INTMINS-November/96 Data Analysis Report

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The fourth session in the ongoing series of INTMINS operations was conducted in November 1996. Instruments were operated on board the MIR Space Station in accordance with the schedule published and distributed as a supplement to *The INSPIRE Journal*. INSPIRE observers attempted to record the VLF radio signal emitted by ISTOCHNIK, the modulated electron gun carried on MIR.

The modulation frequencies of ISTOCHNIK are 10 hertz and 1000 hertz (1 kHz). Since the 10 hertz signal is outside the design band of the RS4 receiver and usually obscured by manmade hum, the 1000 hertz signal is the one we are attempting to detect. ISTOCHNIK is operated for 10 seconds at 10 hertz then 10 seconds at 1000 hertz, alternating between these two frequencies each 10 seconds for two minutes.

Once again, analysis of data tapes has failed to reveal the presence of an electromagnetic signal from ISTOCHNIK. That leads to the question: Where do we (INSPIRE) stand in our investigation? One way to answer this question is to consider the possible descriptions of the radio signal produced by the electron gun. Any of the following is possible:

1. The signal is easily detected on the surface of the earth each time ISTOCHNIK is operated.

2. The signal is routinely detectable with more sensitive receivers than those available now.

3. The signal is detectable only under ideal natural radio conditions (whatever they may be!).

4. The signal is detectable only with a combination of ideal natural conditions and a more sensitive receiver.

5. The signal is detectable under the above conditions plus an increase in the power of the electron gun.

6. The signal is not detectable under any conditions.

We can pretty much rule out the first description since we have made several good efforts with no results. Scenario #2 is being addressed somewhat with the new INSPIRE VLF2 receiver. While the RS4 design is very good, some attempts were made to improve the signal-to-noise ratio and overall sensitivity. Scenarios #3 and #4 remain to be seen as we continue our efforts. Description #5 is an interesting possibility. While it is not possible to change the power of ISTOCHNIK now, it is possible that a more powerful electron gun may be part of the payload of MIR in the future or may be included on the International Space Station. If an electron gun of increased power is ever considered, an argument in its favor will be the existence of an experienced group of ground-based observers (INSPIRE!). Finally, scenario #6 may be correct. It would be disappointing if this were the case, but it is a possibility. We have by no means proven that the signal is undetectable under any conditions. We just haven't found it - yet.

Determination of the INTMINS Schedule

The process of setting the observation schedule is always exciting and a little nerve-wracking. In the fall of 1996, the process went something like this:

1. In mid-October, Bill Taylor created some maps of the orbital tracks of MIR during the last two weekends of November. To do this, the two-line orbital element set is used with an orbit tracking program. The problem with this technique is that is assumes that the orbital parameters are known precisely and that the orbit will not change. Of course, neither of these assumptions is true. The orbital elements are determined from ground based observations which involves uncertainties. The orbit of MIR changes constantly due to natural orbital decay and large changes in orbit may result from maneuvering of MIR.

2. A schedule was set of operations during the last two weekends of November. This schedule was designed to accommodate as much as possible the participation of high school observers. Operations occur between 1800 local time on Friday and 1800 local time on Sunday with early morning operations (before 5 AM local time) minimized. The schedule was also designed to provide passes near INTMINS observers who have submitted data in the past.

3. This schedule was sent to the printer on October 20 in time to be printed and included as an insert with the *Journal* which was mailed on November 1.

4. The schedule was sent to Olga Lapshinova, of the Energis Corporation, in Moscow to be programmed up to MIR.

5. Every couple of days the orbital elements were checked and new maps generated. Any changes in ground track were noted. If significant changes had occurred, adjustments in the schedule were considered. Any adjustment in the schedule would be for the purpose of keeping the ground track as close as possible to the track shown on the published schedule even if that meant modifying the times of operation. On October 23, significant changes in the ground track were noted and a modified schedule was sent to Moscow. It was too late to change the published schedule.

6. As November 1 came and went, the ground tracks stayed pretty stable. By November 12, the change was significant enough to warrant another adjustment to the schedule.

7. On November 26, between the two weekends of INTMINS Operations, a final change was made for the operations on the second weekend.

