THE SETI PROJECT

A proposal by Alberto Caballero

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1. What would the SETI Project be?

The SETI Project would be a coordinated effort made by several amateur radio observatories with the objective to find a potential signal of extraterrestrial origin. The initial campaign is intended to last one month. During this time, 4 stars would be scanned, once per week. The project would be extended if a candidate signal is found. The selected stars should be relatively close to Earth, older than the Sun, and not previously scanned in detail by other observatories.

2. Why is it needed?

Amateur organizations such as the SETI League have been coordinating radio observatories for several decades. One of the main goals of the SETI league in Project Argus was to gather 5,000 observatories with the purpose of scanning all the sky 24/7 (SETI League, 2014). The project itself was a great idea. However, such effort never materialized due to difficult in recruiting and coordinating such a high number of observatories. Currently, there are a little over 100 SETI stations registered under the SETI League, but many of them are not active. Moreover, Project Argus only covered frequencies between 1.3 and 1.7 GHz. Unlike Project Argus, the SETI Project is aimed at observing only a few selected stars in a broader range of frequencies from 1 to 10 GHz, ideally 24/7 as well.

3. What could it be achieved?

In principle, if an extraterrestrial civilization located 2,671 light years away used a 5-km antenna (5 times larger than the Square Kilometre Array), a frequency of 10 GHz, and power as high as the most powerful radar on Earth (the Eglin AFB Site C-6), their signal could be detectable by a 3.7-meter dish with a bandwidth of 2 hertz. The maximum distance at which the radio telescope could detect the signal approximately matches the estimated distance where our furthest target is located.

Alien transmit frequency GHz	10
Alien transmit antenna diameter m	5000
Alien transmit antenna gain dBi	112.161477613
Alien transmit power W	32000000
Alien transmit EIRP dBW	187.212977396
Receive antenna diameter m	3.7
Receive system noise temperature (antenna+LNA) K	48
Receive antenna gain dBi	49.5461120080

Receive antenna G/T dB/K	32.7336996342
Bandwidth Hz	2
Required overall link carrier to noise ratio C/N dB	5
Path (spreading) loss dB	440.5
Range km	25270741417975496.0
Range AU (1AU=Earth to Sun distance)	168922068.3
Range light seconds	84235804726.6
Range light minutes	1403930078.8
Range parsecs	819.0
Range light years	2671.3

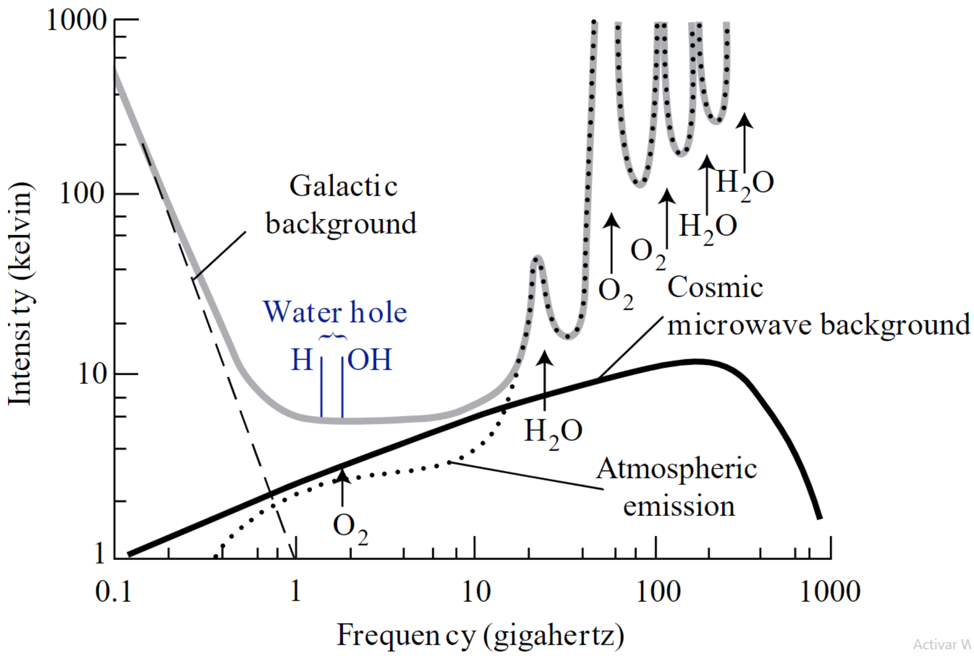
Source: Satsig

4. How could it be organized?

Ideally, each observatory would gather data for approx. 12 continuous hours every week. This way, the total number of radio observatories needed would only be 14 in order to achieve 24/7 coverage of each target at a time. The data could be stored in the own servers of each observatory and linked to the database of the project: https://exoplanetschannel.wixsite.com/home/groups. In principle, each observatory would analyse its own data and, if a potential signal is found, the observatory at hand would inform the coordinator of the project in order to organize with the rest of observatories an attempt to confirm the signal.

