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ACTIVE SETI IN SOL NEIGHBORHOOD

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Abstract. In the search for habitable planets, the ultimate aspiration is finding an extraterrestrial technical civilization. Already, more than a half of century is spent on for an active search for extraterrestrial civilizations. We shall propose a scientifically based METI(Messaging to Extra-Terrestrial Intelligence) program.

1. INTRODUCTION

The projects for sending messages realized so far (Zaitsev 2012) are non-compatible with the scientific search for extraterrestrial civilizations. The targets are not well selected and the messages are not easy to decipher, and there are no possible reply listening programs. The biggest problem is that these messages were sent for very short time period contrary to the expectation (Cocconi & Morrison 1959). The longest emitted message was sent during only 960 minutes in four sesions (Zaitsev 2012). It is hard to expect that anyone received our radio emission. Therefore, we shall present a proposal for the active SETI (Search for Extra-Terrestrial Intelligence) program. We have answered all questions from (Zaitsev 2011).

2. WHERE TO MAKE EMISSION?

More than 50 years have passed since the first article concerning the search for the extraterrestrial civilizations was published (Cocconi & Morrison 1959). We are in line with the first article. We propose sending messages to stellar systems around Solar with at least one star in the spectral range from K5V up to F6V (from 0.7 Solar masses up to 1.2 Solar masses) up to 50 ly, similar to (Soderblom 1986), and receiving signals from them. Star systems should be older than 1 Gyr with no spectroscopic or close orbitting binaries. We have a hundred and ten potential targets. This task is time-consuming; we need to wait at least one century for a reply from possible civilization on an outermost stellar system and to occupy at least two generations of radio astronomers, that is why we put our cut-off limit at this distance. More distant stars need more time for a possible reply. Receiving radio antennas can be placed around existing big radio telescopes where there is enough skilled manpower and good locations for radio antennas.

All stellar systems can be rated as to whether they are good, fair or poor candidates for the search for habitable planets. Such ratings will assist in ensuring our messaging are concentrated on the correct choice of targets. Beside yellow dwarfs we choose yellow-white dwarfs with a lifetime comparable to Earth's and we choose orange dwarfs with masses close to yellow dwarfs, with a smaller probability that a planet in Goldilocks zone is tidally locked. Red dwarfs, although the most promising for the habitable planets (Dressing & Charbonneau 2015, Kopparapu 2013) due to their abundance and longevity, should not be our targets because there is little chance that they can produce exoplanets with highly technological civilization. The problem of retaining water on the surface can prevent life formation on planets around M-dwarfs. During flares, water in the atmosphere can be ionized and solar wind can take oxygen from planet (Collinson et al. 2016, Atri 2017, Airapetian et al. 2017). The new exoplanets' atmosphere dynamics modelling (Carone et al. 2015), shows that even tidal locked exoplanets can be habitable. The problem with irradiation without permanent blue and ultraviolet components of spectra from a star is much bigger. The transition from prokaryotes toward photosynthesizing bacteria could be hampered or it is extremely unlikely. Photosynthetic organisms' productivity would be limited to less than ten percent on that on the Earth depending on star's flares activity (Kiang et al. 2007) combined with low water supply. While we can not rule out the existence of life on planets around the M-dwarf stars (Shields et al. 2016), we can almost certainly assume that there have not been any major changes in the atmosphere. Around M-dwarfs, Earth-mass planets with comparable water contents show up 10-100 times less frequently than around G dwarfs (Feng & Shigeru 2015). Therefore transformation of the planetary atmosphere which happened on Earth is unlikely on dry tidally locked planets around M-dwarfs.

3. WHAT IS SCHEDULE FOR TRANSMISSION?

With one emission system per hemisphere, we will have around half an hour a day per stellar target for emission of our message. Receiving a reply message from the targeted stars can be problematic. It is hard to find universal time synchronization of messaging in deep space. We have experience from previous SETI that it is necessary to recheck potential candidates (Horowitz & Sagan 1993). It would be good to have at least two receiving antennas per hemisphere to enhance our chances to receive a reply from targets. Receiving systems as the Allen Telescope array (Tarter et al. 2011) are now feasible. This part of the project will benefit if international financing remains stable. Other sky surveys besides of METI could be performed, as well as SETI for all stars up to one hundred light years distance.

