Sunset Astronomical Society

The Sunset *Gazette*

Serving the Tri-Cities since 1975

Volume 7, Issue 3 November, 2009

Meeting information

Meetings are generally in the theater in the Delta College Planetarium in Bay City. The meetings will usually be on the 2nd Friday of each month at 7:00 PM. Watch the newsletter for changes in dates and times. Membership is not required to participate in meetings and activities. See Page 6 for this month's meeting site.

Membership Information

Student / Senior: (17 years & younger, 65+ years)

1 year - $15

2 year - $20

Regular: (18+ years)

1 year - $20

2 year - $30

Family: 1 year - $25

2 year - $40

Membership includes voting privileges, the newsletter and free admission into Delta College Planetarium shows.

Treasurer's address for renewals and subscriptions:

Tom Smith

3423 Hidden Rd.

Bay City, MI 48706-1243

Subscription Information

Subscription prices available at club rate with the purchase of individual or family membership.

"Sky and Telescope" Magazine:
1 year - $33.00 + Membership

"Astronomy" Magazine:

1 year - $34.00 + Membership

2 year - $60.00 + Membership

ARE WE ALONE? or

"The discovery of one-cell organisms on a distant planet in our solar system or beyond would have an impact as big as the Copernicus revolution"

By Martin Grasmann. This is the 14th part of an extended summary of a lecture about Astrobiology that Dana Bachmann, SETI Institute/SOFIA-Ames gave on Wednesday, March 26th 2008 at the CMU.

In the last part of our ongoing series we have looked at the Drake equation, which was a first attempt to estimate the number of intelligent civilizations currently present in our galaxy. We are now going to look a little bit closer on how this number changed over the course of the last 50 years since Frank Drake came up with his equation. At Drakes time (1961) the values for the equation ($N = R^* \times f_p \times n_e \times f_\ell \times f_i \times f_c \times L$) were

- R^* = 10/year (10 stars formed per year, on the average over the life of the galaxy)
- f_p = 0.5 (half of all stars formed will have planets)
- n_e = 2 (stars with planets will have 2 planets capable of supporting life)
- f_ℓ = 1 (100% of these planets will develop life)
- f_i = 0.01 (1% of which will be intelligent life)
- f_c = 0.01 (1% of which will be able to communicate)
- L = 10,000 years (which will last 10,000 years).

If you put these values into the equation you come up with approximately 10 intelligent civilizations currently occupying our galaxy. So how well established are these values? R^* is probably the most undisputed value because it stems from observable astronomical data; the next value f_p is less certain, but is still much firmer as for example n_e. The problem with n_e are the recently discovery of numerous hot Jupiter's in close orbit with their stars. Current theory says that these gas giants formed far more outwards and then over time moved inwards into the close proximity of their star. Naturally any Earth-like planet would have been thrown out of the star system during that process. Secondly it is now known that most stars in our galaxy are red dwarfs: these star have violent flares in UV and X-rays which make not very good life supporting stars, because this kind of radiation can seriously erode the atmosphere of a planet over time. Further uncertainty to n_e is introduced by the possibility of life bearing moons of giant gas planets. The value f_ℓ may actually be rather high knowing that mono-cellular life on Earth started very early after its formation (ca 500 million years). Very important to further refine the value of f_ℓ would be the discovery of life on Mars or any other planet or moon in our solar system because this would lead to a higher value of f_ℓ. The values f_i and f_c are also very much biased by using Earth as a model. It took a very long time (until 500-600 million years ago) for the mono-cellular life to develop into multi-cellular life (Cambrian explosion) and it is still not clear why it took so long or why the transformation then happened so sudden. If Earth is taken as a model ca 1 intelligent civilization develops per 4 billion years and only relative old planets may have intelligent life capable of extra-terrestrial communication. The next values f_i, f_c and L, like f_l, are also estimates: for example it is now coming clearer that a large moon like Earth's Moon has very stabilizing effect on the planets axis of rotation, also it seems that the solar system's orbit around the