5. What frequencies would be used?

1,420 MHz is the frequency by default in the search for extraterrestrial intelligence. Considering that hydrogen is the most common known element in the universe, the scientific community believes that any civilization is more likely to transmit in this frequency than in any other frequency. However, extraterrestrial civilizations might use other frequencies instead. They might think that precisely because hydrogen is the most known common element in the universe, any signal transmitted in that frequency would be too noisy. Another possibility is that dark matter for example could make up to 80% of the Universe, but we do not know its frequency. In a similar manner, the water hole is a symbolic region for humanity, but a similar extraterrestrial civilization might opt for a frequency with an energy-per-photon slightly higher (all the METI transmissions humanity have sent were on a frequency higher than the water hole) (Dumas, 2015). In any case, the SETI Project would stay between 1 and 10 GHz for being the region less affected by cosmic and atmospheric noise.



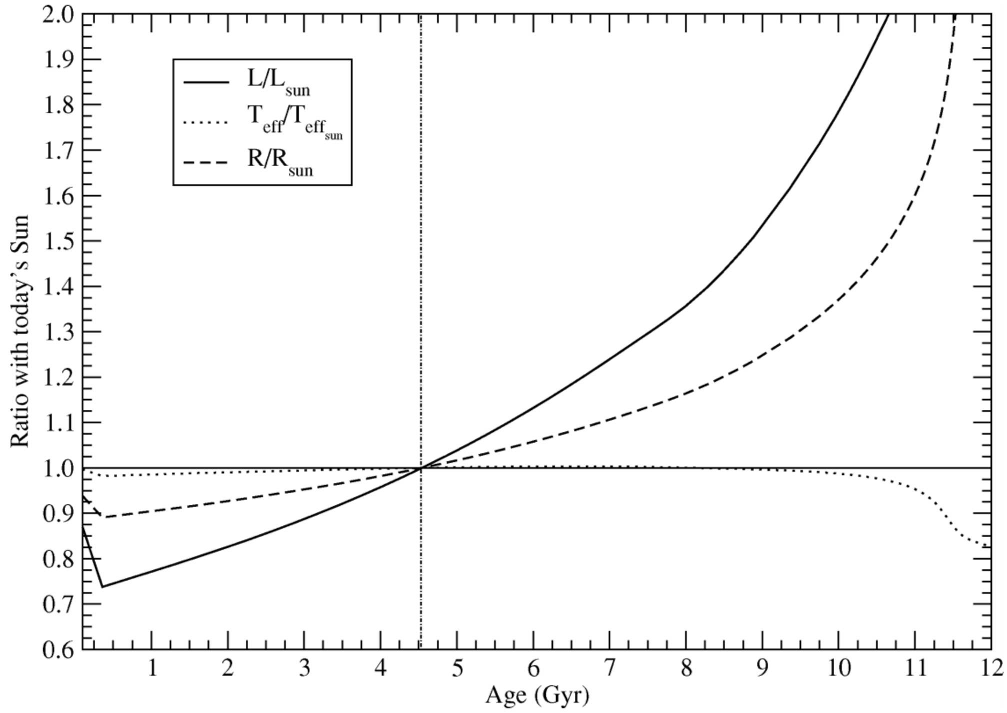
But, what frequencies each observatory would listen to? This is the most complex question that should be addressed. The definition of a second that we use was random-based: a second is 1/86,400 of the time that it takes the Earth to rotate once on its axis. However, the definition of the meter is related to something physical. It is one ten-millionth the distance from the equator to the North Pole along the great circle, which is just dividing that distance 10 million times. Even if an extraterrestrial civilization also uses the decimal numeral system, it is impossible to know whether they exactly used this definition of a meter. But, if they did, considering Earth-like planets of 0.99 and 1.91 Earth radii, our meter would be equivalent to their 0.99 and 1.01 meters, respectively. If they divided that distance by the immediately inferior order of magnitude of one million, our meter would be 10 meters for an Earth-sized planet, 9.9 for a 0.99 Earth radii planet, and 10.1 for a 1.01 Earth radii planet. If it was divided by the superior order of magnitude of 100 million, the results would be 0.099, and 0.101. All these results (9.9, 0.99, 0.099, 0.101) seem to be values that are too extreme and not practical for physically measuring things (again, consider that they have a similar body). Even a foot (which is less old than the meter) would be 3 times higher than 0.101. Thus, here we calculate the possible wavelengths considering that our meter could be equivalent to their 9.9 and 10.1 decimetres:

1 Earth radii (decimeters)	0.99 Earth radii (MHz)	1.01 Earth radii (MHz)
3	1009.4022155	989.41405281
2	1514.1033232	1484.1210792
1	3028.2066465	2968.2421584
0.9	3364.6740516	3298.0468427
0.8	3785.2583081	3710.302698
0.7	4326.0094949	4240.3459406

Each observatory would need to calculate the bandwidth needed with this Doppler shift calculator: http://www.setileague.org/software/doppler.xls

6. What are the targets?

1. **2MASS 08052406+6829051** is the oldest potential Sun-like star before the end of its main phase in 4.5 billion years. It was filtered out after estimating what temperature, luminosity and radius the Sun will have when it reaches 9.1 billion years of age. The upper limit for the distance was used based on Maccone (2012) estimation that there is a 75% probability that the closest civilization is between 1,361 and 3,979 light years (2,670 is the mean).



Credit: Ribas (2009)

<u>Filter:</u>

Distance: between 2,670 and 3,979 ly

Temperature: 5,768 – 5,788

Luminosity (including error): 1.45 – 1.65

Radius (including error): 1.24 – 1.26

<u>Data:</u>

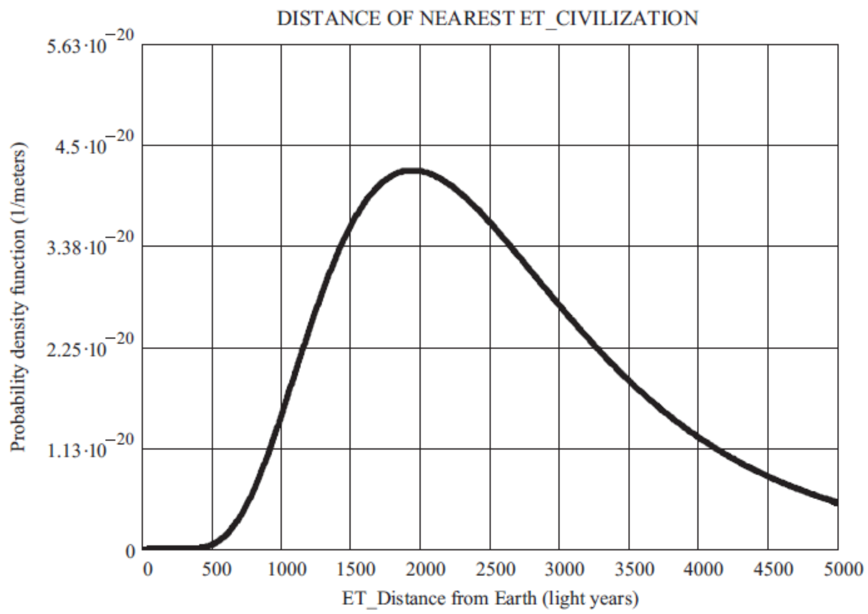
Distance: 2,673 ly

RA: 121.35020751646182

DEC: 68.48477851214948

The star only has a 3-ly difference with respect to Claudio Maccone's mean distance of 2,670 ly at which we can expect to find the closest civilization (Maccone, 2012).

2. **2MASS 08030350+7005349** is the star closest to the distance with the highest probability of existing a communicative civilization according to Maccone (2012), which is 1,933 light years.



Credit: Claudio Maccone (2010)

<u>Filter:</u>

Temperature: 5,768 – 5,788

Luminosity: 0.9 – 1.1

Radius: 0.99 – 1.01

<u>Data:</u>

Distance: 1,933 ly

RA: 120.76475304621607

DEC: 70.09297977706092

3. **2MASS 22423990-5411205** is the closest star (among 5) most similar to the Sun.

<u>Filter:</u>

Distance: between 500 and 2,670 ly

Temperature (including error): 5,768 – 5,788

Luminosity (including error): 0.9 – 1.1

Radius (including error): 0.99 – 1.01

Data:

Distance: 1,377 ly

RA: 340.6666032528256

DEC: -54.189234002856374

The star is within the distance range between 1,361 and 3,979 light years that, according to Maccone (2012), it has a 75% probability of having the closest communicative civilization.

4. **K08253.01** orbits the most potentially Earth-like planet candidate according to the NASA Exoplanet Archive (2020).

Distance: 1,982 ly

RA: 291.529510

DEC: 40.252918

The star only has a 49 ly-difference with respect to Maccone's peak of 1,933 ly.

References

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