The net result of all of this changing was a final schedule that differed from the original by only a minute or two for each operation (and some had their times unchanged). As long as the actual operation time of ISTOCHNIK occurs during the 25-minute interval that is recorded and the ground track stays fairly constant the operation time will appear somewhere on the tape. The two-minute interval of actual operation is the segment that will be analyzed. The following table shows the original ISTOCHNIK start time and all of the subsequent modifications.

Operation Number	Original Schedule	Modified 10/23	Modified 11/12	Modified 11/26
23-1	0558	0601	0559	
23-2	1226	1229	1227	
23-3	1534	1537	1535	
E24-1	0207	0210	0208	
E24-2	0338	0340	0338	
24-3	1124	1127	1125	
24-4	1259	1302	1300	
24-5	1429	1432	1430	
24-6	1607	1610	1608	
30-1	0347	0351	0349	0348
30-2	0521	0525	0523	0522
30-3	0651	0656	0654	0653
30-4	1319	1323	1321	1320
E30-5	2214	2217	2215	2214
E30-6	2356	2359	2357	2356
E1-1	0130	0133	0131	0130
E1-2	0304	0307	0305	0304
1-3	0417	0421	0419	0418
1-4	0553	0555	0553	0552
1-5	0728	0732	0730	0729
1-6	1222	1226	1224	1223

Data Analysis Procedure

Analysis of data tapes consisted of making a 2-minute sound file coinciding with the actual operation time of ISTOCHNIK. This involved listening to the tape and following the log and time marks until the appropriate time, then recording the sound file on computer. The file was then used to create a frequency-time graph, or spectrogram. Using a screen-grab utility, images of the spectrograms were then transferred to Word files for storage, analysis and printing. A common sequence of spectrogram images was:

1. A picture of the entire 2-minute time. The initial frequency range is 0 - 11.025 kHz. This range uses half the CD sampling rate and includes the lowest OMEGA frequency (10.4 kHz). At this scale, the ISTOCHNIK signal should appear as an intermittent dash (10 seconds ON, 10 seconds OFF) at 1000 Hz.

2. A one-minute portion of the file was then cropped and enlarged. This minute was designed to include a time mark either at the beginning of the interval or at the end. This makes it easier for the observer to find the recorded segment on the data tape. The ISTOCHNIK signal will also be easier to see at this time scale.

3. Spectrograms of the above two time intervals were then made using a frequency range of 0-4 kHz. This reduced frequency range was chosen to make the 1 kHz frequency and the next couple of harmonics more easily visible.

INTMINS-November/96 Operations Summary

(NOTE: All times are UT on the date indicated.)

European Passes

Pass	ISTOCHNIK Start Time	Path during ISTOCHNIK Firing	Number of Observers Recording Data
E24-1	0208	South of England	2
E24-2	0338	Russia, south of Moscow	2
E30-5	2214	Northern Italy	4
E30-6	2356	Russia, south of Moscow	4
E1-1	0130	Northern Italy	3
E1-2	0304	Russia, south of Moscow	2

North American Passes

Pass	ISTOCHNIK Start Time	Path during ISTOCHNIK Firing	Number of Observers Recording Data
23-1	0559	Coast of SC, NC, south of DC	2
23-2	1227	Central NY, CT	1
23-3	1535	NM, west TX	3
24-3	1125	Eastern Ontario, QC CANADA	1
24-4	1300	Southern MN, IL, IN	1
24-5	1430	West of WA, northeast OR	3
24-6	1608	Off coast of southern CA	4
30-1	0348	Northern VA, PA, NY, VT, NH	5
30-2	0522	Northwest IA, southern MN, WI	2
30-3	0653	Northern CA, southeast OR	3
30-4	1320	CA (Bay Area), southeast CA	4
1-3	0418	West TX, central OK	3
1-4	0552	Coast of central CA, northeast NV	4
1-5	0729	West of WA, ID, northeast MT	2
1-6	1223	Southern NM, south TX	1