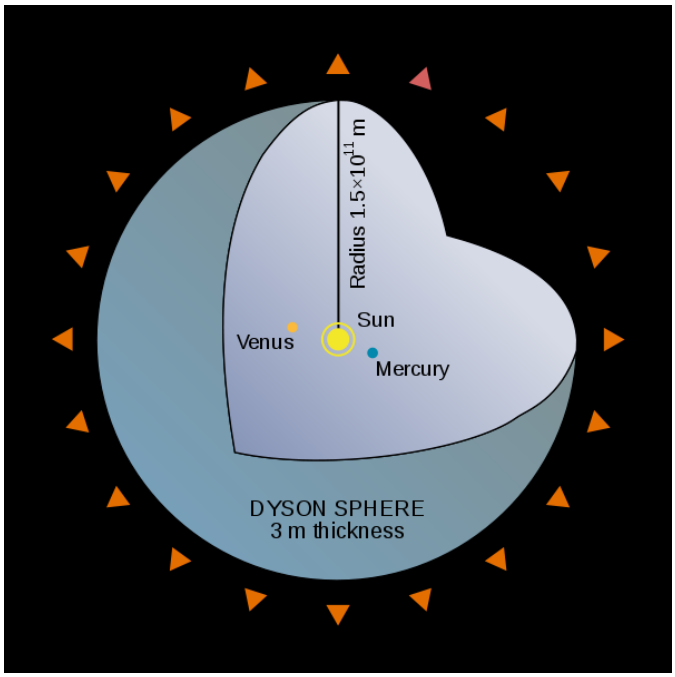
center of our galaxy is circular at such a distance that it remains out of the spiral arms for hundreds of millions of years evading deadly radiation from novae etc.

The values will become more precise over time as our knowledge about star, planet formation, exobiology, evolution etc increases. A modern estimate for these values is result in $N = 7 \times 0.5 \times 2 \times 0.33 \times 0.01 \times 0.01 \times 10000 = 2.31$. However, so far we have no evidence for extraterrestrial civilizations. This conflict is often called the Fermi paradox after the Italian-American physicist Enrico Fermi: In an informal discussion in 1950, Fermi questioned why, if a multitude of advanced extraterrestrial civilizations exist in our galaxy, no evidence such as probes, signals our even remains of ancient alien civilizations are seen in our closer proximity. A more complete version of the paradox would be

> The apparent size and age of the universe suggests that many technologically advanced extraterrestrial civilizations ought to exist.
> However, this hypothesis seems inconsistent with the lack of observational evidence to support it.

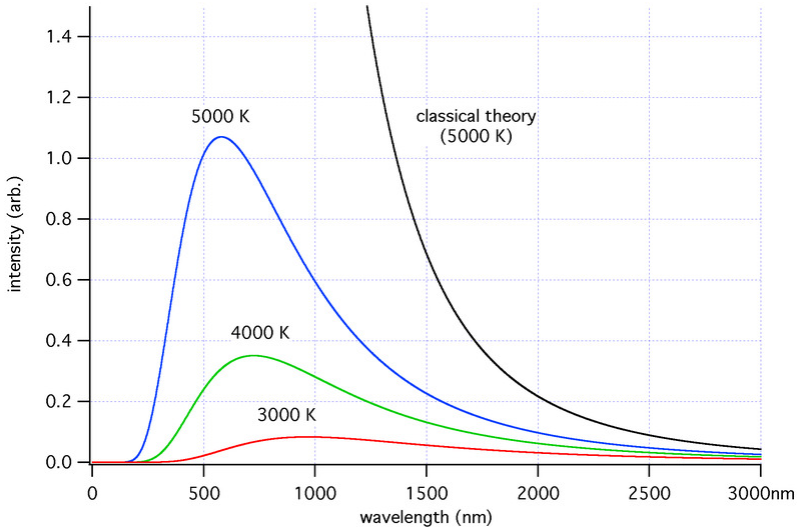
The first aspect of the paradox is the "the argument by scale and age": there are an estimated 250 billion stars in the our galaxy and 70 sextillion (7×10^{22}) in the universe as we know it. Assuming that intelligent life only occurs on a tiny fraction of planets around these stars, the number of civilizations in the milky way alone should still be large. Also, the universe is an estimated 13.5 to 14 billion years old, this time span should have allowed a very large number of civilizations come into existence. This part of the paradox uses the mediocrity principle by stating that Earth is not special, but merely a typical planet. The second aspect deals t counter the argument of scale and age: Lets assume a civilization which uses technology as their base drive of progress (as our own civilization does currently) and lets assume further that such a civilization does not reach a 'saturation point' where it becomes static with no further progress. Such a civilization would tend to colonize its habitat and from there on it would reach out to new frontiers, seek out new resources and colonize first their own star system and then the surrounding star systems. So the question from the Fermi paradox arises "why are there no aliens here, why are we not seeing any artifacts?" If we assume that interstellar travel is possible even on a very slow pace it should take a civilization not more than 5 to 50 million years to colonize the galaxy, a feat which given the age of our galaxy could have been achieved many hundred to thousand times (just assuming that in this time span there was only one civilization in existence). The galaxy should have been colonized over and over again by know. This takes into account that the civilization may not have carried out the civilization themselves - they could have build or evolved into self-replicating conscious machines (von Neuman machines). It also take into account that colonization is impractical or undesirable, but a technological advanced civilization could have still carried out large scale *exploration* of the galaxy. However, no signs of either colonization or exploration have been generally acknowledged.

