LAMONT GEOLOGICAL OBSERVATORY OF COLUMBIA UNIVERSITY
PALISADES, NEW YORK

SYNOPTIC MEASUREMENTS OF GEOMAGNETIC FIELD SPECTRA

by
J. R. Heirtzler and M. J. Davidson

Technical Report No. 1
CU-1-67 Nonr 4259 (05)

August 1967

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Introduction. As part of a program of a systematic study of the variation of rapid geomagnetic activity over small distances rapid fluctuations of the total field intensity were recorded with pairs of magnetometers. Recordings were made at three pairs of stations for one day at each of the three station pairs.

Davidson (1964) has shown that this type data, when analyzed in hourly batches, yields stable spectra. Hourly spectra of the instrument records were made for each hour and each instrument. Individual spectra and cross - spectral determinations were made. Additionally the time variation of individual frequency components were extensively analyzed. A full account of this observational program and the general interpretation of the results has been given by Davidson (1966) and Davidson and Heirtzler (in press). All of the spectral analyses could not be presented in those papers because of lack of space. However, these spectral results are of interest for many reasons and are presented fully here with a minimal descriptive text.

Data. The total magnetic field strength was measured by a rubidium magnetometer and recorded digitally once each second, on the second, to an accuracy of ±0.2 gammas and to a relative time accuracy of ±0.1 seconds. The absolute simultaneity of recording at the two stations is within 0.6 seconds. The time the various stations were occupied is given in Table 1 and the locations of the stations is illustrated in the map on page 4. One station of each station pair is located in

a field station in Lebanon State Forest in southern New Jersey The instrument at that location was connected by a leased telephone line to a digital recorder in Palisades, New York. The block diagram of this recording system is shown on page 5. The second system, which was mobile, is represented in the block diagram of page 6.

Analysis and Figures.

Consider two time functions and their Fourier representation

$$f_k(t) = \int_{-\infty}^{\infty} A_k(\omega)\, e^{i\theta_k(\omega)}\, e^{-i\omega t}\, d\omega$$

where K = 1,2 and $A_k(w)$ represents the amplitude spectrum and $\theta_k(w)$ the phase spectrum. The Fourier transform of the cross-correlation function of $f_1(t)$ and $f_2(t)$ is the cross-power density spectrum.

$$\Phi_{12}(\omega) = A_1(\omega)^{*} A_2(\omega)\, e^{i[\theta_2(\omega) - \theta_1(\omega)]}$$

The power density spectrums $\Phi_{11}(\omega)$ and $\Phi_{22}(\omega)$ are similarly defined. The real part of $\Phi_{12}(\omega)$ is Co(w) and the imaginary part is Quad(w). The coherence is defined as

$$|\gamma(\omega)| = \left[\frac{[Co(\omega)]^2 + [Quad(\omega)]^2}{\Phi_{11}(\omega)\ \Phi_{22}(\omega)}\right]^{1/2}$$

and the phase angle is $\theta_2(w) - \theta_1(w)$. The confidence limit associated with the relative phase angle can be determined from an expression

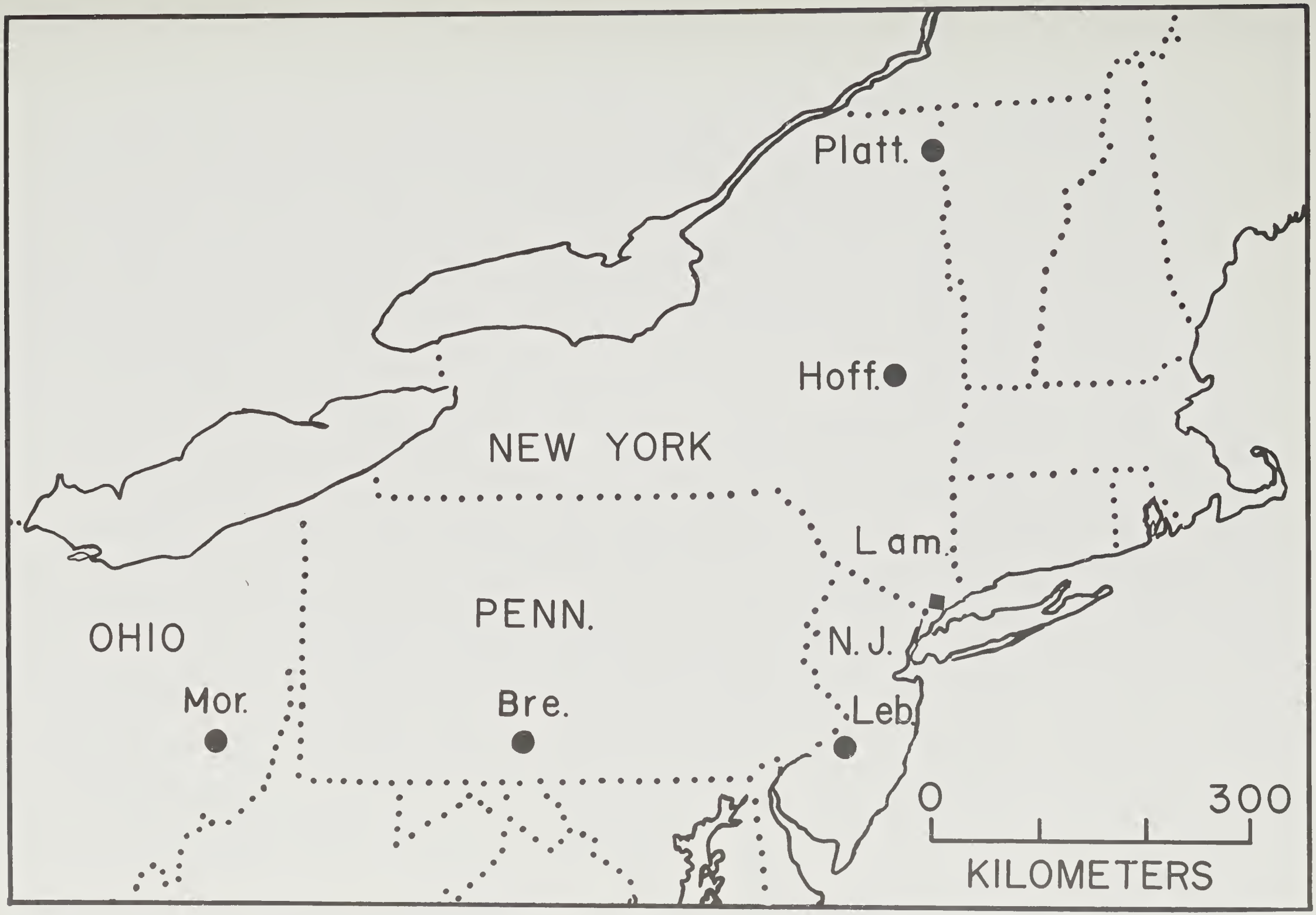
given by Goodman (1957). Vertical bars on the phase values in the figures of this report show the range for 95 confidence. The method for the spectral analysis follows the procedure of Blackman and Tukey (1958).

The figure on page 7 shows the total intensity variation on the day the Lebanon-Plattsburgh station pair was occupied. Pages 8 through 11 show individual hourly spectra, coherence and phase for this time. Pages 17 through 25 illustrate the diurnal behavior of coherence, phase and power density (at Lebanon) for a number of individual frequencies. On pages 26 through 47 the same types of presentation are made for the Lebanon-Hoffmans pair, pages 48 through 67 for the Lebanon-Morristown pair and pages 68 through 88 for Lebanon-Breezewood. The two basic types of presentation are power density, phase and coherence as a function of frequency for each hour, then as a function of time for each frequency. The same data is thus presented in two different formats to illustrate its different behavior.

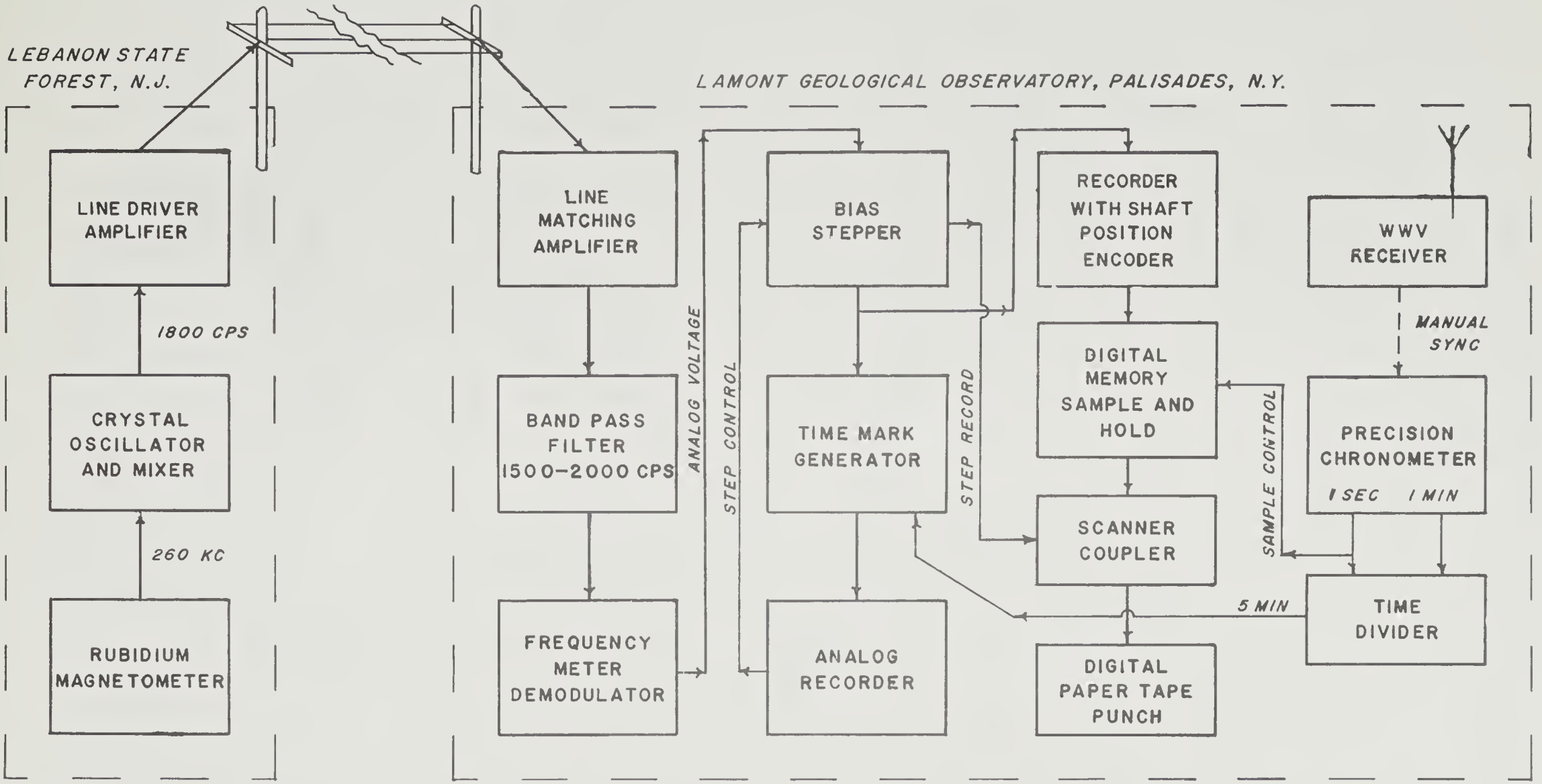
Acknowledgements

This work was supported by Office of Naval Research contract Nonr 4259(05).

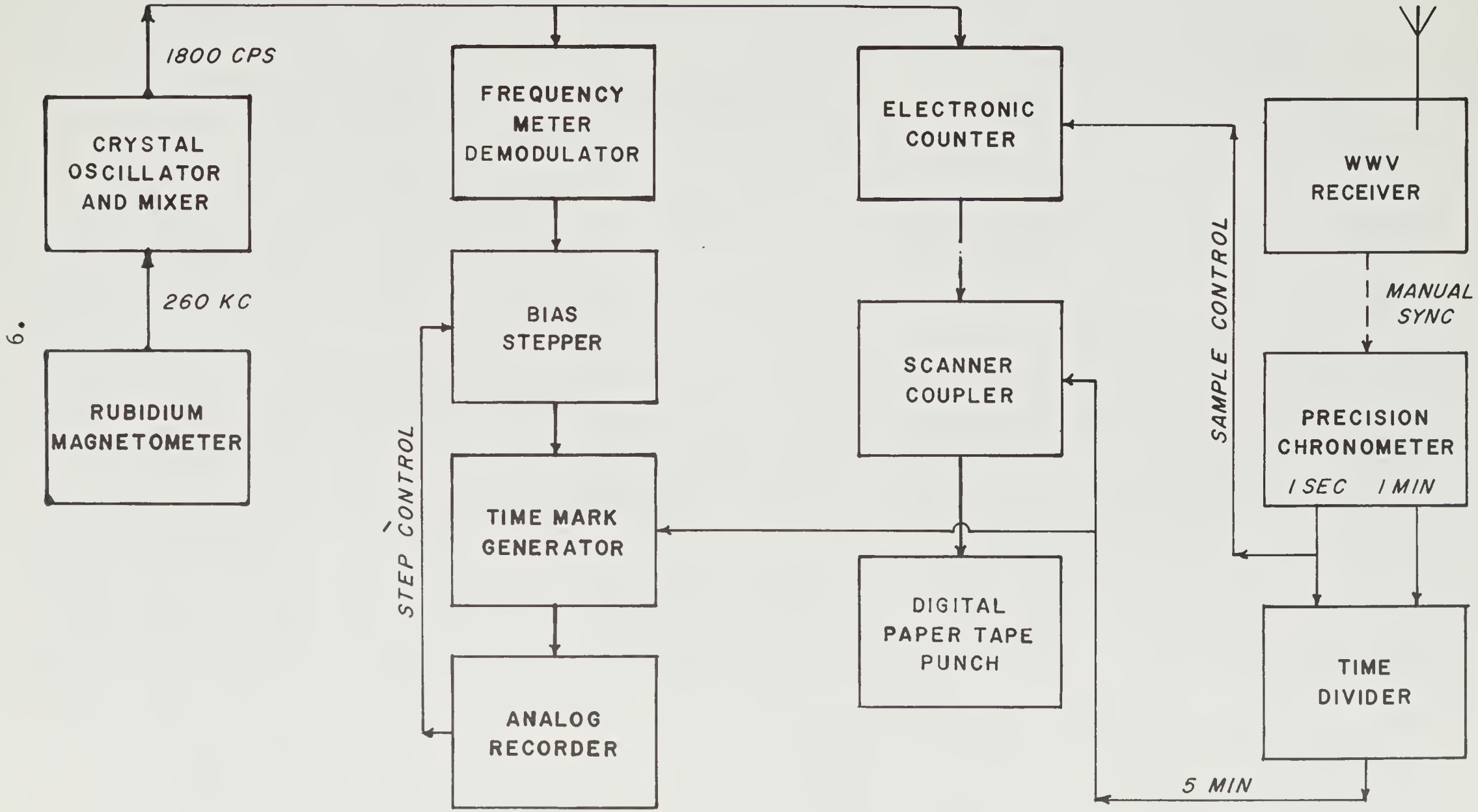
Fig. 4.


Platt.
Hoff.
NEW YORK
Lam.
PENN.
OHIO
N.J.
Mor.
Bre.
Leb.
0
300
KILOMETERS

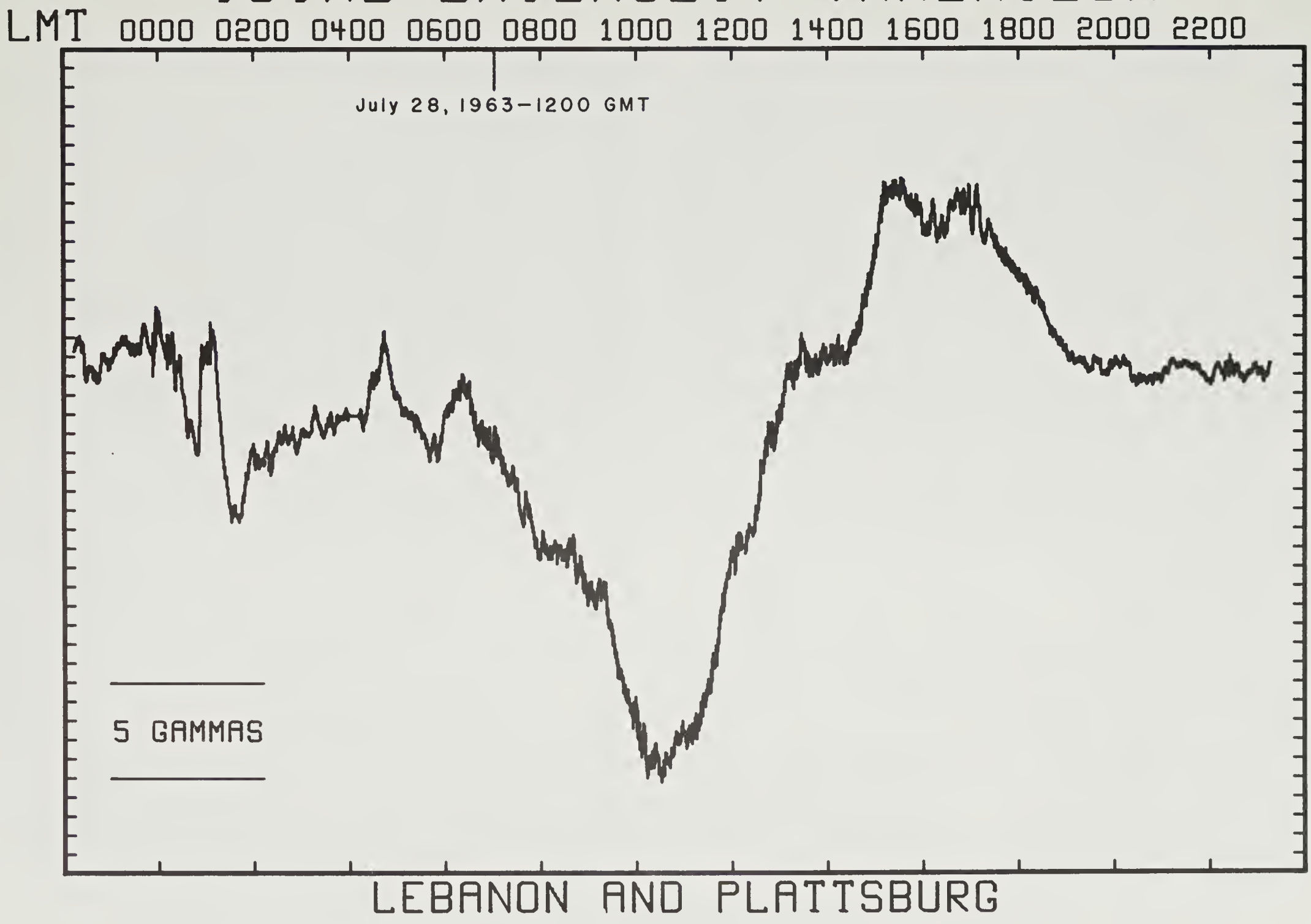
LEBANON BASE STATION INSTRUMENTATION

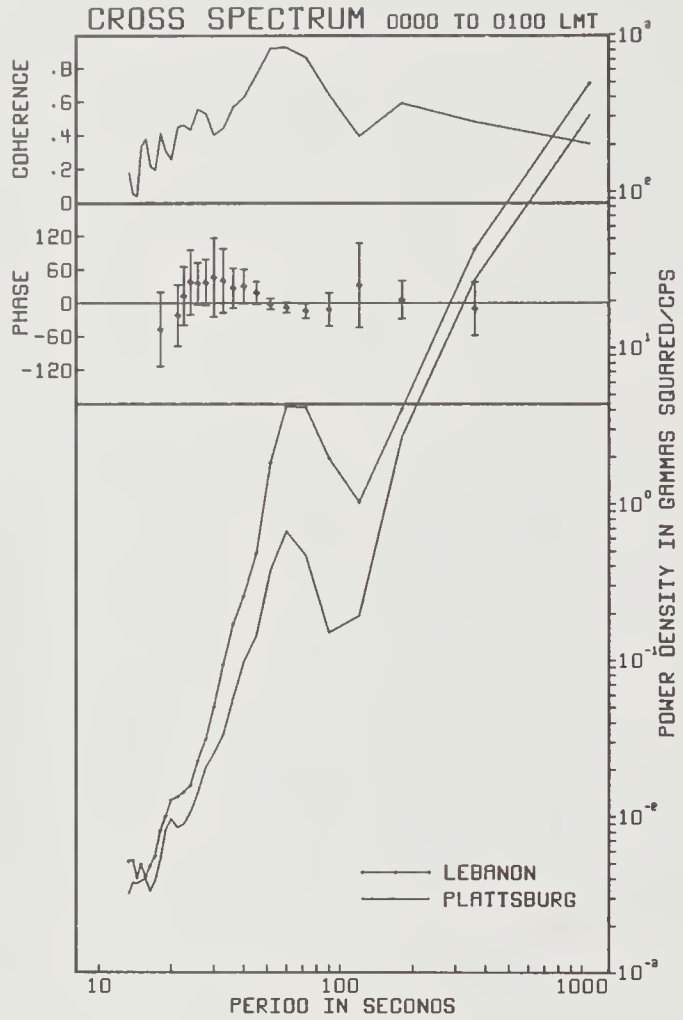


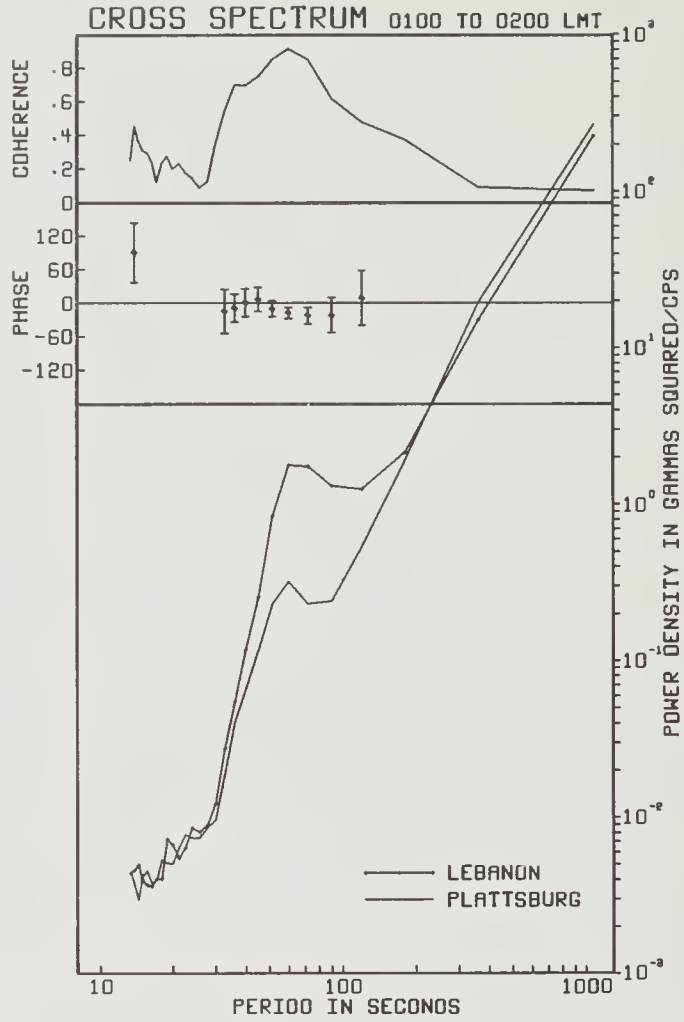
MOBILE FIELD STATION INSTRUMENTATION

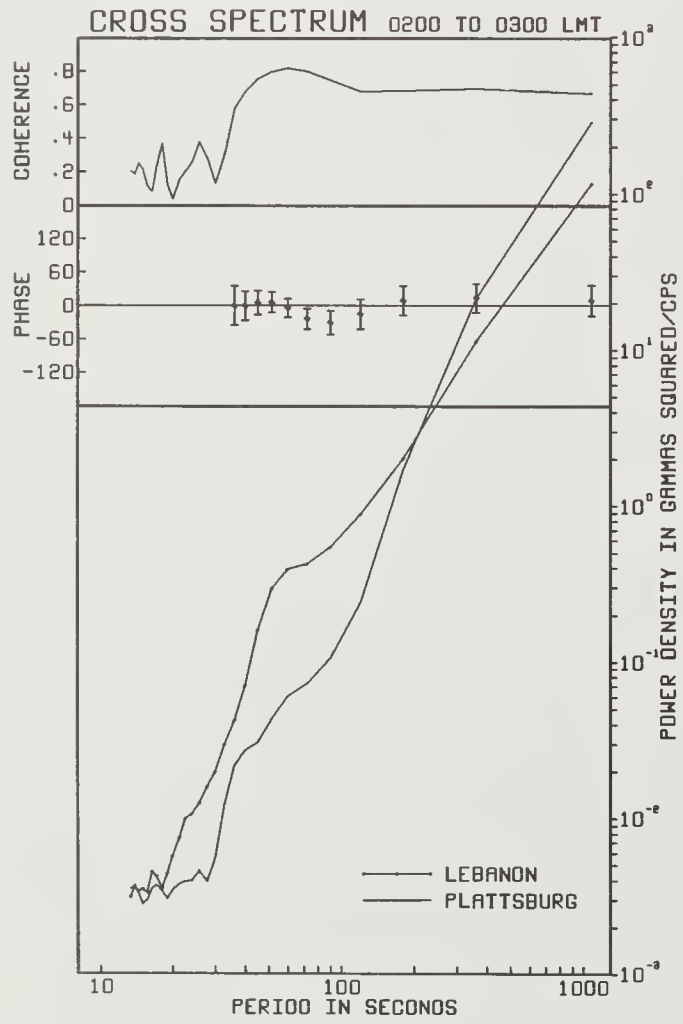


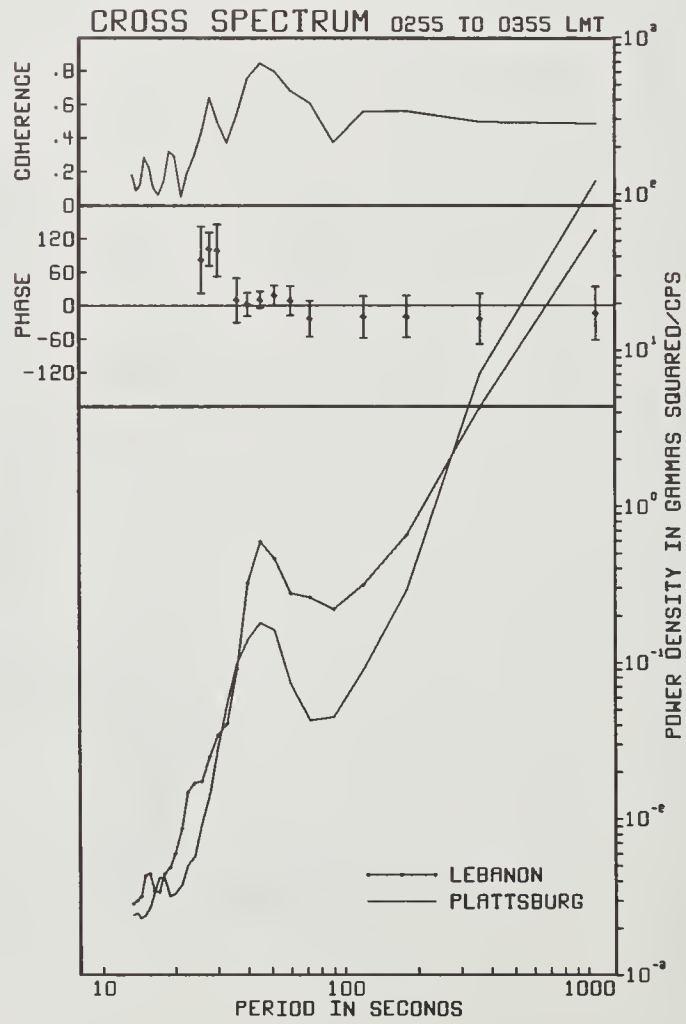
TOTAL INTENSITY VARIATION

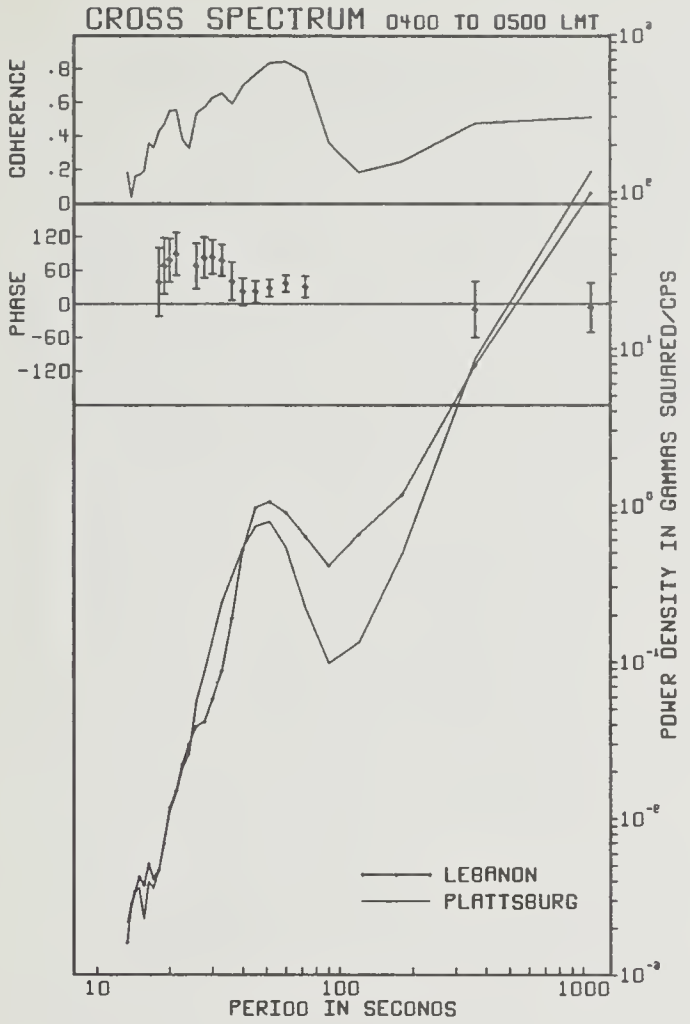


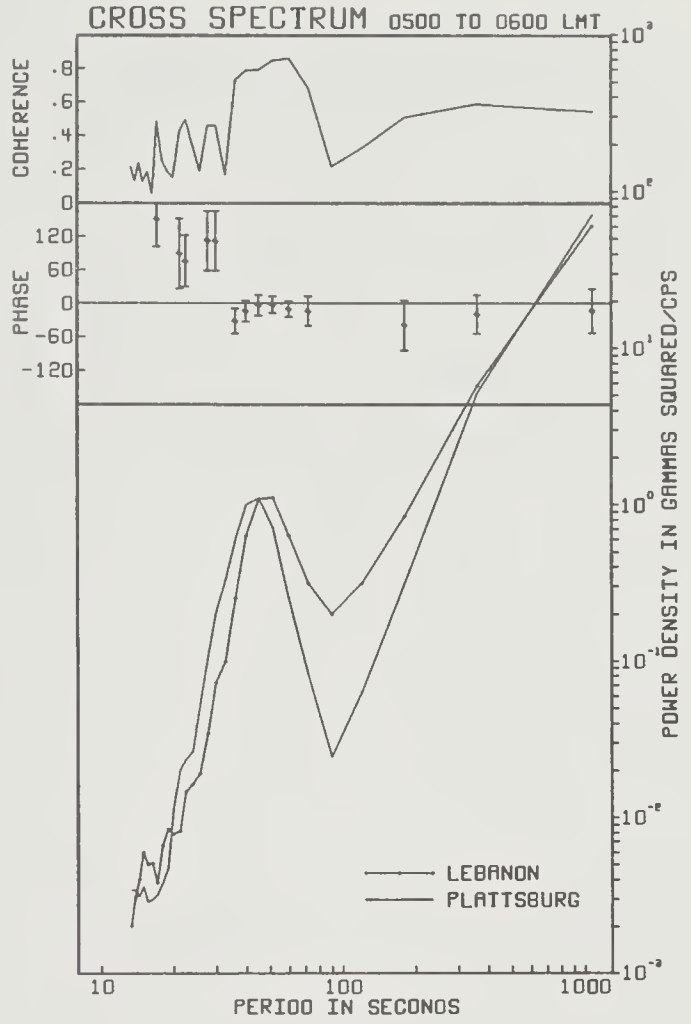

CROSS SPECTRUM 0000 TO 0100 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG

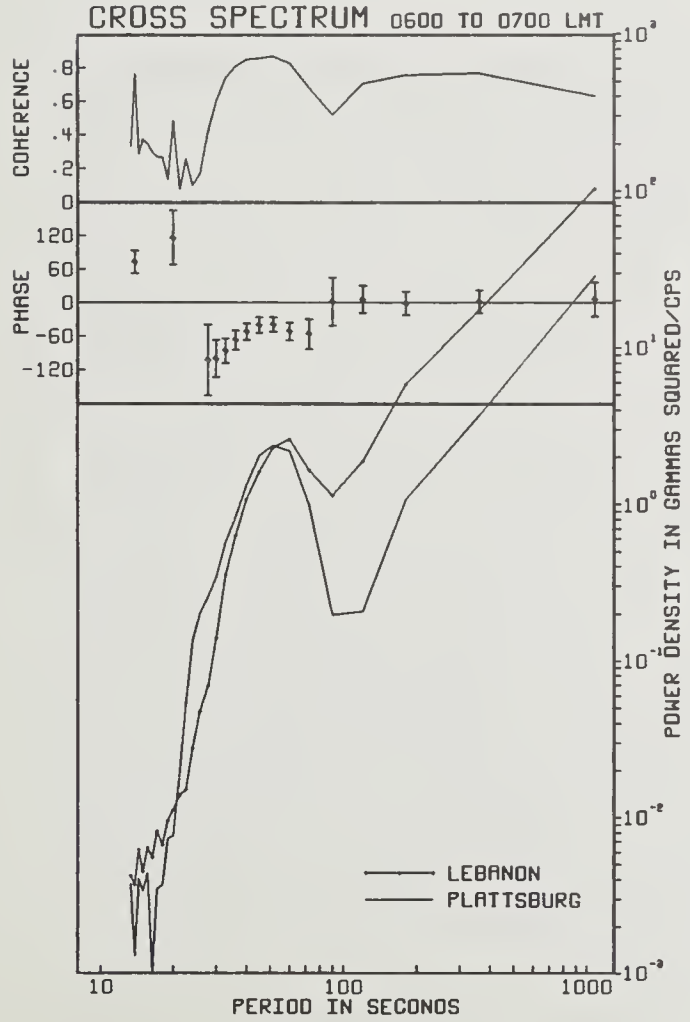

CROSS SPECTRUM 0100 TO 0200 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG


CROSS SPECTRUM 0200 TO 0300 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG


CROSS SPECTRUM 0255 TO 0355 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG


CROSS SPECTRUM 0400 TO 0500 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG


CROSS SPECTRUM 0500 TO 0600 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG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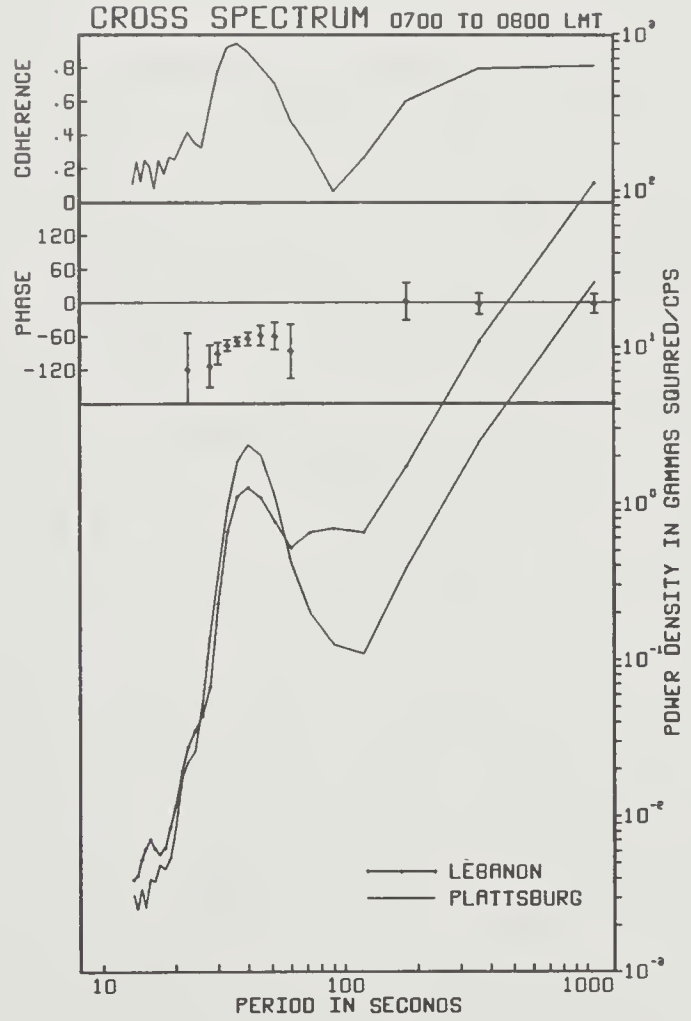
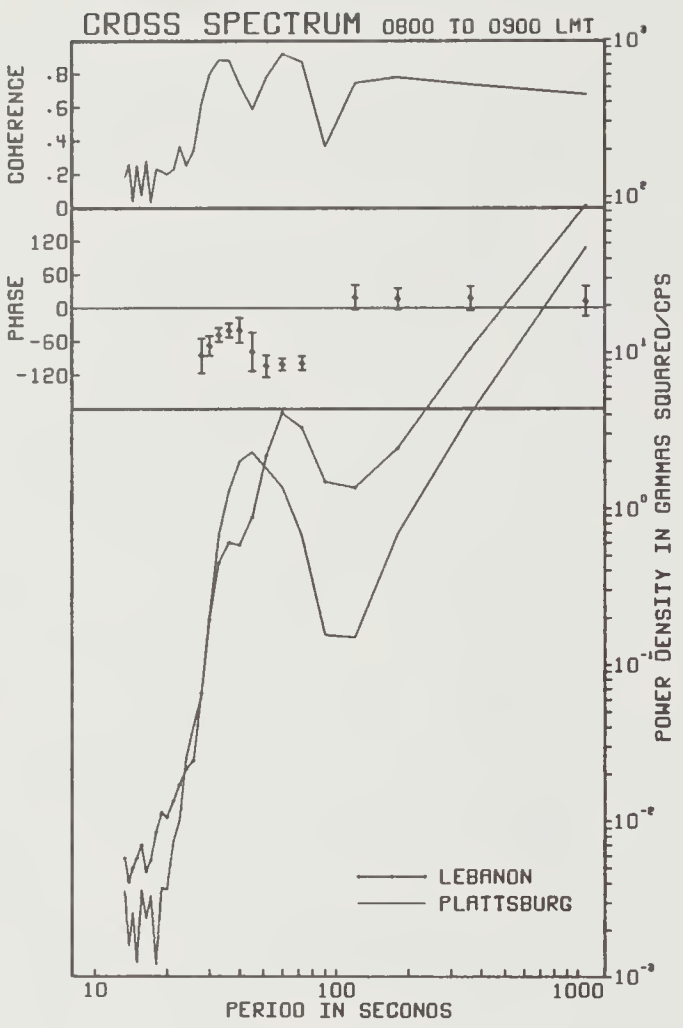
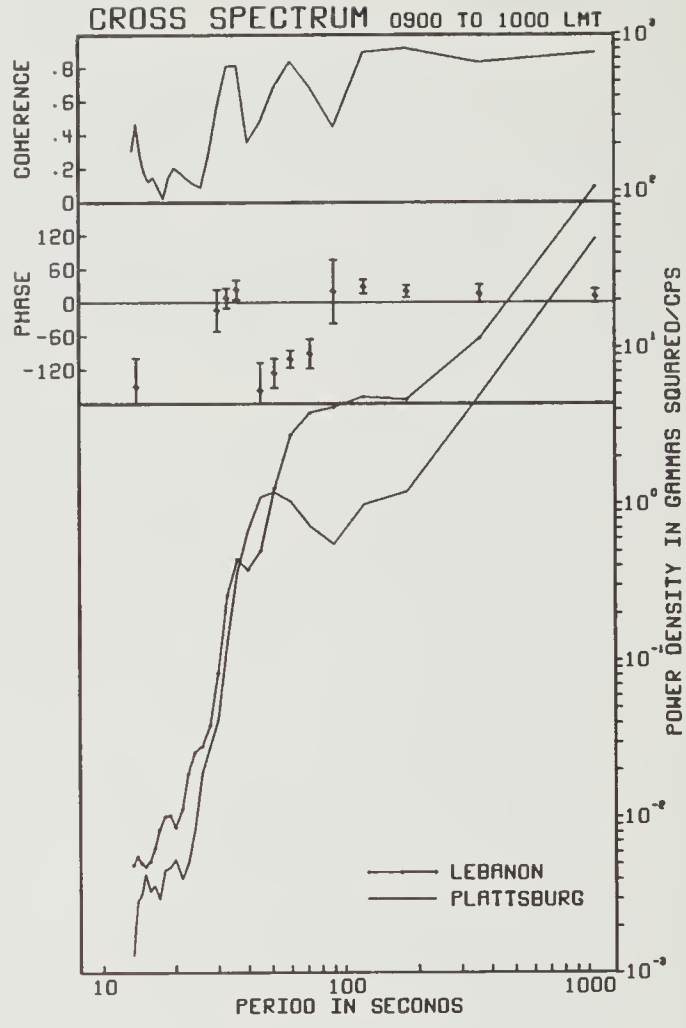
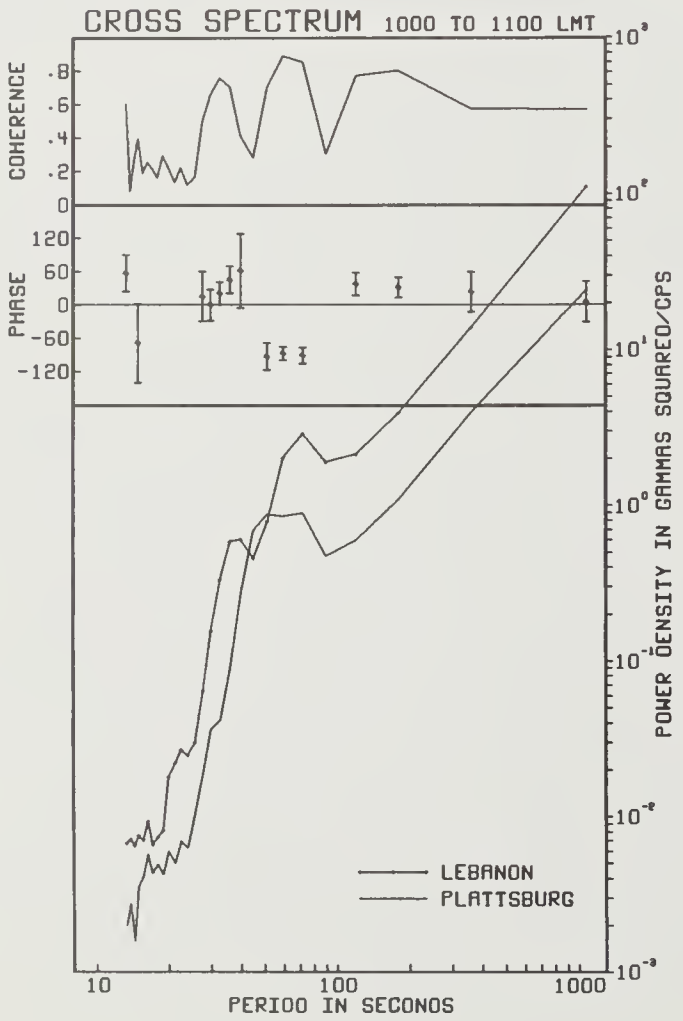
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG


CROSS SPECTRUM 0700 TO 0800 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG


CROSS SPECTRUM 0800 TO 0900 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG


CROSS SPECTRUM 0900 TO 1000 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG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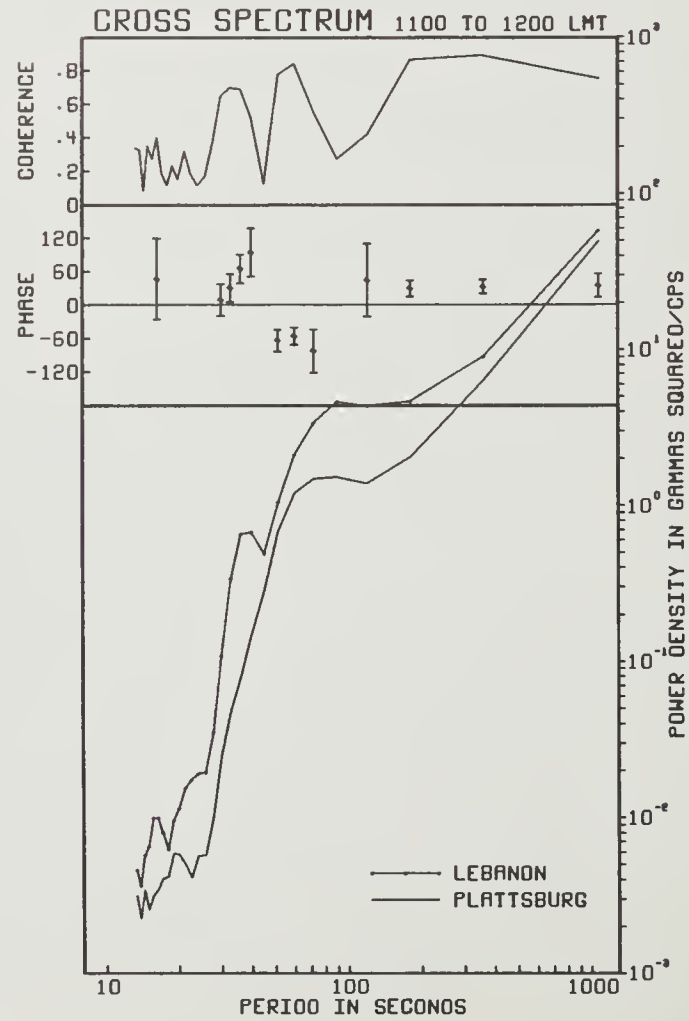
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG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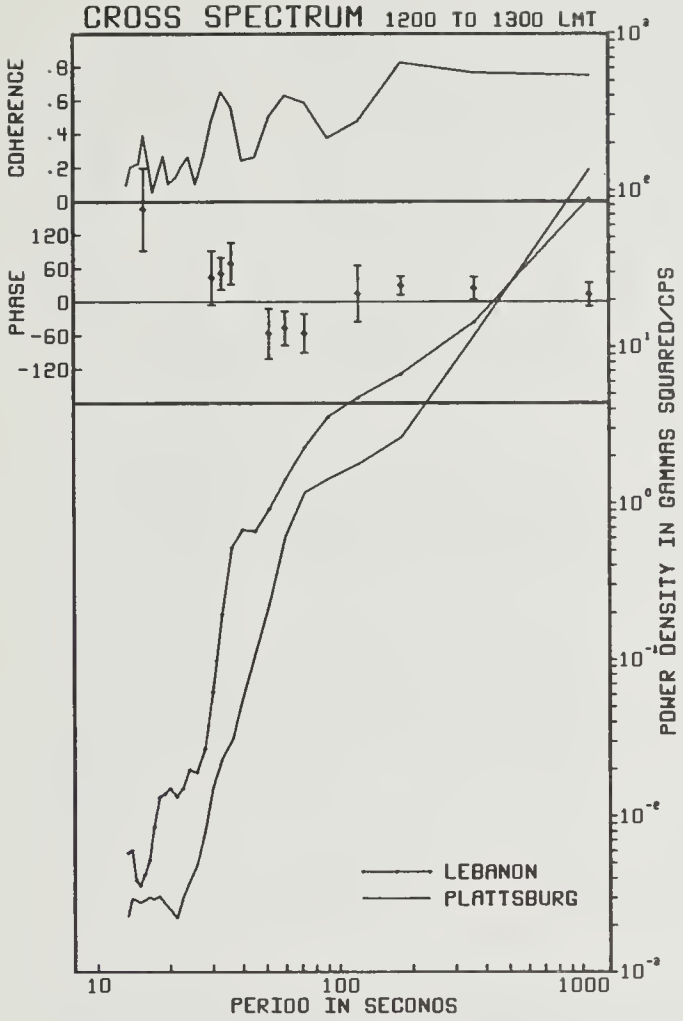
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG


CROSS SPECTRUM 1200 TO 1300 LMT
COHERENCE
PHASE
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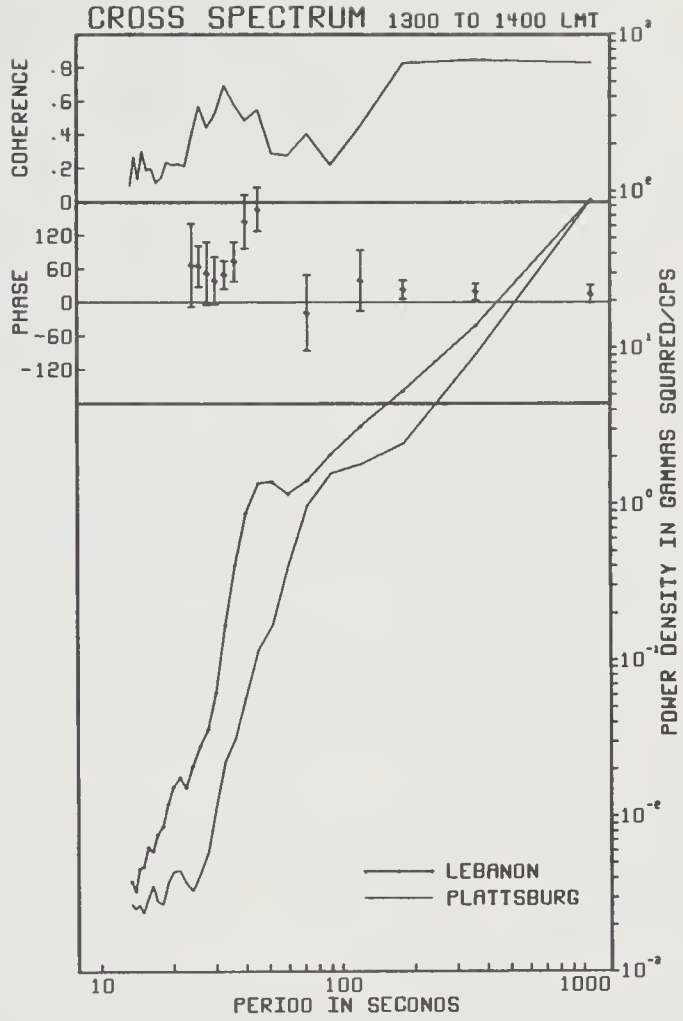
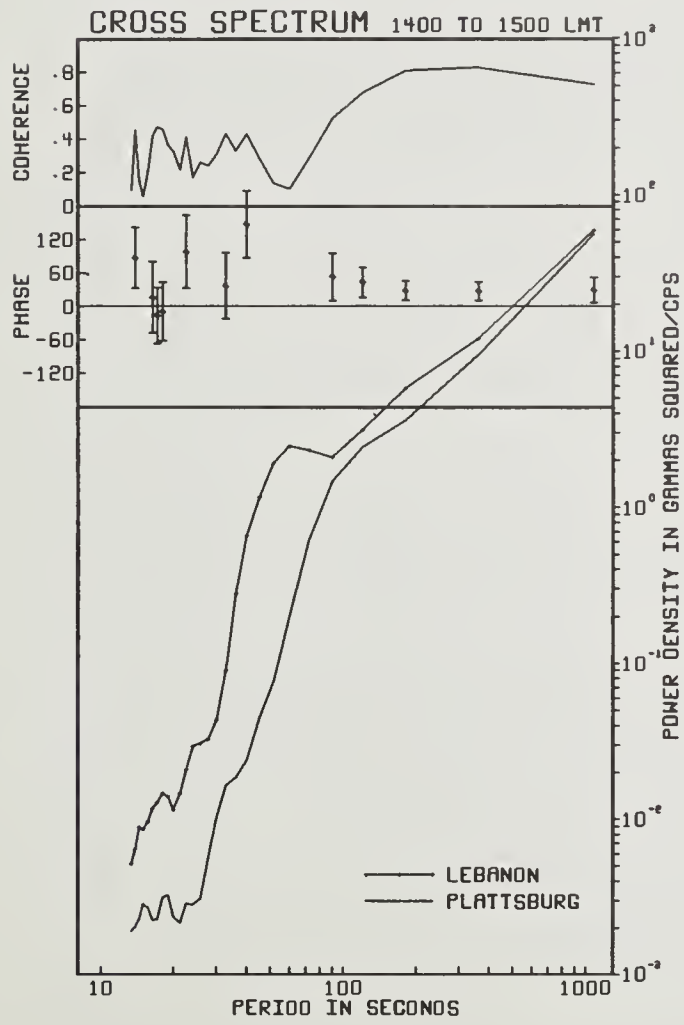
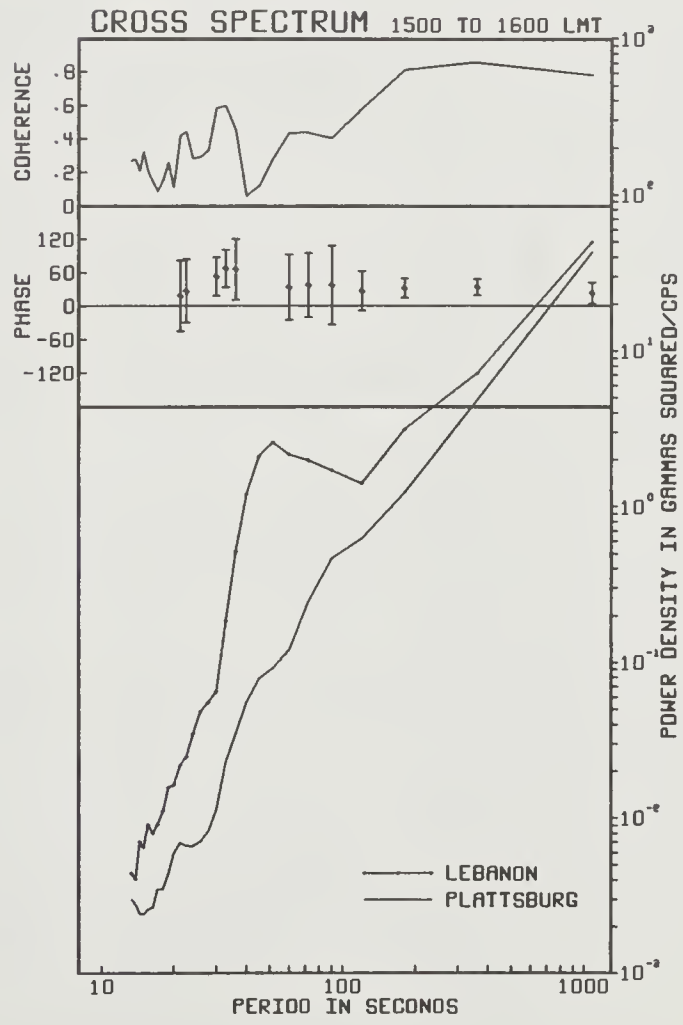
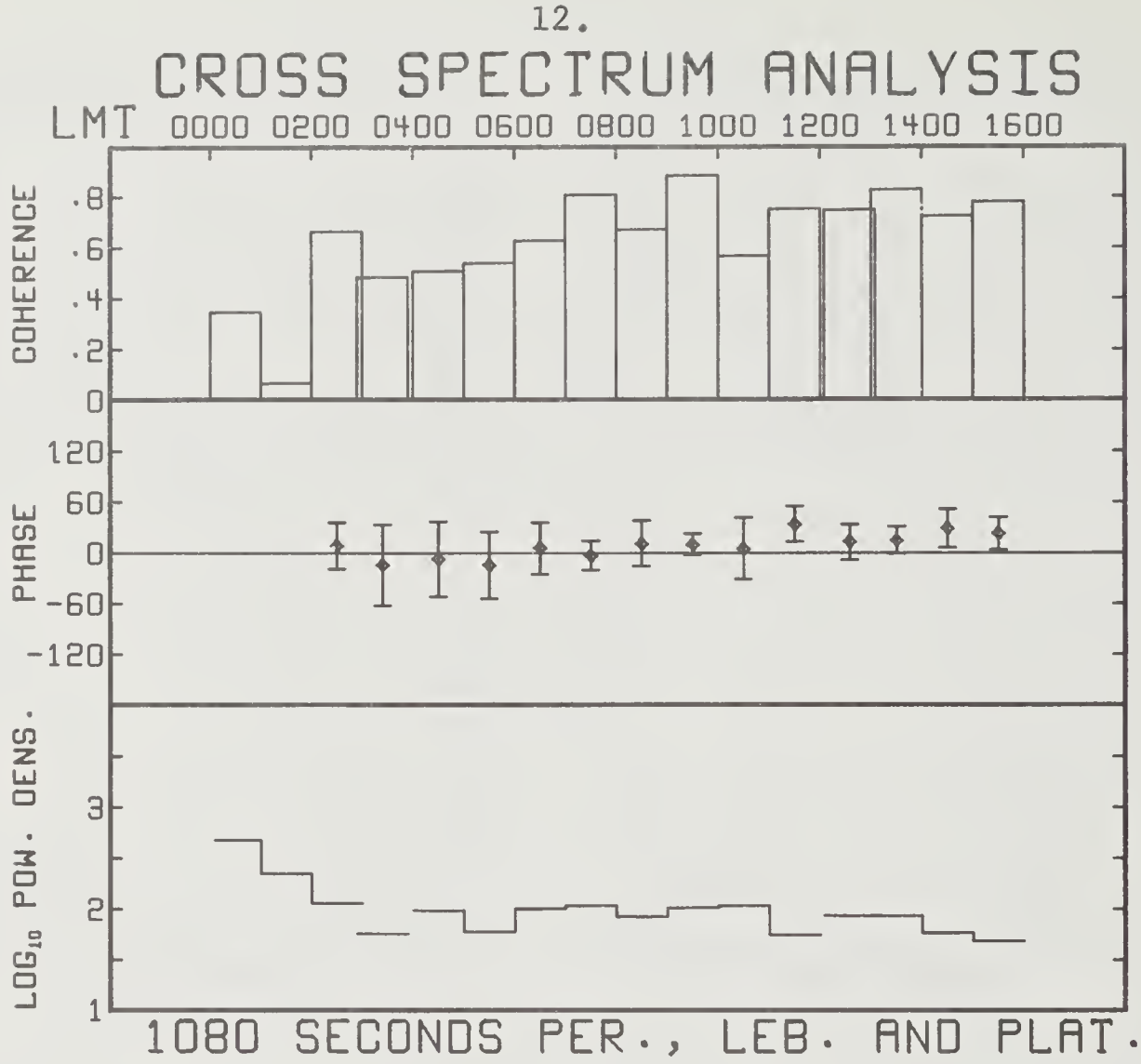
PERIOD IN SECONDS
LEBANON
PLATTSBURG


CROSS SPECTRUM 1300 TO 1400 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG


CROSS SPECTRUM 1400 TO 1500 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG


CROSS SPECTRUM 1500 TO 1600 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
PLATTSBURG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COHERENCE
.8
.6
.4
.2
0
PHASE
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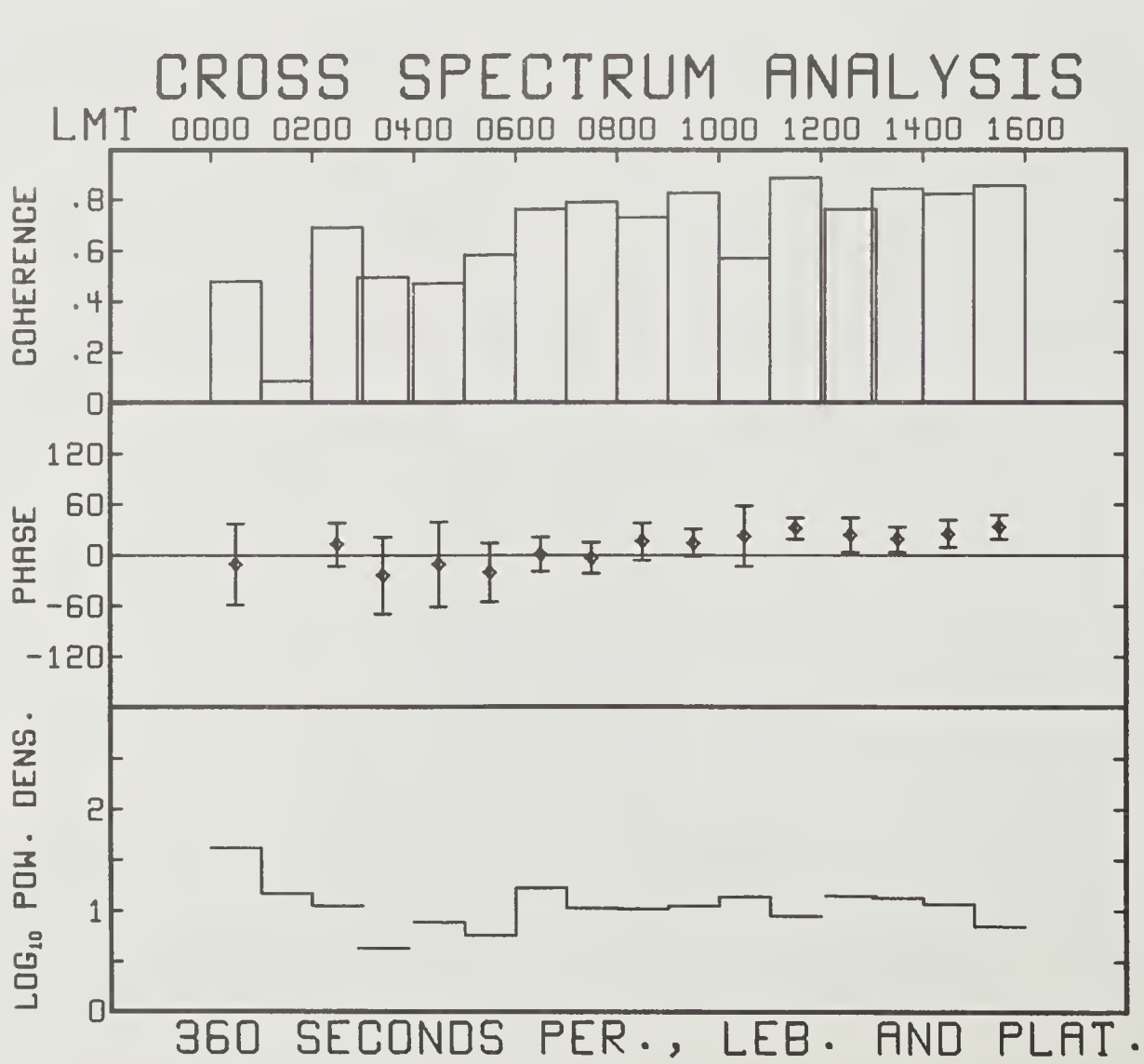
60
0
-60
-120
LOG10 POW. DENS.
3
2
1
1080 SECONDS PER., LEB. AND PLAT.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COHERENCE
.8
.6
.4
.2
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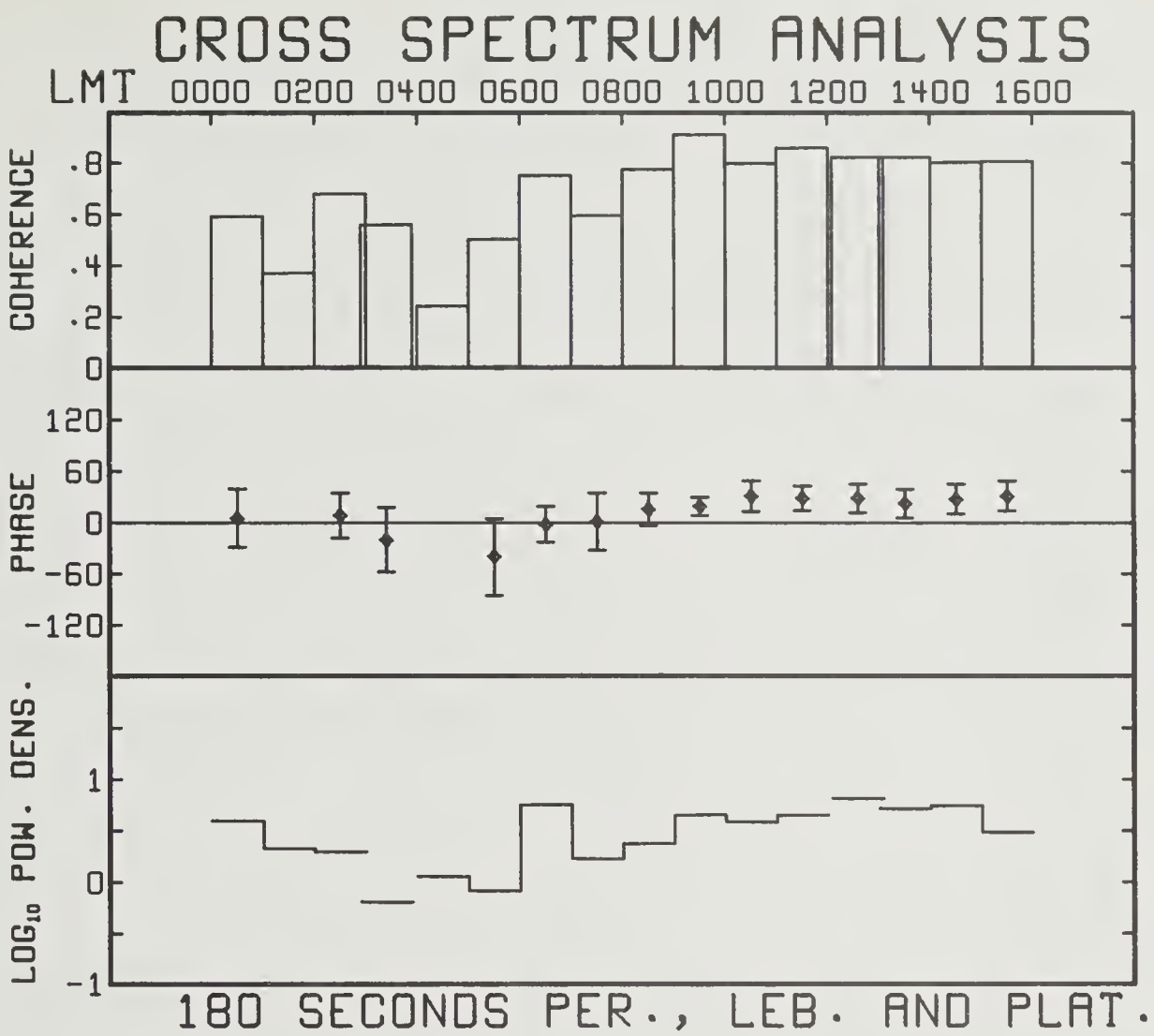
-120
LOG10 POW. DENS.
2
1
0
360 SECONDS PER., LEB. AND PLAT.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COHERENCE
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.6
.4
.2
0
PHASE
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60
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LOG10 POW. DENS.
1
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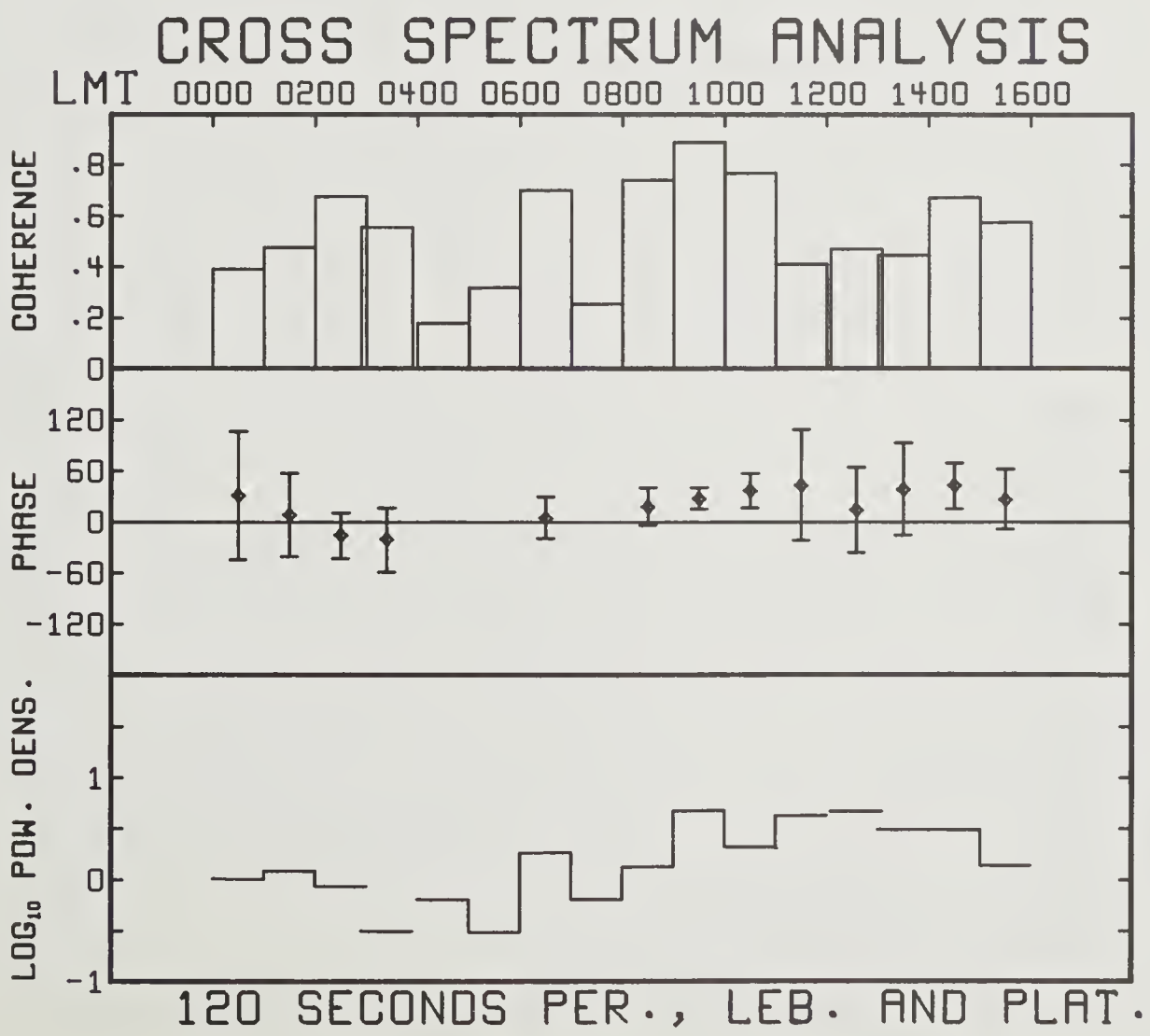
-1
180 SECONDS PER., LEB. AND PLAT.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.4
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-120
LOG10 POW. DENS.
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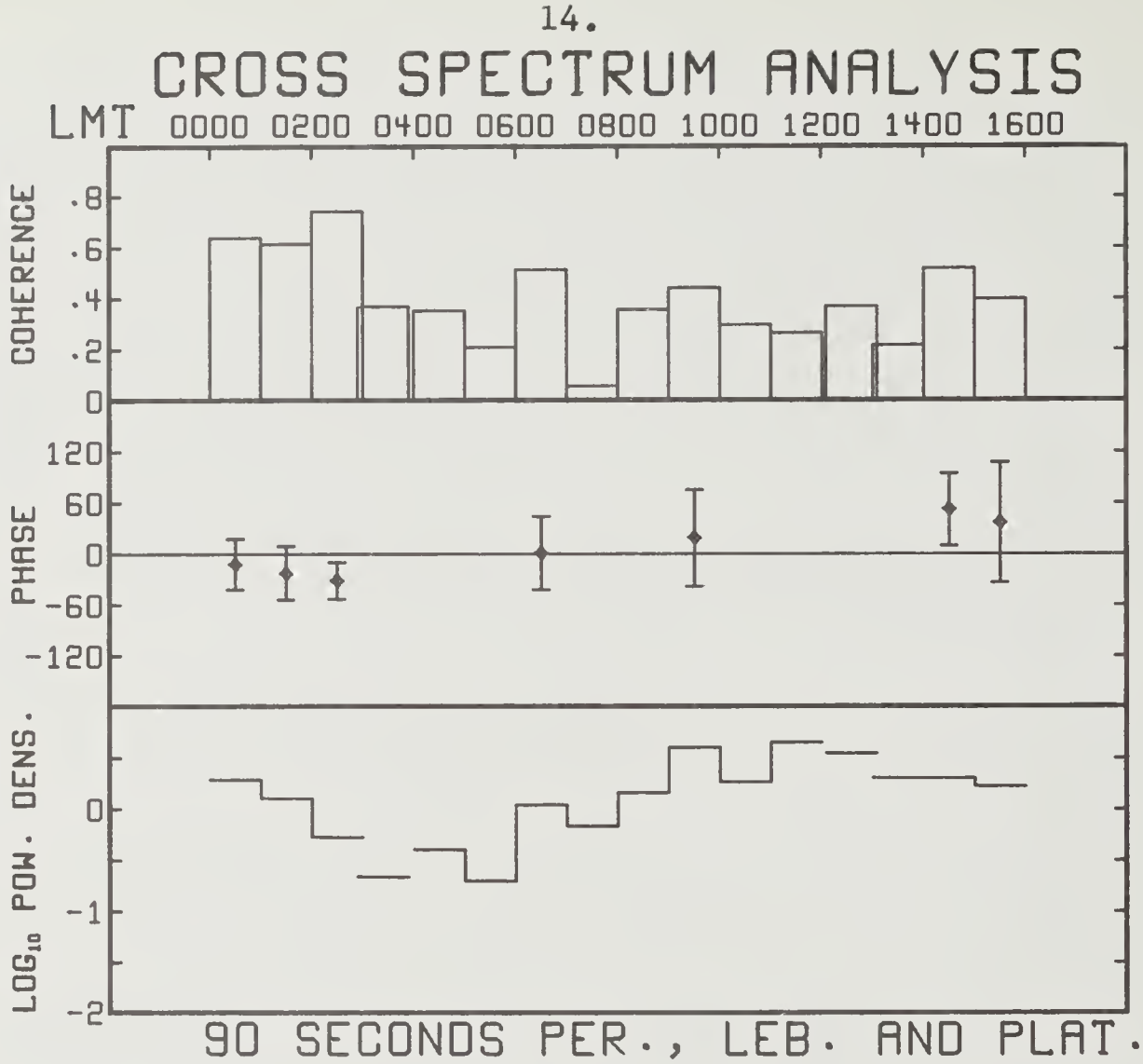
120 SECONDS PER., LEB. AND PLAT.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COHERENCE
.8
.6
.4
.2
0
PHASE
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60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
90 SECONDS PER., LEB. AND PLAT.

CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
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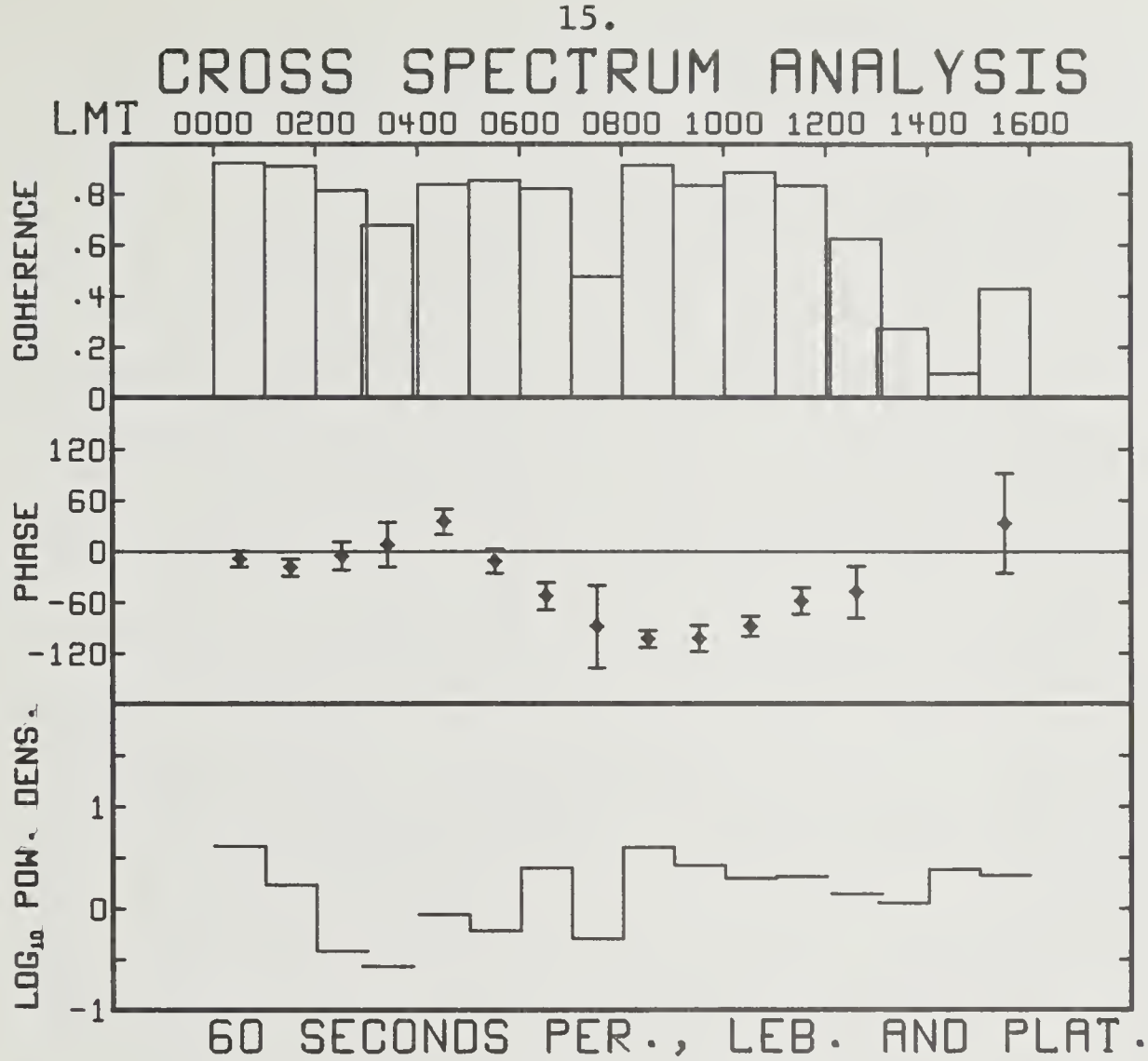
-120
LOG10 POW. DENS.
1
0
-1
72 SECONDS PER., LEB. AND PLAT.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PHASE
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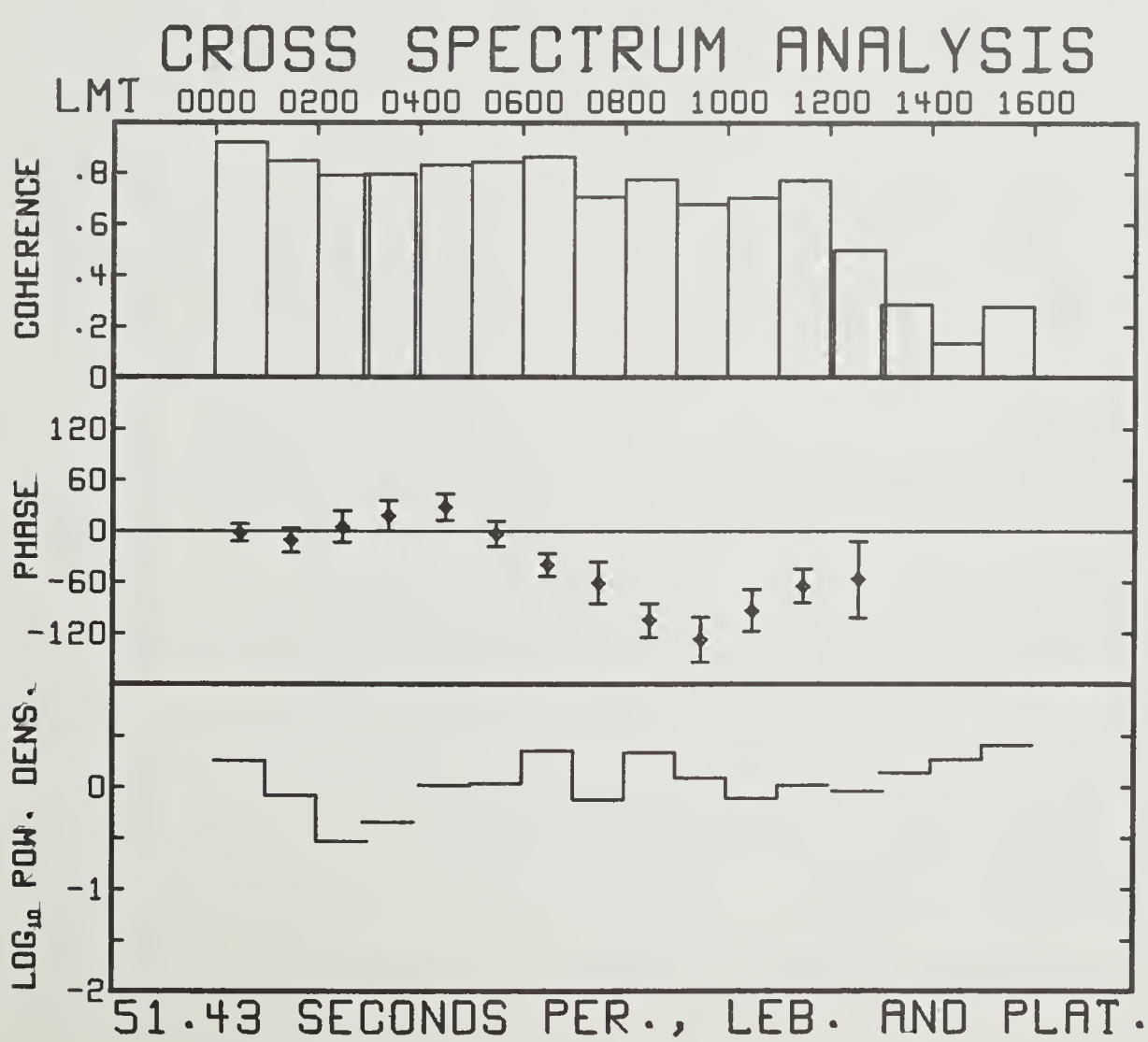
60 SECONDS PER., LEB. AND PLAT.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COHERENCE
.8
.6
.4
.2
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PHASE
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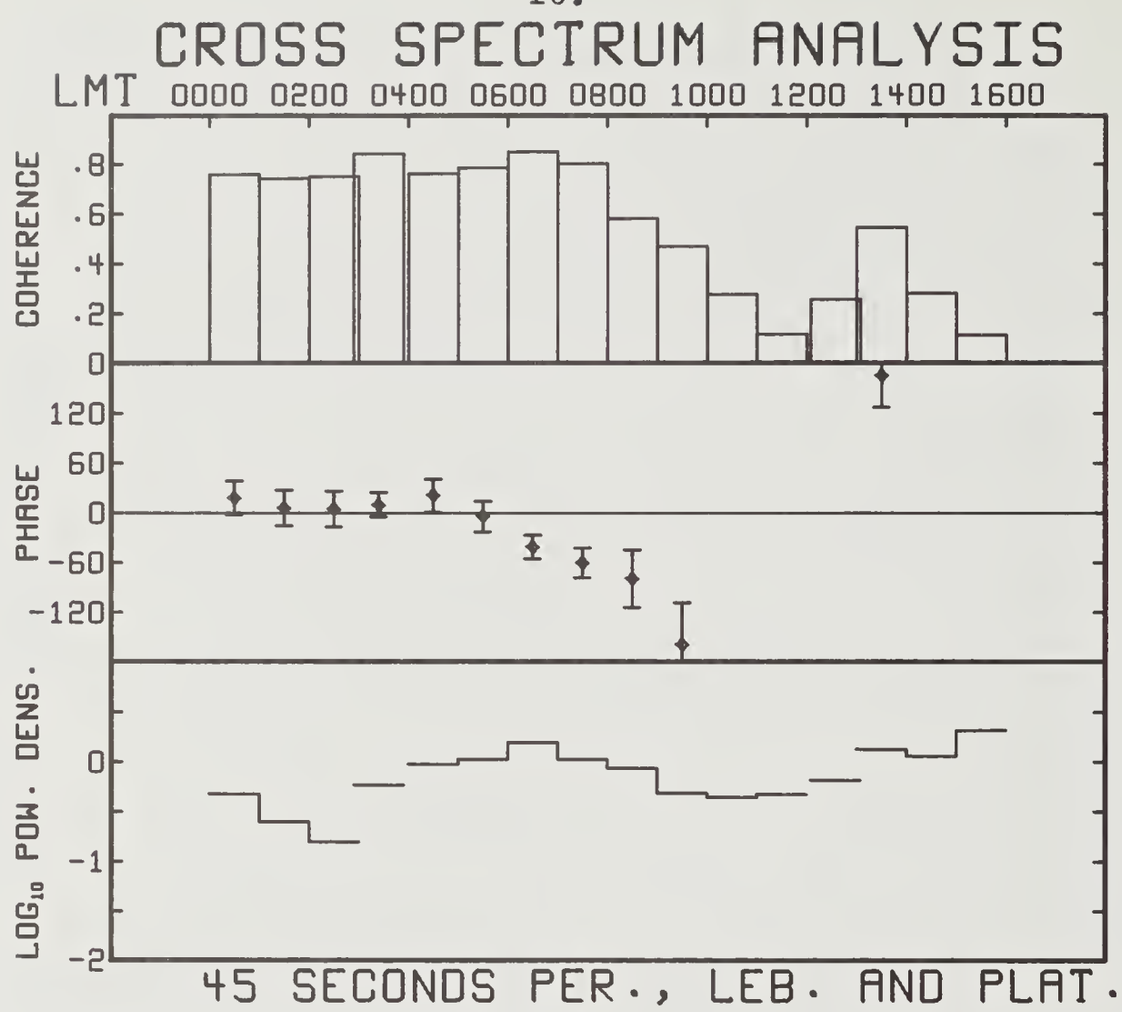
51.43 SECONDS PER., LEB. AND PLAT.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COHERENCE
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.6
.4
.2
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-120
PHASE
LOG10 POW. DENS.
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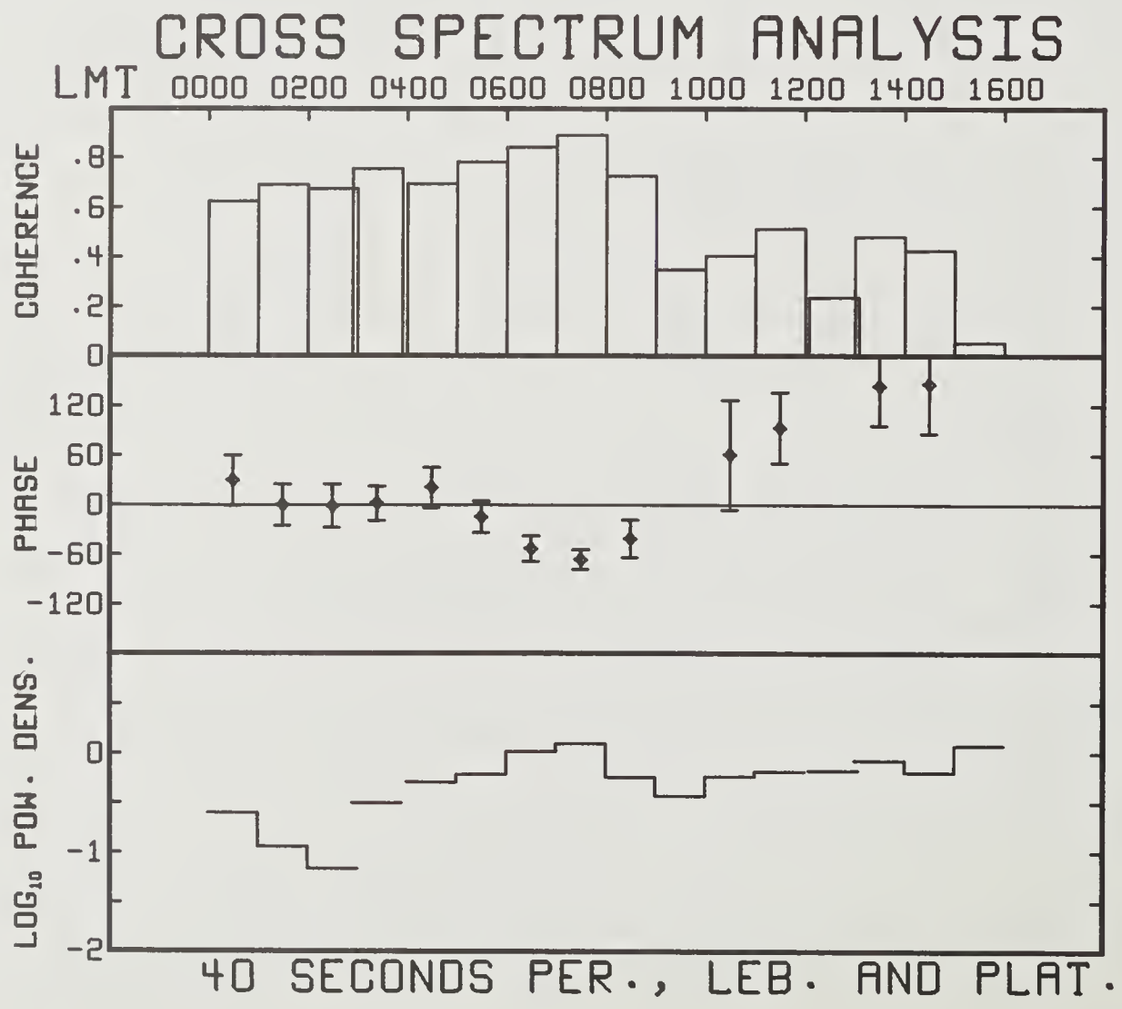
-1
-2
45 SECONDS PER., LEB. AND PLAT.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LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
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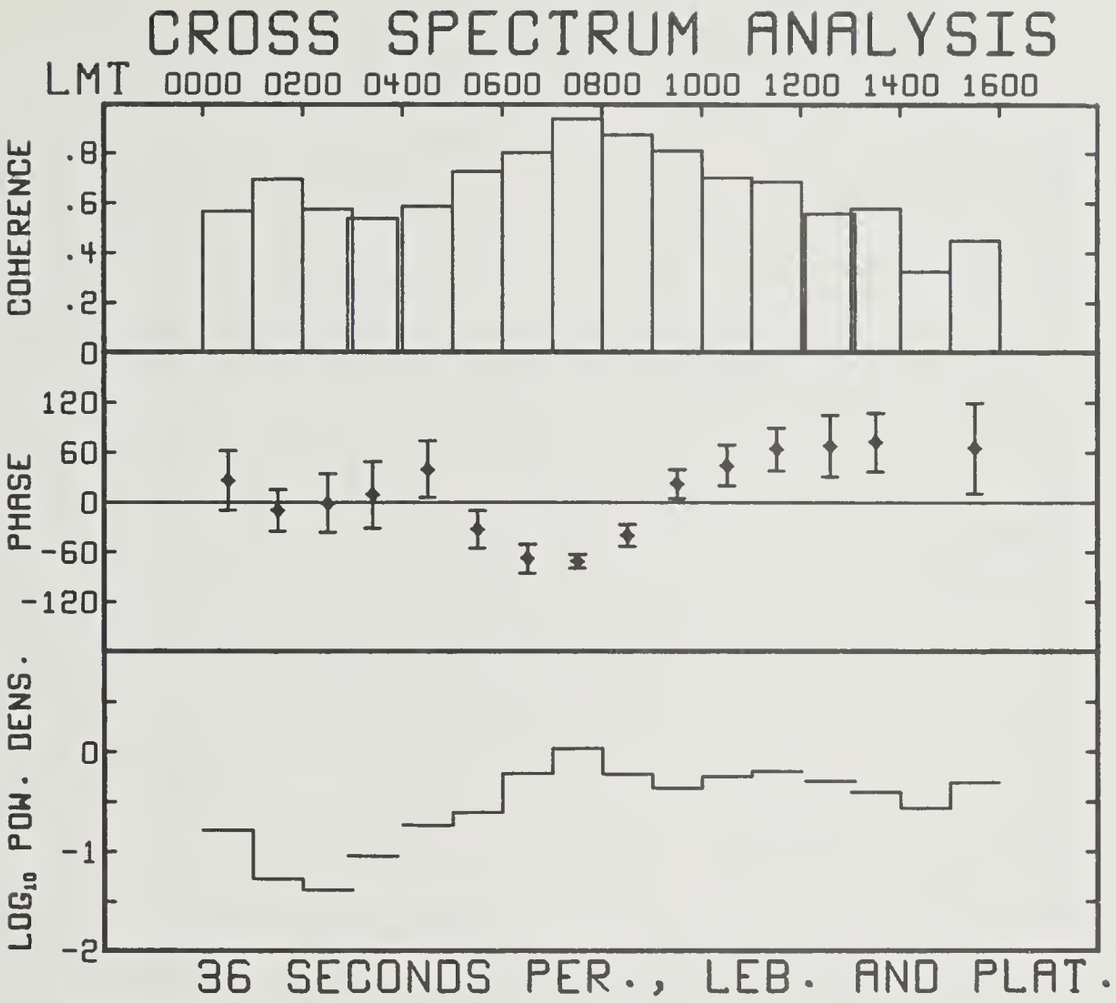
60
0
-60
-120
PHASE
LOG10 POW. DENS.
0
-1
-2
40 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
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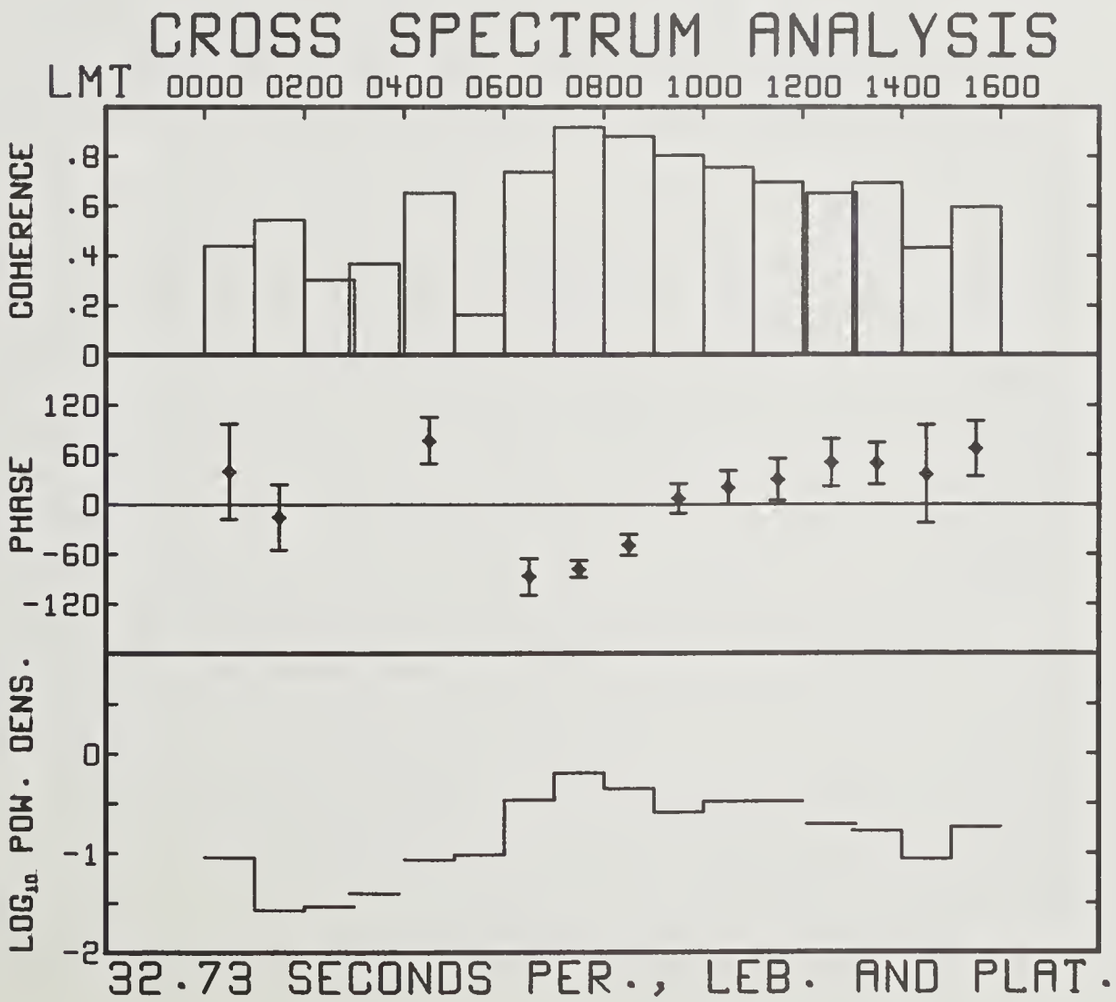
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
36 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
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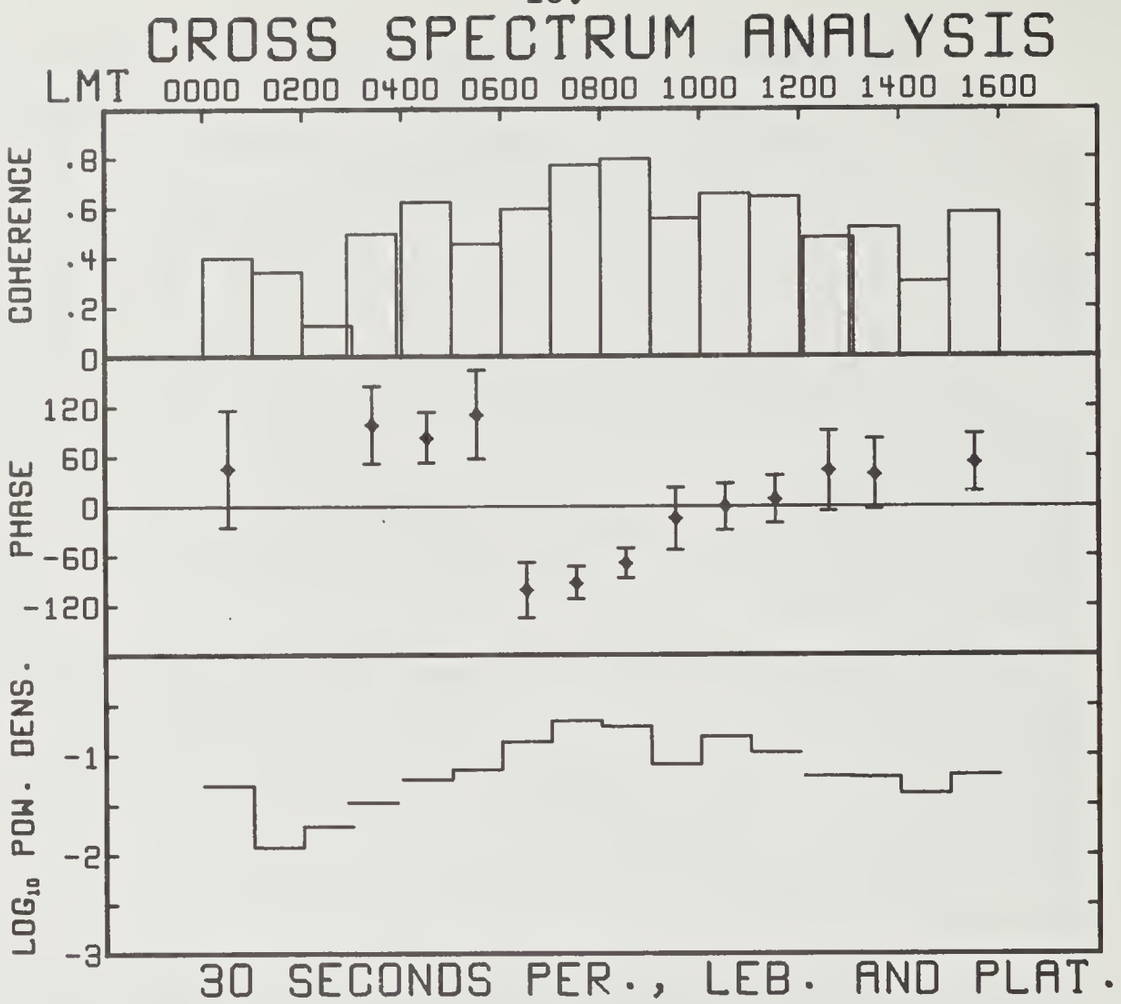
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
32.73 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
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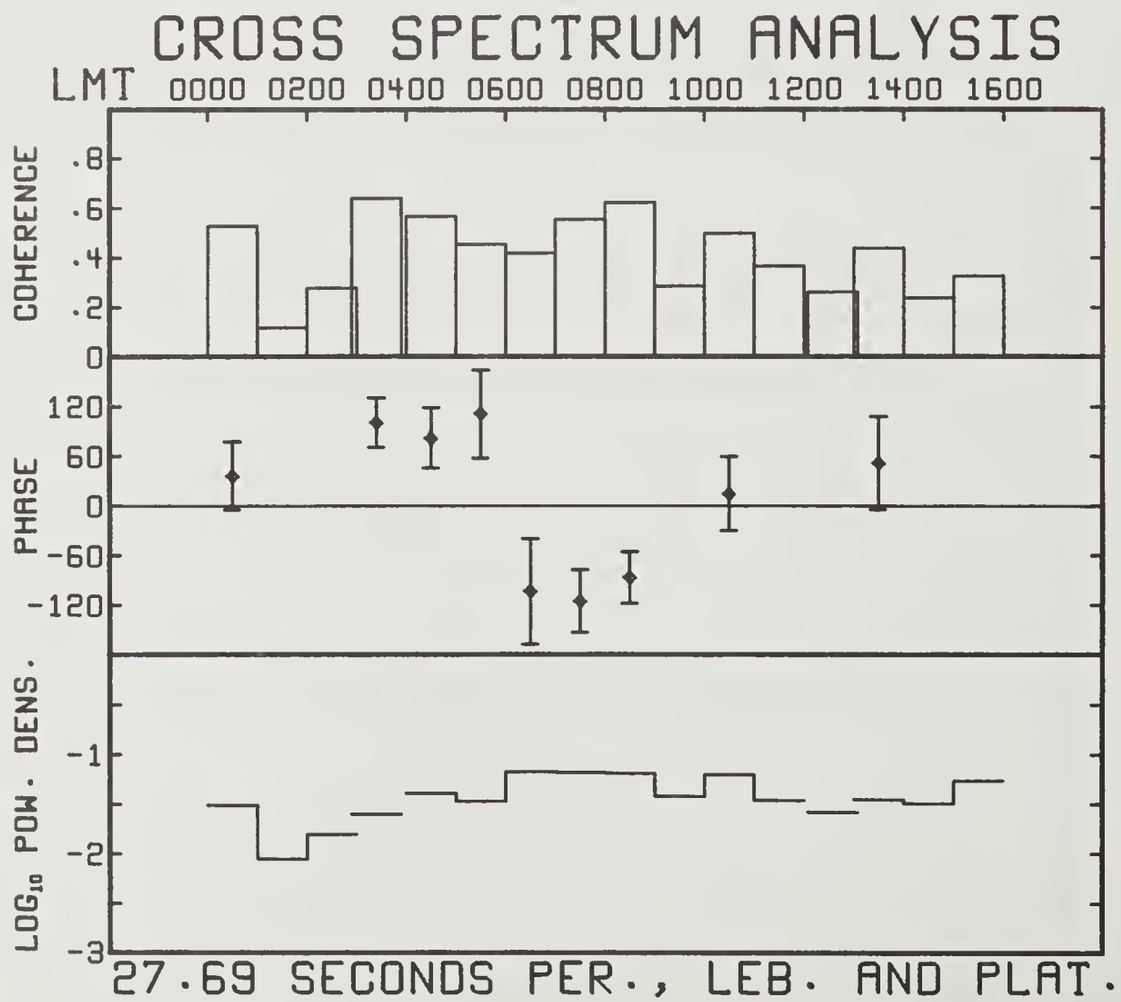
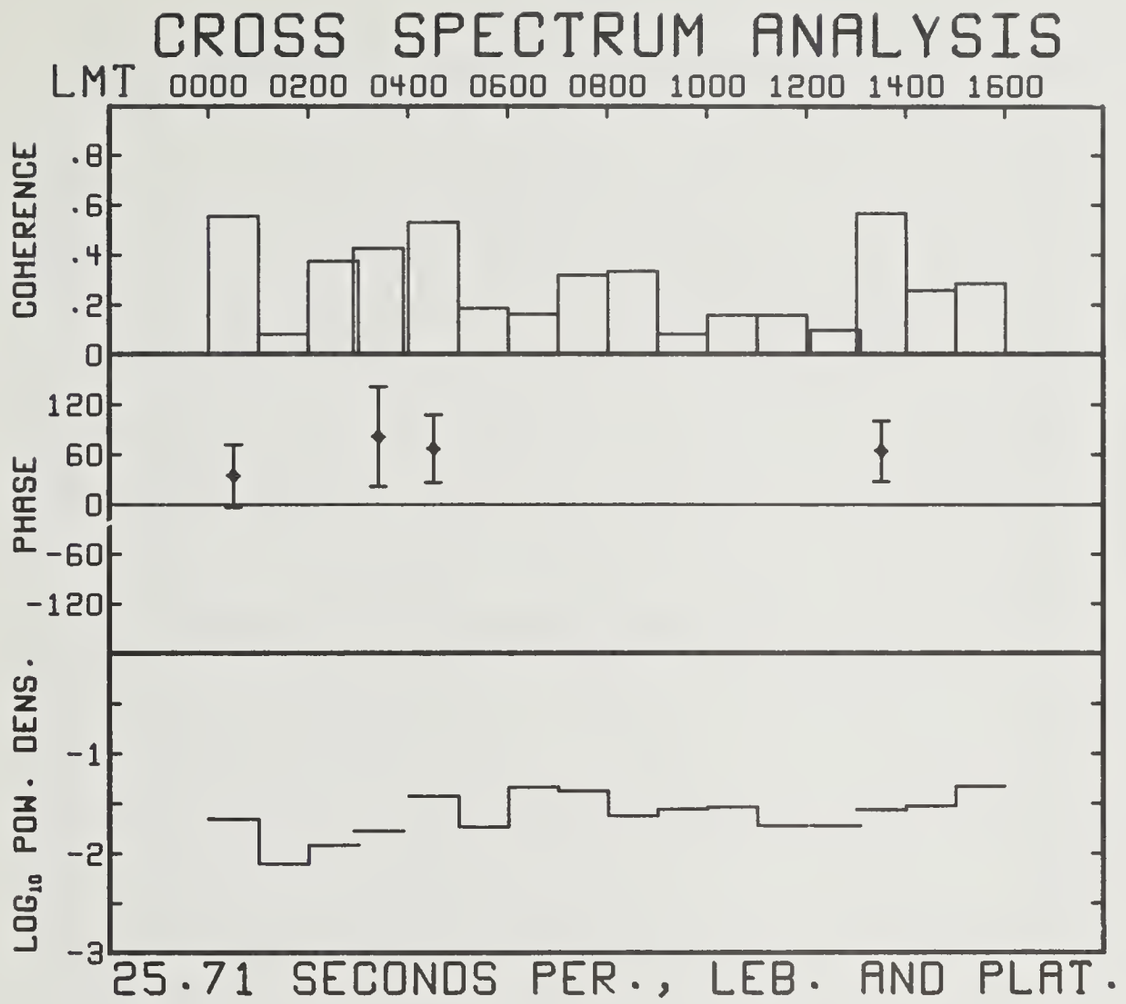
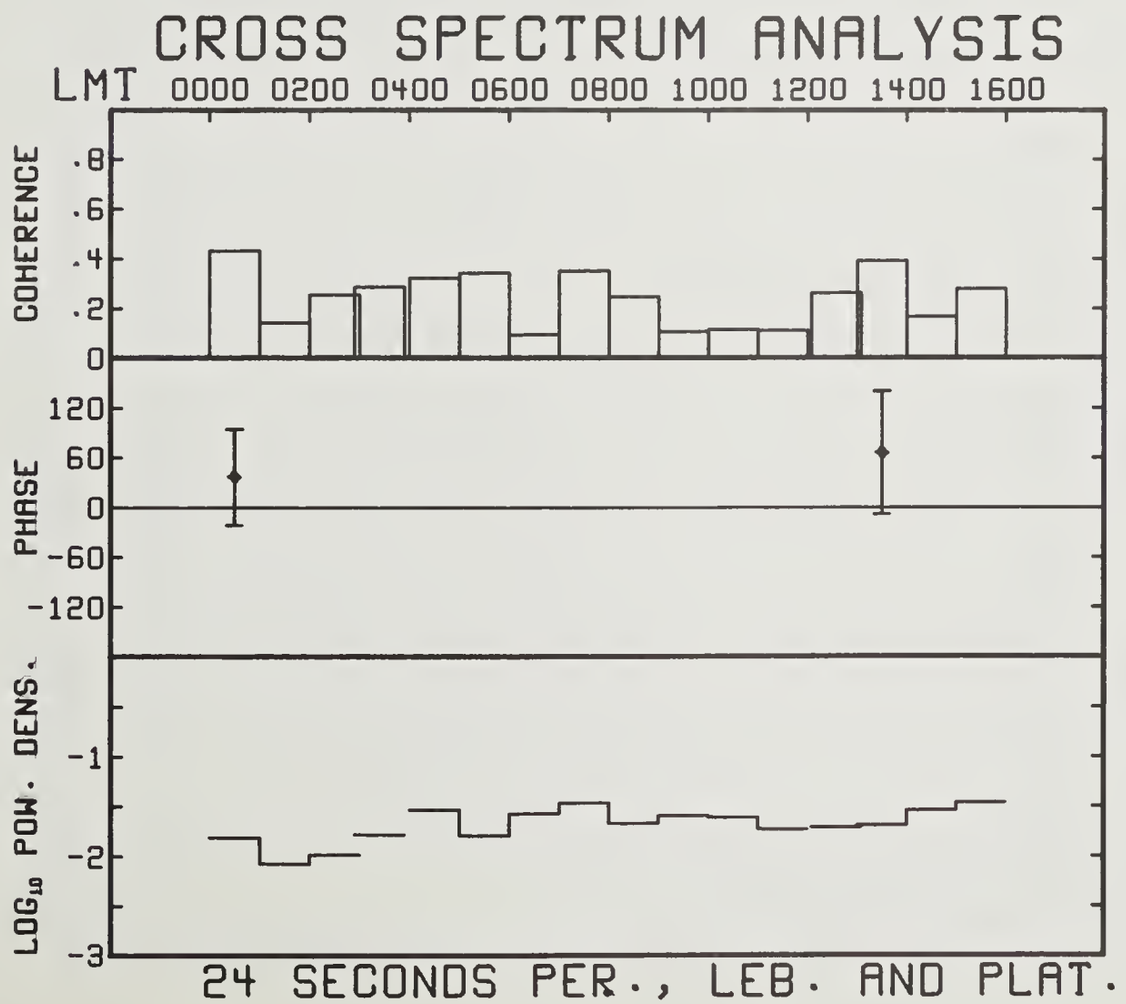
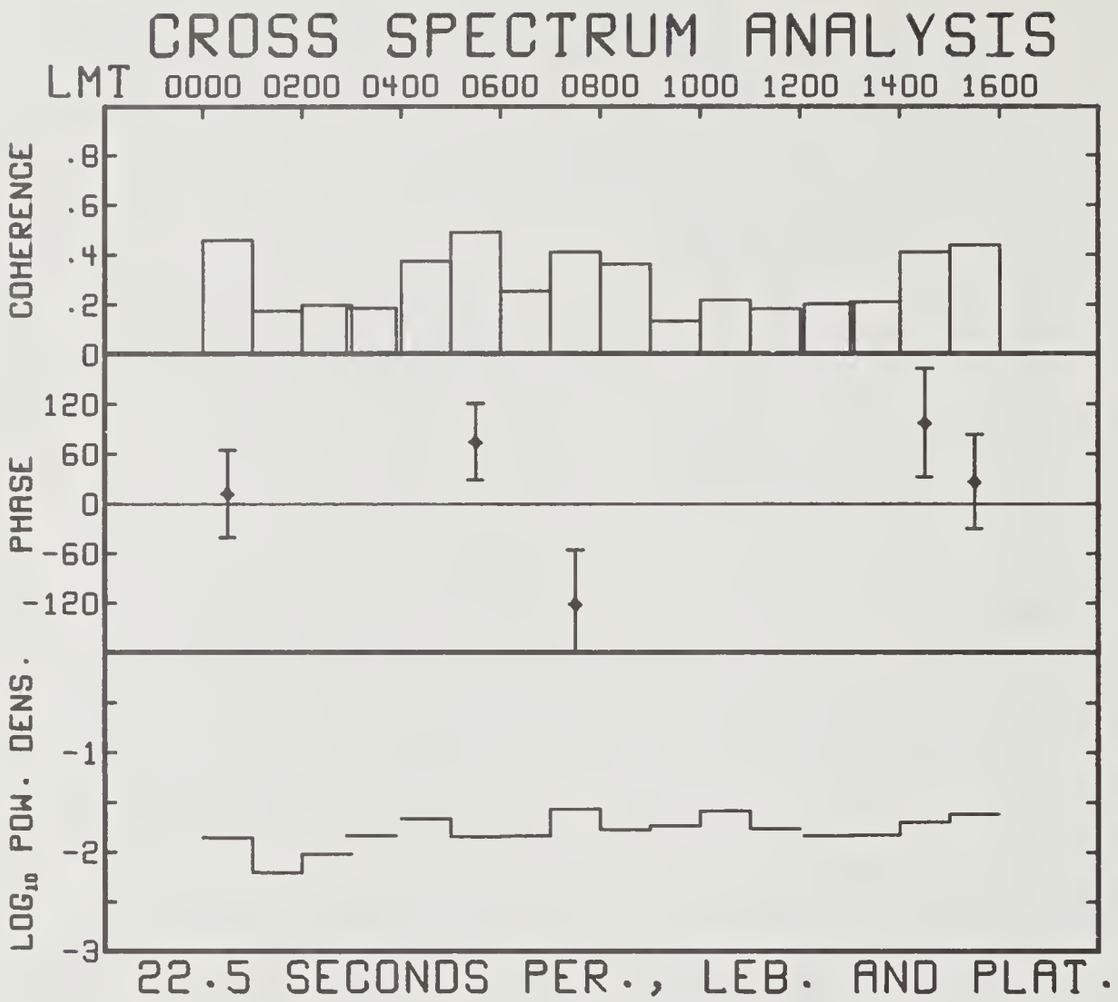
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
30 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
27.69 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
25.71 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
24 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
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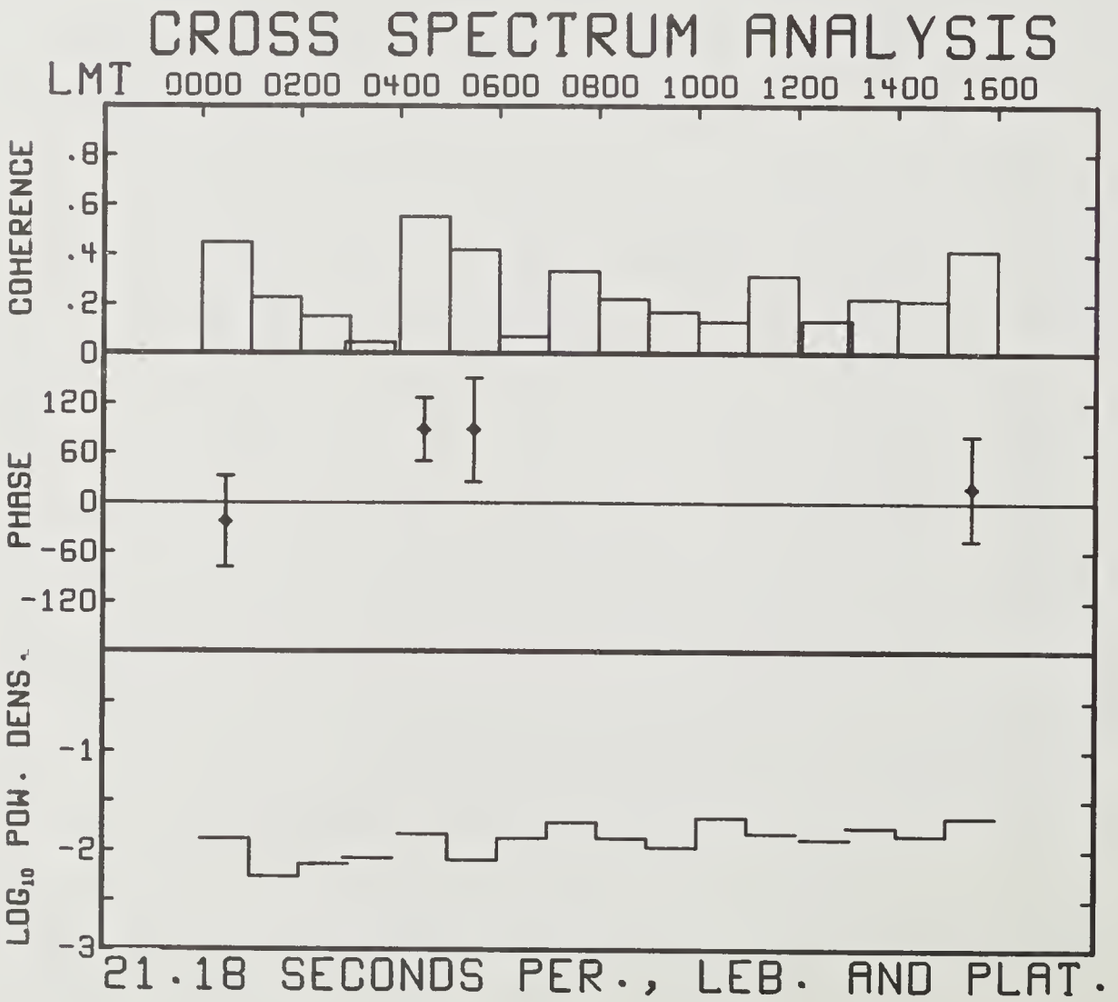
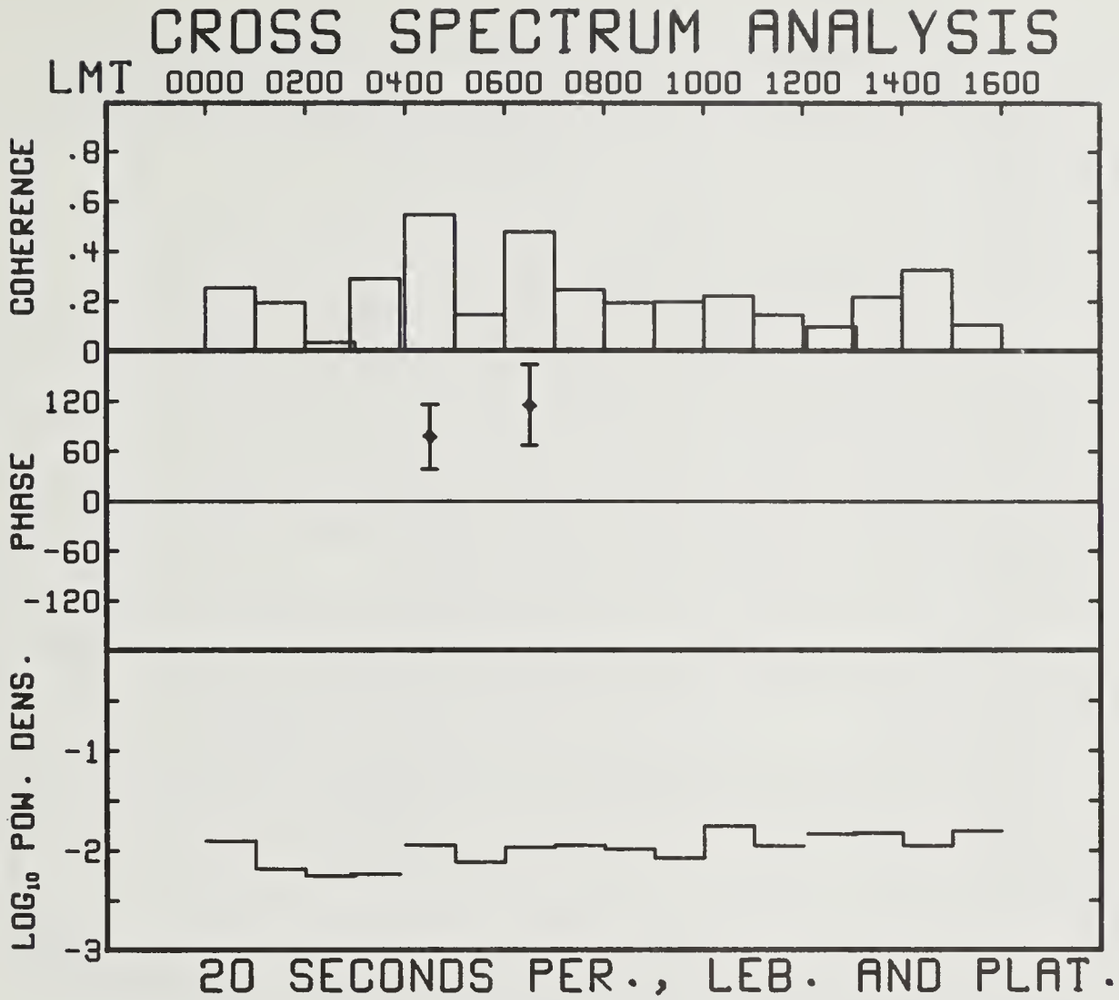
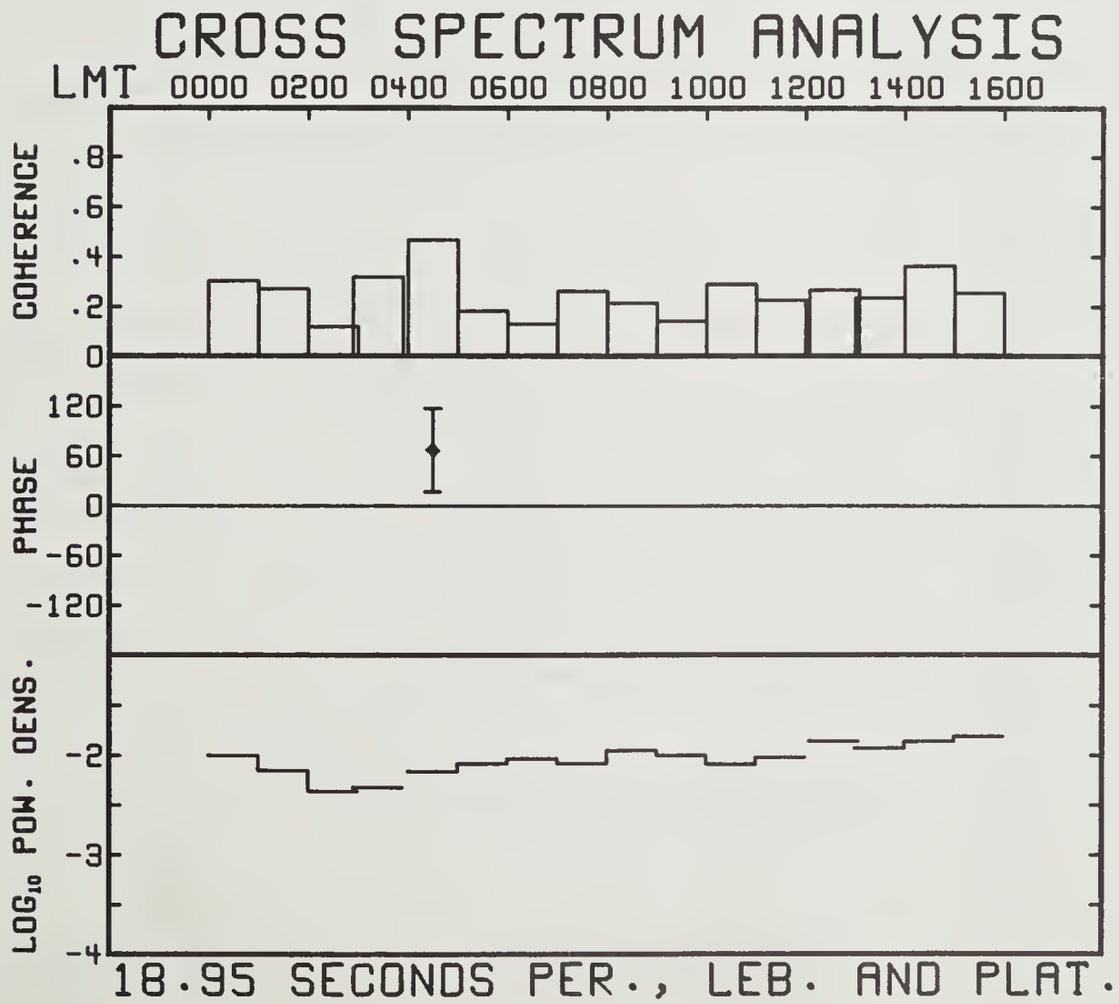
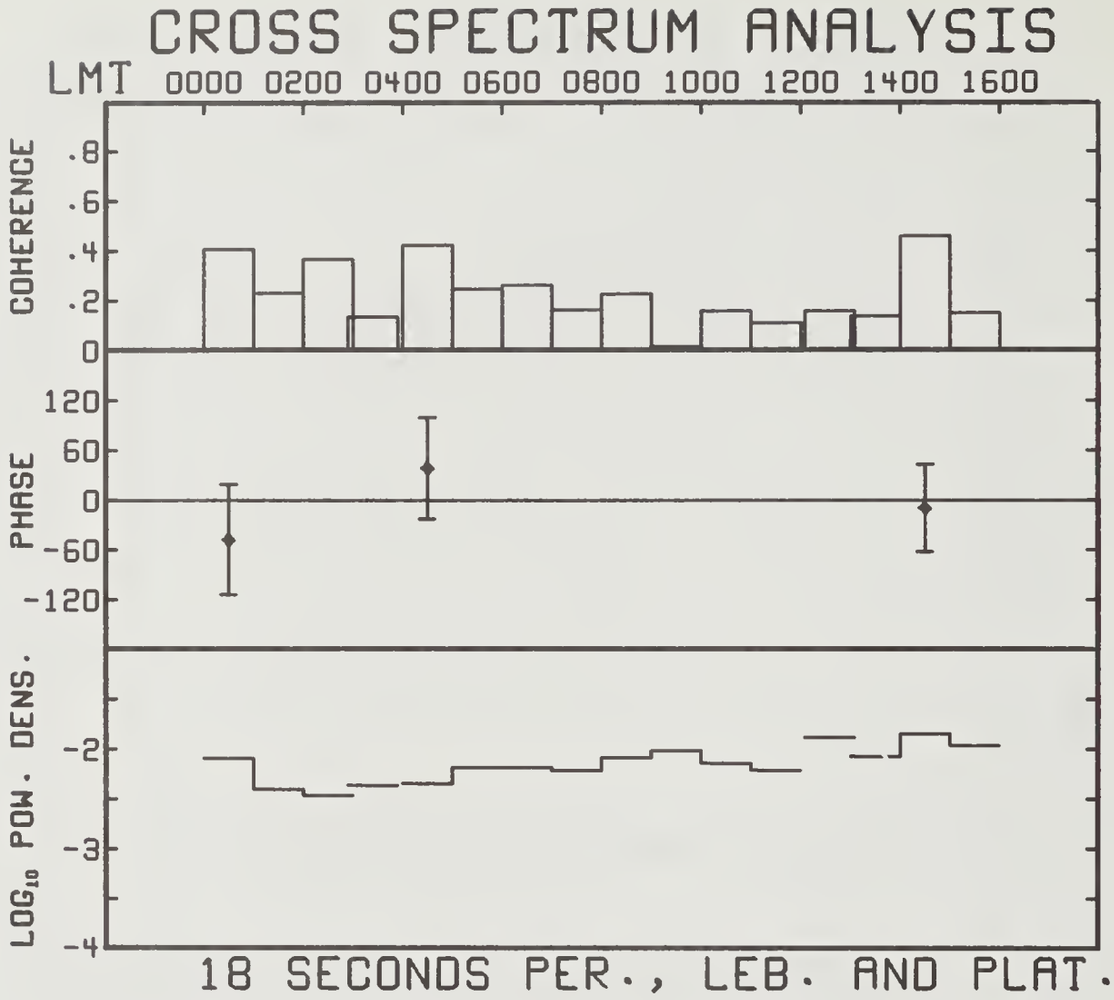
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
22.5 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
21.18 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
20 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
18.95 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
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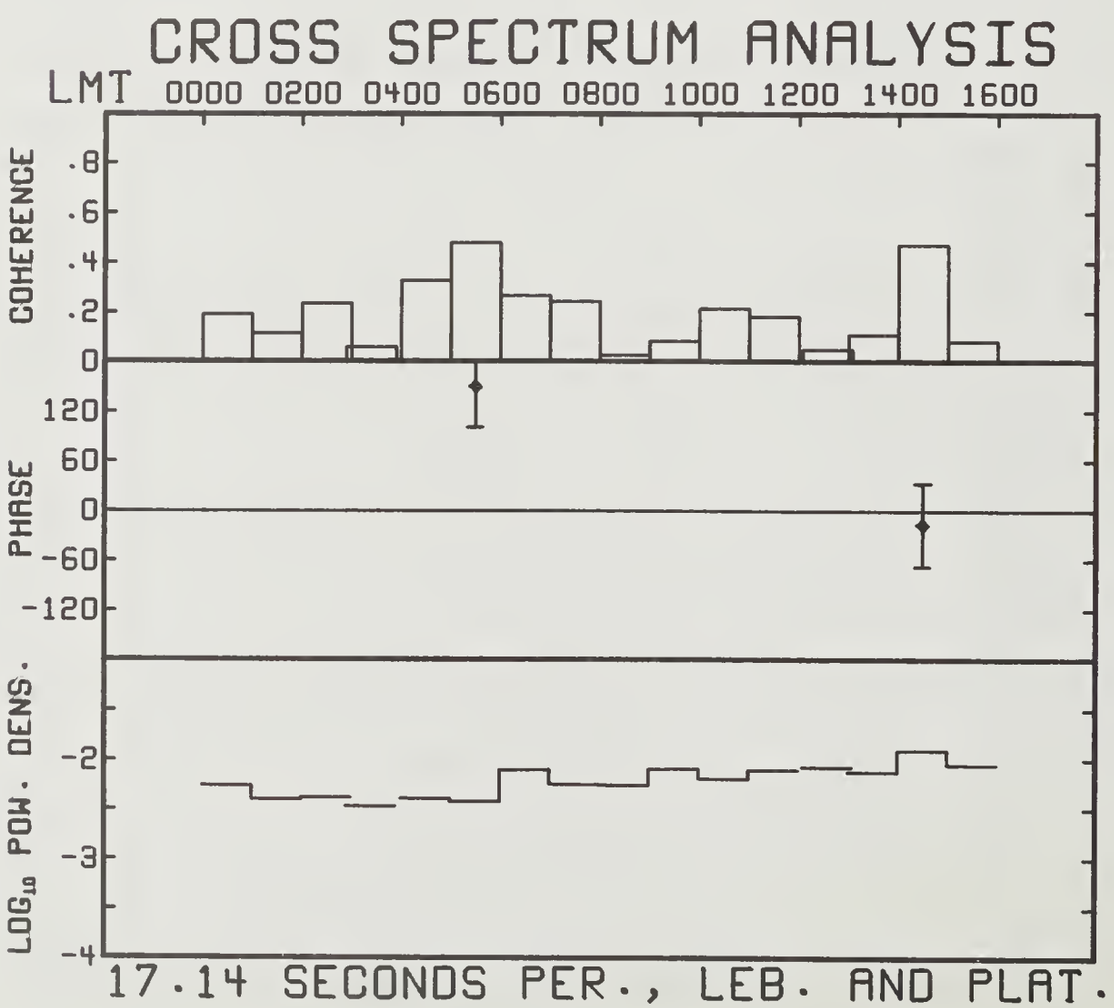
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
18 SECONDS PER., LEB. AND PLAT.


CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
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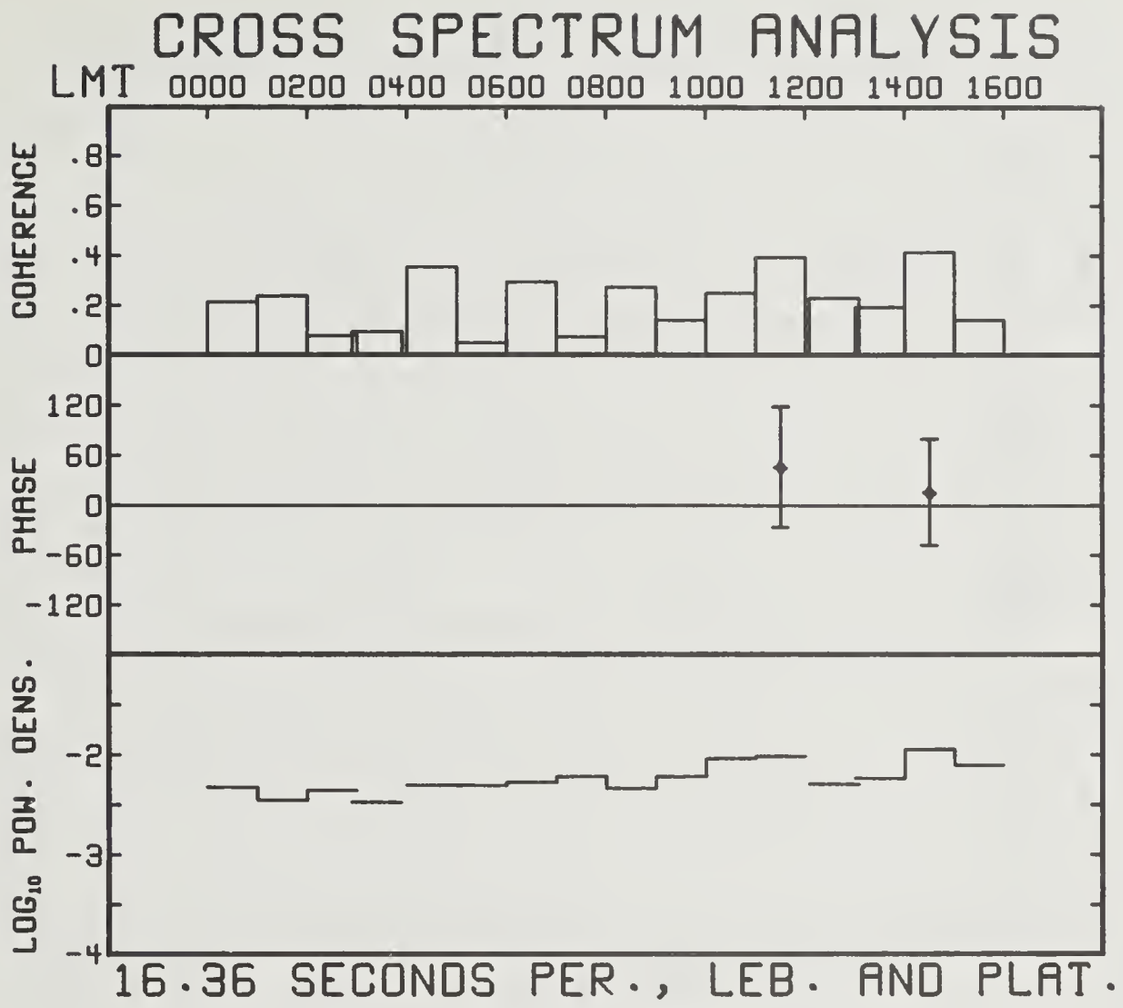
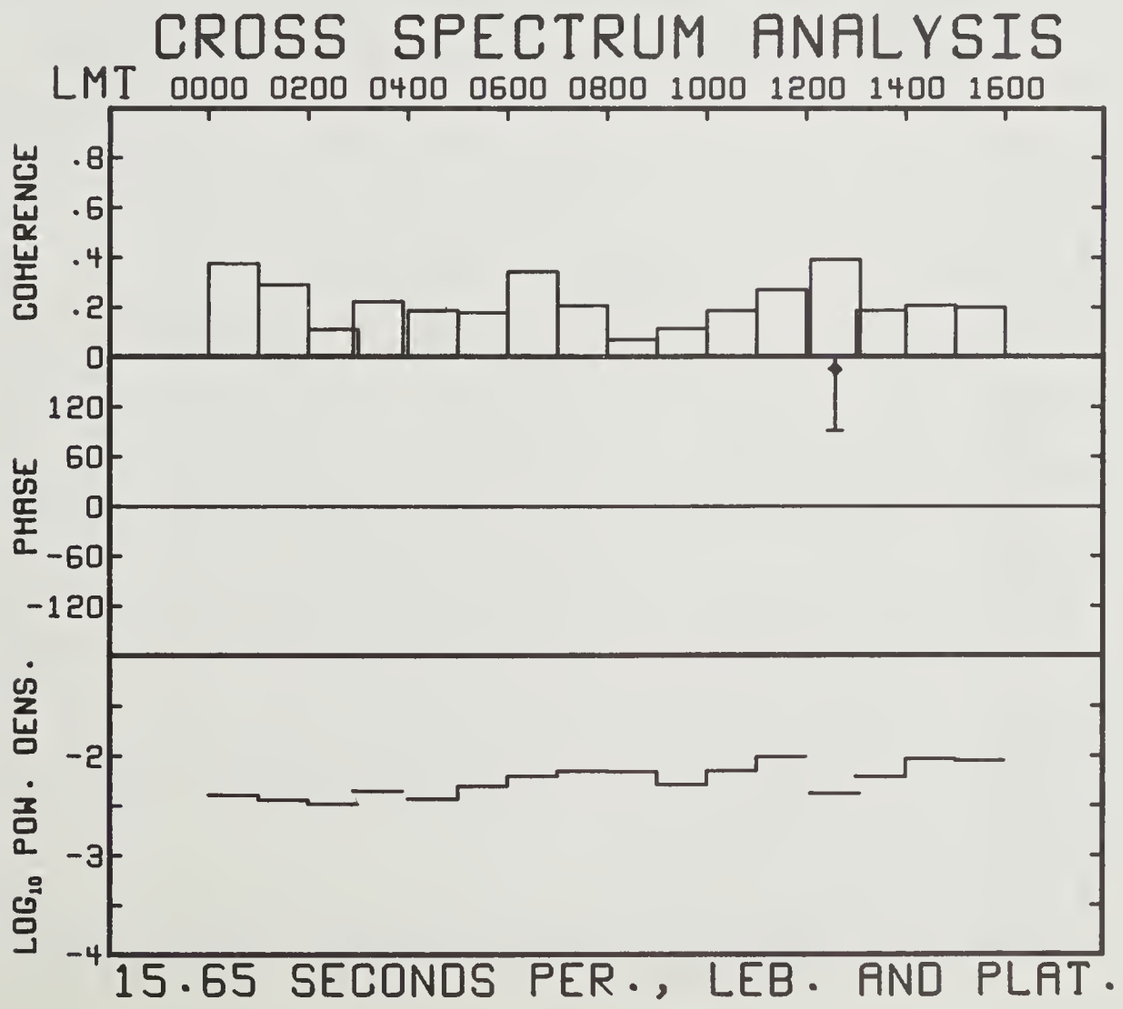
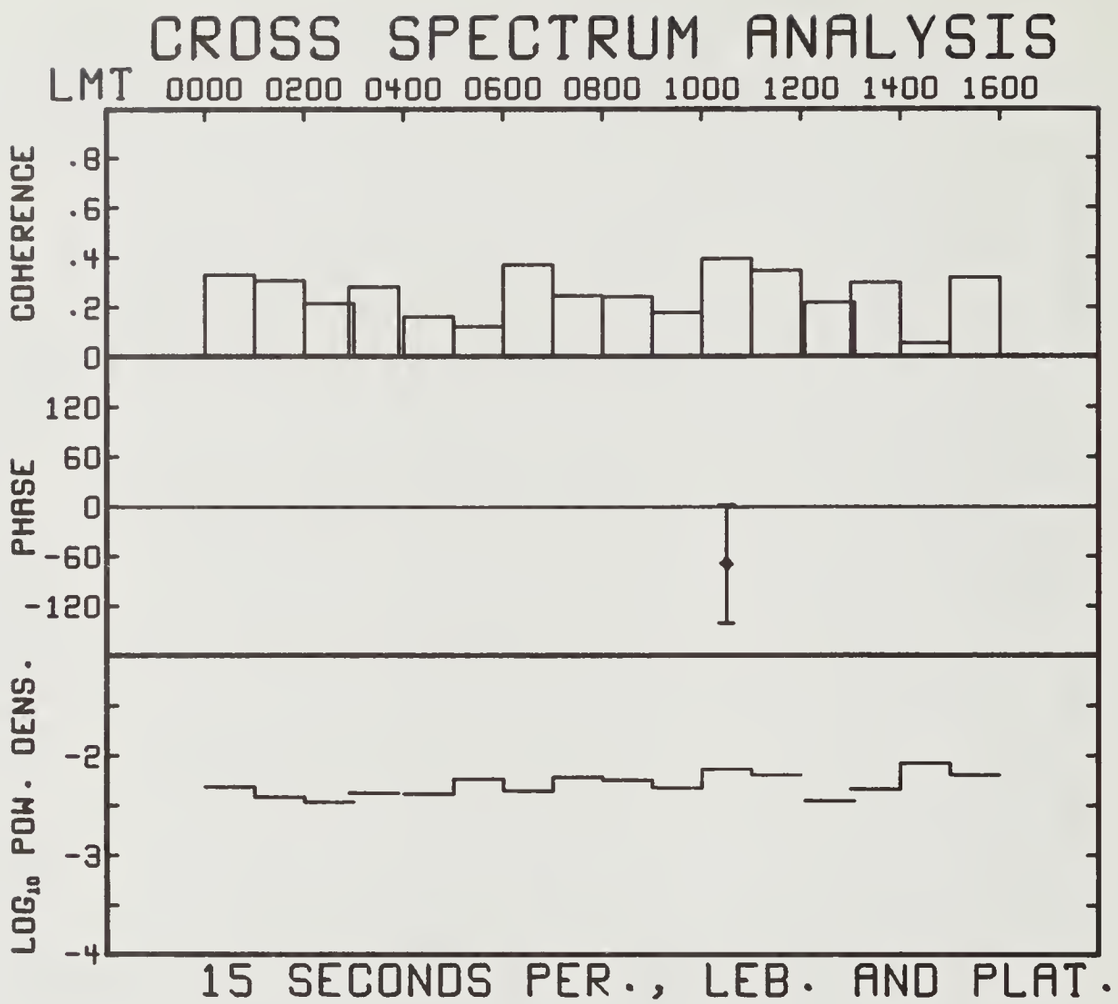
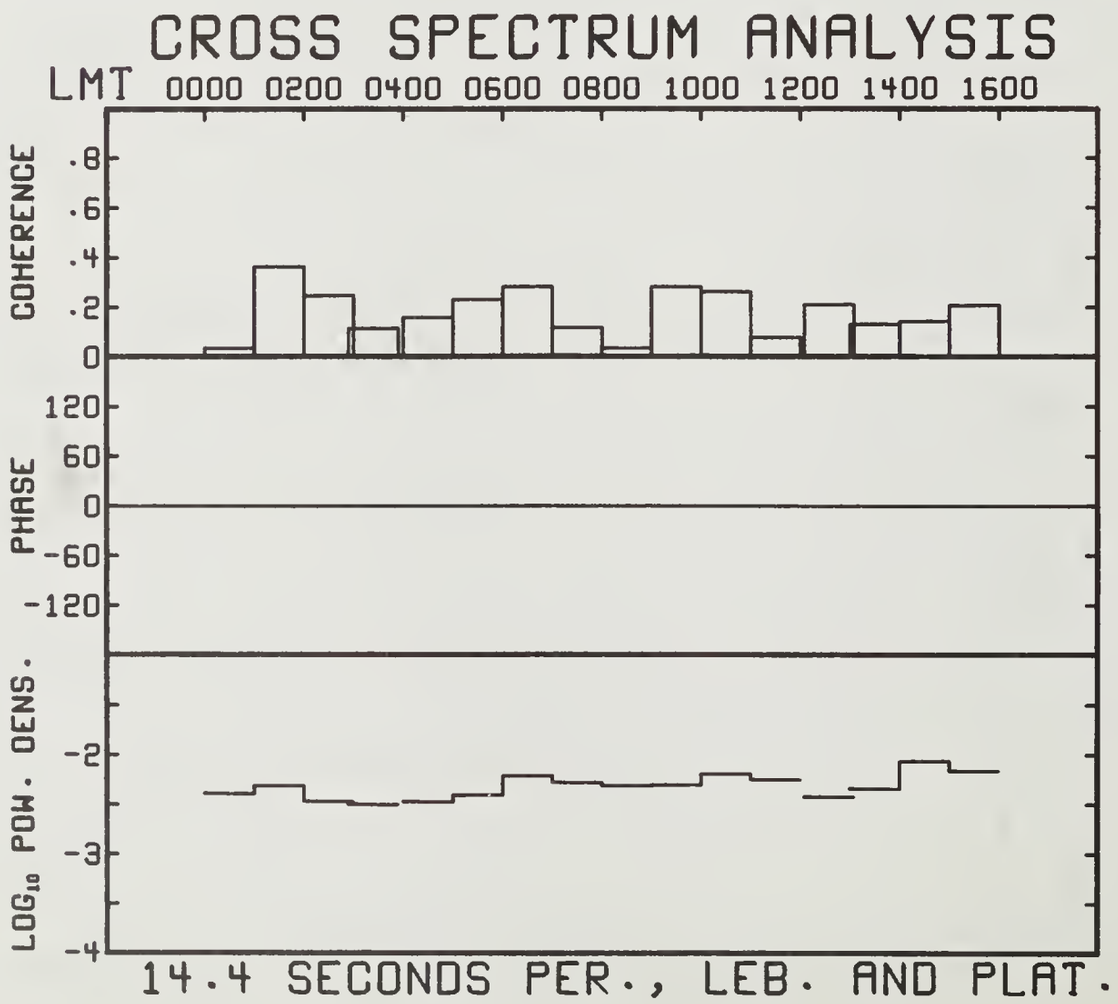
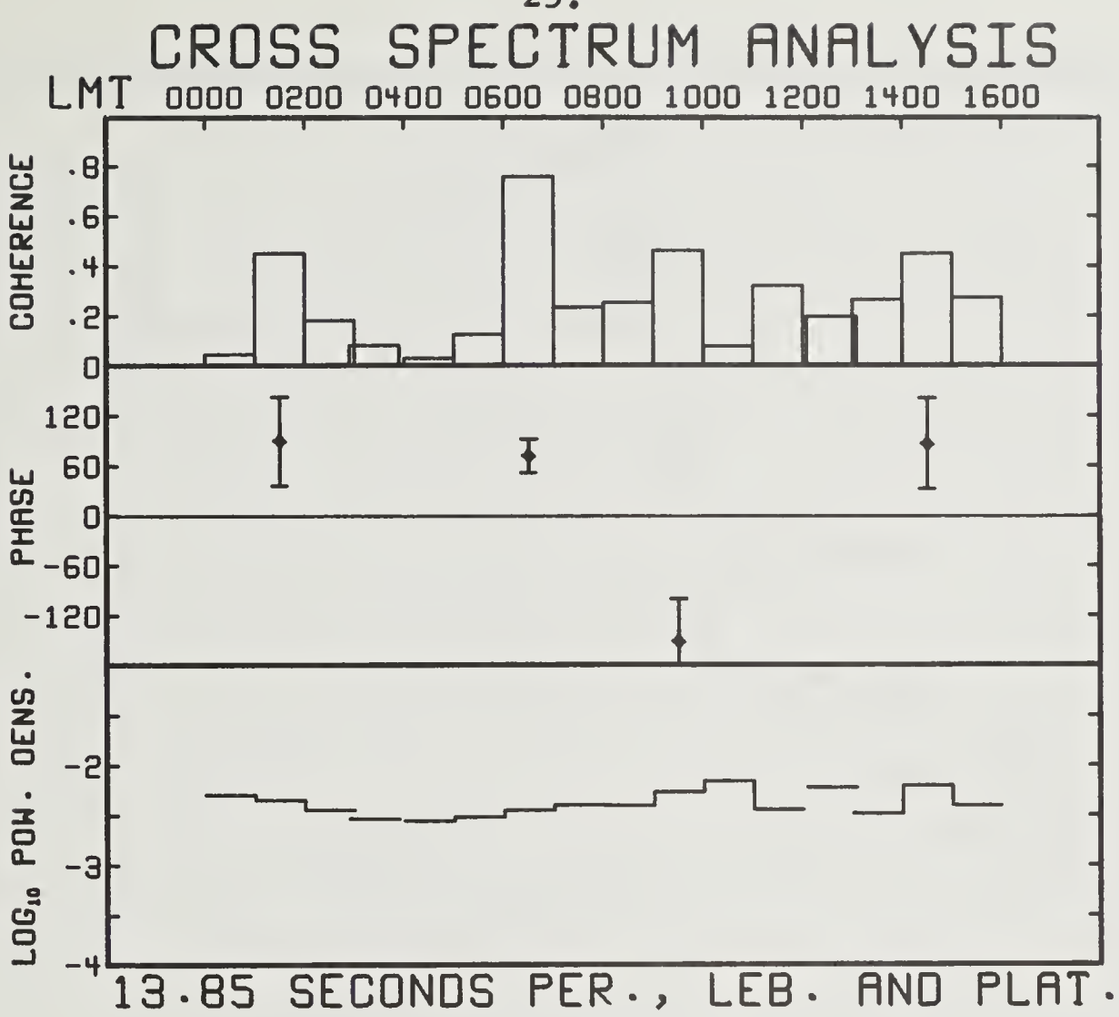
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
17.14 SECONDS PER., LEB. AND PLAT.

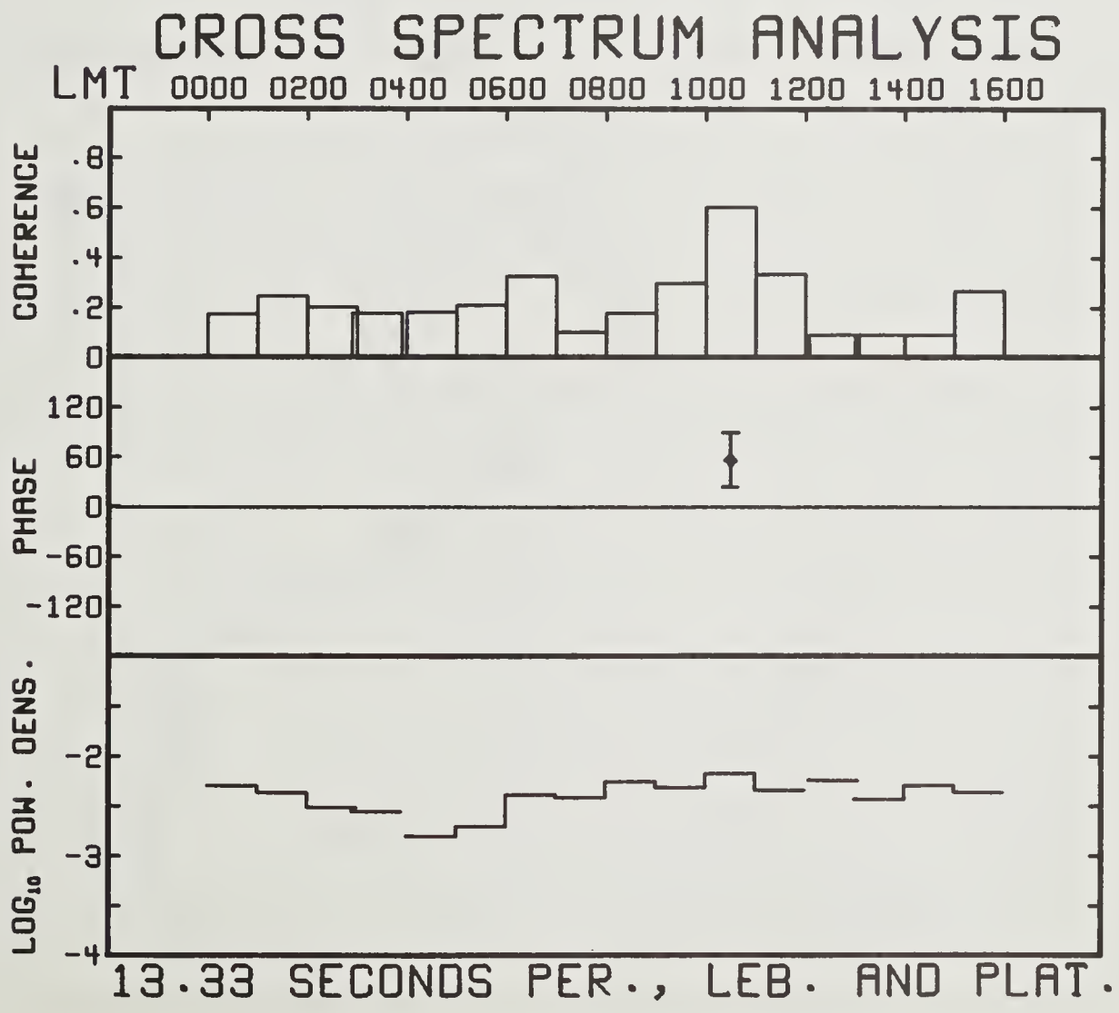

CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
16.36 SECONDS PER., LEB. AND PLAT.

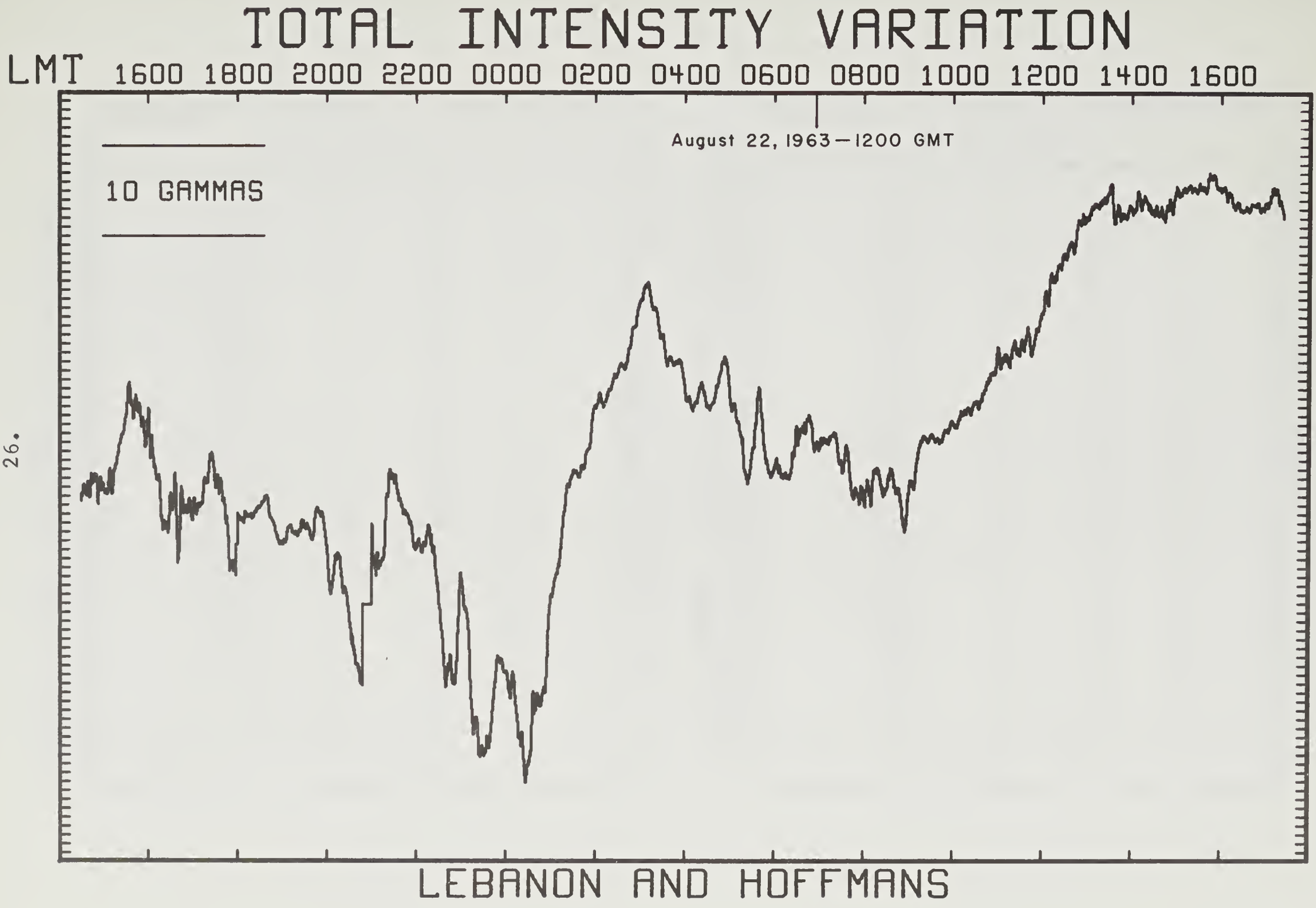

CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
15.65 SECONDS PER., LEB. AND PLAT.

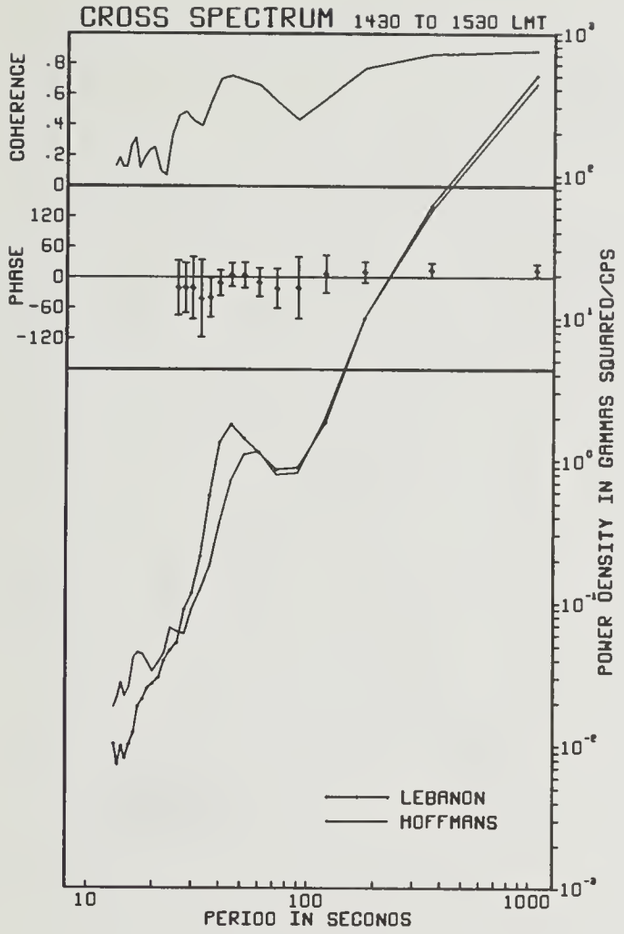

CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
15 SECONDS PER., LEB. AND PLAT.

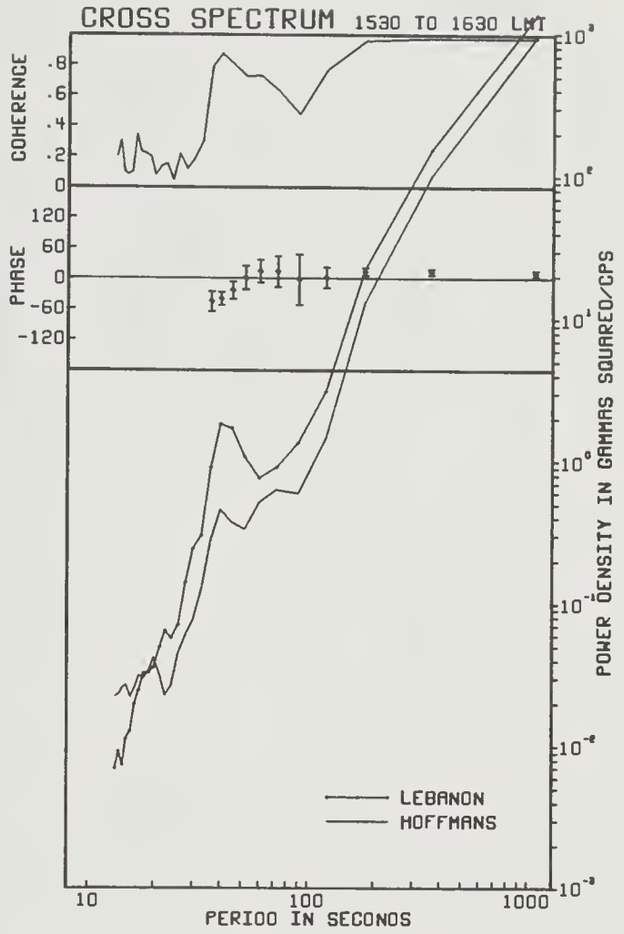

CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
14.4 SECONDS PER., LEB. AND PLAT.

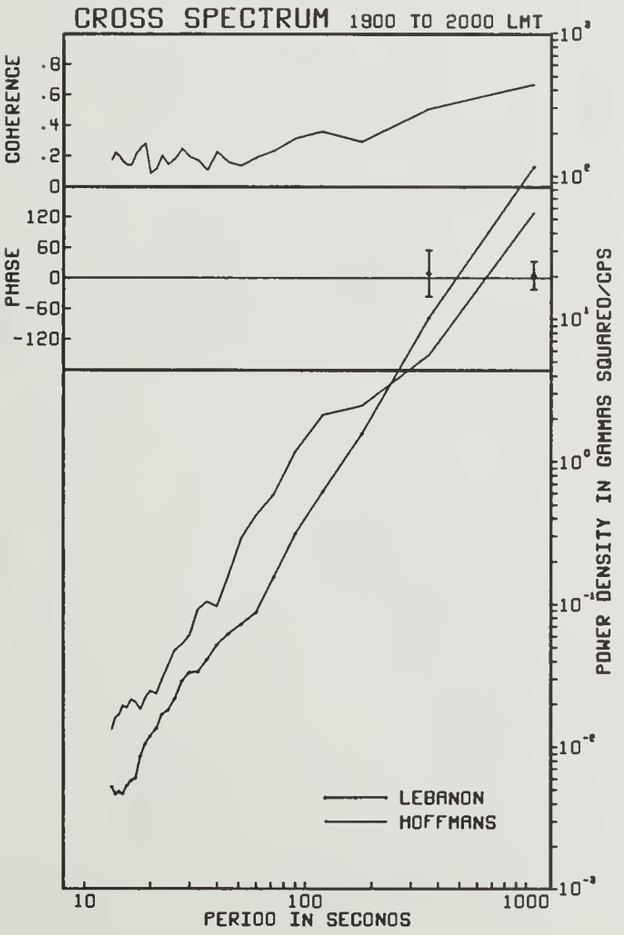

CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
13.85 SECONDS PER., LEB. AND PLAT.

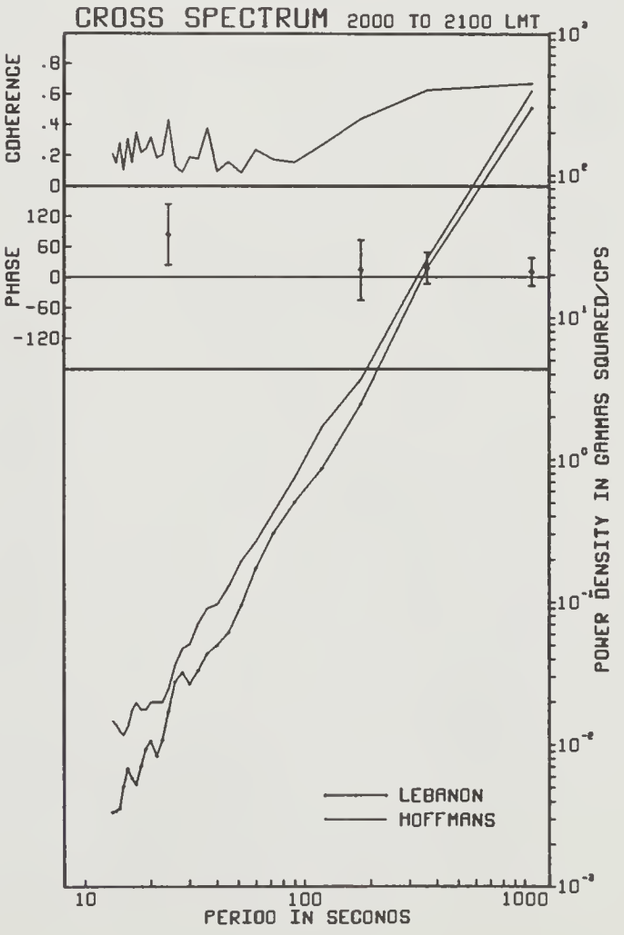

CROSS SPECTRUM ANALYSIS
LMT 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
13.33 SECONDS PER., LEB. AND PLAT.

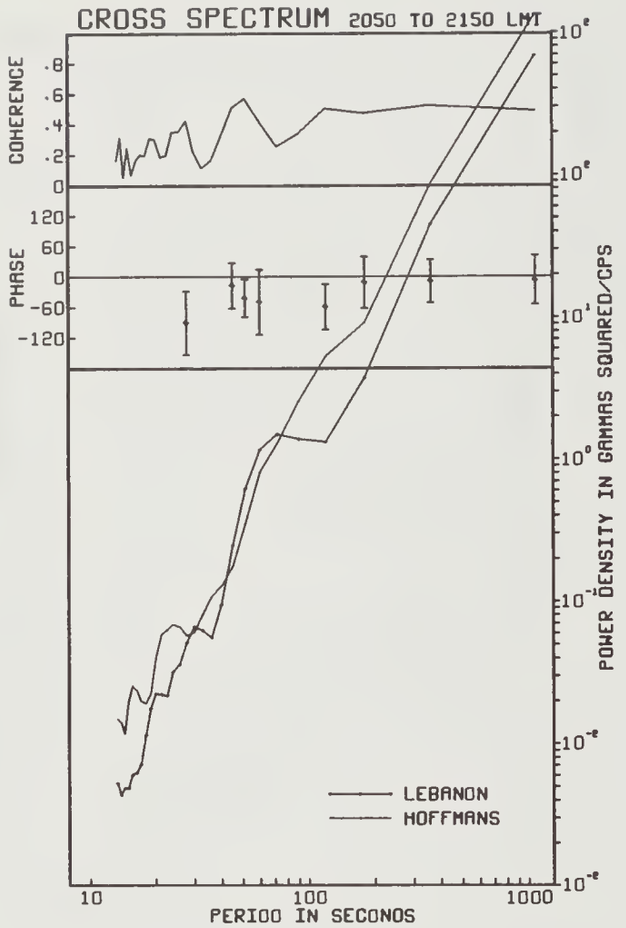

TOTAL INTENSITY VARIATION
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
August 22, 1963—1200 GMT
10 GAMMAS
LEBANON AND HOFFMANS

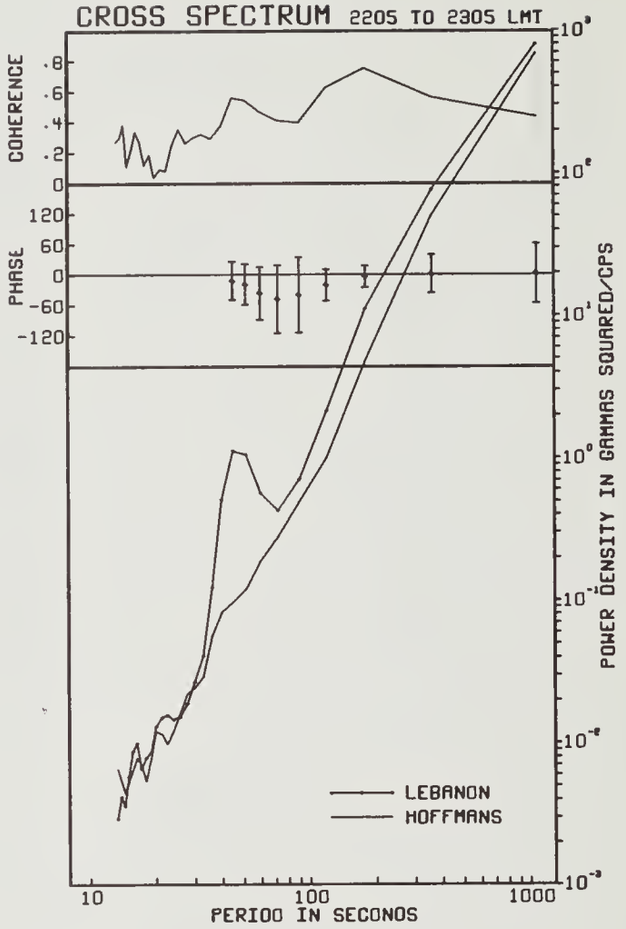

CROSS SPECTRUM 1430 TO 1530 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

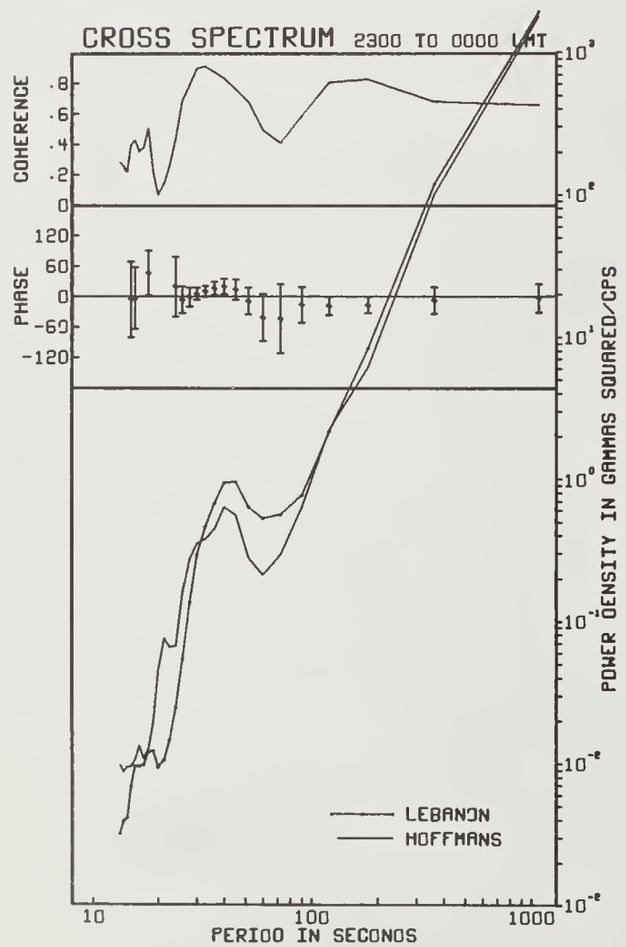

CROSS SPECTRUM 1530 TO 1630 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

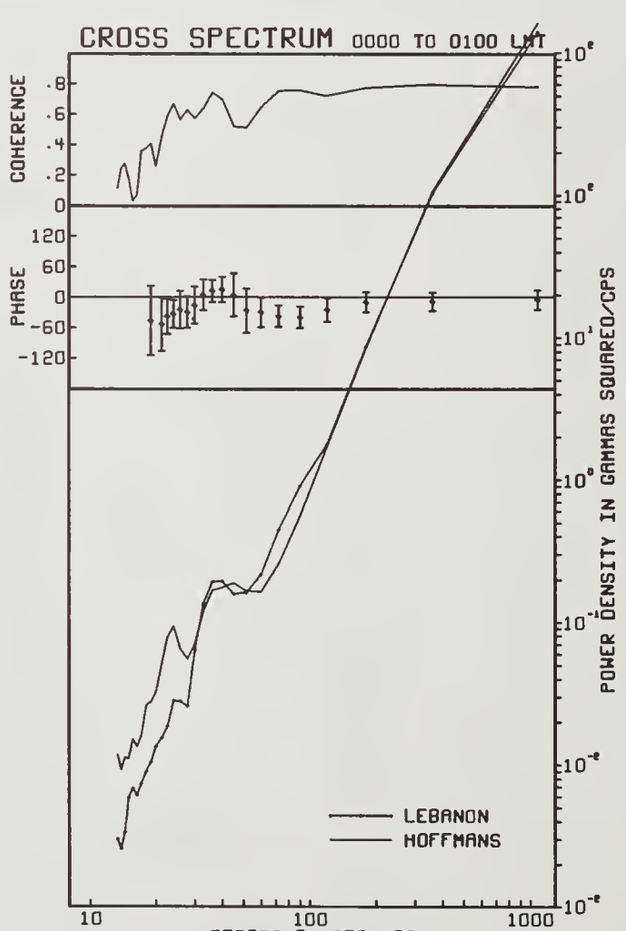

CROSS SPECTRUM 1900 TO 2000 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

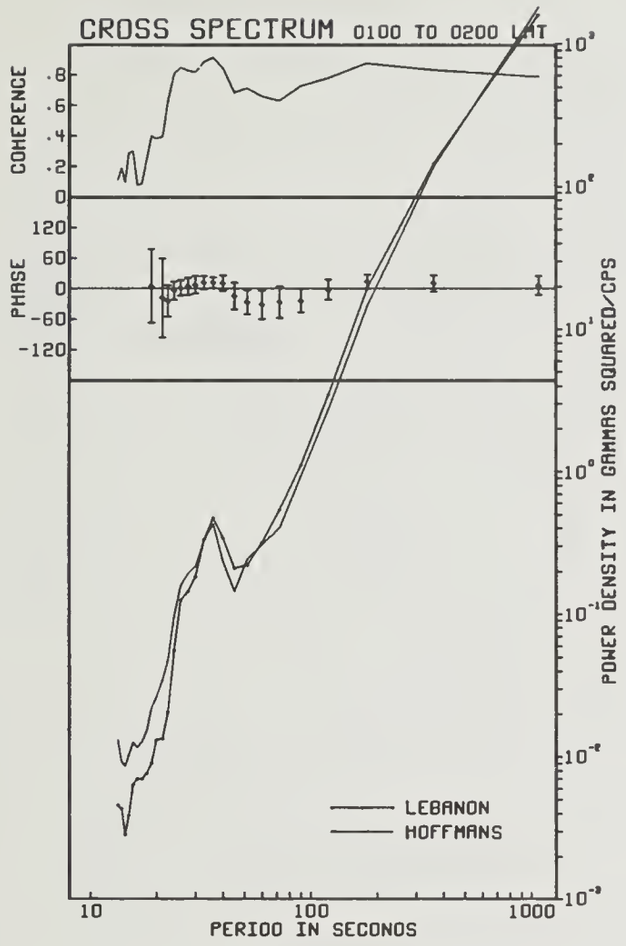

CROSS SPECTRUM 2000 TO 2100 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

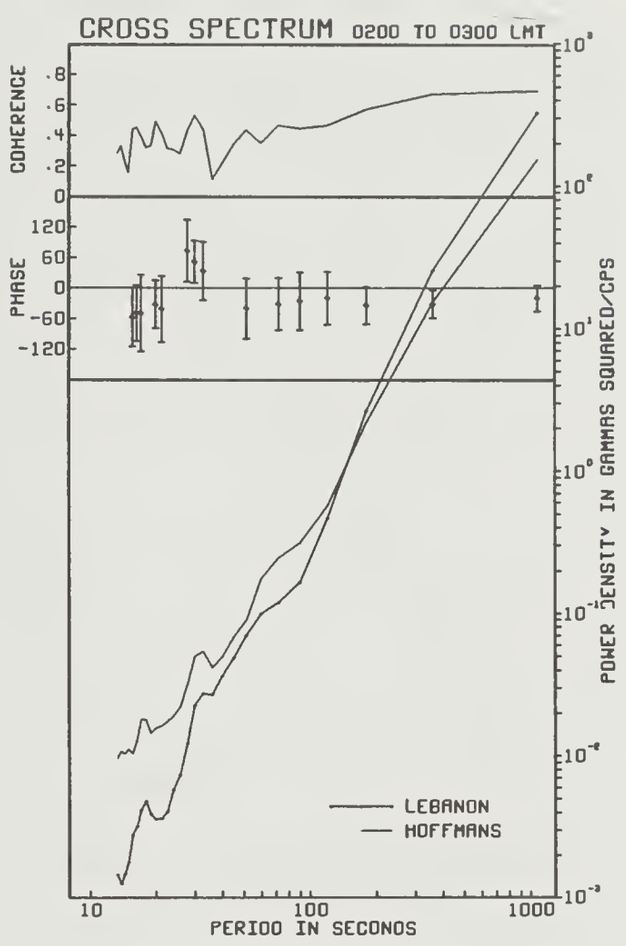

CROSS SPECTRUM 2050 TO 2150 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