Summary of Passes Recorded

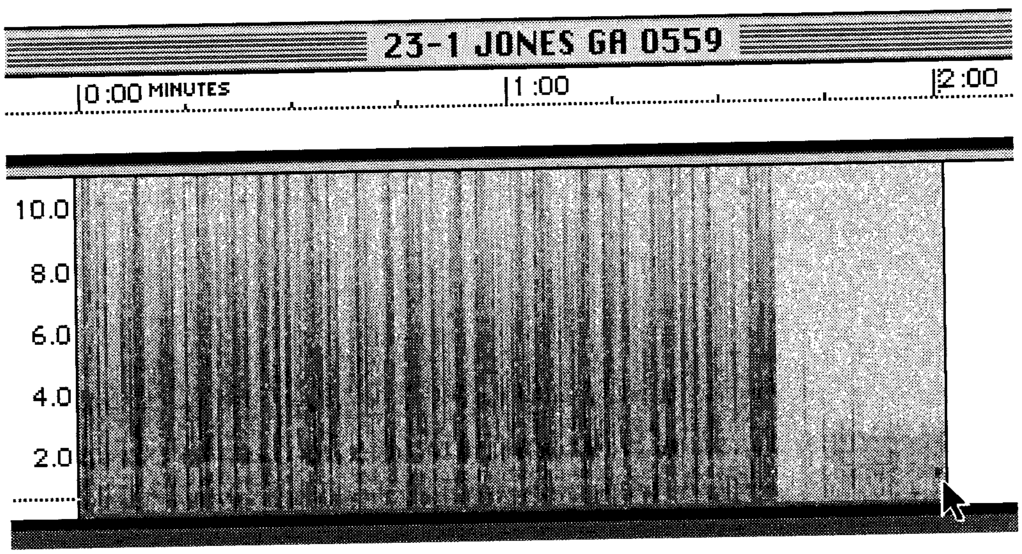
Team/Pass	E24-1	E24-2	E30-5	E30-6	E1-1	E1-2
E2			x	x	x	
E5	x	x	x	x	x	x
E6	x	x	x	x		
E9			x	x	x	x

Pass	11/23			11/24				11/30				12/1			
Team	1	2	3	3	4	5	6	1	2	3	4	3	4	5	6
1			x									x			
2								x							
3												x			
5		x		x				x	x						
6							x			x	x		x		
7						x	x			x	x		x		
8														x	
9					x	x									
15	x		x				x	x		x			x	x	
17						x	x				x		x		
18	x							x							
19											x		x		
20								x							
21			x						x			x			x

INTMINS Data

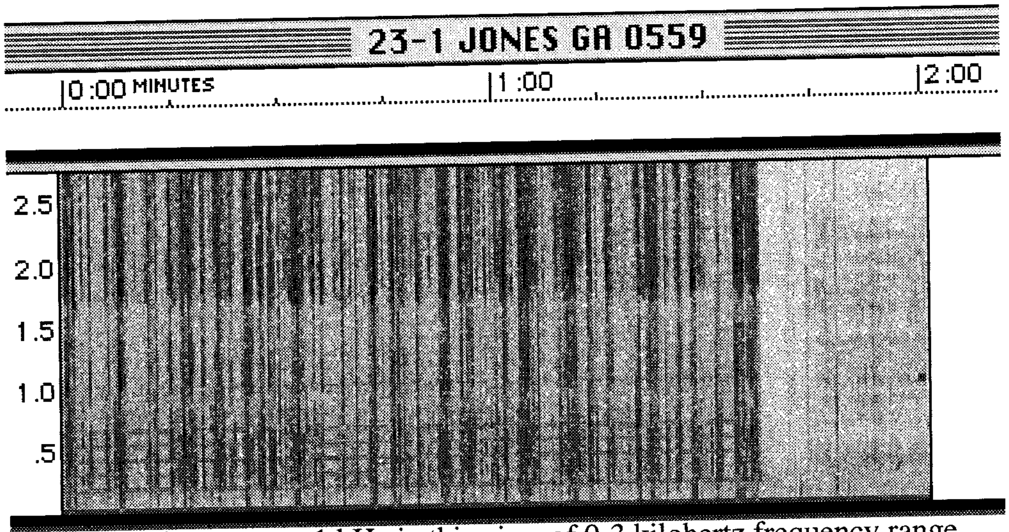
The following spectrograms are taken from the data tapes submitted by INSPIRE observers. The first view shown will be that of the entire two-minute interval analyzed. This first view will contain the file name identifying the observer and the start time of the recording. Subsequent views will be of parts of the interval or with a reduced frequency range. If the start time of the spectrograph differs from that of the data file, it will be indicated. Refer to the time scale at the top of the spectrogram and the frequency scale to the left to determine the parameters for that view.