One could now argue what about the whole universe? Would travel times not be too long (we are leaving out such hypothetical travel arrangements like wormholes, warp-drives, hyperspace etc) from a far away galaxy? However that does not solve the problem, the question then becomes "Why do we see no signs of intelligent life?" as a sufficiently advanced civilization (= super-civilization, one who could manipulate and harness the energy of a whole galaxy or galaxy cluster) could potentially be seen over a significant fraction of the of the observable universe. The previously mentioned scale argument indicates that even if such civilizations are very rare, they should still exist somewhere at some point during the history of the universe. Because they could be detected over a long distance over a considerable period of time we should see them. However, so far we have not detected incontrovertible signs which point clearly to artificial sources and the presence of such super-civilizations.



The first way to solve the Fermi paradox would be to find an extraterrestrial civilization. The way to do this have been extensively mentioned in the last back issues of this newsletter. What may be the important point is to avoid an overly anthropocentric approach to solve the problem. Because we know only one technological civilization we focus our search on types of activities we humans have performed or would perform in the future given more advance technology. But this may mot hold true for an alien civilization. One possible alien artifact to look for are the so-called Dyson spheres (again a anthropocentric concept but reasonable for a sufficiently technological advanced civilization).

The Dyson sphere (a thought experiment of the physicist Freeman Dyson, see previous page) is a shell or cloud of objects around a star in order to harness as much radiant energy as possible. This would mean astro-engineering on a truly massive scale and should change the normal emission lines of the center star to that of a black body radiation with a peak in the infrared. An alien civilization might therefore be detected by search for stars with such an altered spectrum. But depending on the desired internal environment such sphere may be more difficult to detect than initially anticipated. Life based on high temperature reactions may result in an altered radiation in the visible spectrum not the infrared.



As the temperature decreases, the peak of the black-body radiation curve moves to lower intensities and longer wavelengths (infrared). The black-body radiation graph is also compared with the classical model of Rayleigh and Jeans.

Apparently there have been some preliminary attempts to find evidence of the existence of Dyson spheres or other large scale constructs of astro-engineering of civilizations of type II (according to the Kardashev scale, see below), but so far optical surveys have concluded no evidence of any of these structures. If these constructs are extended to galactic scale their absence is even more detrimental to the theory "live is common". As we all know observations of thousands of galaxies has not shown any evidence of their existence. This leads actual to an upper limit of the number of those super-civilizations which is less than one per 10,000 galaxies per 13 billion years (= age of the universe).