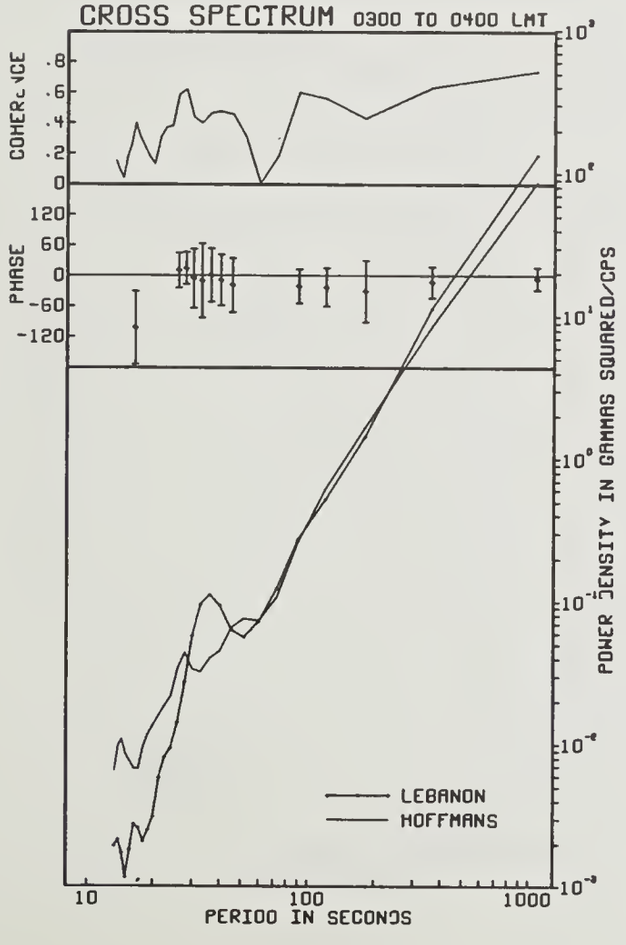

CROSS SPECTRUM 2205 TO 2305 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

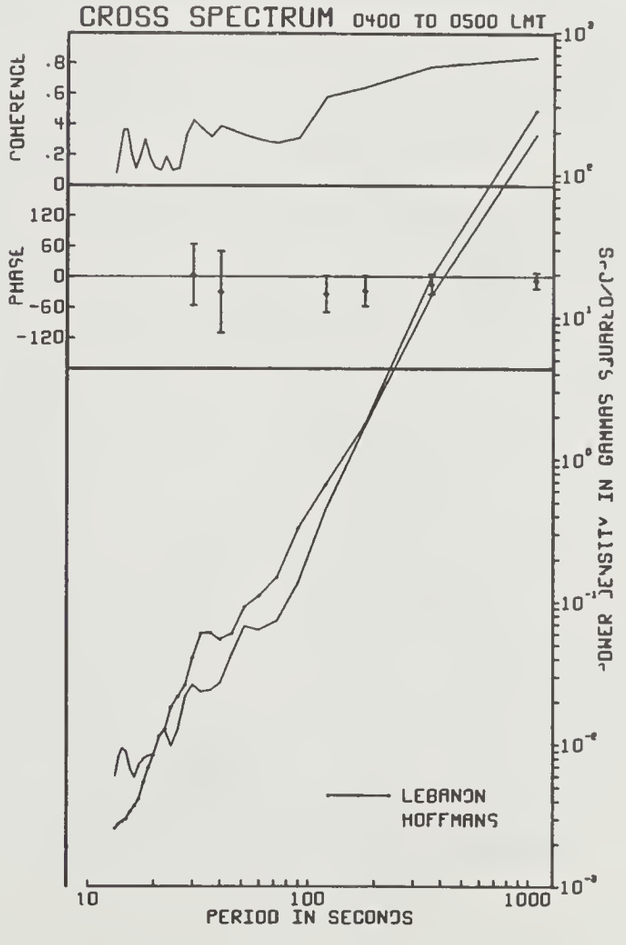

CROSS SPECTRUM 2300 TO 0000 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

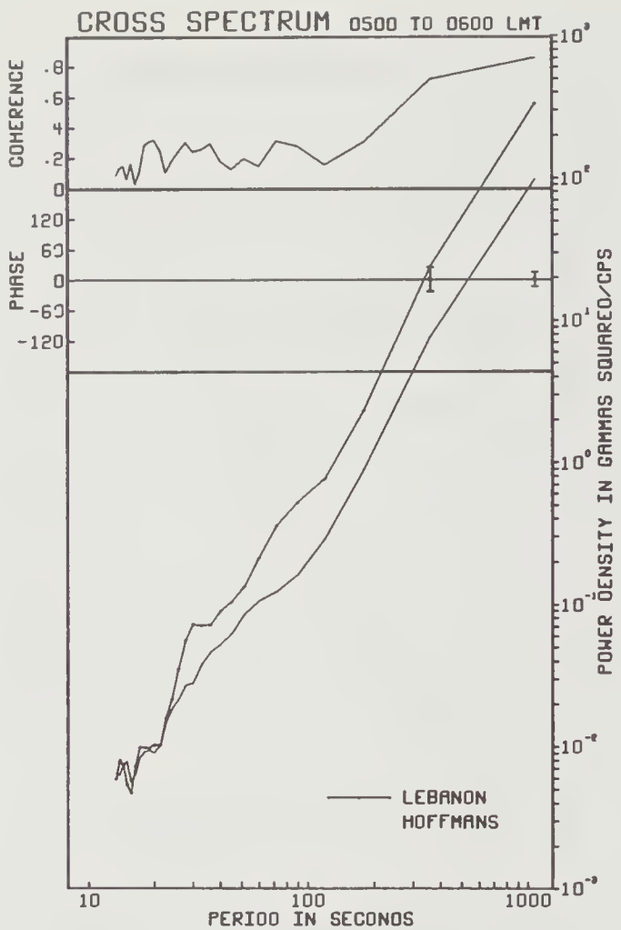

CROSS SPECTRUM 0000 TO 0100 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

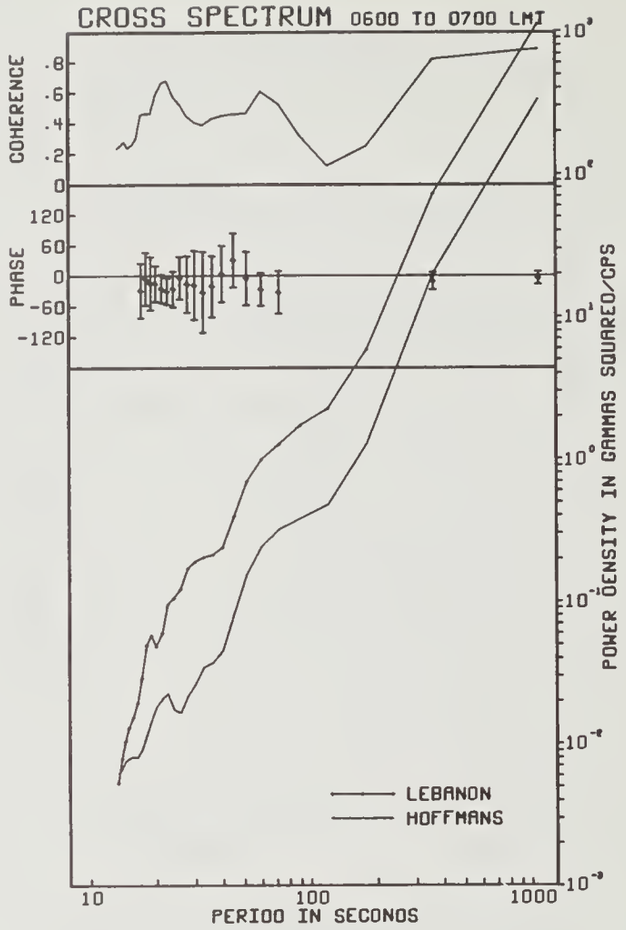

CROSS SPECTRUM 0100 TO 0200 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
HOFFMANS
PERIOD IN SECONDS

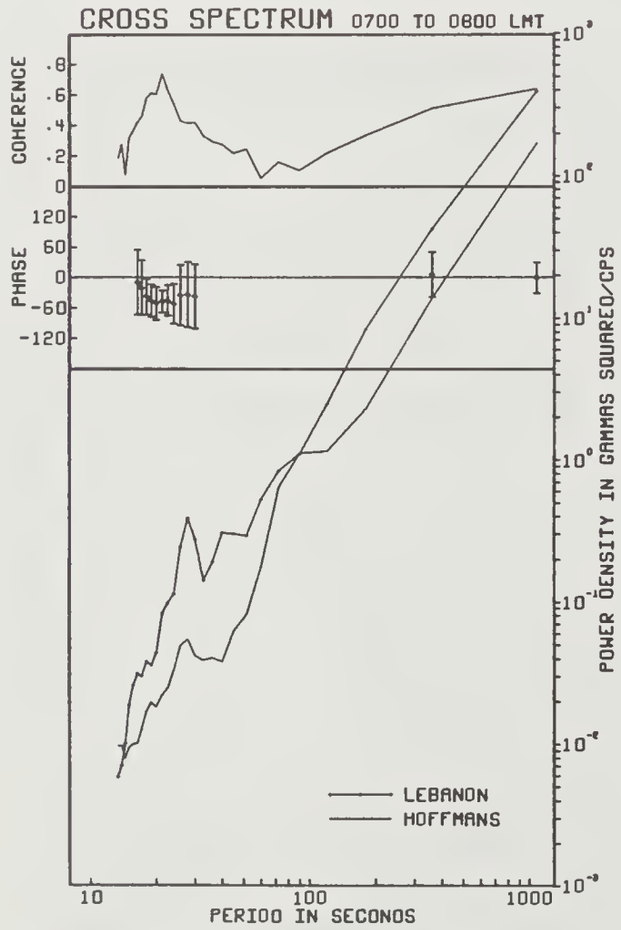

CROSS SPECTRUM 0200 TO 0300 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
HOFFMANS
PERIOD IN SECONDS

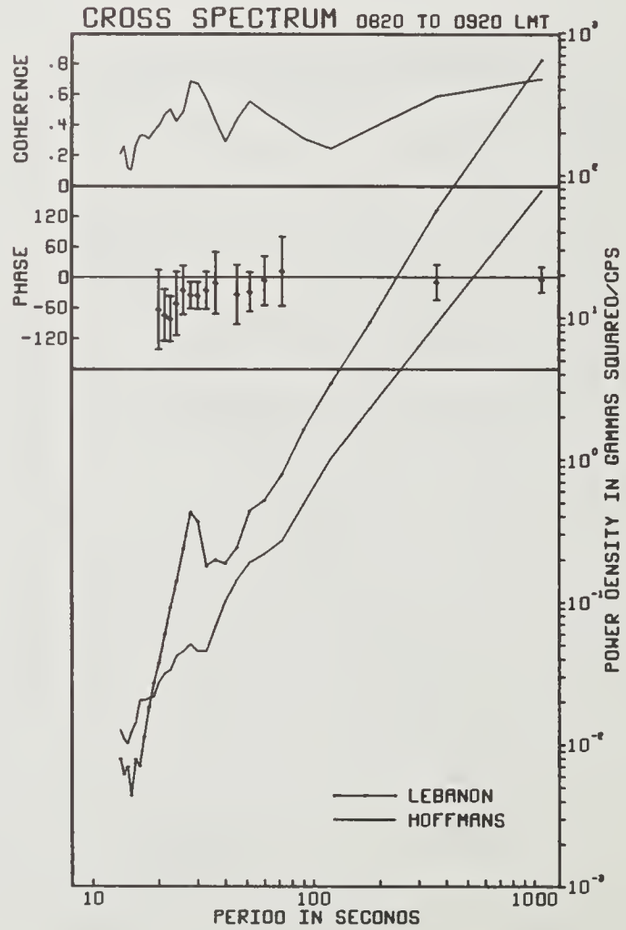

CROSS SPECTRUM 0300 TO 0400 LMT
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
HOFFMANS
PERIOD IN SECONDS

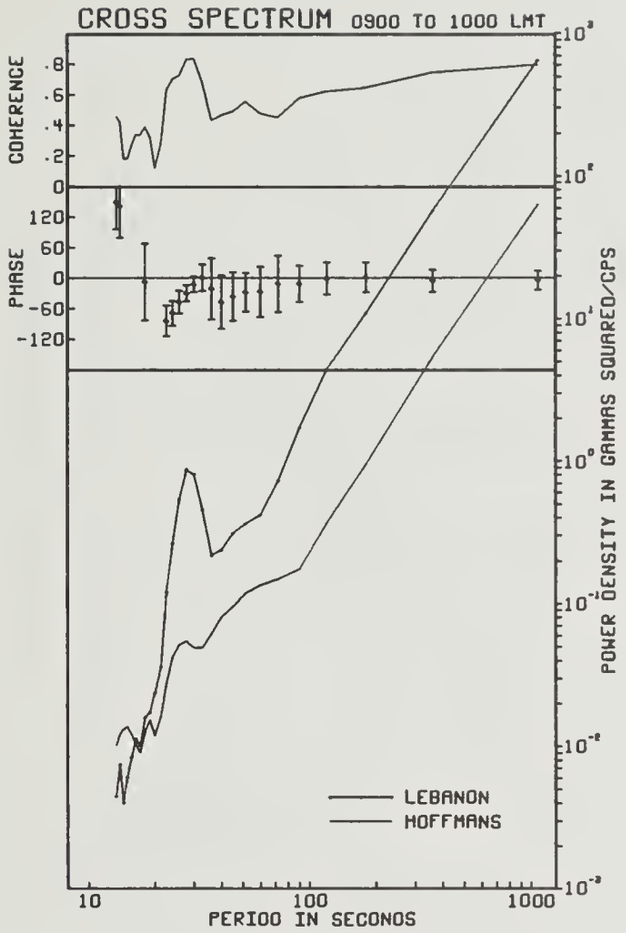

CROSS SPECTRUM 0400 TO 0500 LMT
PHASE
LEBANON
HOFFMANS
PERIOD IN SECONDS

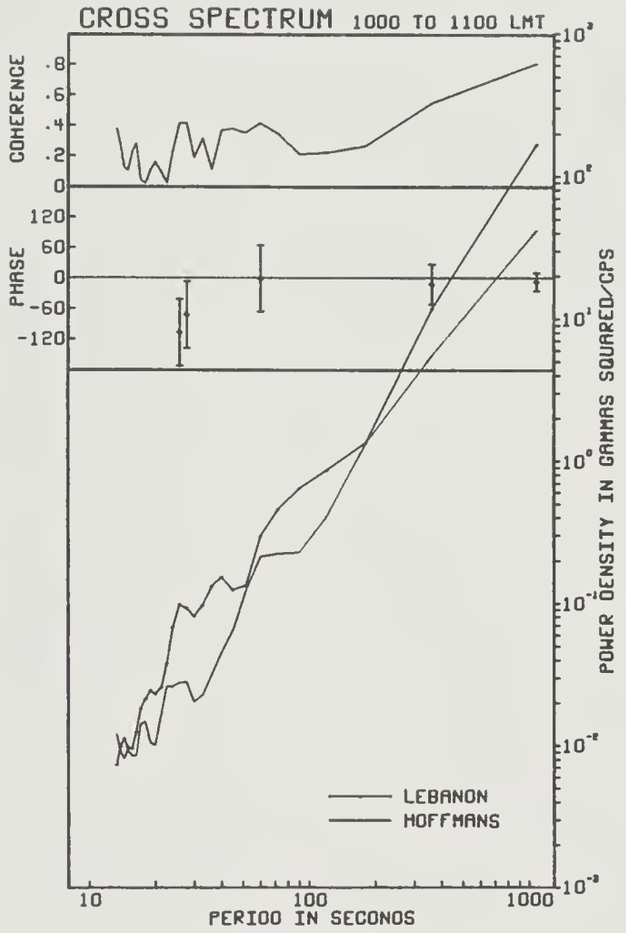

CROSS SPECTRUM 0500 TO 0600 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

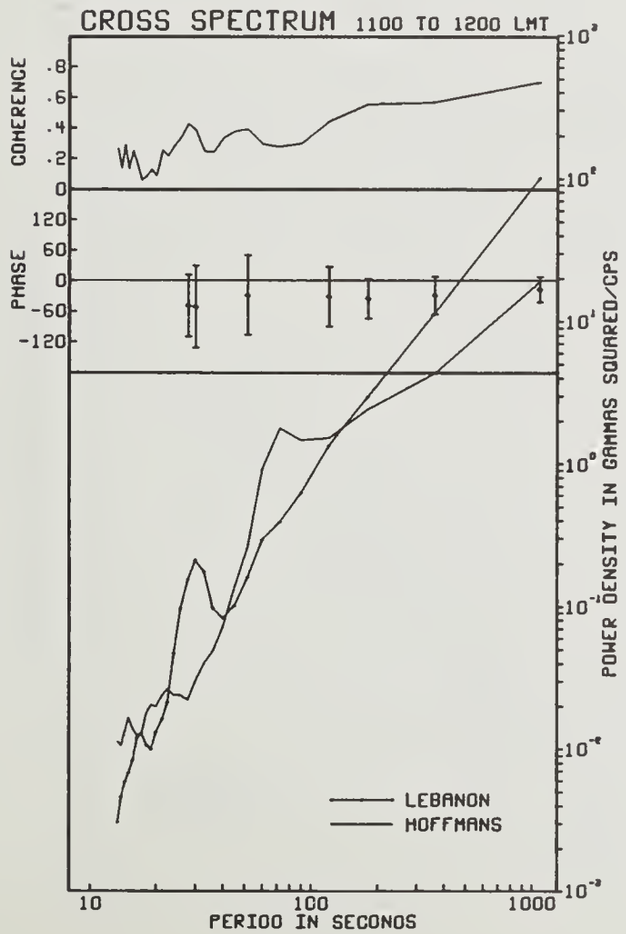

CROSS SPECTRUM 0600 TO 0700 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

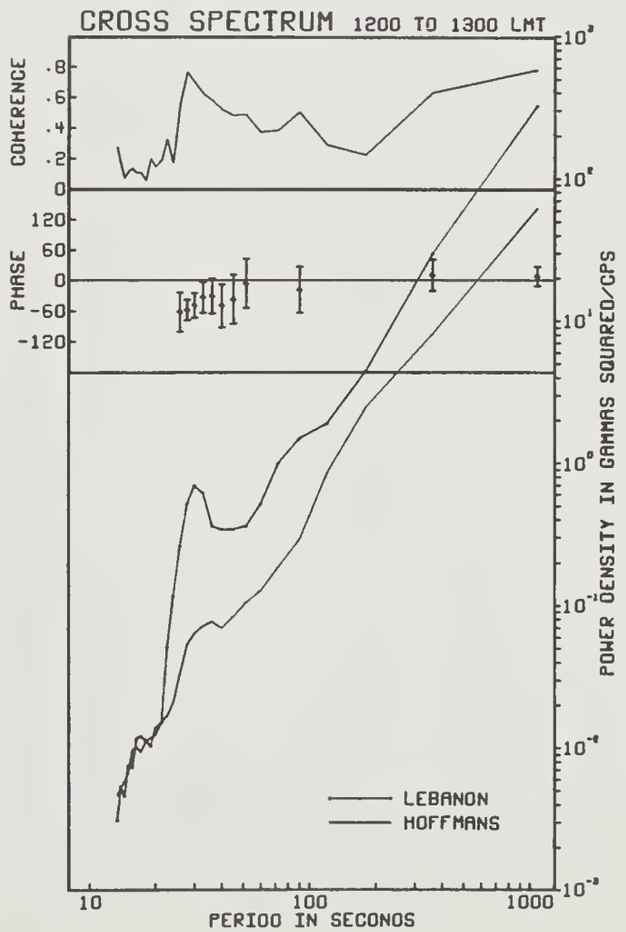

CROSS SPECTRUM 0700 TO 0800 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

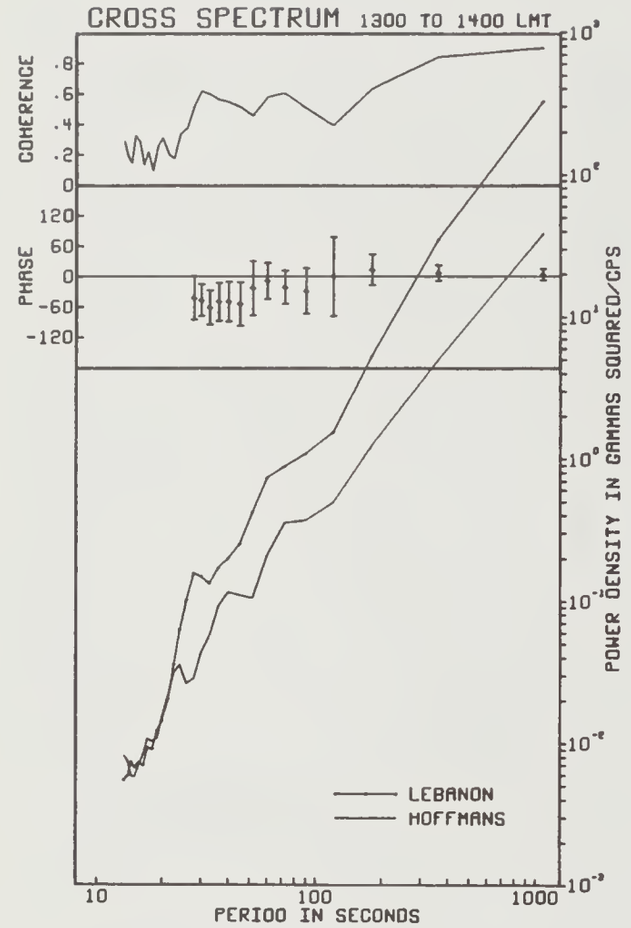

CROSS SPECTRUM 0820 TO 0920 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

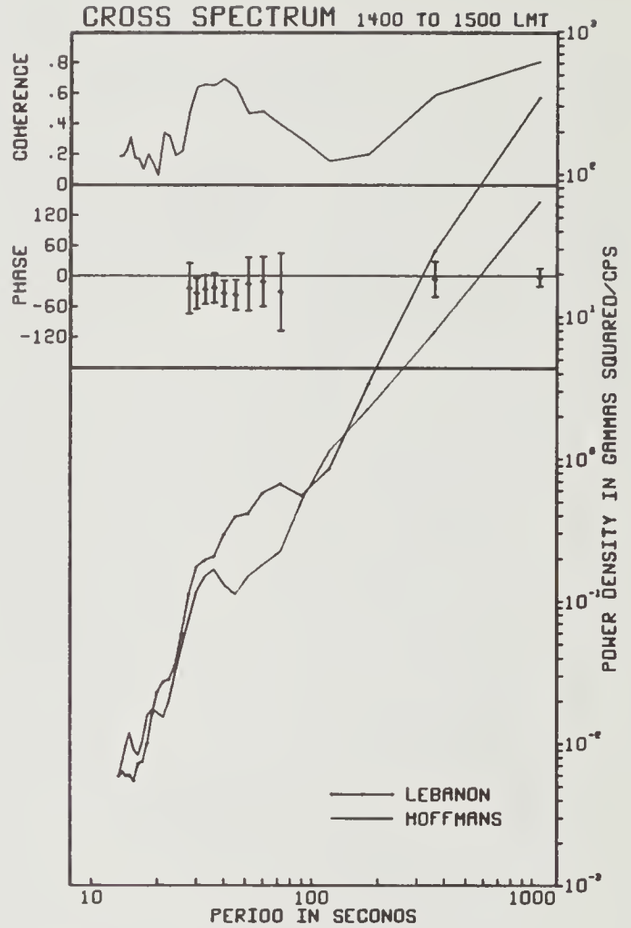

CROSS SPECTRUM 0900 TO 1000 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

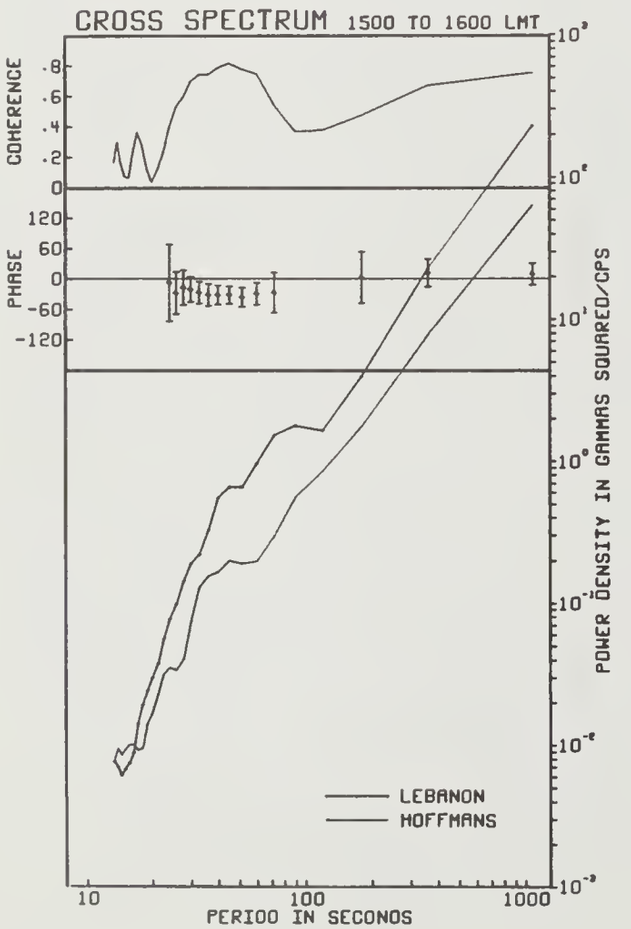

CROSS SPECTRUM 1000 TO 1100 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

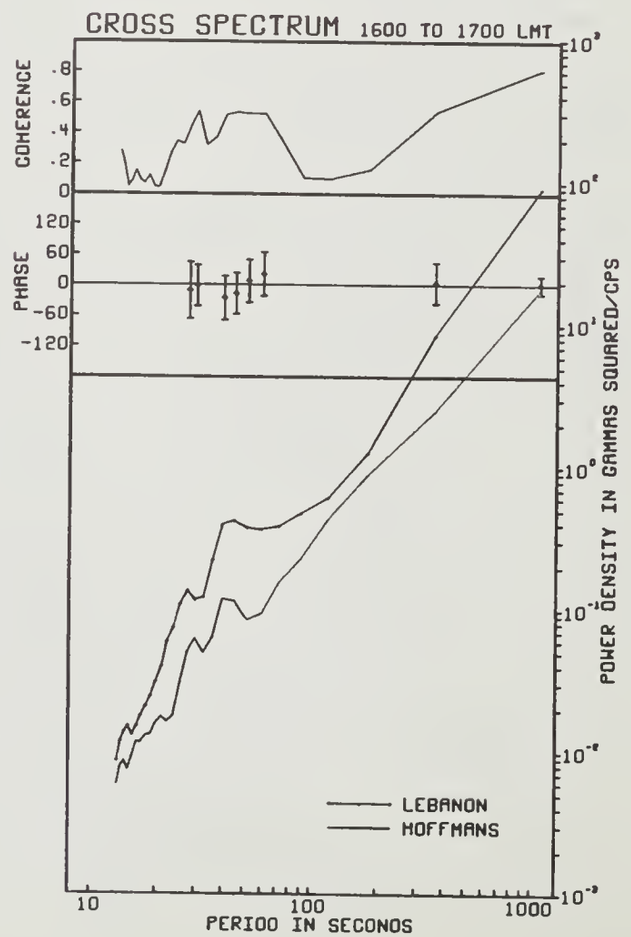

CROSS SPECTRUM 1100 TO 1200 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

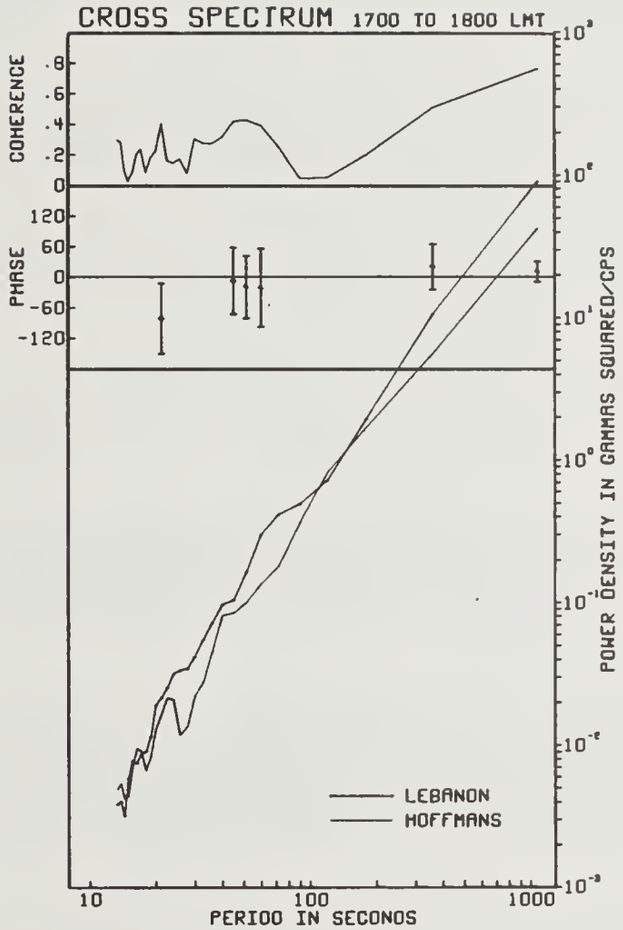

CROSS SPECTRUM 1200 TO 1300 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
HOFFMANS

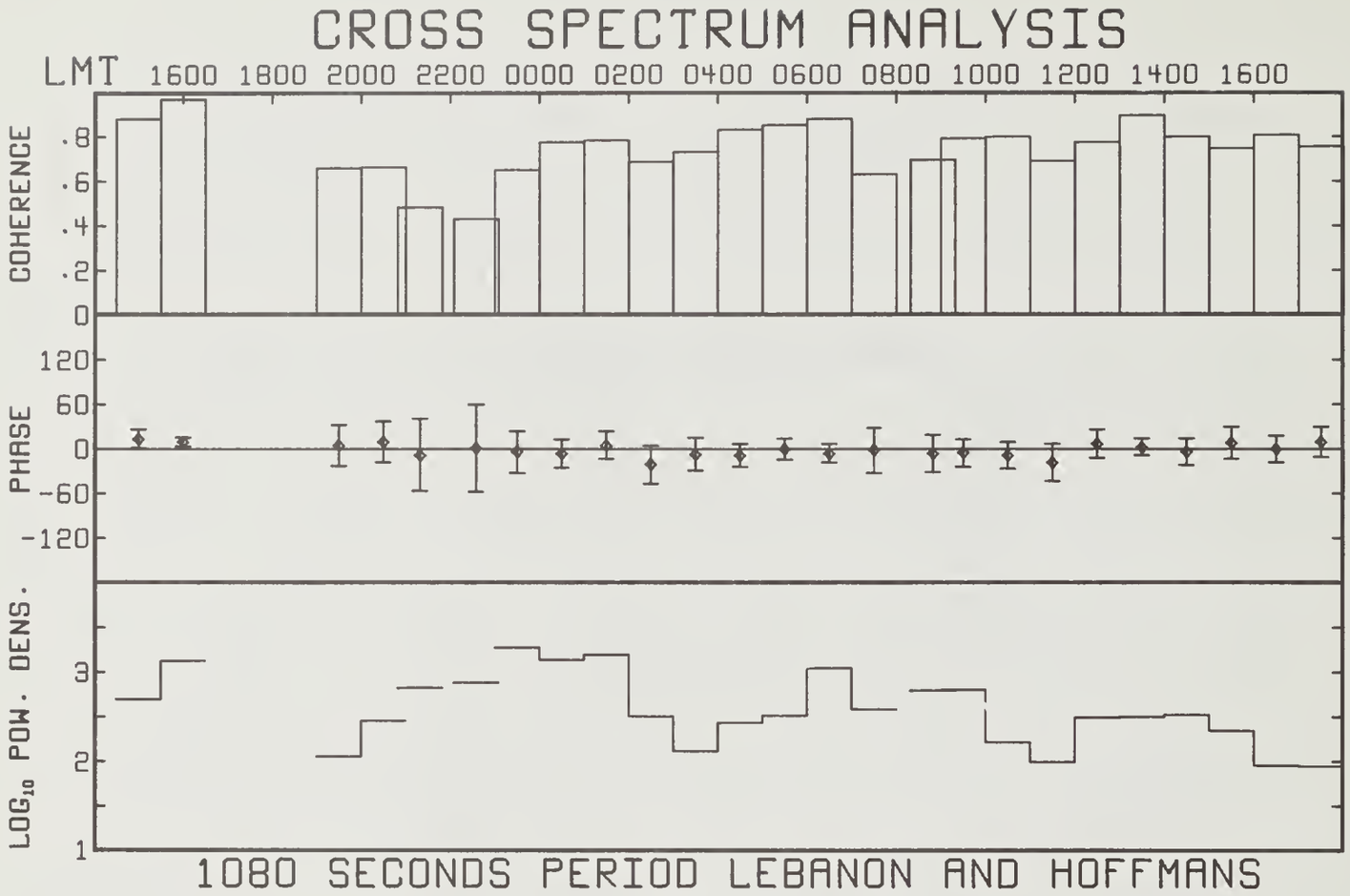

CROSS SPECTRUM 1300 TO 1400 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
HOFFMANS
PERIOD IN SECONDS

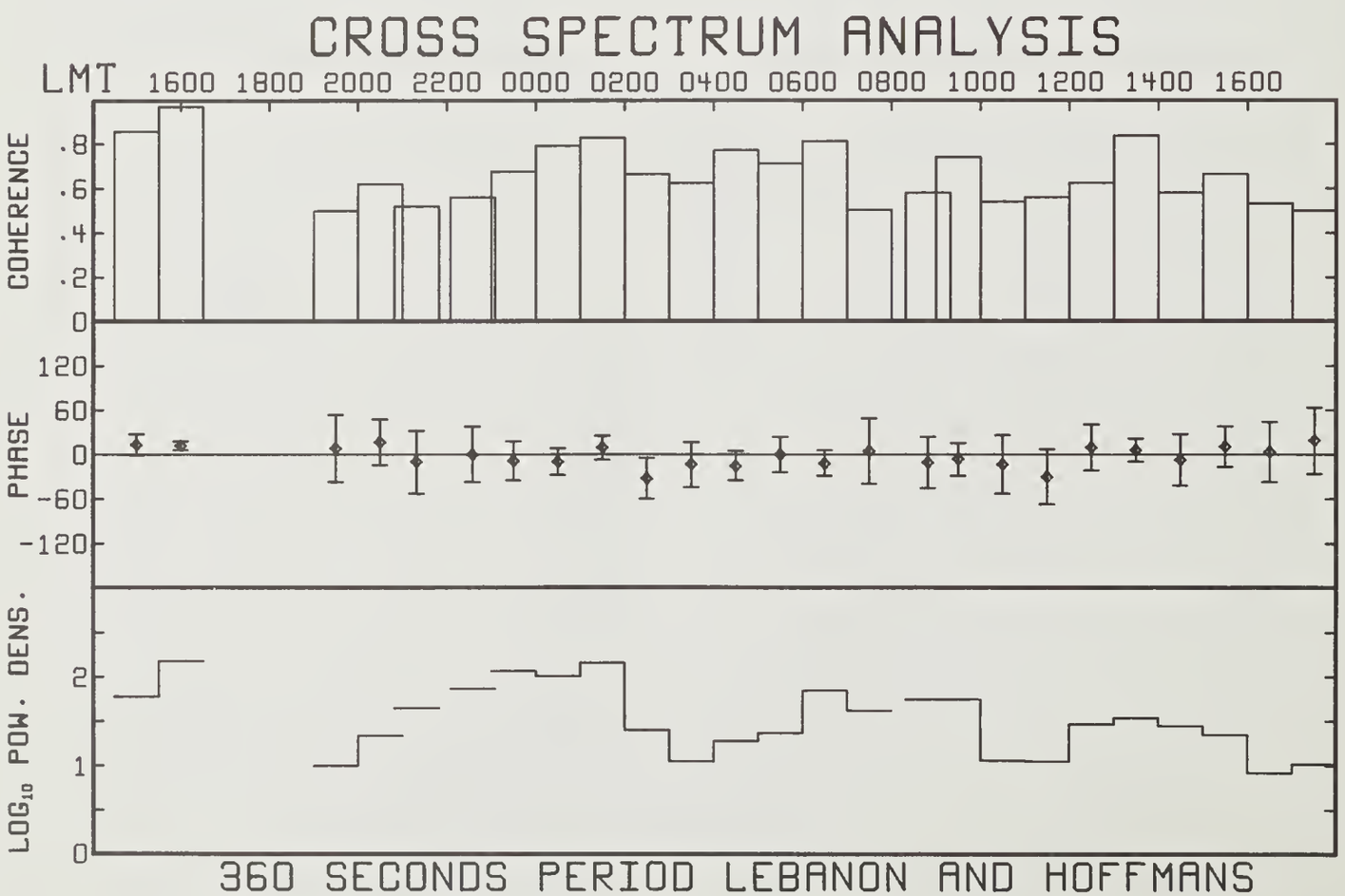

CROSS SPECTRUM 1400 TO 1500 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
HOFFMANS
PERIOD IN SECONDS

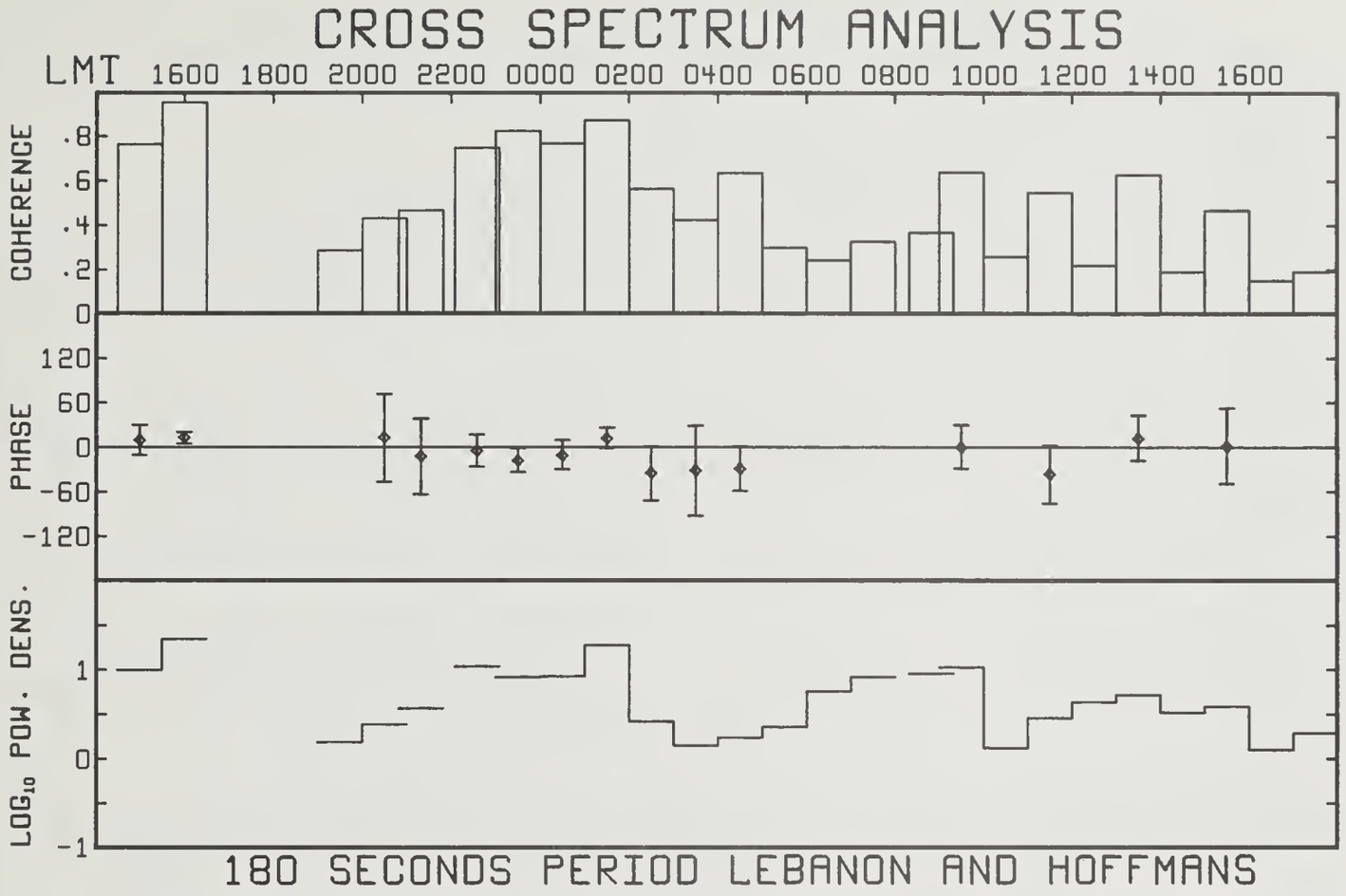

CROSS SPECTRUM 1500 TO 1600 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
HOFFMANS
PERIOD IN SECONDS

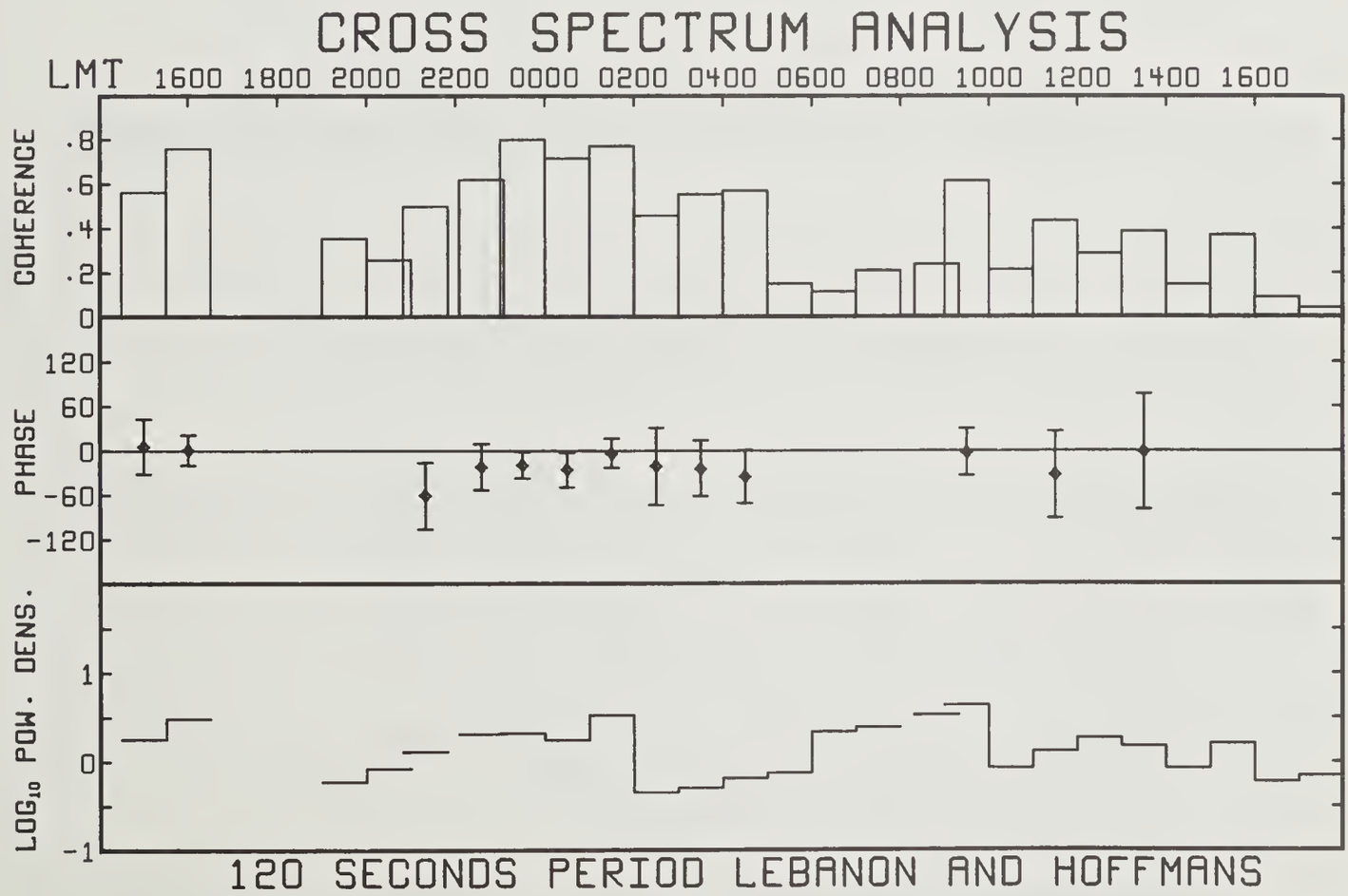

CROSS SPECTRUM 1600 TO 1700 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
HOFFMANS
PERIOD IN SECONDS

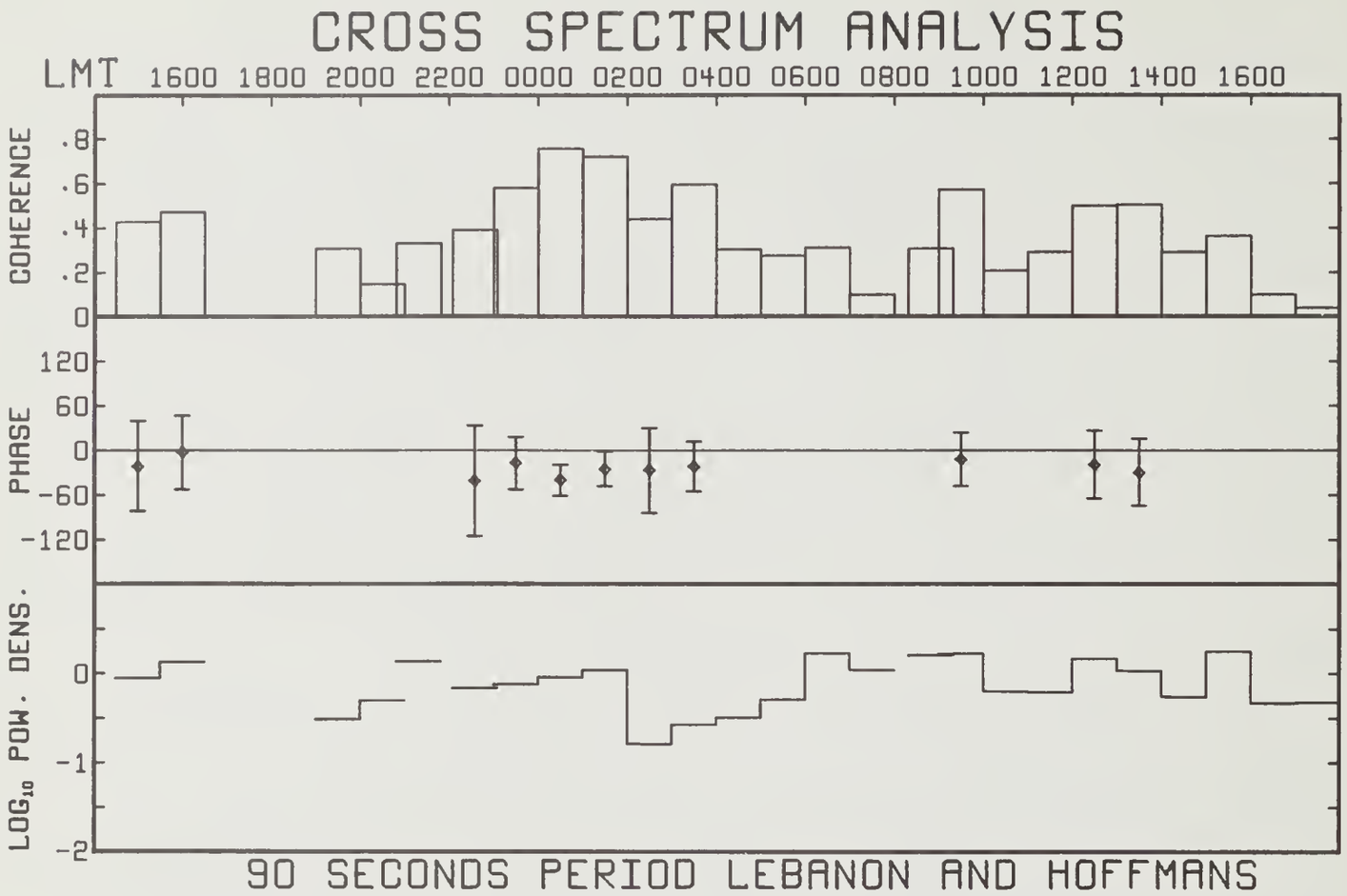

CROSS SPECTRUM 1700 TO 1800 LMT
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LEBANON
HOFFMANS
10
100
1000
PERIOD IN SECONDS
POWER DENSITY IN GAMMAS SQUARED/CPS

