ACTIVE SETI :
target selection and message conception

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By opposition to passive SETI, which wants to detect extraterrestrial civilizations, the goal of active SETI is to establish a communication link with those civilizations. Already difficult, this task is complicated by the lack of knowledge about the nearest civilizations. Even worst, since resources available are even more limited than for passive SETI, targets selection is critical. We will show, that at radio-wavelength, early efforts may be concentrated in a small region of the sky. Technical and astrophysical considerations severely limit the communication bandwidth for radio waves. Careful design of the message is needed in order to facilitate its detection and decoding. We will describe the solutions we have implemented in the scope of the Encounter 2001 project.

Technical limitation

Active SETI has to deal with numerous technical limitations. Transmitters suitable for the task are rare and often limited in frequency and modulation flexibility. In any case, the broadcast duration will be very short. On the other hand, the characteristics of the receiver are completely unknown. Therefore, we have been conservative and assume it will be equivalent to the SKAI (0.5 km2, T=25 K). Limitation of the transmitter render impractical any tentative to create amultilayermessage (palimpseste) [Sagan 1985].

Target Selection

To increase our chances of detection, we must carefully choose the destinations. Such a task is quite difficult because we don't know much about the conditions favorable to the formation of Earth-like planets and apparition of life. Therefore, target selection should be considered as an educated guess at best.

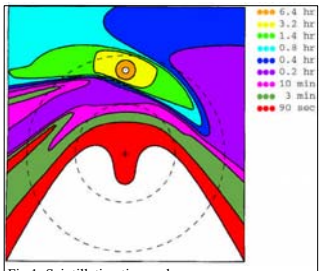

Fig 1: Scintillation timescale
Adapted from Cortes, Lazio & Sagan 1997

- The targets must be visible for long periods from Evpatoria Observatory ($\delta > 15$ deg)
- They should be near the galactic plane where the density of Solar-like stars is maximum ($l < 90$ deg and $|b| < 15$ [Sullivan & Mighell 1984]). This is also supported by the result of META search if their candidates are genuine signals [Horowitz & Sagan 1993].
- Over long range (≈ 1 kpc), scintillation should be minimized ($l \geq 50$ deg, see Fig 1) [Cordies, Lazio & Sagan 1997] .
- Stars listed in the SETI Institute's target catalog that fulfill the previous requirements were selected.
- Further selection based on spectral type, duplicity, metalicity and age reduced evenmorethelist(table1).

TABLE 1: list of targets

Names	l	|b|	a (J2000)	d (J2000)	Type	log Fe/H	D	V
HD190360	67	1	20h03m37.41s	+29d53m48.51s	G7V	+0.17	51.8	5.73
HD190406	57	8	20h04m06.23s	+17d04m12.64s	G1V	-0.05	57.6	5.08
HD186408	83	13	19h41m48.95s	+50d31m30.21s	G3V	+0.11	70.5	5.99
HD178428	50	4	19h07m57.32s	+16d51m12.24s	G6V	+0.10	68.3	6.08
HD190067	55	8	20h02m34.15s	+15d35m35.51s	G6V	-0.37	63.0	7.15

Message Conception

Conception of an interstellar message is not a trivial task. Since we known nothing about those who may receive the message, everything needs to be explained and defined very carefully. In a sense, this is the ultimate pedagogical experience. Obviously, logic will be the base of the message construction. We followed the rules established by the Dutch mathematician Hans Freudenthal [1960]. However, we had to relax some requirements due to our limited bandwidth.
Following the suggestion of Heidmann (1993), we tried to send an encyclopedia. Therefore, the message contains basic notions of mathematic, physic, chemistry, biology and astronomy. It tells also that we have now reached a level of civilization beyond the simple survival and we are eager to increase our knowledge. More important it formally asks for a reply.
The non-cultural nature of the message is primordial since it should speak for the humanity.

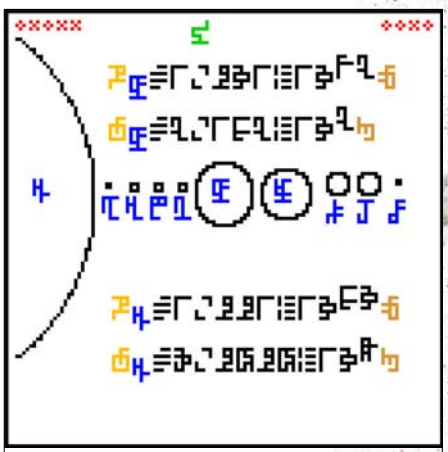
Fig 2: One of the 23 pages of our message. On this one, you can see a representation of the solar system.

Message Format

Many criteria have been used to select the message format. We had to maximize the amount of information content, the redundancy and the readability of the message and at the same timeminimize its size.
Each page is a square image with a frame around it, a page number, a section number and a title. This helps to reconstruct a fragmented message and establish a logical link between different concepts (see Fig 2).
Unlike the Arecibo message [Fig 3, Shklovsky & Sagan 1996] ourmessage has been designed from the beginning to be noise resistant. We developed a set of characters, each of them maximally different from the others. In addition, the message will be repeated thrice in order to add redundancy and protection against RFI (table 2).

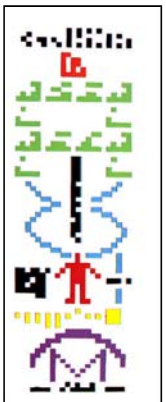
Fig 3: Drake's message sent on November 16th 1974 using the Arecibo antenna [Sagan 1980].

TABLE 2: differences between transmissions

	Evpatoria	Arecibo
Size	70 m	300 m
EIRP	2×10^{12} W	10^{14} W
Wavelength	6 cm	12.6 cm
Duration	3 hr	3 min
Range	60 lyr	25,000 lyr
Bits	3 x 370,967	1,679
Rate	100 Hz	10 Hz

Ethical problems

- Who has the right to speak for the Earth ?
- Do freedom of speech apply ?
- What are the dangers for us? for them ?
- Is that in conflictwiththeSETIDetection Protocol ?

It is not a person to person call !

Acknowledgments

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