23-1

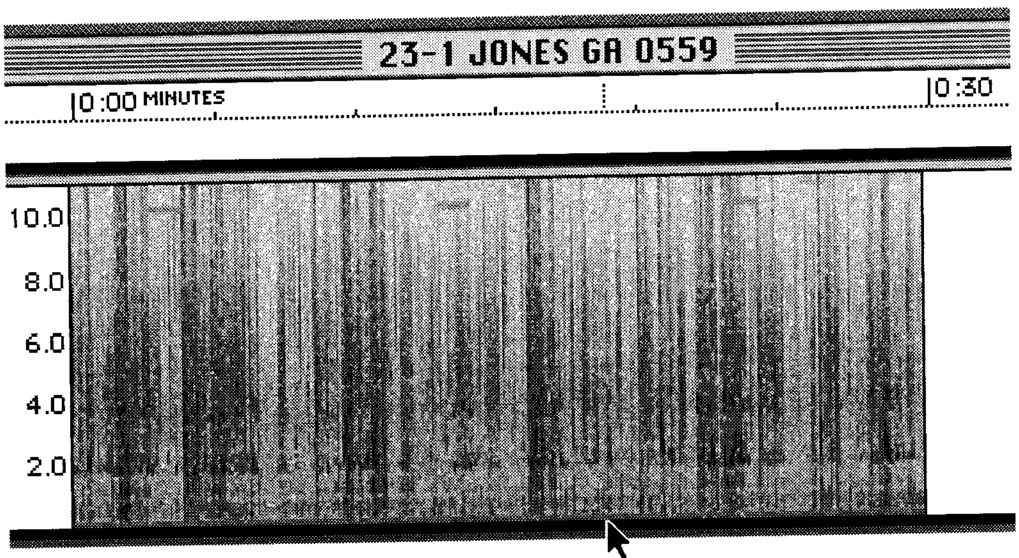


David Jones, Columbus, GA — Team 18

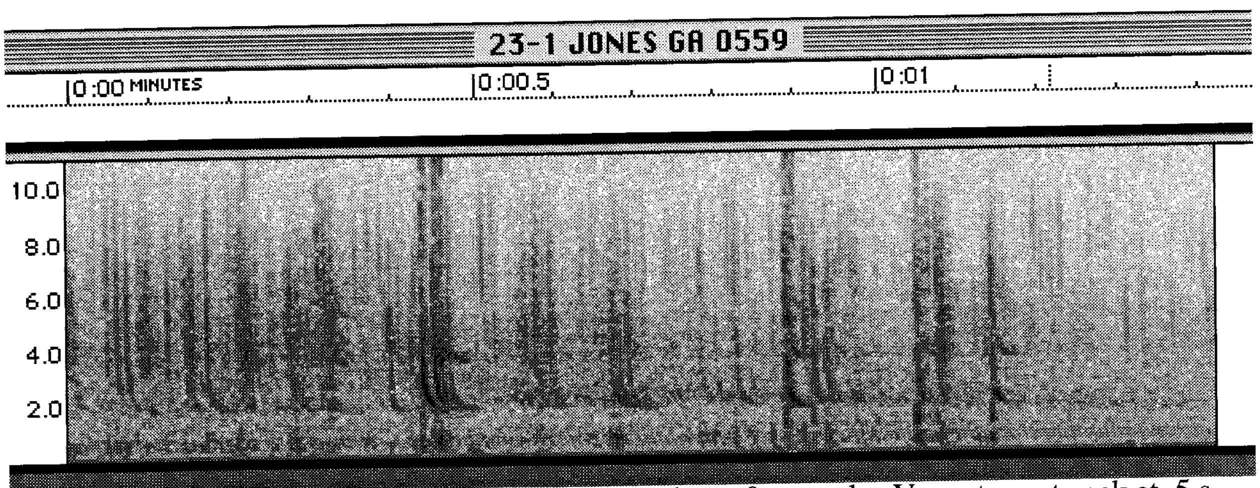
The arrow indicates the WWV time tone at 0601 UT. Dense sferics are present, OMEGA is visible and many tweeks were recorded.



