SPECTRAL-LINE SKY SURVEYS FROM THE NASA-JPL SETI PROJECT

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The Jet Propulsion Laboratory (California Institute of Technology) has recently begun preparations for a modest SETI (Search for Extra-Terrestrial Intelligence) project at radio wavelengths. The proposed project is two-fold: (1) to search the entire sky visible from Goldstone, California (site of one of the NASA Deep Space Network Stations), i.e. that north of $\delta \sim -30^{\circ}$, at all frequencies between 1 and 24 GHz using a horn receiver and (2) to carry out a more sensitive sky search at a few selected frequency bands, using dedicated 26 and 10m antennas. The search will be for signals of the type unlikely to be produced by natural causes, e.g. narrow spikes in frequency space. The basic rationale behind this search is discussed by Murray, Gulkis and Edelson (1978).

The interest of this project to Galactic astronomy is, of course, that a possible offshoot of the search at selected frequency bands is the acquisition of sensitive surveys of the Galactic emission at several useful frequencies (Cuzzi and Gulkis 1977). The proposed instrumentation is: the 26 m dish for wavelengths $\lambda \gtrsim 3$ cm and the 10m dish for shorter wavelengths: (2) a dual-polarization maser receiver, with a series of parametric down-converters, operable between 26 and 1 GHz; the target system temperature is 12K on the telescope: (3) a 10^6 channel fourier-transform spectrometer of bandwidth 320 MHz.

The frequency bands of primary interest to SETI are (1) the 'water hole', containing the four OH ground-state 18 cm-lines and the HI 21-cm line, and (2) the regions near the 22.3 GHz H_2O line and (possibly) the 24-GHz NH_3 line. The possible observing strategy to optimize the radio astronomical output would be to devote one year to the H_2CO and H_2O lines and two to the water-hole band.

In Table 1 we list the following system parameters at each frequency: telescope beamwidth, and system sensitivity to flux and to brightness temperature. This list has been calculated assuming a 'reasonable' (astronomical) value of the width of the observed line,

W. B. Burton (ed.), The Large-Scale Characteristics of the Galaxy, 85–86.

which is also given in the table, that each point is observed for the same amount of time and that half of the one- or two-year period is spent observing. The limit has been taken as five times the rms noise. It can easily be seen by consulting Table 1 that very useful astronomical surveys can be extracted from this project.

The purpose of this presentation is to solicit advice from the astronomical community regarding priorities and, particularly from colleagues experienced in spectral line sky surveys, techniques. The surveys will be conducted with SETI as the primary goal, but the desire to obtain useful astronomical data will play a major role in the planning. Because the SETI rationale tends to emphasize the search for very narrow spectral features, the motivation and techniques for obtaining flat baselines and well-calibrated spectra will need to come from the radio astronomical community. Colleagues who feel that they are able to contribute towards the planning in this area are particularly urged to communicate with us.

Table 1 Survey Sensitivity

Wave-length	Line	Beamwidth arcmin	Flux Limit (Jy)	Ass.line width(km s^{-1})	Brightness temp.limit (K)	Ass.line width
21 cm	HI 1420.4	35	0.2	10	0.20	0.2
18 cm	OH 1665.7	30	0.7	1	0.10	0.5
6 cm	H_2CO	11	2	1	0.20	0.5
2 cm	H_2CO	10	9	1	0.20	0.5
1 cm	H_2O 22.3GHz	4	10	1	0.25	0.5
1 cm	NH_3 24GHz	4	10	1	0.25	0.5

REFERENCES

J.N. Cuzzi, S. Gulkis, "Summary of Possible Uses of an Interstellar Search System for Radio Astronomy", in The Search for Extraterrestrial Intelligence. NASA SP-419, U.S. Govt. Printing Office, Washington, D.C. (1977), pp. 147.

B. Murray, S. Gulkis, R.E. Edelson, 1978, "Extraterrestrial Intelligence: An Observational Approach", Science, 199, pp. 485 (1978).