In 1964 the Soviet astronomer Nikolai Kardashev first proposed a scale into which civilizations can be categorized according to their energy consumption and technological advancement. The scale consist of three types called *Type I*, *II*, and *III* in is of course highly hypothetical and in terms of an actual civilization highly speculative; however, it puts energy consumption of an entire civilization in a cosmic perspective. Type I — a civilization that is able to harness all of the power available on a single planet — has approximately 10^{16} or 10^{17} W available. Earth for example has an available power of 1.74×10^{17} W and currently we are using ca 15×10^{12} W so we are currently not a Type I civilization but somewhere below**.** Type II is a civilization that is able to harness all of the power available from a single star approximately 4×10^{26} W (e.g. our sun). Type III finally is a civilization that is able to harness all of the power available from a single galaxy, approximately 4×10^{37} W (e.g. our milky way). Using energy usage/need to rate extraterrestrial civilizations can be of course: misleading: We have no idea how an alien civilization advances and the Kardashev scale may not reflect what will actually occur for an advanced civilization. Given our current problems with higher and higher energy usage and increasing CO_2 levels a civilization may actually start to conserve energy and its rating on the Kardashev scale drops despite the development of more advanced technology.

The second way to solve the Fermi paradox is theoretically and a multitude of theories have been developed why "they" have not been found yet. These can be divided into the following topics, which itself will have several under topics:

- No other civilizations currently exist
- They do exist, but we see no evidence
- They choose not to interact with us
- They are here unobserved

The next parts will talk more the theoretical solutions of the Fermi paradox and the possibility of interstellar travel. Interested? Then watch this space! The next parts of this gripping story of 'Are We Alone?' will follow in the next issues of the Sunset *Gazette*!

SUNSET ASTRONOMICAL SOCIETY
THE SUNSET GAZETTE
SERVING THE TRI- CITIES SINCE 1975

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This issue can now be accessed in color on the website of the SAS!!!
http://sunsetastronomicalsociety.com

SAS Meeting

November 13, 2009

Delta College Planetarium Theater

7:00 Welcome, new members

7:10 **Dale Sisson's**

Constellation of the month:

'Andromeda'

Jim Mentele's

Relativity: Concepts and Implications of the Special and the General Theories'

The talk will describe the basic concepts of the theories that explain two of the basic forces of nature. There won't be time to derive many of the implications of the theories but the derivations will be outlined: for the Special Theory, time-dilation, mass-energy equivalence, the magnetic field;
for the General Theory: the source of the gravitational field, Black holes, gravitational lenses, etc.

Break: Refreshments served

If the weather is clear please bring your telescope!

UPCOMING EVENTS

Nov 8: Mars to be found a few deg upper left of the Moon

Nov 9: Last-quarter Moon

Nov 10: Dawn: Regulus about 4 deg upper left of the Moon

Nov 12: Dawn: Saturn about 8 deg left of the Moon.

Nov 14: Dawn: Spica about 4 deg upper left of crescent Moon.

Nov 15: Dawn: Very thin crescent Moon about 6-7 deg to right or lower right of Venus half hour before sunrise.

Nov 16: New Moon

Nov 16 - 17: Leonid shower peaks from midnight on the 16th to dawn on 17th.

Nov 23: Evening: Jupiter 3 - 4 deg below the Moon.

Nov 21: First-Quarter Moon

Dec 2: Full Moon

Dec 6,7: Dawn: Mars about 9 deg upper left of the Moon on 6th and upper right of it on the 7th, with Regulus nearby.

Dec 7: Earliest Sunset of the year

Dec 8: Last-quarter Moon

Dec 10: Dawn Saturn about 9 deg about waning crescent Moon.

Dec 11: Dawn: Spica is 4-5 deg left of the Moon.

UPCOMING MEETINGS

Supporting the International Year of Astronomy 2009:

First Friday of each month: Public Observing at the Planetarium

Nov 20, 7:00 - 9:00: Delta College Planetarium Theater

A Night with Galileo: Telescope Workshop & Great Lakes Night Sky

Club Members: Please bring your telescopes for public viewing.