No signal appears at 1 kHz in this view of 0-3 kilohertz frequency range.

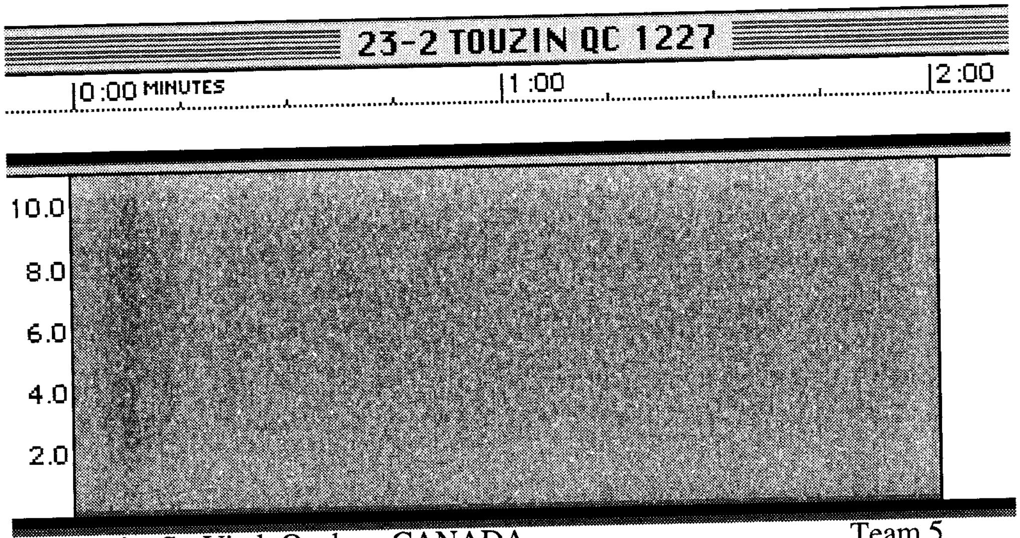


A 30 second interval starting at 0600. Arrow points to a whistler at 0600:18 UT

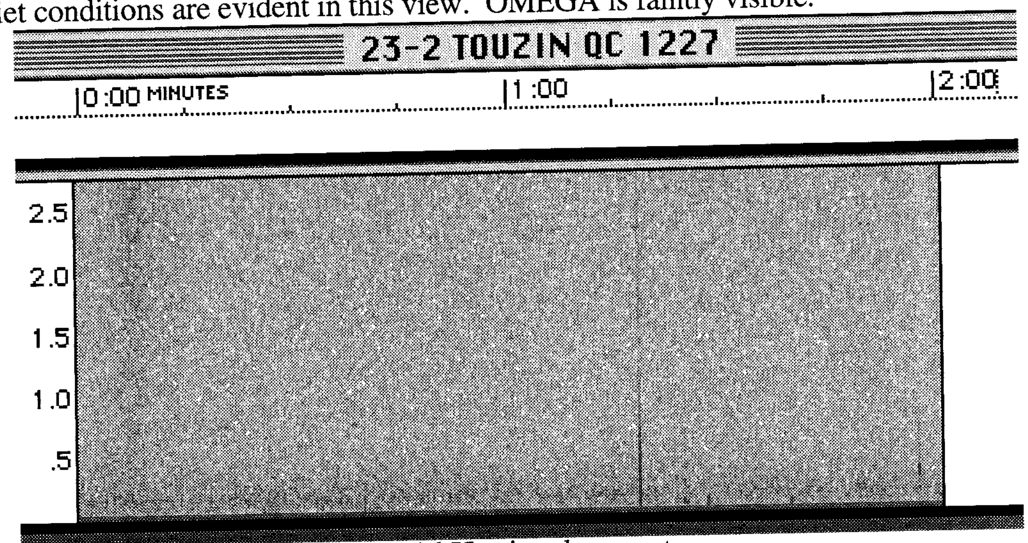


Closeup of above. Whistler is faintly audible at about .9 seconds. Very strong tweek at .5 s.