4. THE PARAMETERS OF OUR EMITTED SIGNAL

Judging by our extraterrestrial search programs that applied modulation, the emitted signal should have a clear spectral signature, allowing decoding with minimal ambiguity, by the parallel spectral analyzers. We need to make emission with a narrow band frequency modulation between five centimeters and twenty-one centimeter wavelength and to keep it as simple as possible, with circular polarization. Changing the polarization of signals can reveal intelligent life but we should keep our emission as simple as possible at least till the first contact. Emission power should be comparable with present 70-100 m diameter dish antennas around 500 kW (Zaitsev 2011) or with recently proposed transmitter sistems (Scheffer 2005). The cost of required emitting and receiving radio astronomy systems should not be larger than several billions of dollars. Funding should come from international cooperation by donation of national governments. After detection of exoplanets, the time of stigma against radio astronomers searching for extraterrestrial civilizations or life is hopefully over now.

5. WHAT TO SEND?

What is the optimum structure for transmitted messages? Message emitted toward stars should be made from three parts. The first part of the message should be digitally modulated signal with a varying length of signal and pause. The second part is textual part of the message and third should be the visual one in form of pictograms. It is more or less in line with the proposal for interstellar radio messaging of Dr. Alexander Zaitsev with less artistic details (Zaitsev 2011). More complicated messages can be applied later in case that we establish contact. Once a day emission can reveal to extraterrestrial civilizations our planet's rotational period.

6. IS IT SAFE TO MESSAGE TO AN EXTRATERRESTRIAL CIVILIZATION?

What are the dangers of pursuing METI? Despite we do not have much activity in sending messages to the stars we have growing concern about it. Recently, opponents of METI strongly raised voice against messaging to the extraterrestrial civilizations. However, the concerns do not seem justified. If such civilization is able to bring all technical equipment needed to conquer our civilization, from an enormous distance, they probably already have superior detecting technique in all spectral ranges and, for example, they can detect our leaked radio signals without big problems. Moreover, the METI opponents' scenario leads to living in permanent fear with or without messaging, since potential extraterrestrial civilization is much more powerful than ours. We did not hide our radio emission presence in space in the last half century. The radio emission of powerful military radars in the USA and Russia formed the basis of their national ballistic missile warning systems, continuously working since the sixties of the last century. Although there is a big difference between narrow-angle targeted and broad angle dissipated radiation this should not make the big problem to civilization more advanced than ours. The big question is if someone receives our early warning radar signals will they really understand their meaning, but it is sure they will recognize their artificial origin. We also searched for asteroids, comets, and planets with emission from big radio antennas, but in this process, we did not aim at any star (Zaitsev 2011). With our active and targeted signaling, we show that we want to make a contact and initiate communication.

Comparing interstellar voyage with sending three caravels to India is not possible; the scale of economy is different. In the first case the econoomy scale is on the magnitude of one state, while in the second it might require to mobilize the resources and expertize of the entire planet. Interstellar travel is not simple and there will be no immense movements of aliens to our planet. Interstellar space is far from being empty (Crawford 2009) and we actually do not know how to avoid radiation hazards during a relativistic interstellar flight (Semyon 2009). It is just a speculation that potential extraterrestrial civilization has such knowledge. We can only theoretically send one-way probe spaceships with low v/c ratio (Hoanget al. 2016, Obousy et al. 2011, Long et al. 2011). While sending a message is usually strongly opposed, there is no opposition to randomly spraying nearby stellar systems with probes. We did not observe any manifestation of something like an exotic wormhole in our vicinity either. We can conclude that fear from extraterrestrials cannot be based on physical reality.

7. PROSPECTS FOR INTERSTELLAR RADIO MESSAGES

It is not our intention to spread overly optimistic veiw on this subject. We did not extrapolate our signals to the thousands of light years away, we just want to search in our neighborhood where there is some possibility to make meaningful bidirectional communication with unavoidable big delay. Otherwise, we can wait to build a bigger antenna and to receive dissipated radiation from possible technological civilization but this signals will be deteriorated. If we never send the message, the chance of success is close to zero. Our chances to find an advanced extraterrestrial civilization in our neighborhood are extremely slim but this should not stop our active search for them. Even if we succeed exchange of information will be difficult. Since it is hard to expect any exchange of the material with extraterrestrial civilisation, the fear of our sudden collapse after the contact of the civilisations is not justified.

Apart from the above proposition for new section title the section could benefit from a bit of discussion on conducting a SETI data analysis on present and future large data sets from big surveys.

8. CONCLUSIONS

The main difference between our plan for METI and others SETI and METI plans is that we selected only targets up to 50 ly for messaging and we want to be persistent in listening. Stable funding from international cooperation by donation of national governments is essential for the accomplishment of our plan. We do not know if it is possible but we are still in the quest with very small chances for success.

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