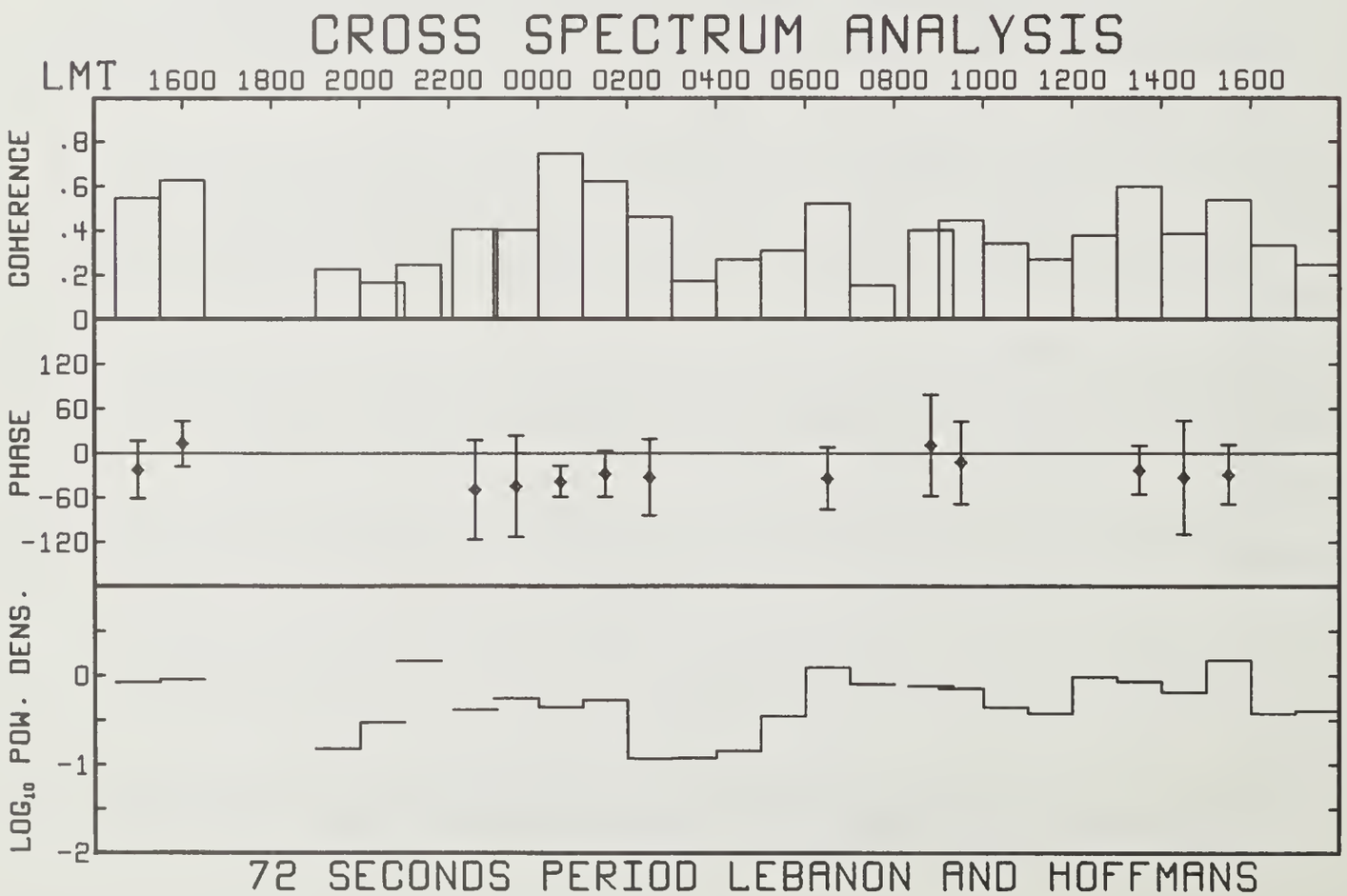

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
3
2
1
1080 SECONDS PERIOD LEBANON AND HOFFMANS

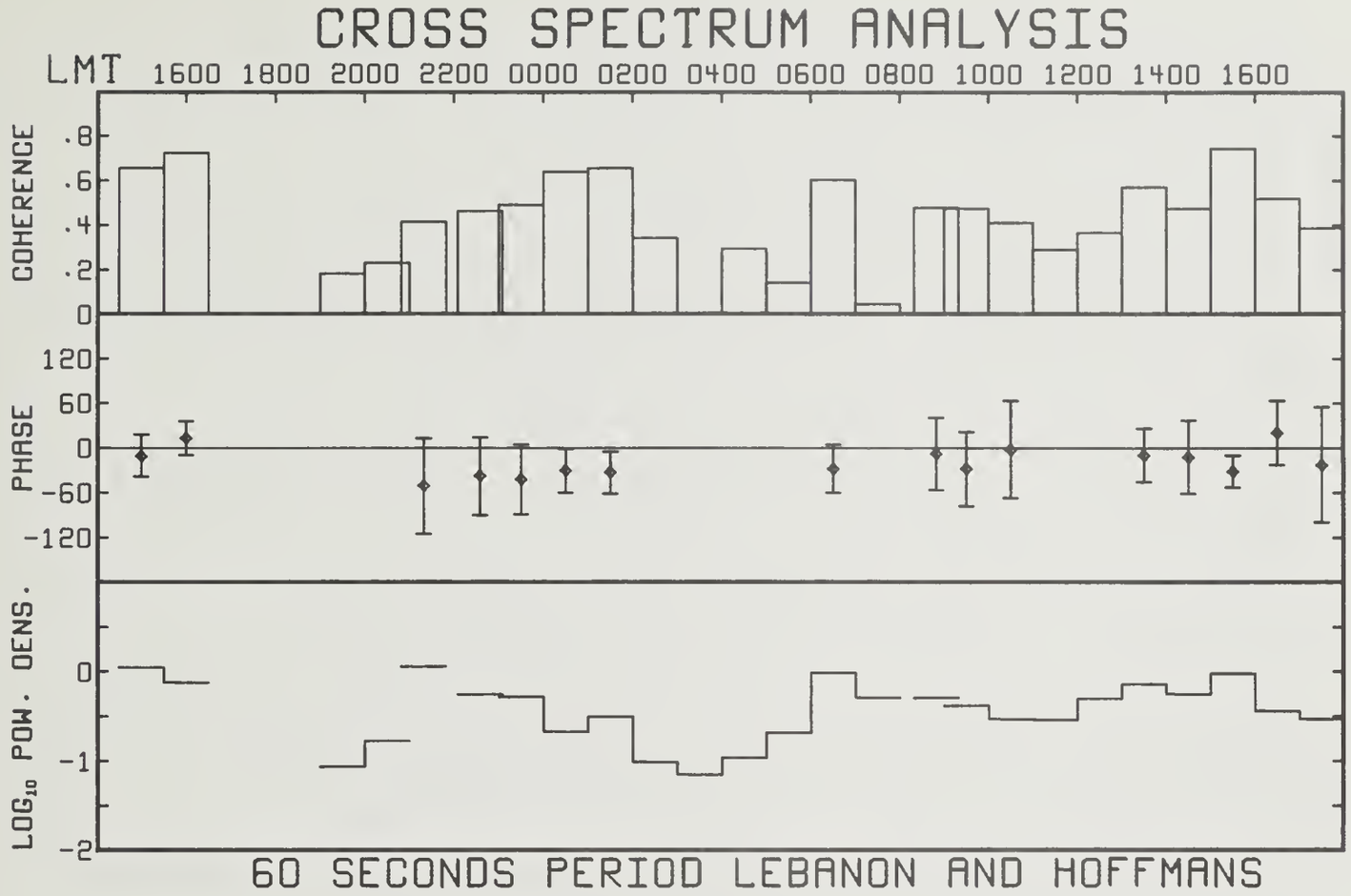

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
2
1
0
360 SECONDS PERIOD LEBANON AND HOFFMANS

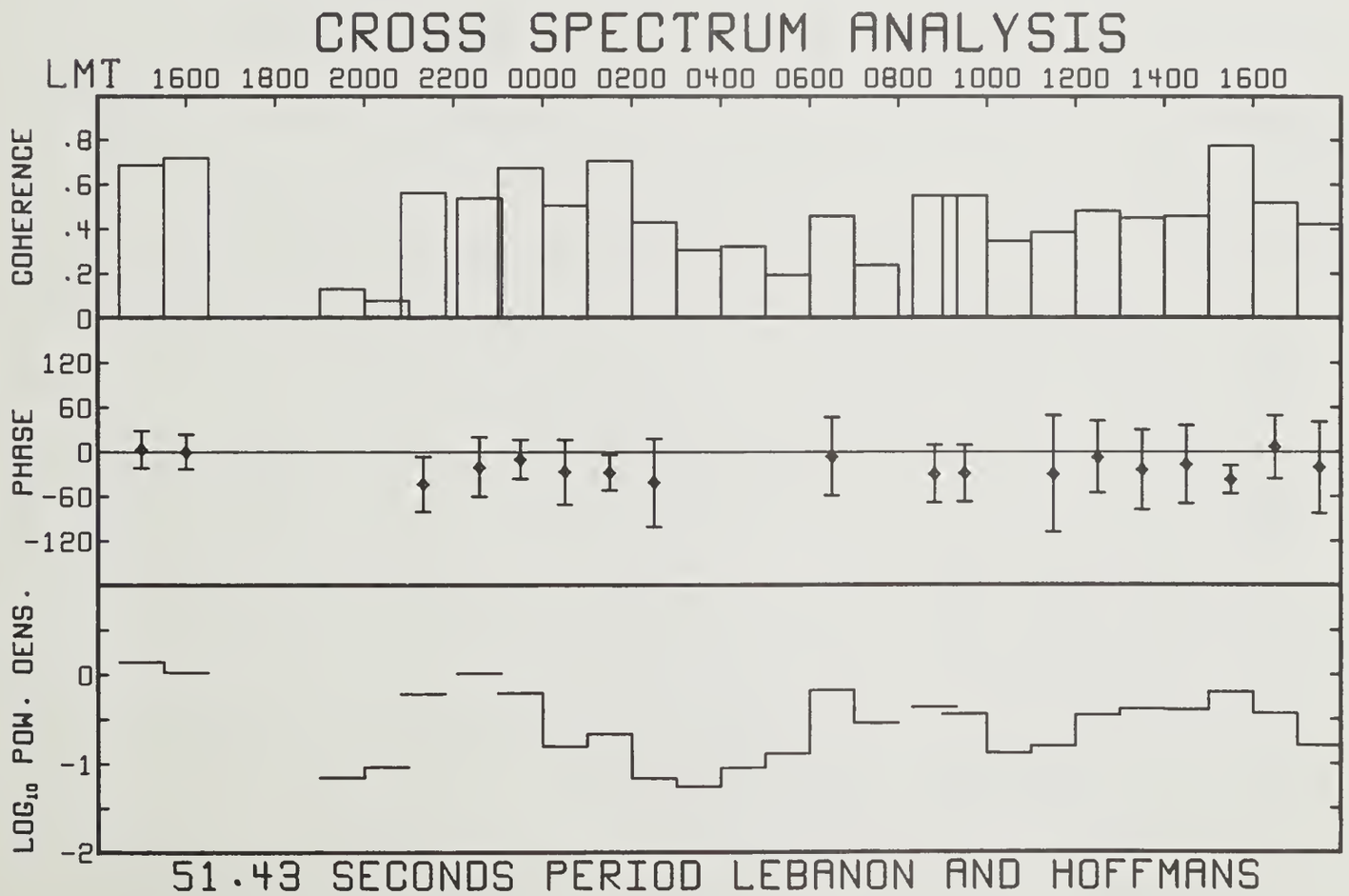

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
1
0
-1
180 SECONDS PERIOD LEBANON AND HOFFMANS

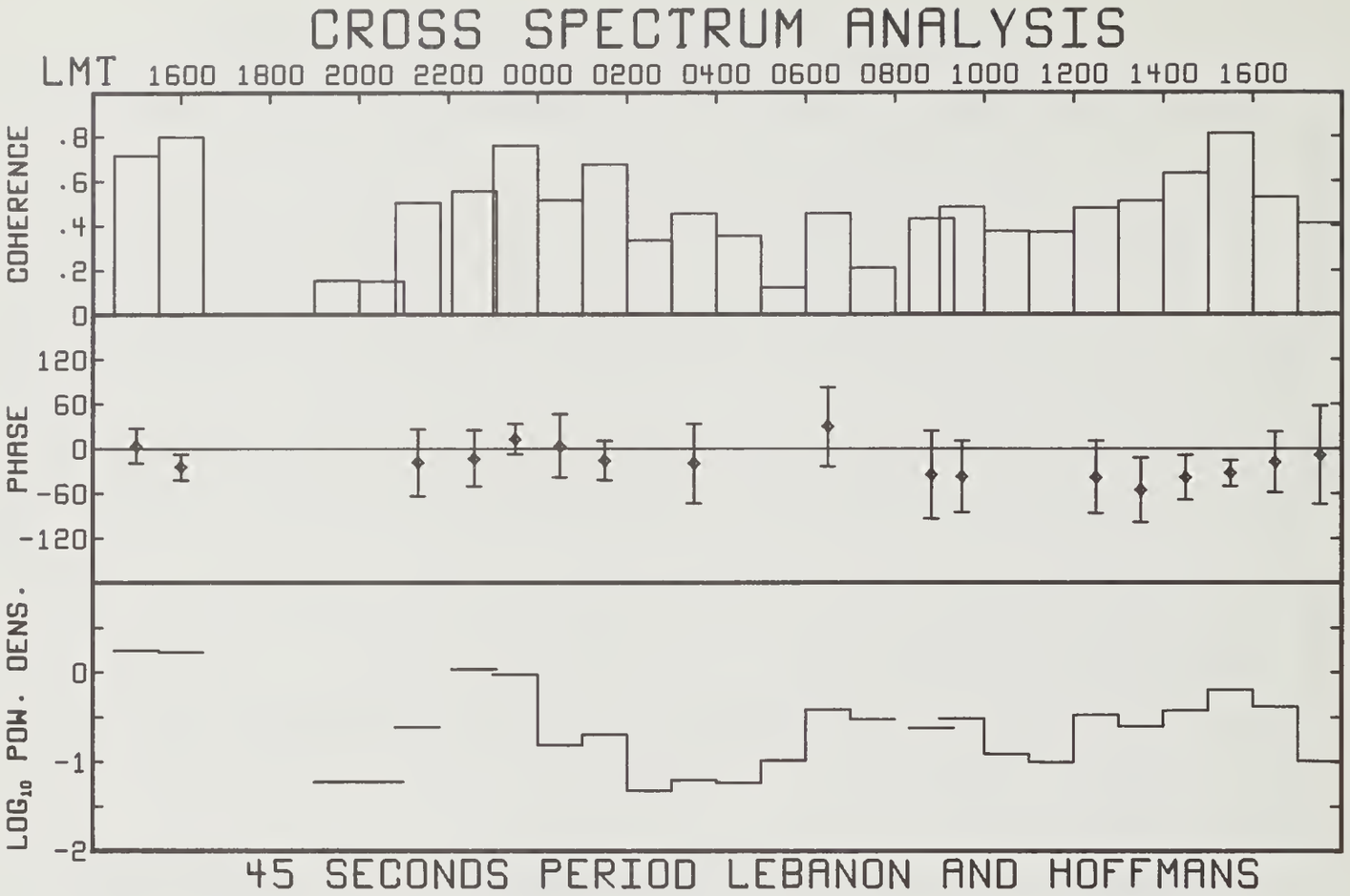

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
1
0
-1
120 SECONDS PERIOD LEBANON AND HOFFMANS

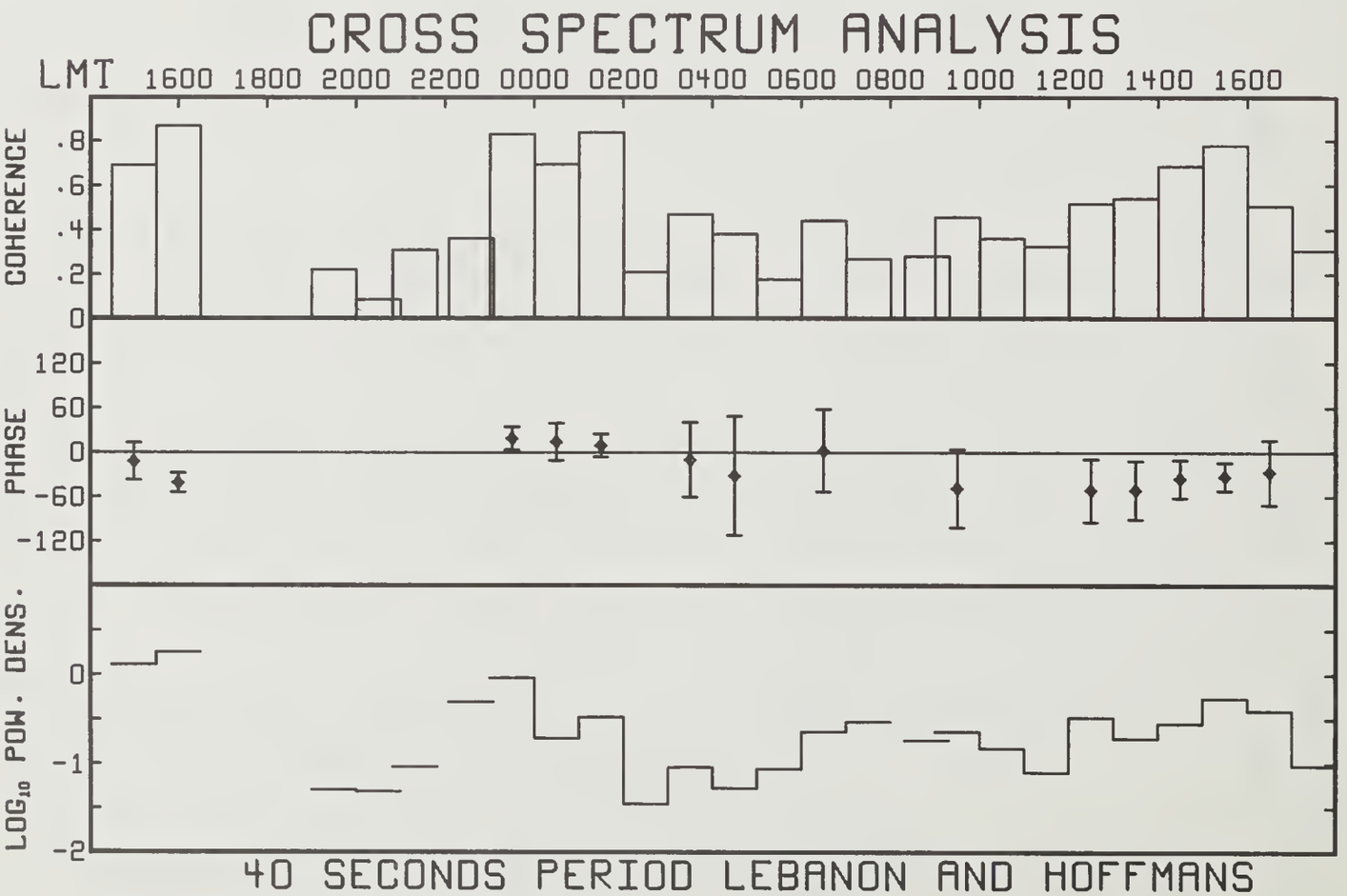

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
90 SECONDS PERIOD LEBANON AND HOFFMANS

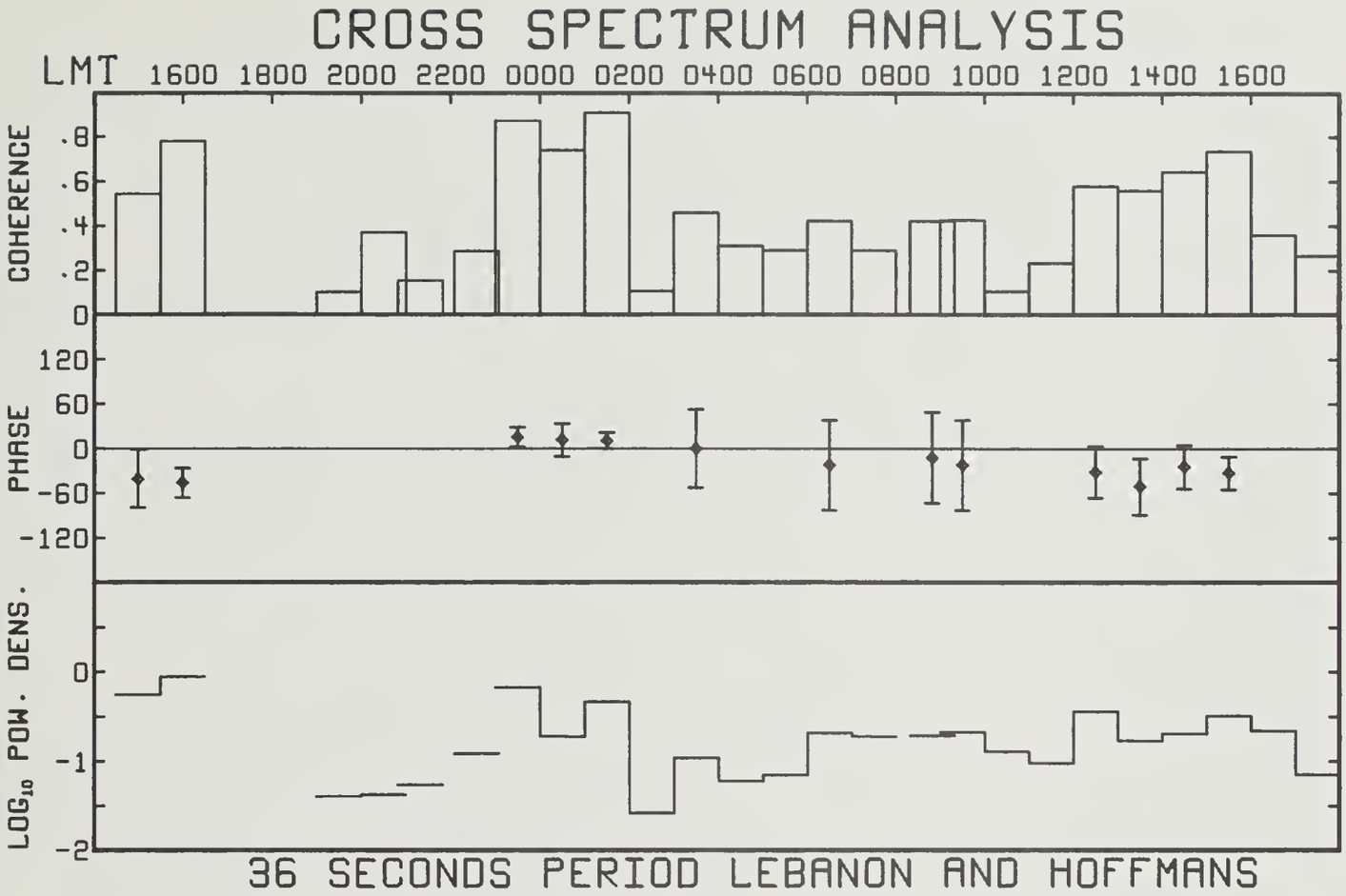

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
72 SECONDS PERIOD LEBANON AND HOFFMANS

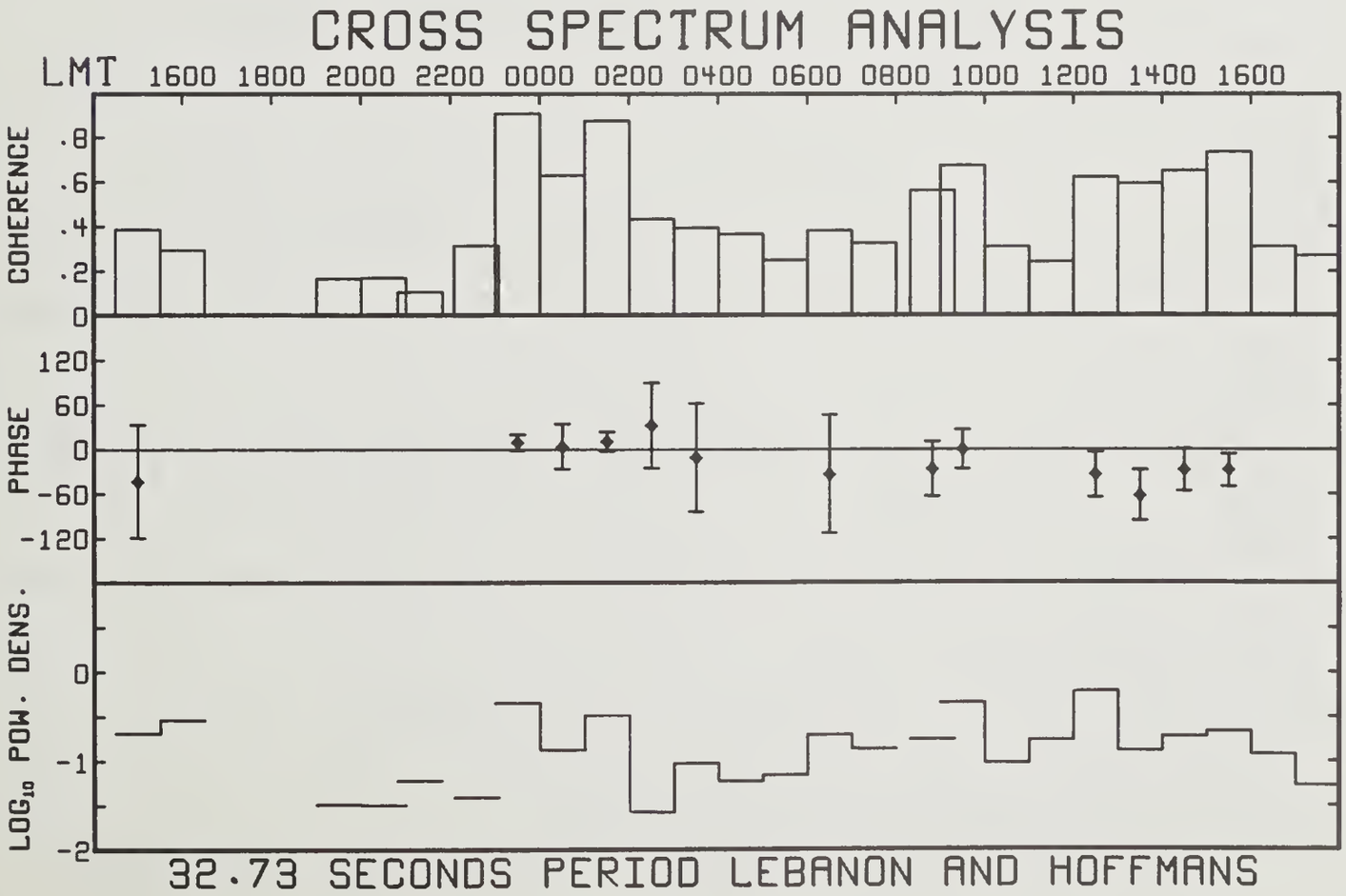

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
60 SECONDS PERIOD LEBANON AND HOFFMANS

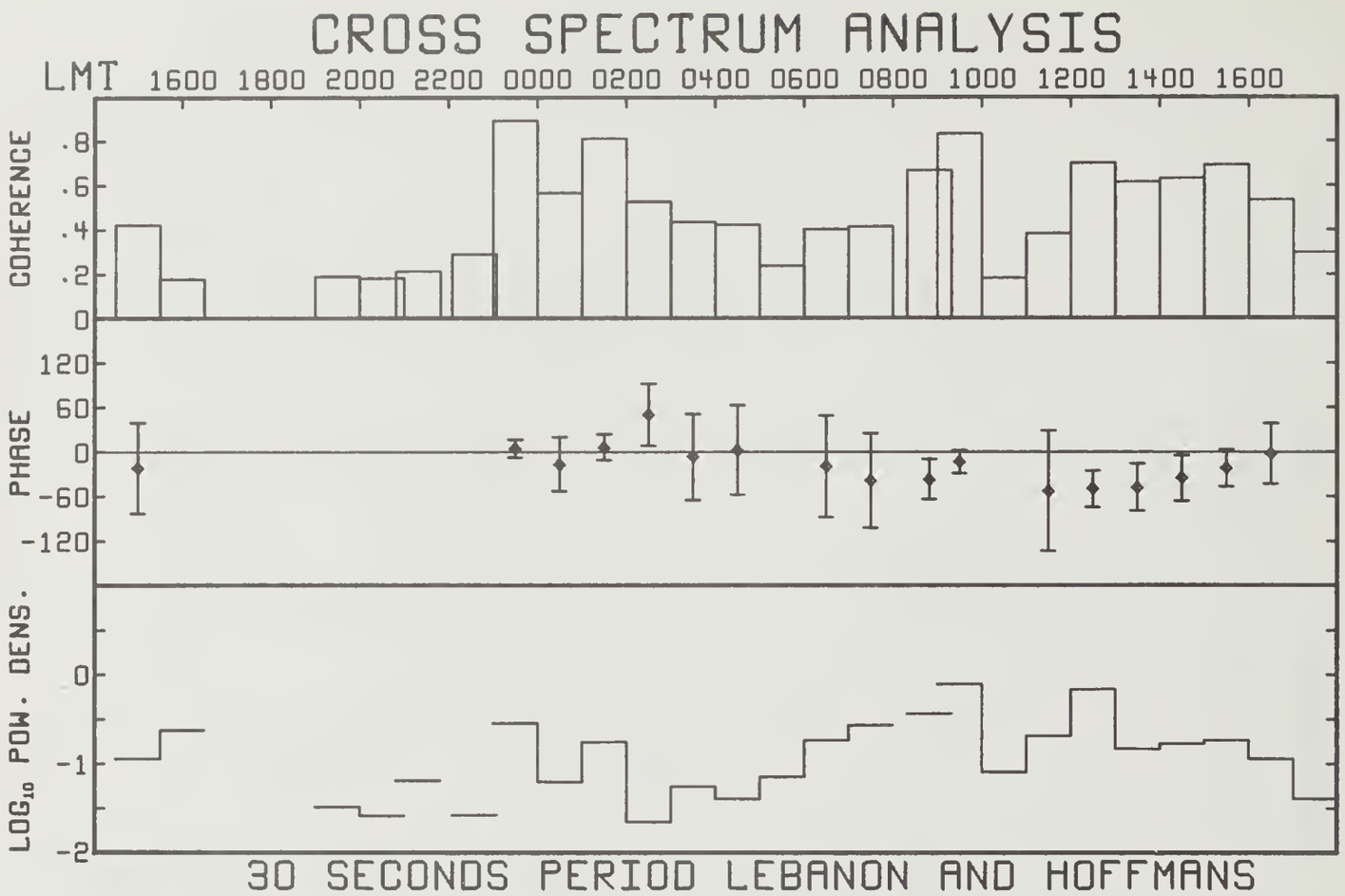

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
51.43 SECONDS PERIOD LEBANON AND HOFFMANS

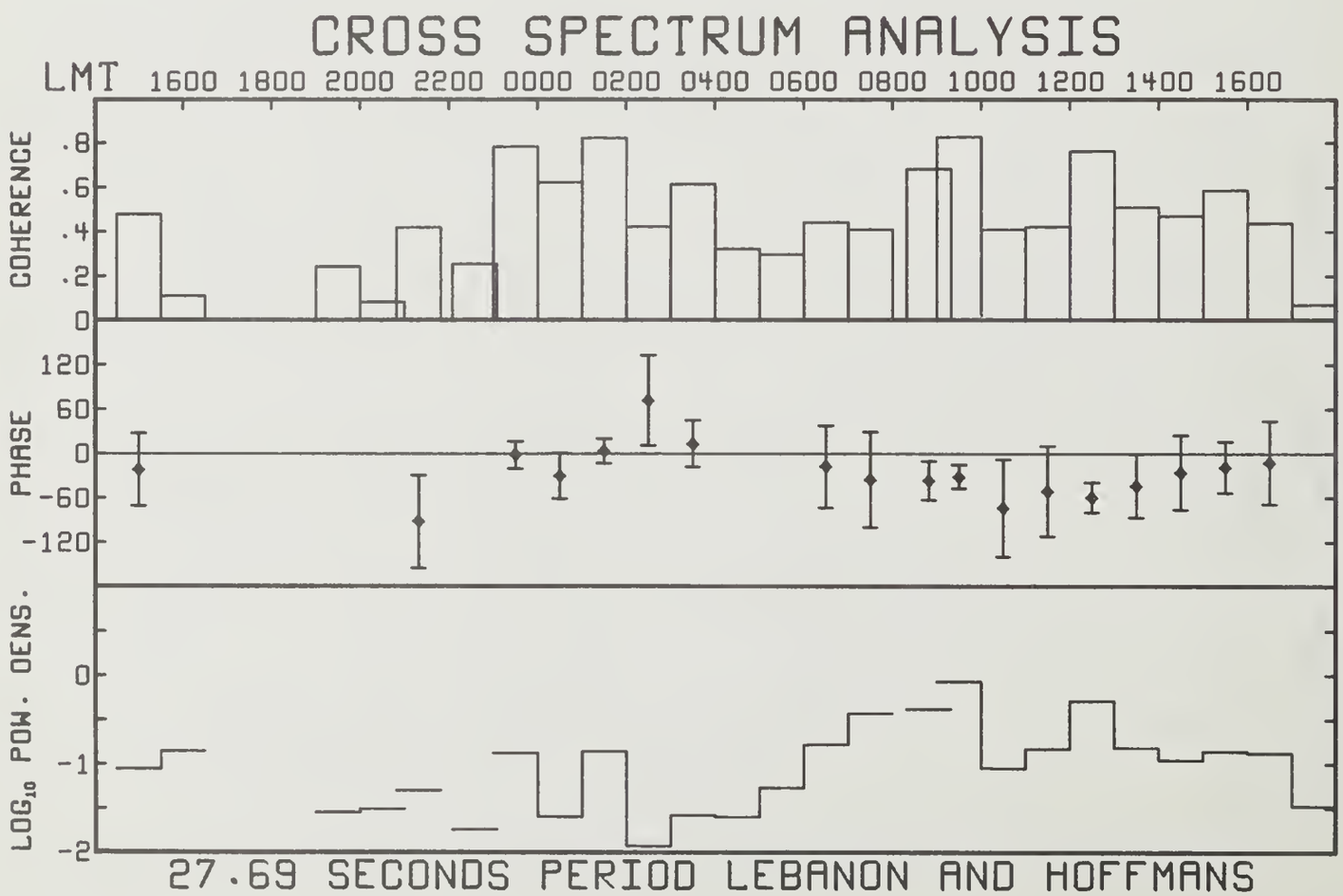

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
45 SECONDS PERIOD LEBANON AND HOFFMANS

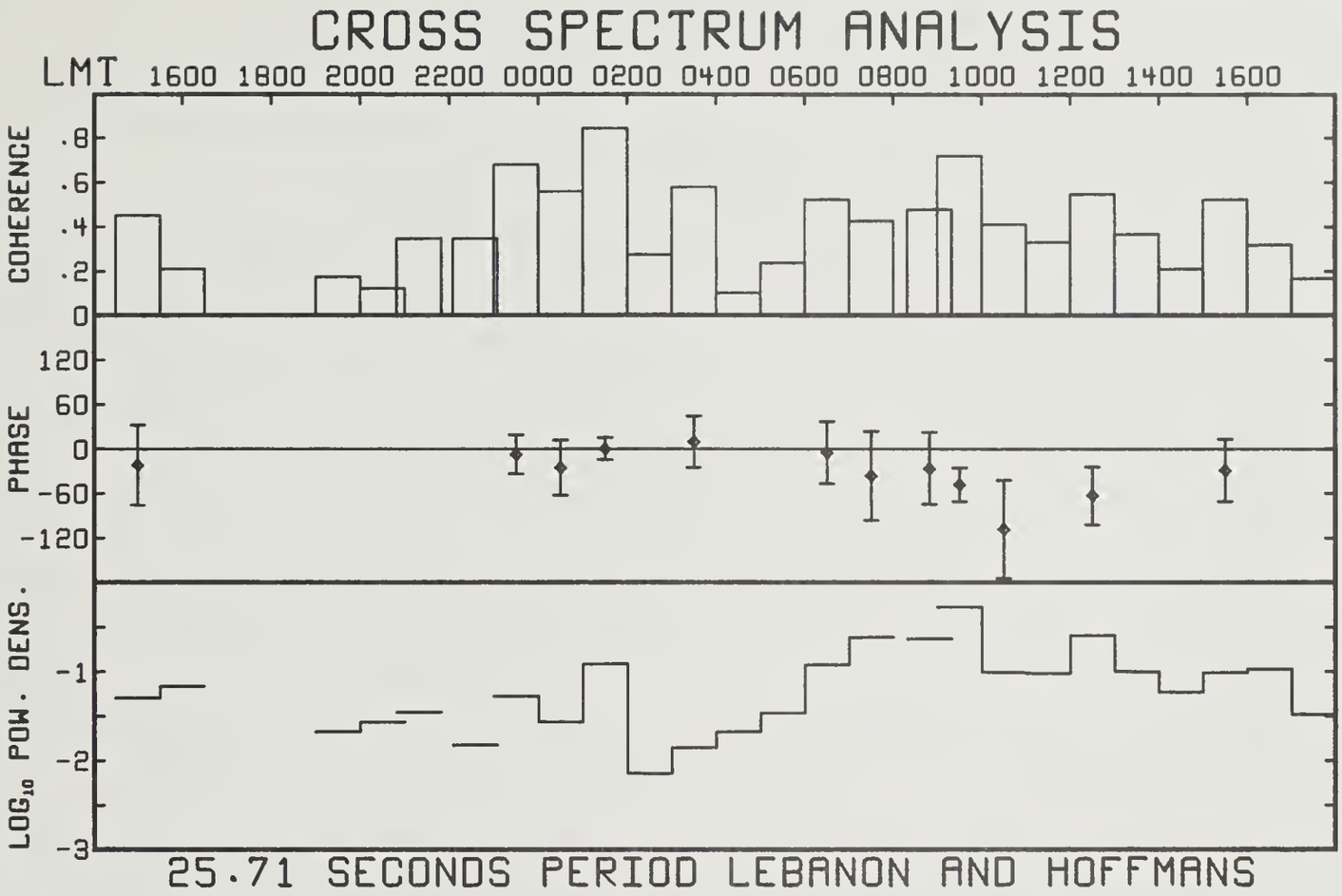

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
40 SECONDS PERIOD LEBANON AND HOFFMANS

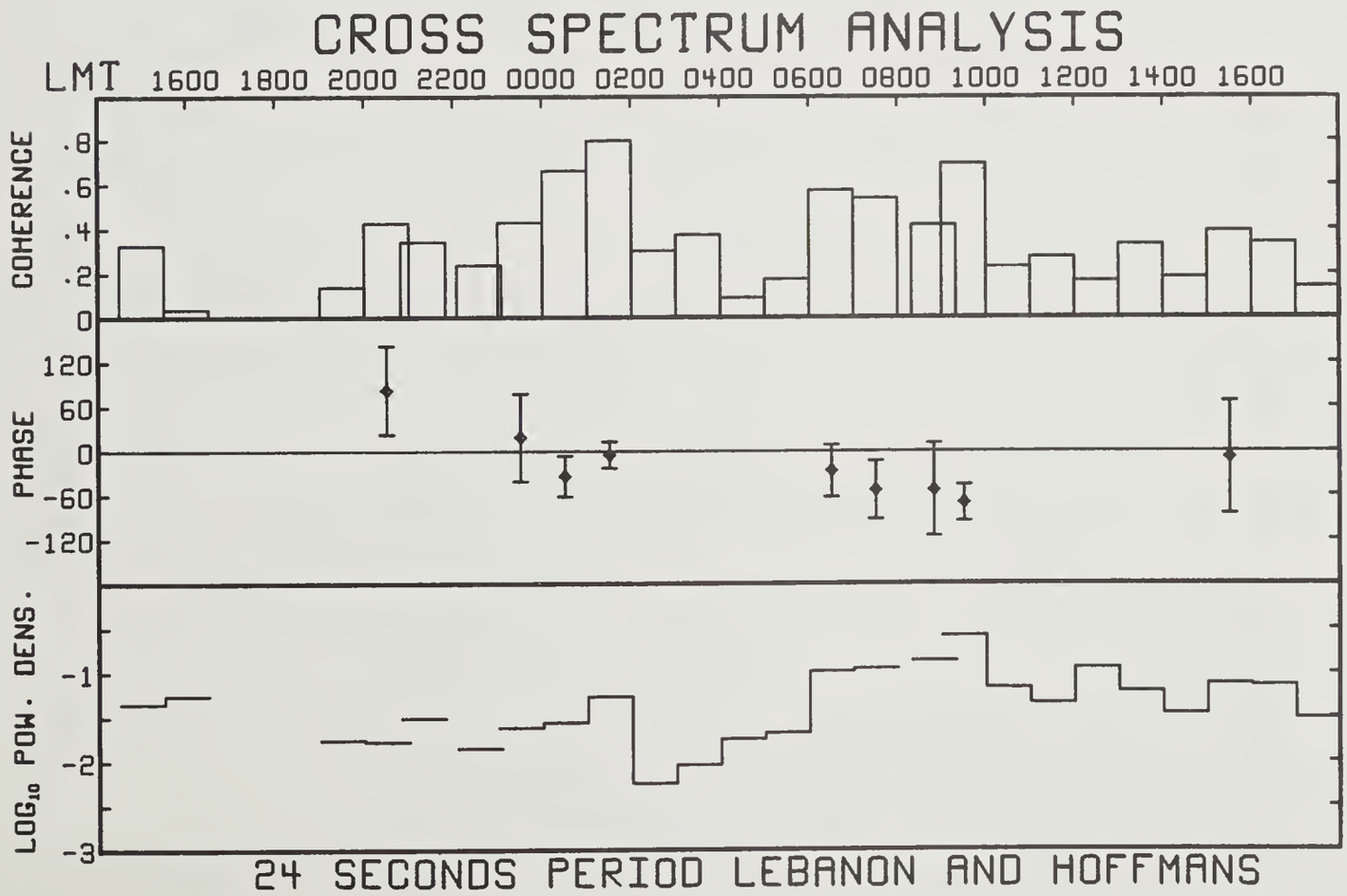

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
36 SECONDS PERIOD LEBANON AND HOFFMANS