23-2

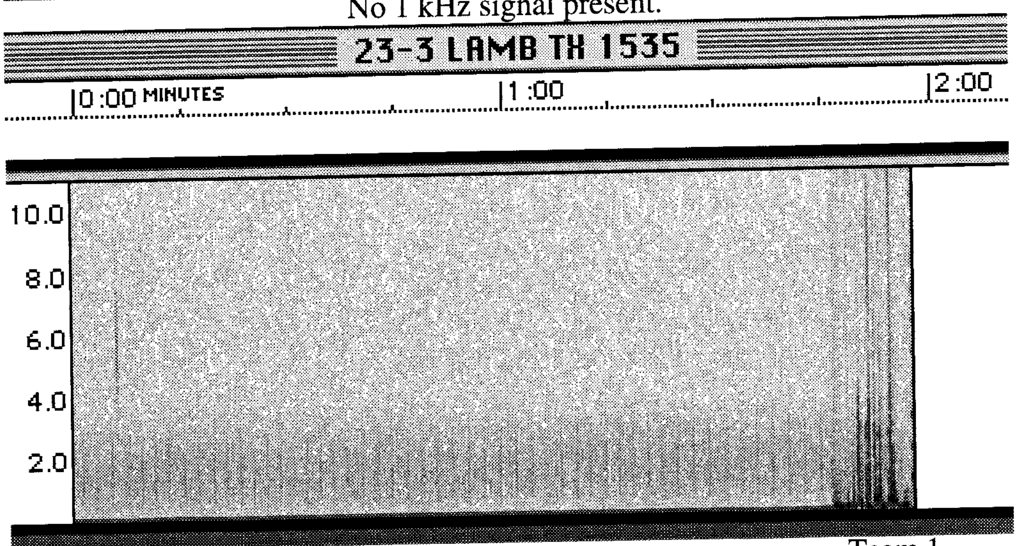


Jean-Claude Touzin, St. Vital, Quebec, CANADA Team 5
Very quiet conditions are evident in this view. OMEGA is faintly visible.

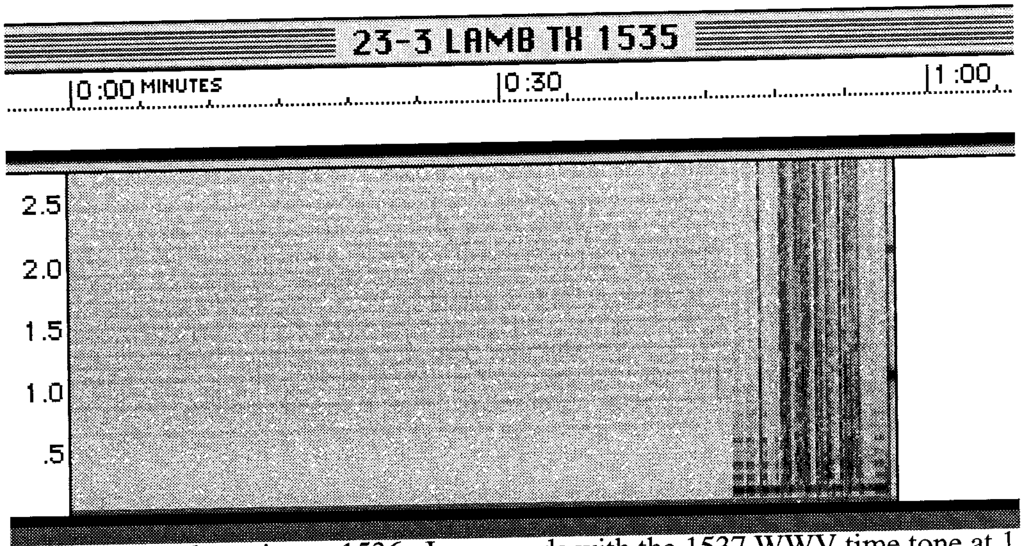


No 1 kHz signal present.

