains of ET biological activity somewhere on our planet or in the solar system.
- ET clearly announce themselves.
- If you expect to have your scientific investigation received seriously, you have to follow simple logic and common sense
  – The rules for the scientific method are just logic and common sense

http://www.biochem.wisc.edu/wickens/jpgs/2001_spac_odd.jpg

UFO Phenomenon

- Some argue that we have proof:
  - UFO sightings.
  - Strange historical accounts or grand technological accomplishments of humans in the past.
  - Alien abductions.
- This all falls into the realm of pseudo-science.
- There has never been any concrete evidence of extraterrestrials having anything to do with UFOs.
- UFOs could be so very many things. Why assume automatically that there is an otherworldly explanation? But those who want to believe will do so even despite evidence to the contrary.
- In this class, we think that "**Extraordinary Claims Require Extraordinary Evidence**" - Carl Sagan.

Witness This

- In a court of law, testimony is used and it has to be judged for legitimacy
  - Bad testimony often gets judged as good and vice verse
- Science is not a court of law
  - We know that testimony can be flawed, so we can not rely on it as a reliable source of information
  - The mind can deceive or be deceived or it can relate observations accurately
    - We don't ever know which for sure

http://www.buttonhouse.com/catalog/aliens-ufo.html