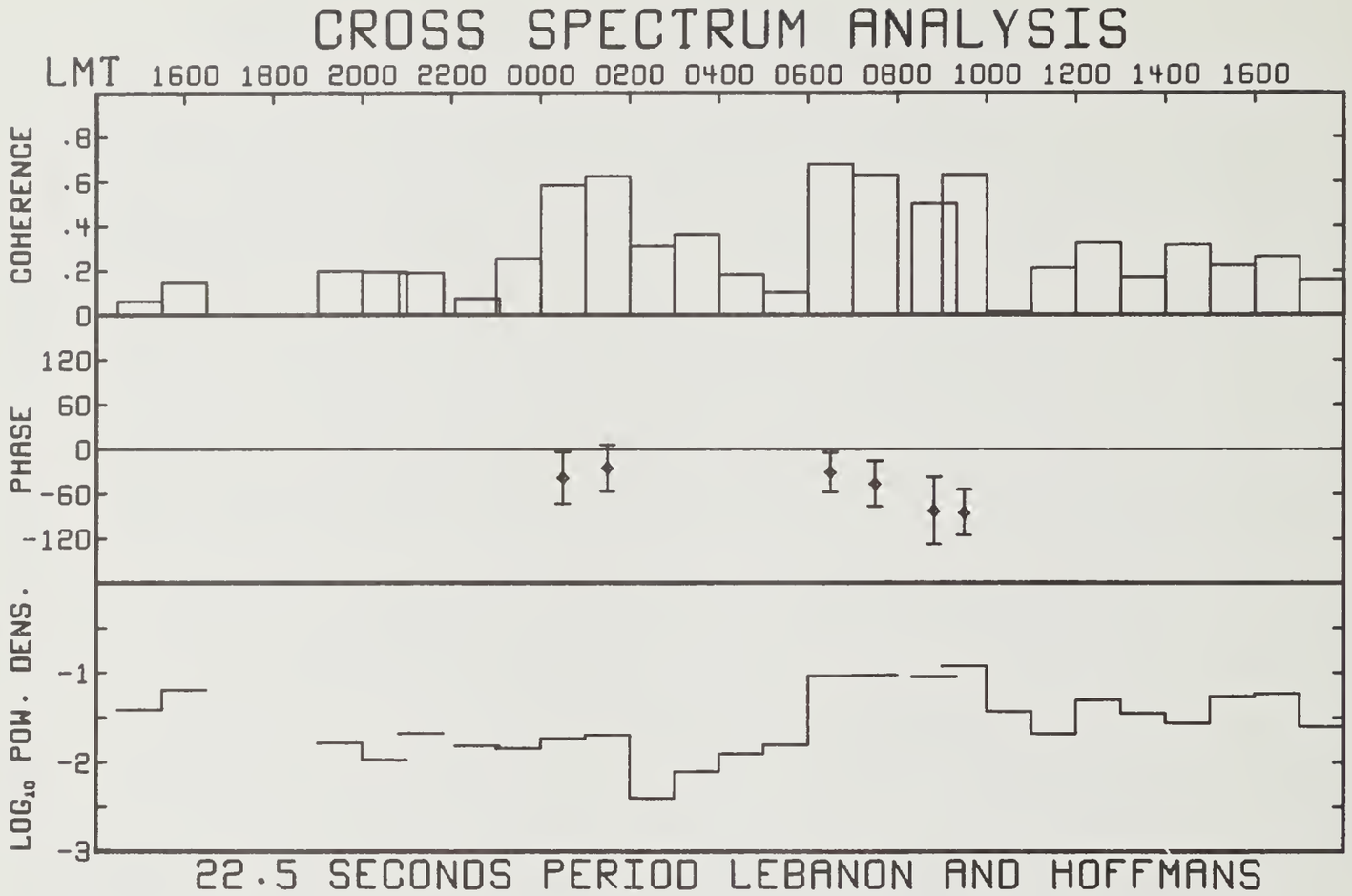

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
32.73 SECONDS PERIOD LEBANON AND HOFFMANS

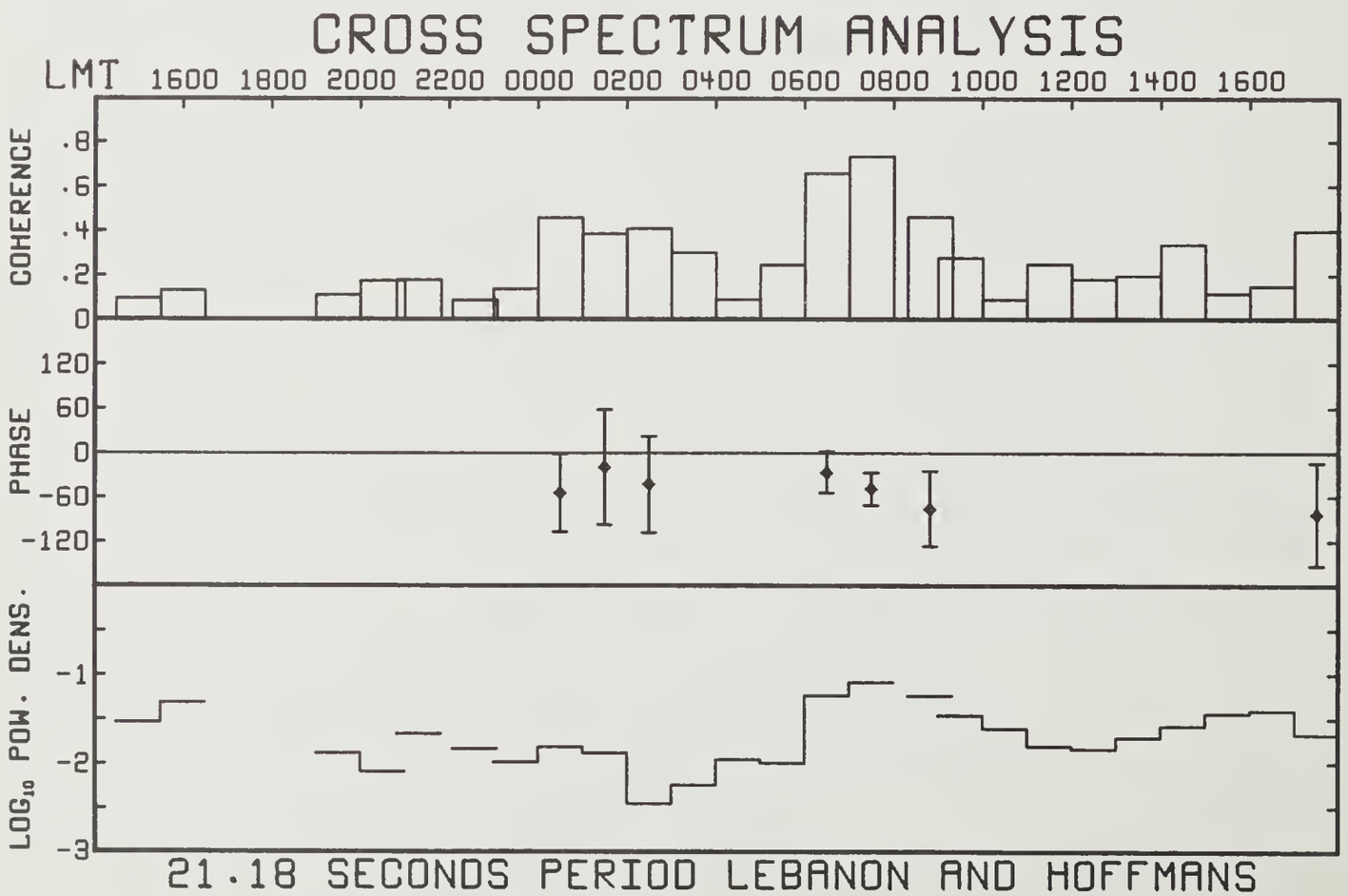

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
30 SECONDS PERIOD LEBANON AND HOFFMANS

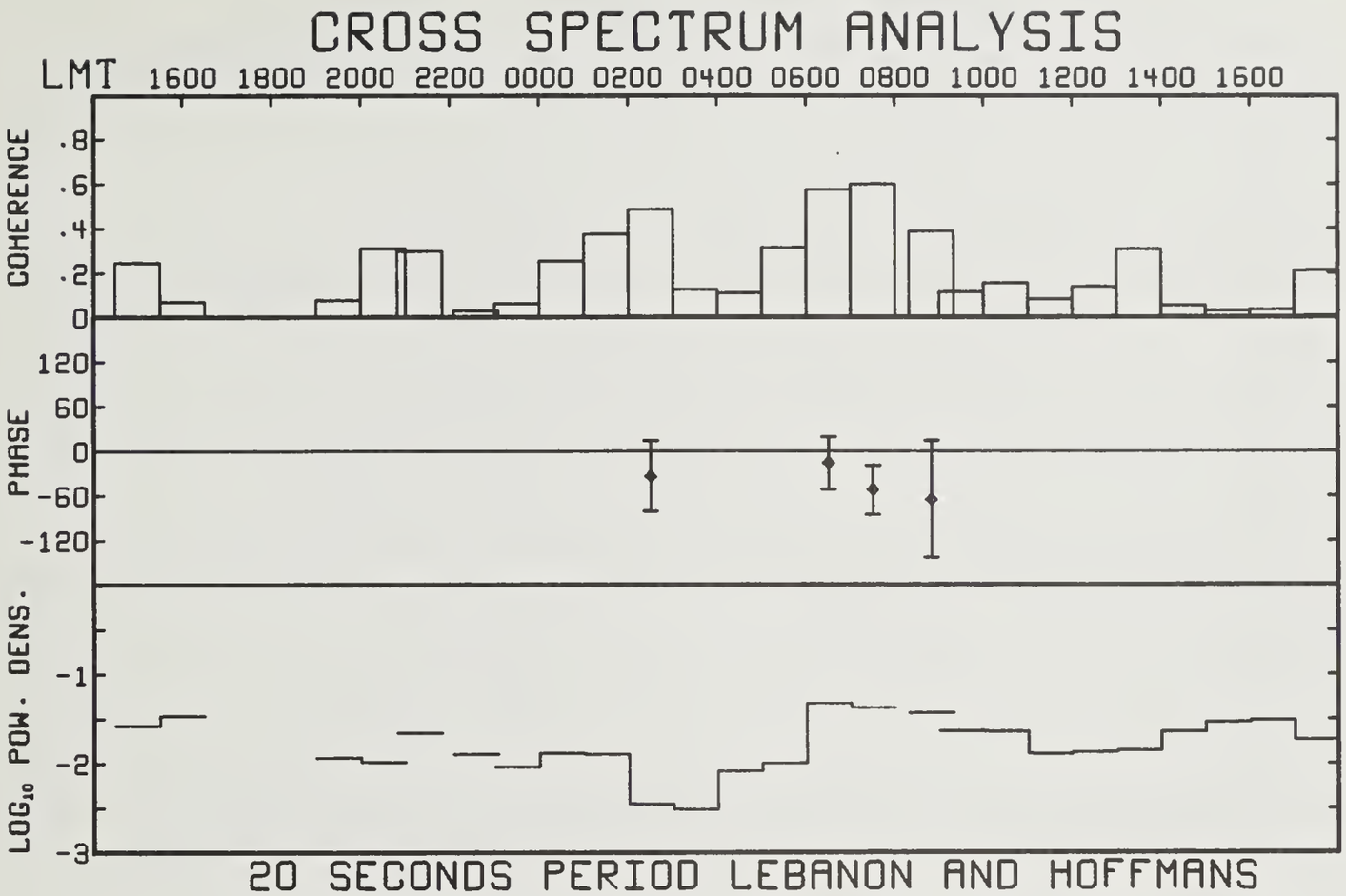

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
27.69 SECONDS PERIOD LEBANON AND HOFFMANS

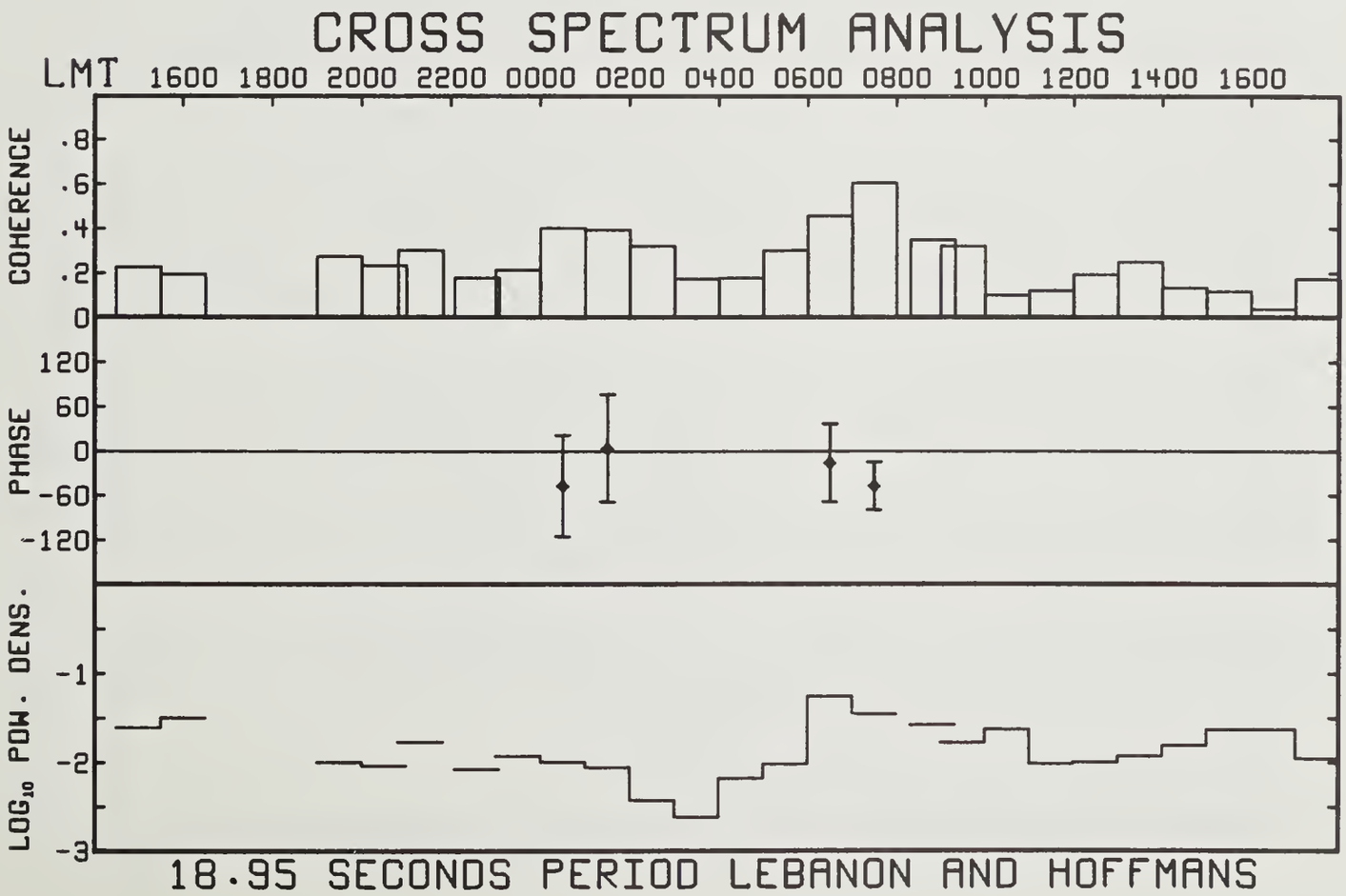

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
25.71 SECONDS PERIOD LEBANON AND HOFFMANS

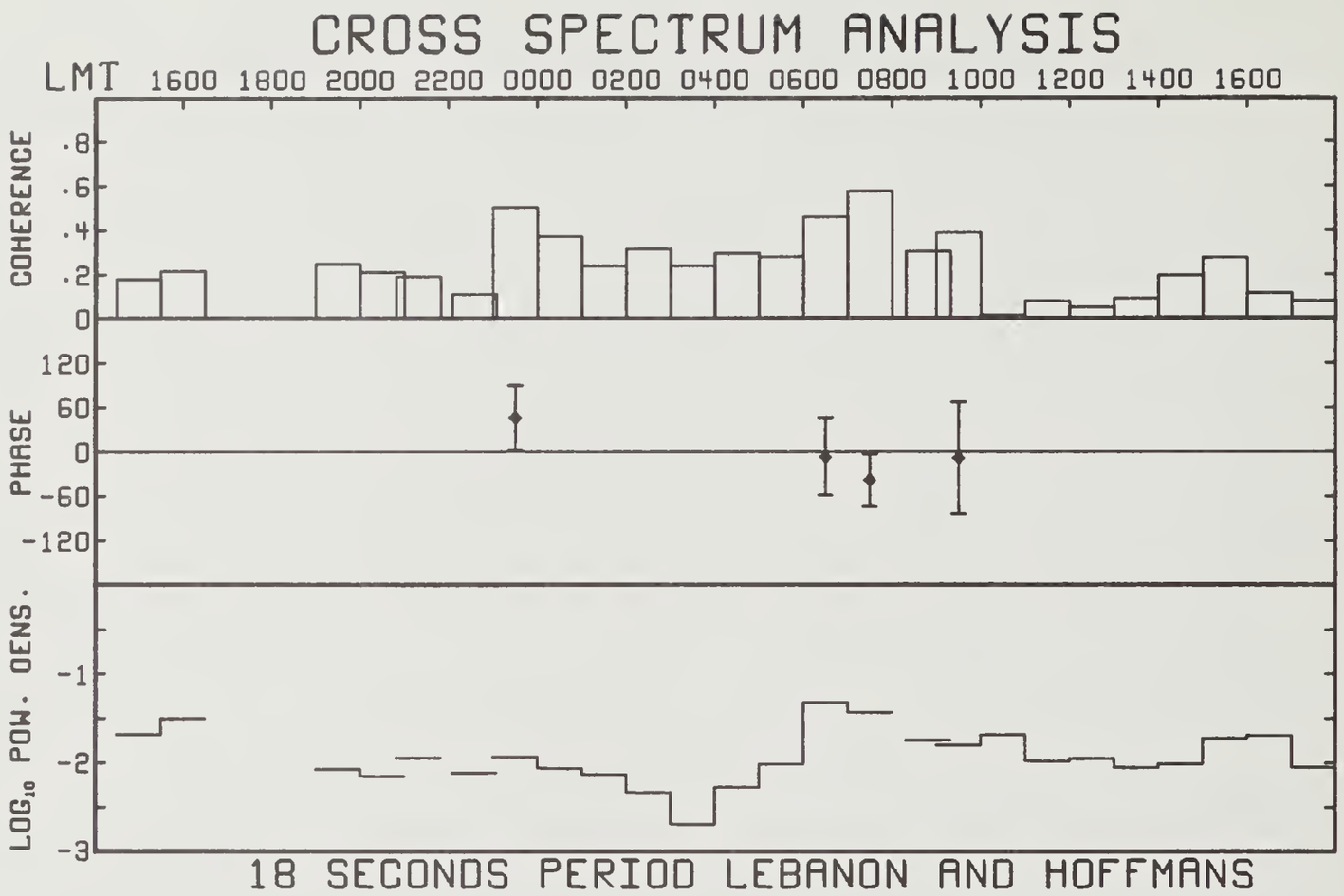

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
24 SECONDS PERIOD LEBANON AND HOFFMANS

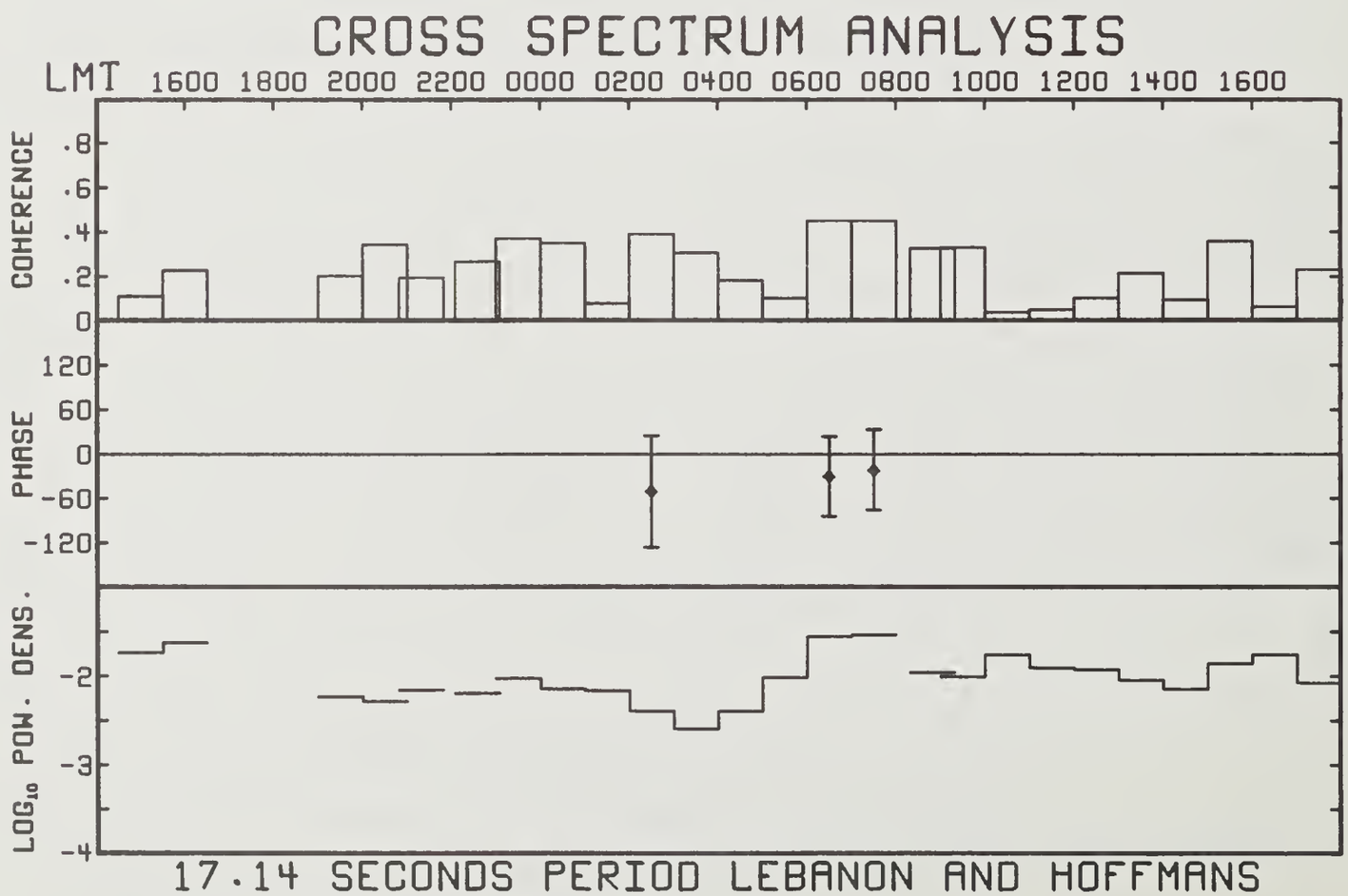

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
22.5 SECONDS PERIOD LEBANON AND HOFFMANS

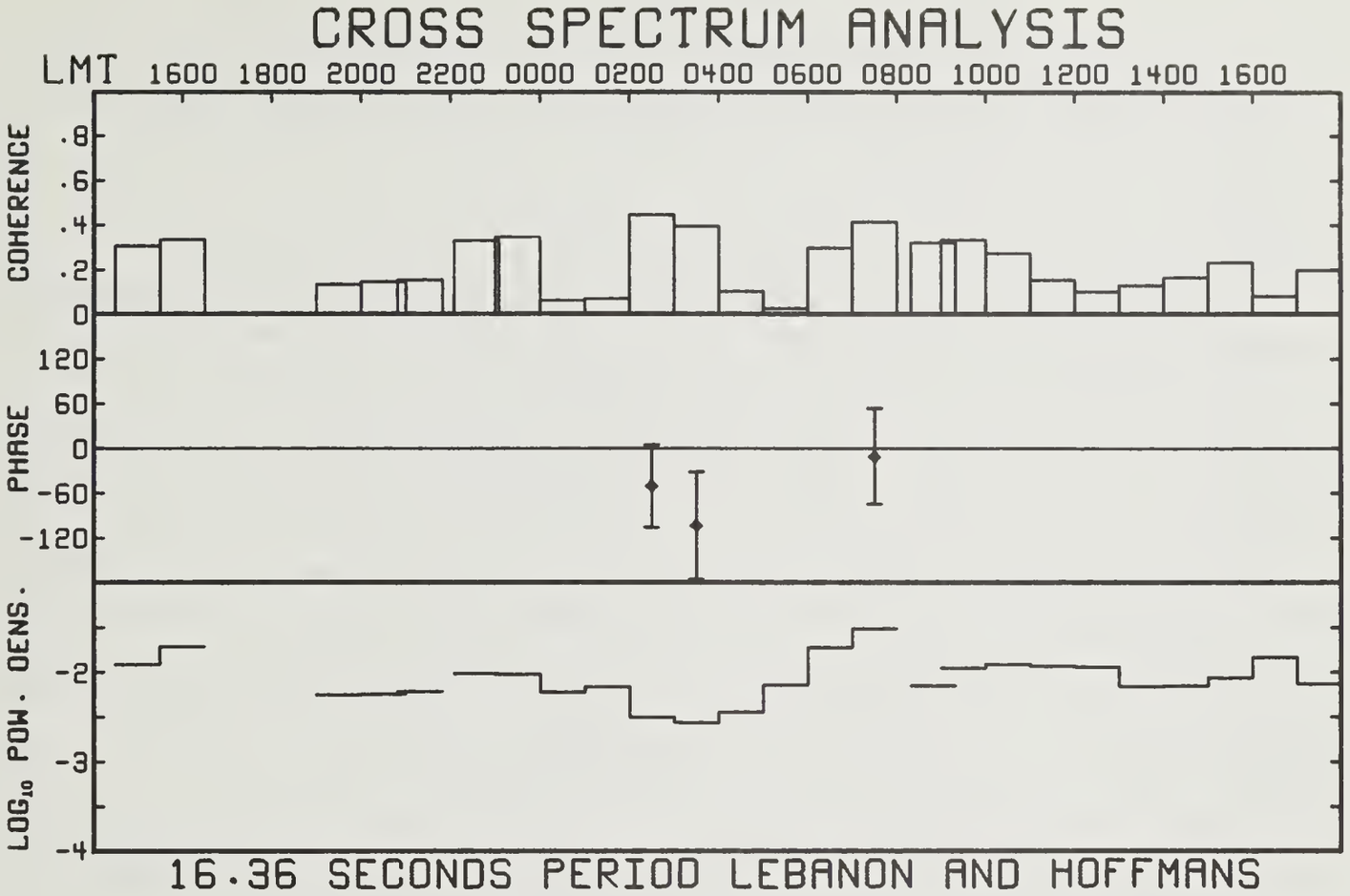

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
21.18 SECONDS PERIOD LEBANON AND HOFFMANS

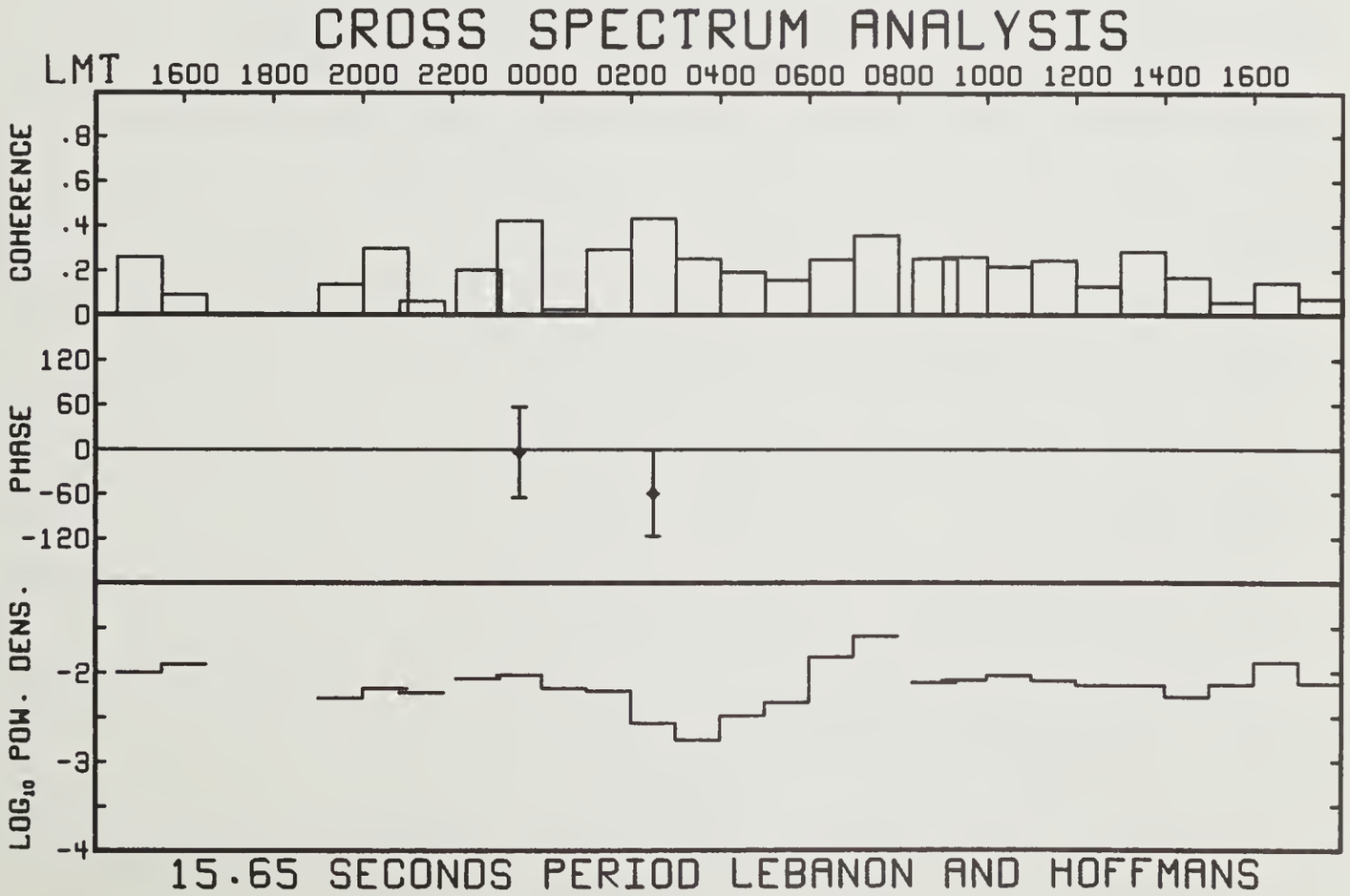

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
20 SECONDS PERIOD LEBANON AND HOFFMANS

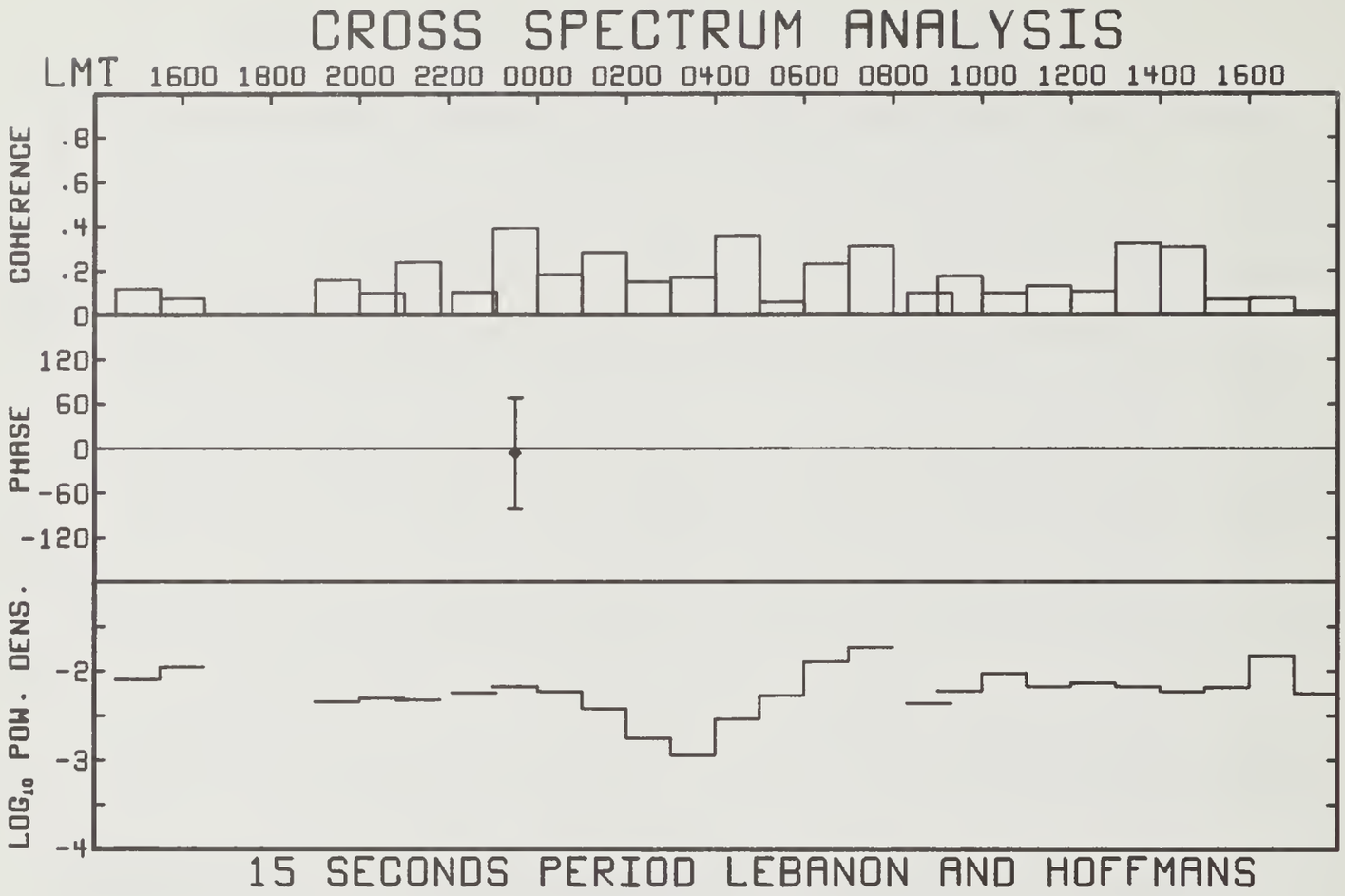

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
18.95 SECONDS PERIOD LEBANON AND HOFFMANS

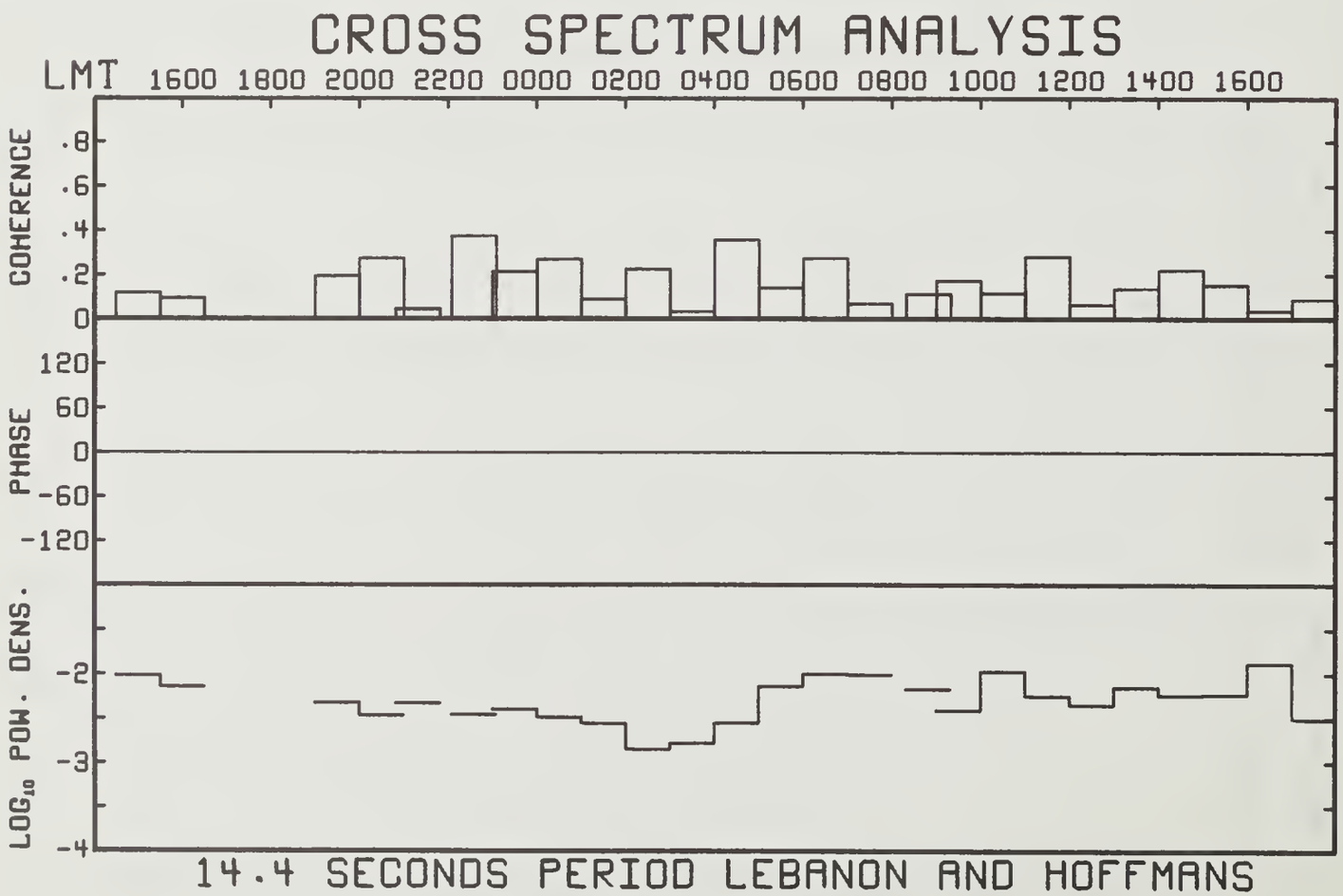

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
18 SECONDS PERIOD LEBANON AND HOFFMANS

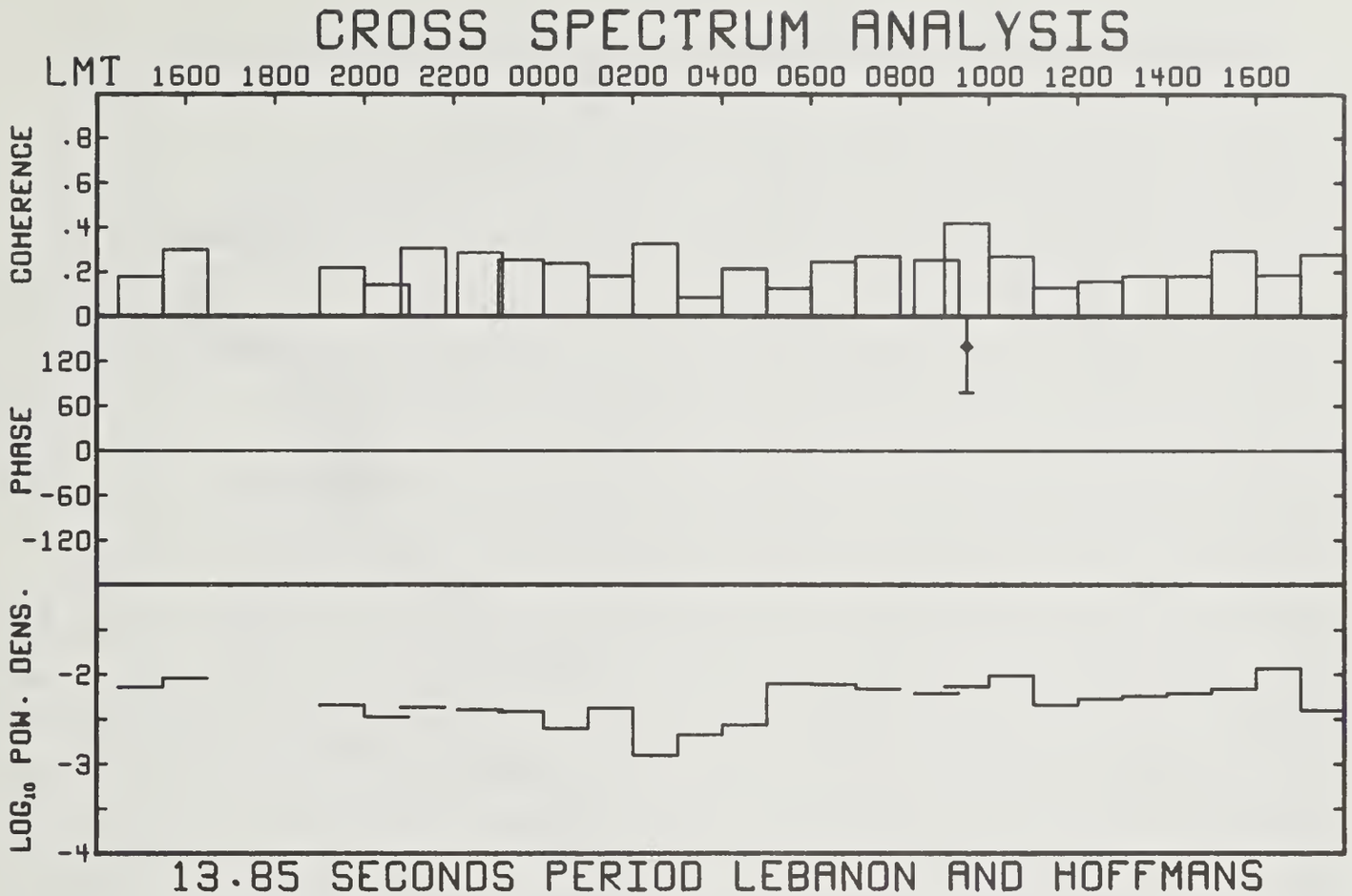

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
17.14 SECONDS PERIOD LEBANON AND HOFFMANS