23-3

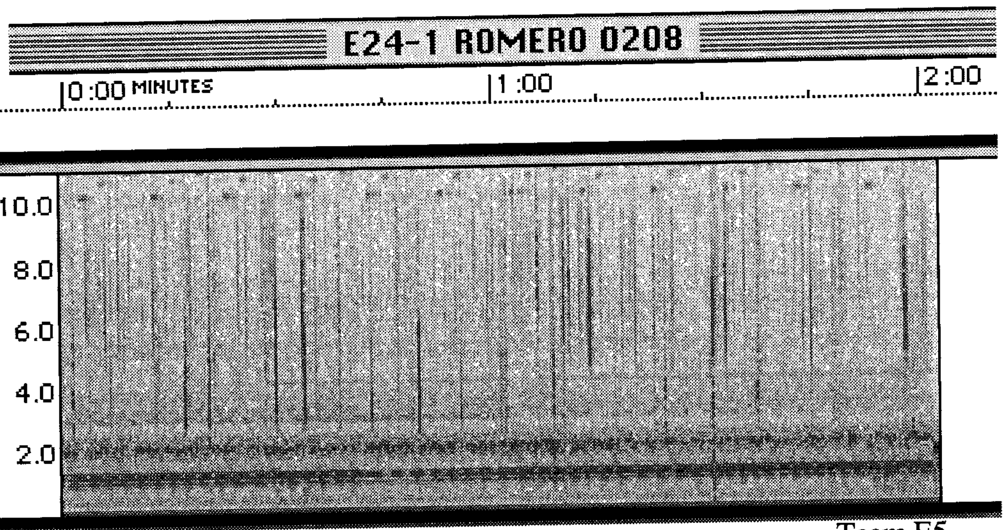


Dr. Jack Lamb, Belton, TX Team 1
Also shows very quiet conditions.



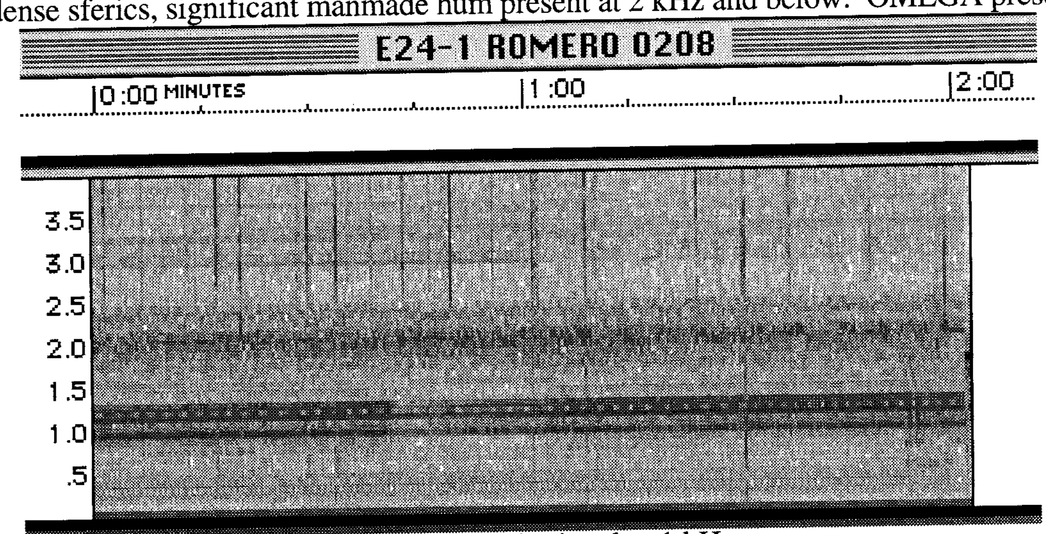
One minute interval starting at 1536. Image ends with the 1537 WWV time tone at 1 kHz.

E24-1

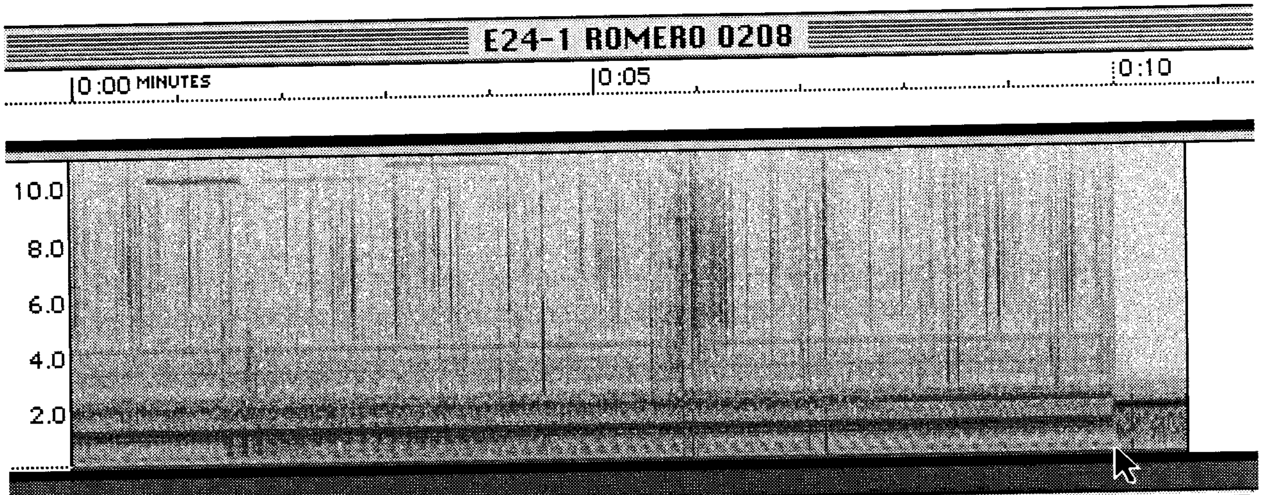


Renato Romero, Cumiana, ITALY — Team E5

Fairly dense sferics, significant manmade hum present at 2 kHz and below. OMEGA present.



Strong manmade signal at 1 kHz.

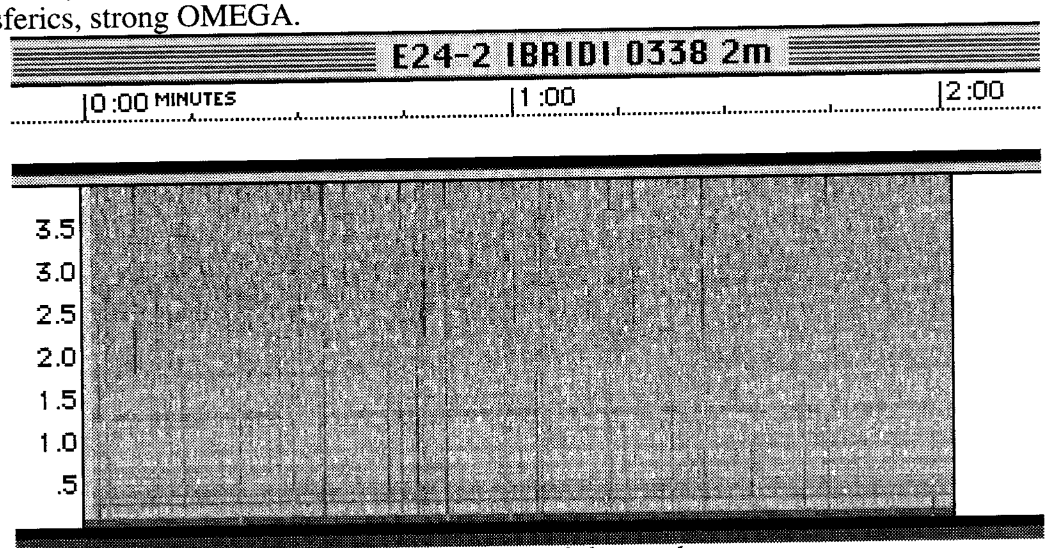


Ten second interval starting at 0209:50. Arrow shows the start of the time signal code at 0210 UT.

E24-2

Marco Ibridi, Finale, E., ITALY
Dense sferics, strong OMEGA.

Team E6



No 1 kHz signal detected.