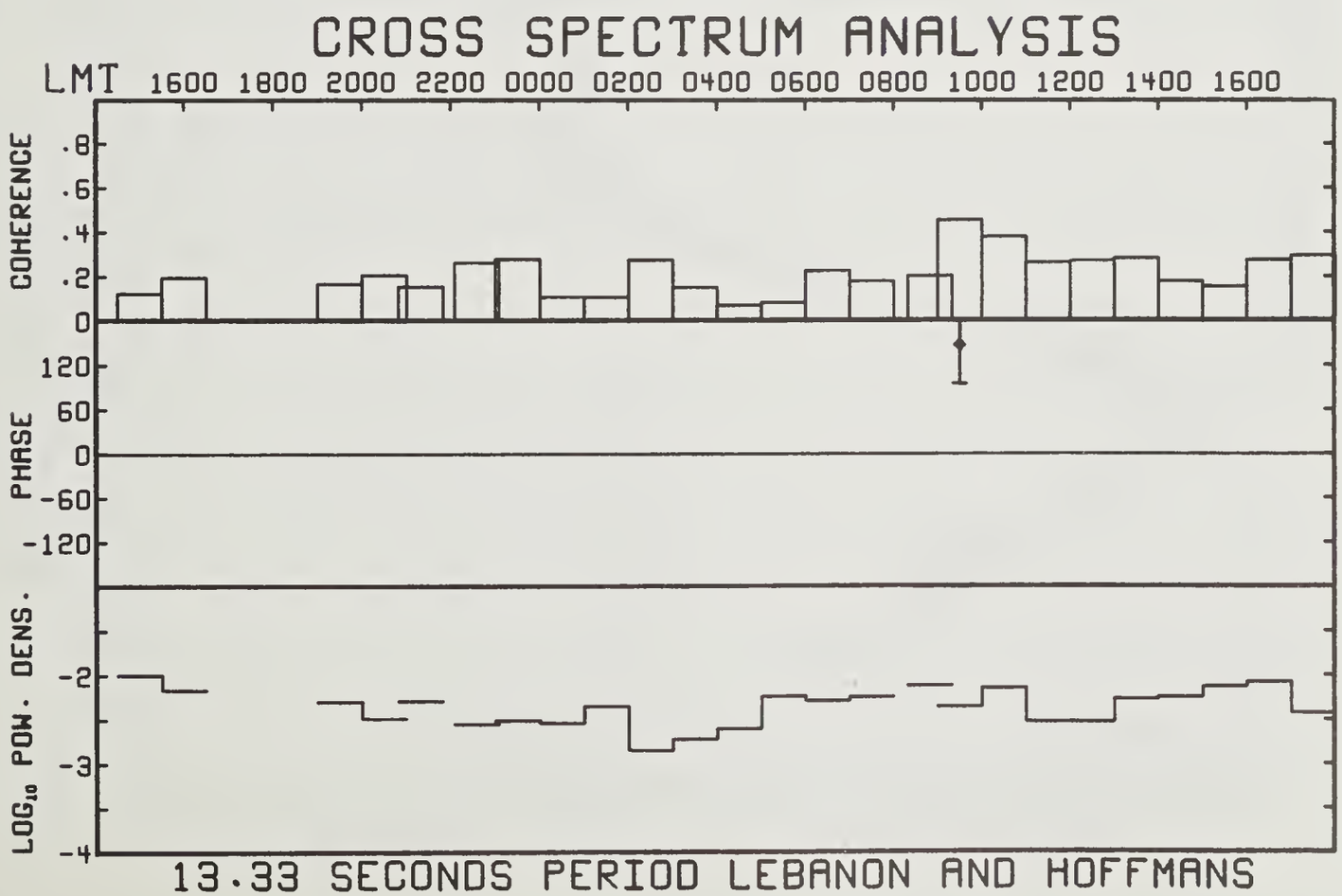

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
16.36 SECONDS PERIOD LEBANON AND HOFFMANS

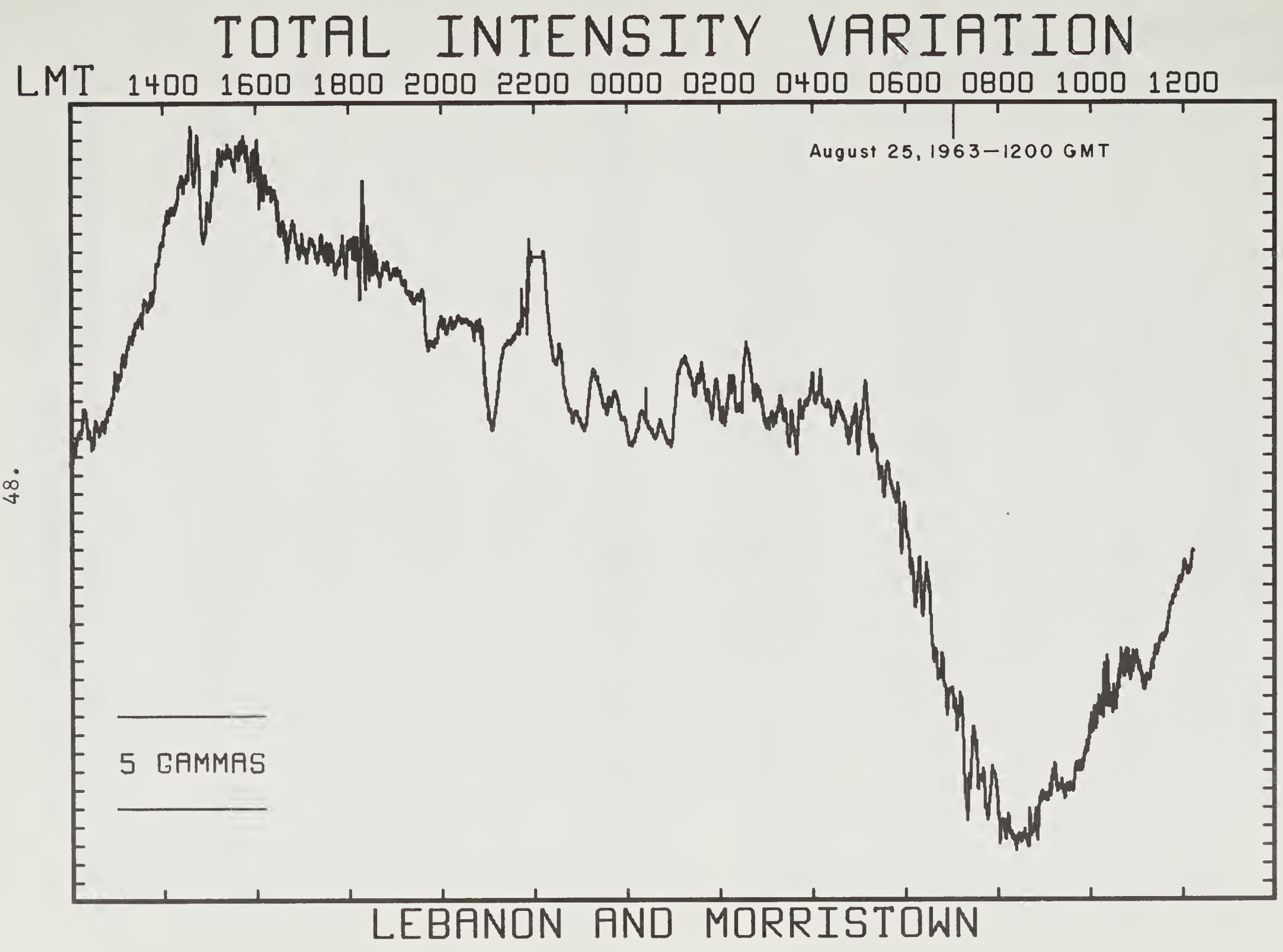

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
15.65 SECONDS PERIOD LEBANON AND HOFFMANS

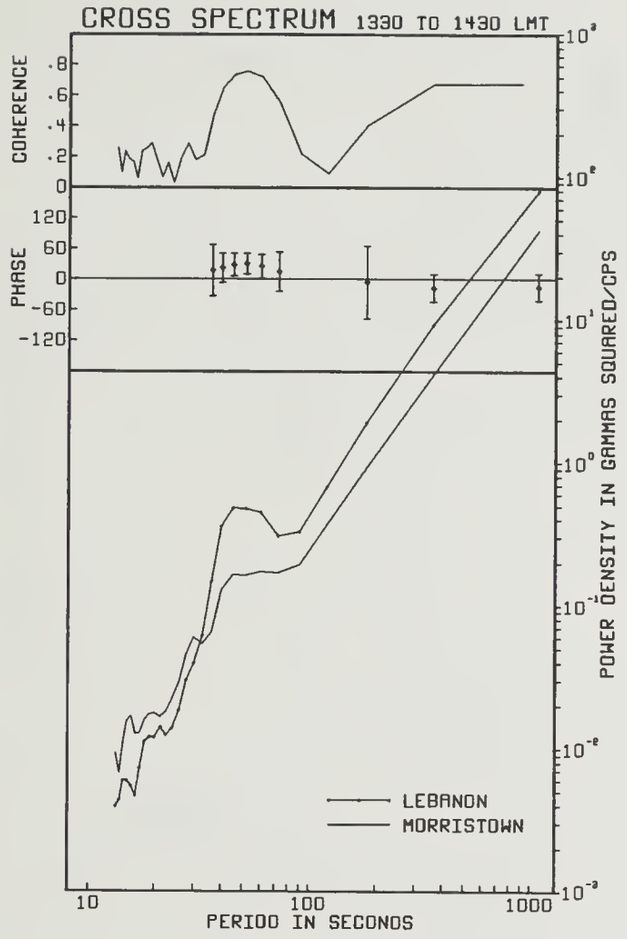

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
15 SECONDS PERIOD LEBANON AND HOFFMANS

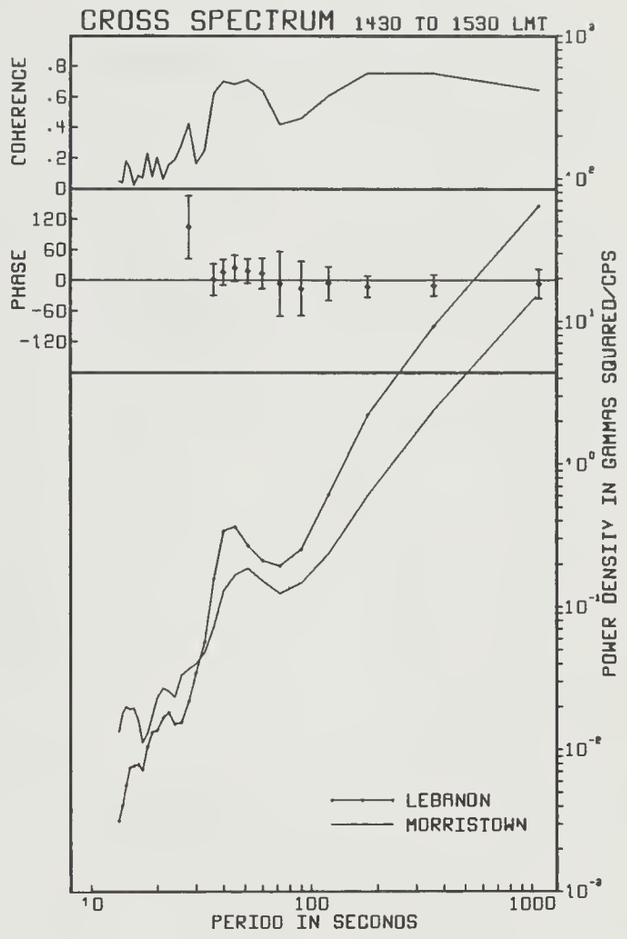

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
14.4 SECONDS PERIOD LEBANON AND HOFFMANS

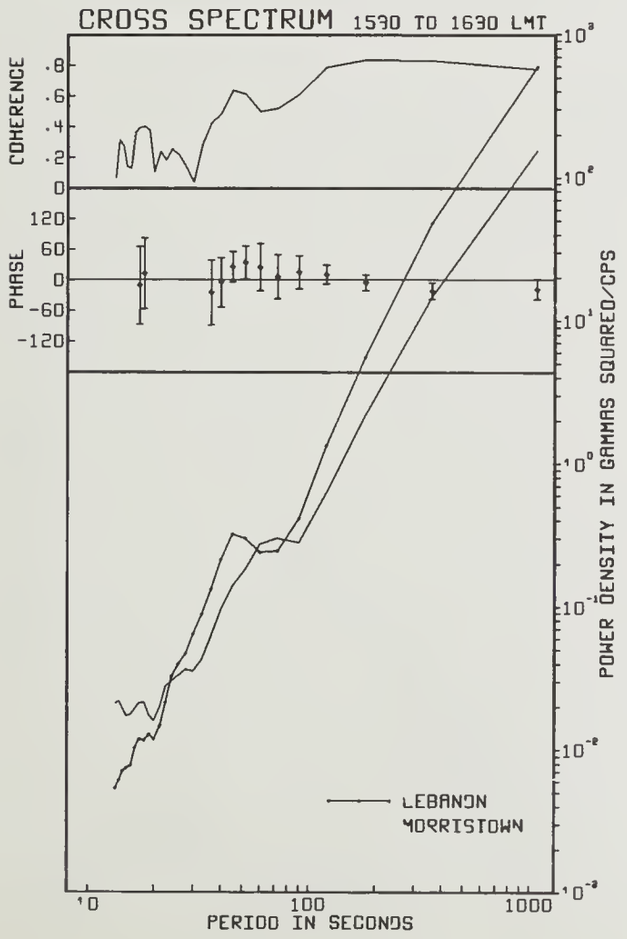

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
13.85 SECONDS PERIOD LEBANON AND HOFFMANS

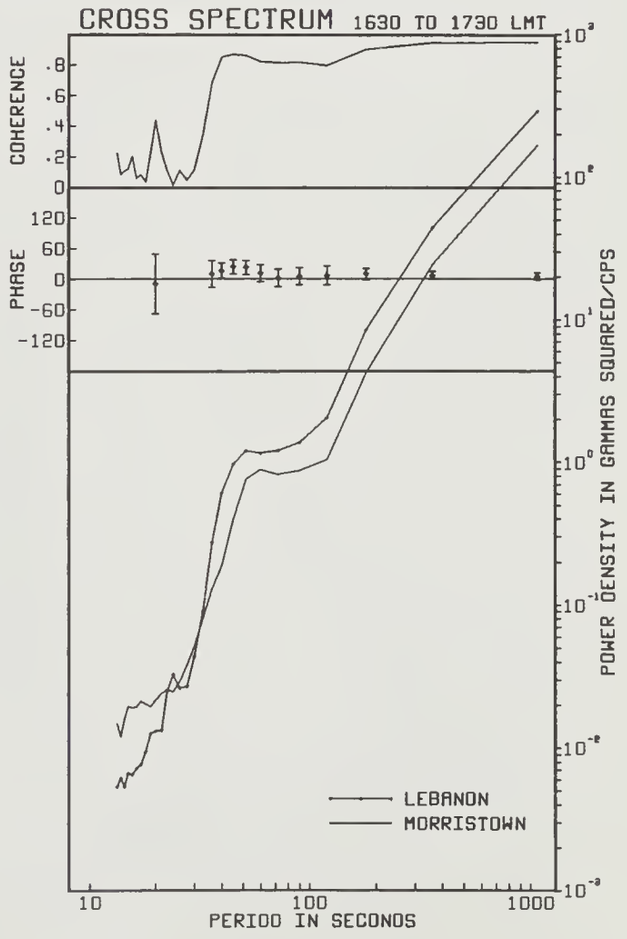

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400 1600
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
13.33 SECONDS PERIOD LEBANON AND HOFFMANS

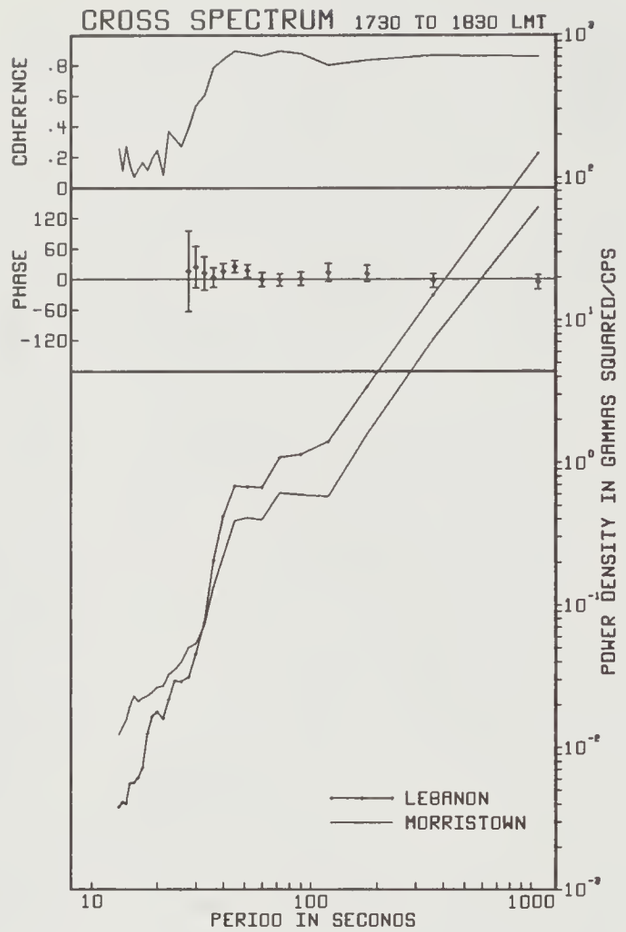

TOTAL INTENSITY VARIATION
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
August 25, 1963—1200 GMT
5 GAMMAS
LEBANON AND MORRISTOWN

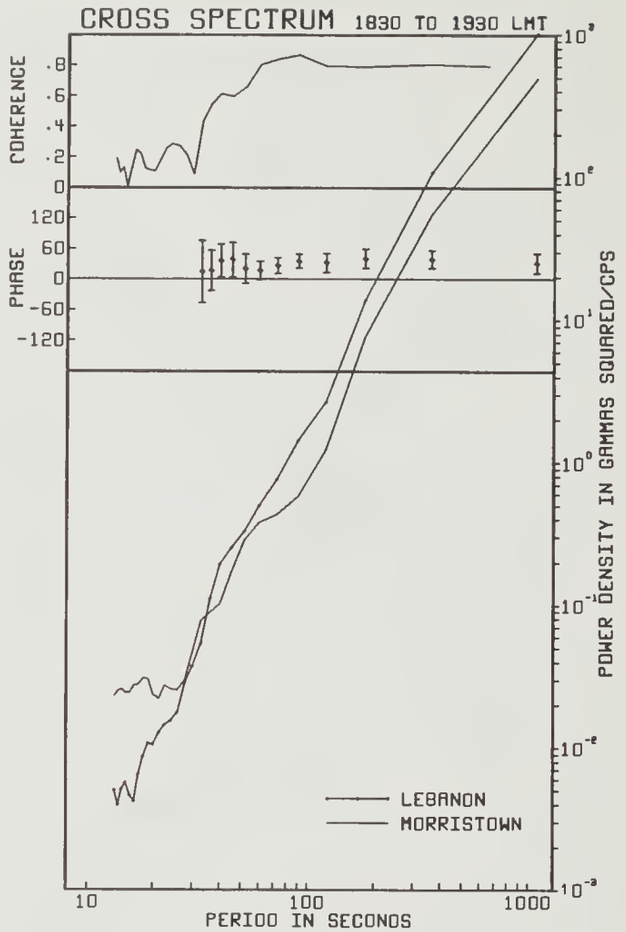

CROSS SPECTRUM 1330 TO 1430 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

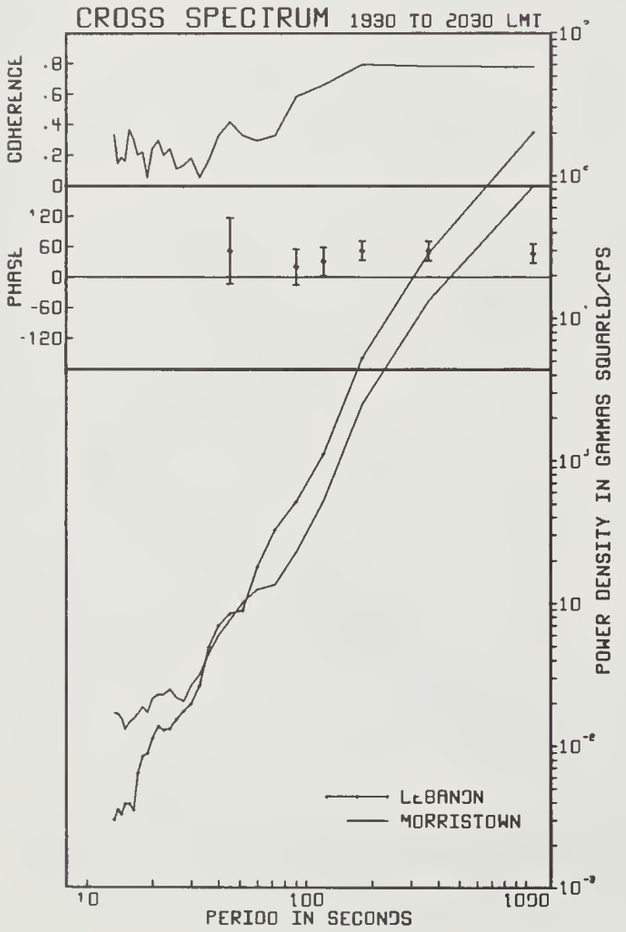

CROSS SPECTRUM 1430 TO 1530 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

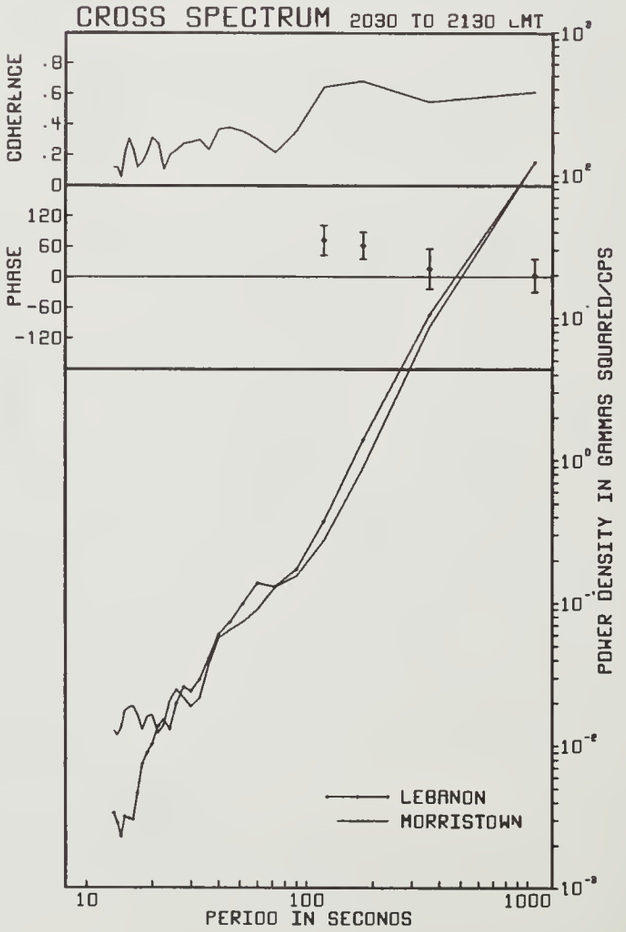

CROSS SPECTRUM 1530 TO 1630 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

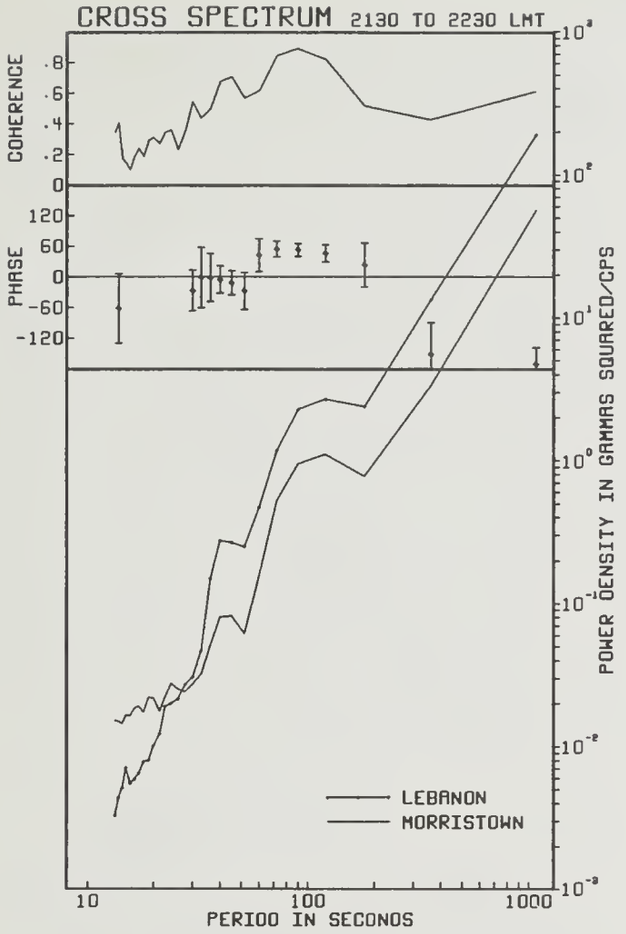

CROSS SPECTRUM 1630 TO 1730 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

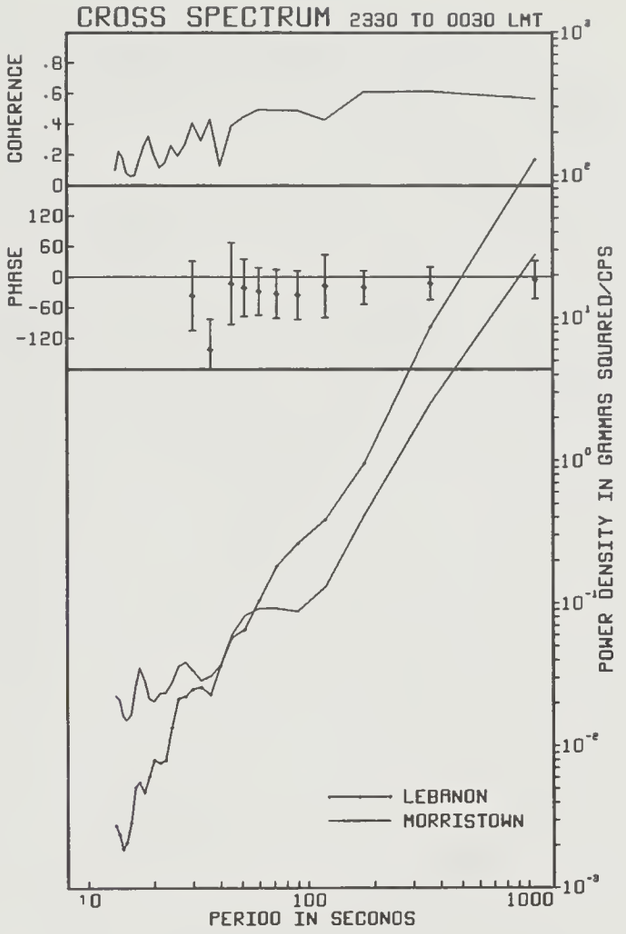

CROSS SPECTRUM 1730 TO 1830 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

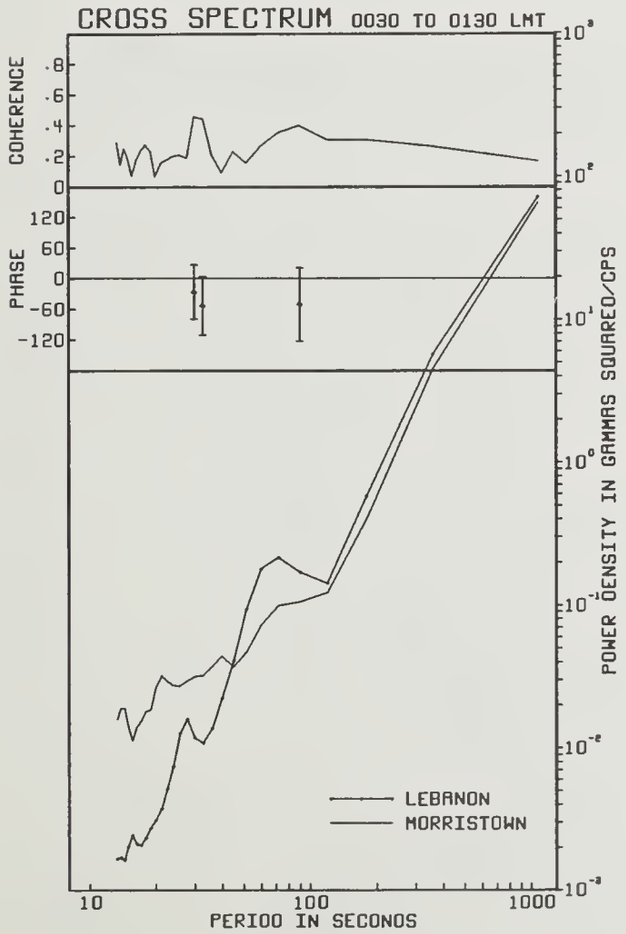

CROSS SPECTRUM 1830 TO 1930 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

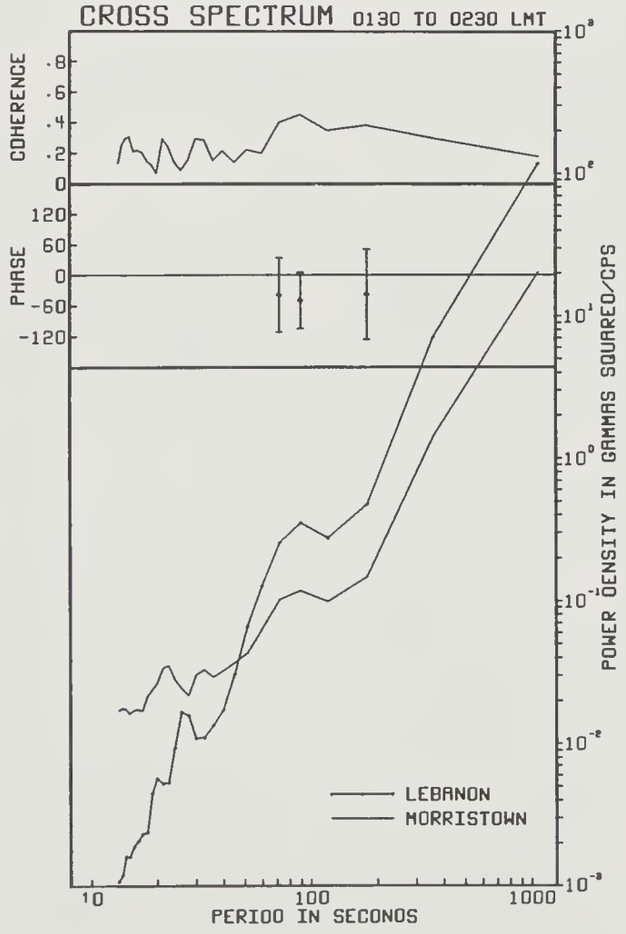

CROSS SPECTRUM 1930 TO 2030 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

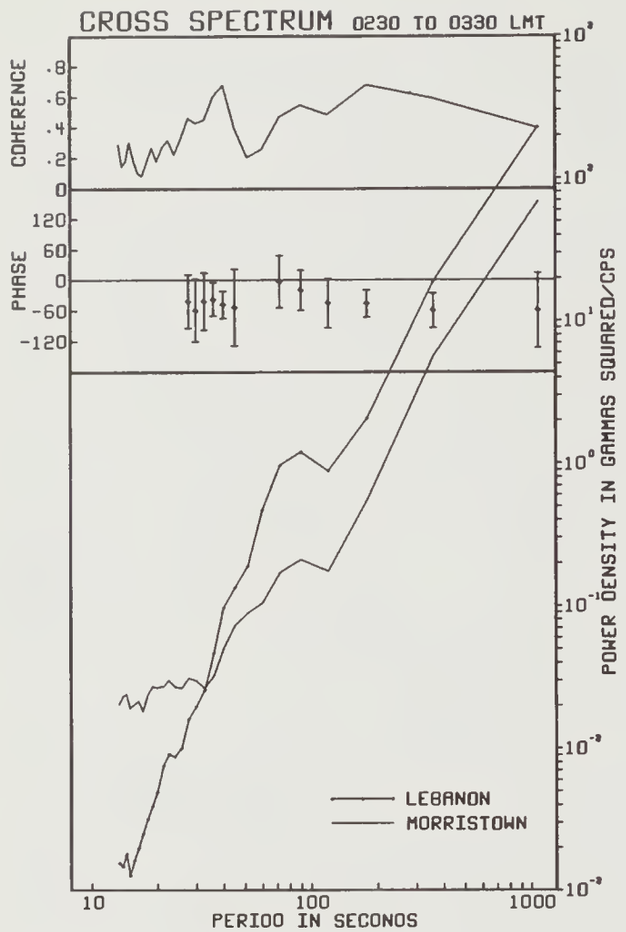

CROSS SPECTRUM 2030 TO 2130 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

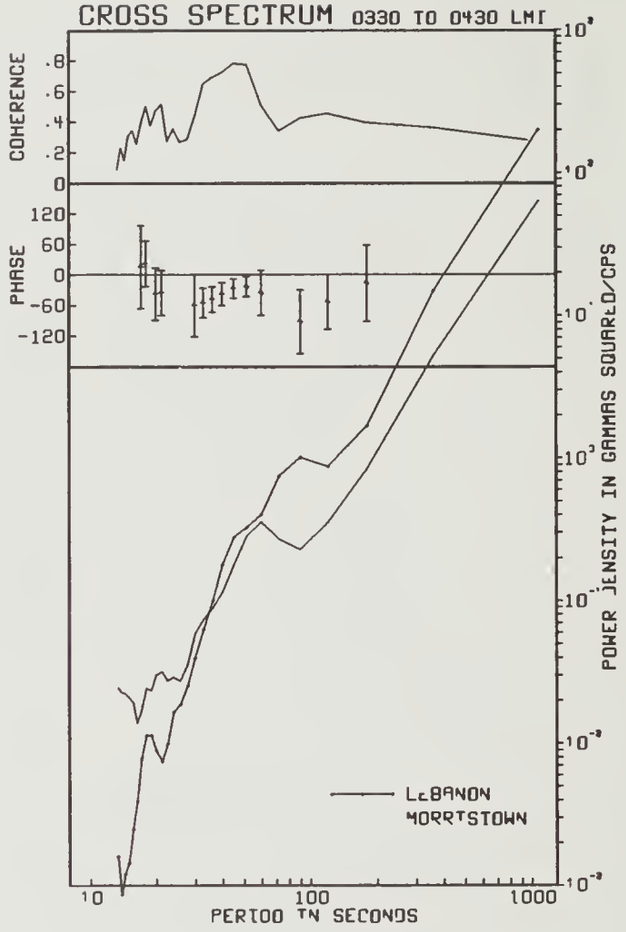

CROSS SPECTRUM 2130 TO 2230 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

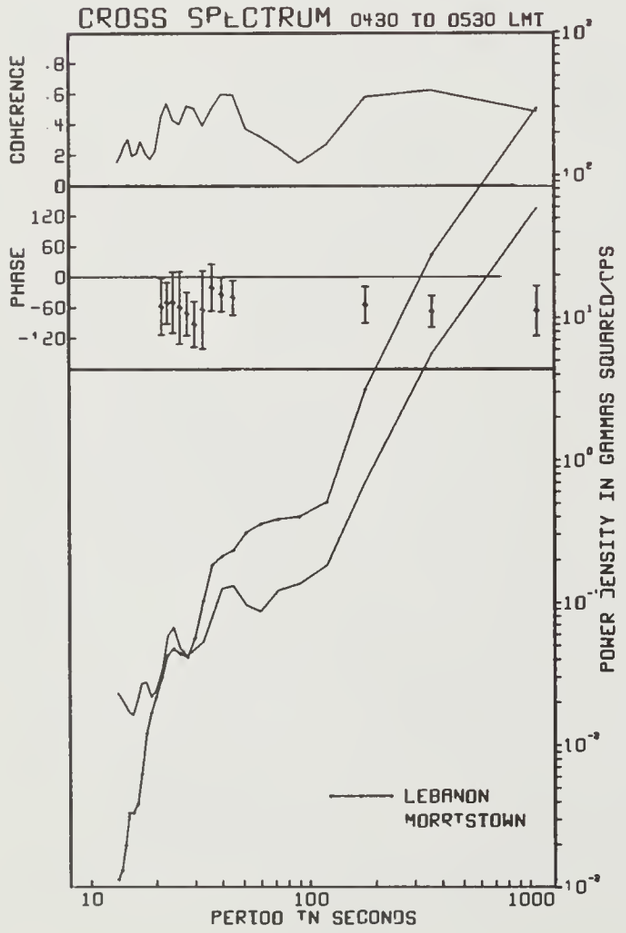

CROSS SPECTRUM 2330 TO 0030 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

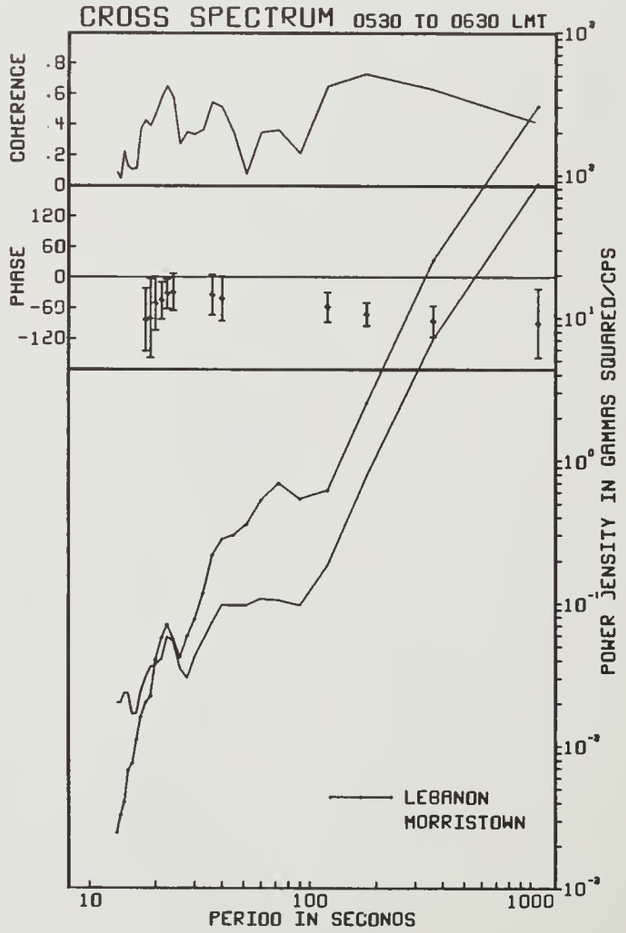

CROSS SPECTRUM 0030 TO 0130 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

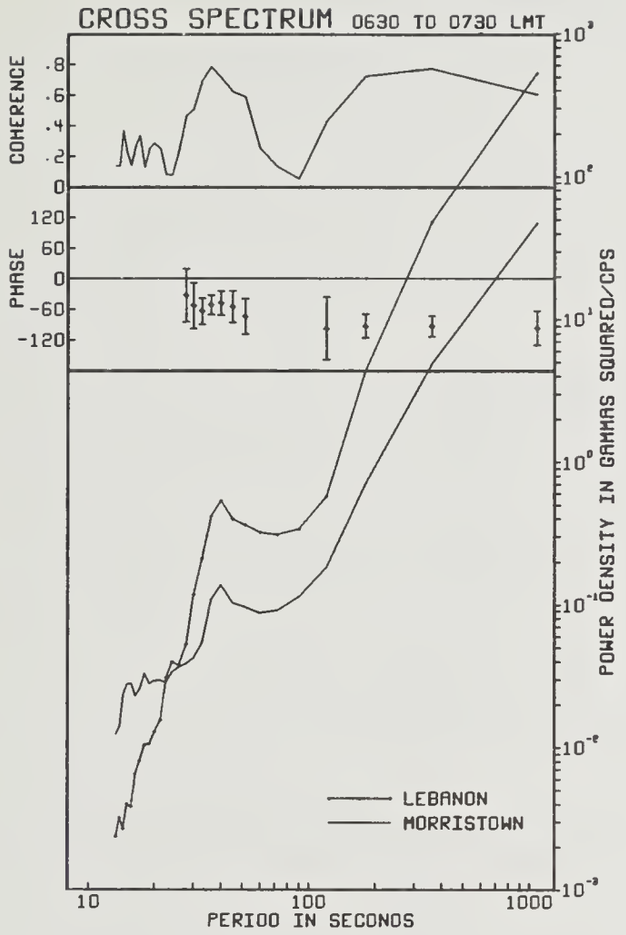

CROSS SPECTRUM 0130 TO 0230 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

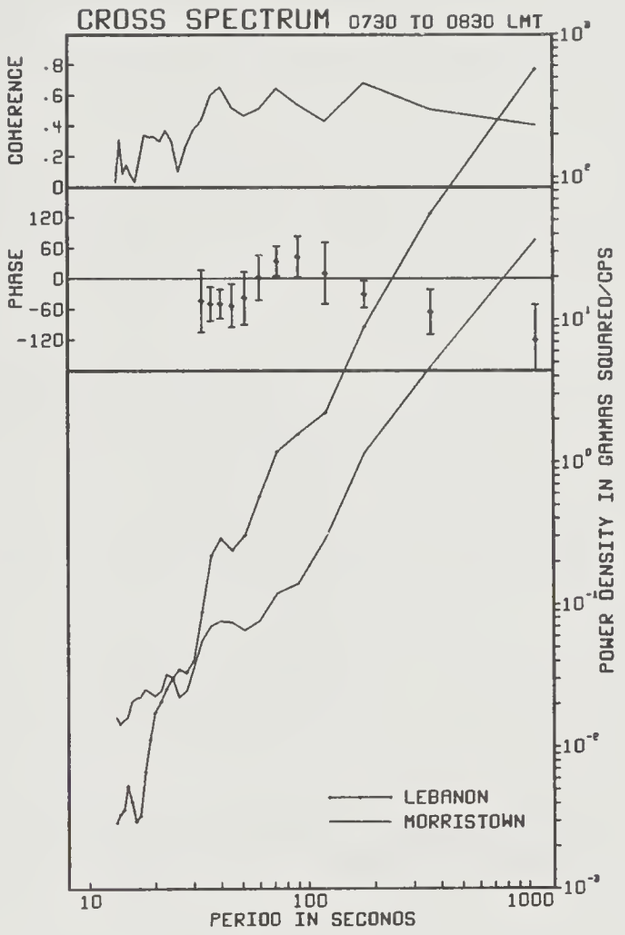

CROSS SPECTRUM 0230 TO 0330 LMT
COHERENCE
PHASE
LEBANON
MORRISTOWN
PERIOD IN SECONDS
POWER DENSITY IN GAMMAS SQUARED/CPS

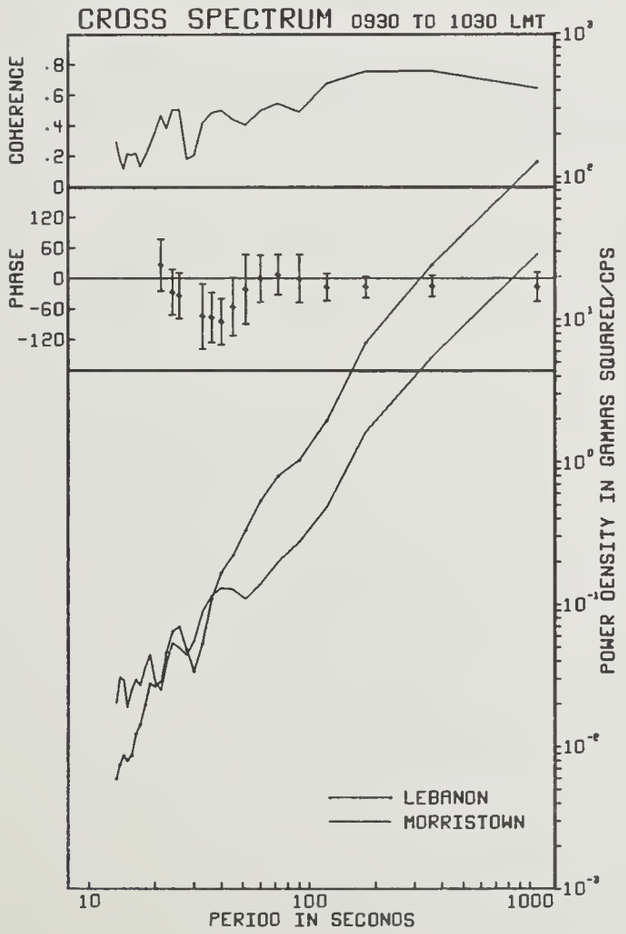

CROSS SPECTRUM 0330 TO 0430 LMT
COHERENCE
PHASE
LEBANON
MORRISTOWN
PERIOD IN SECONDS
POWER DENSITY IN GAMMAS SQUARED/CPS

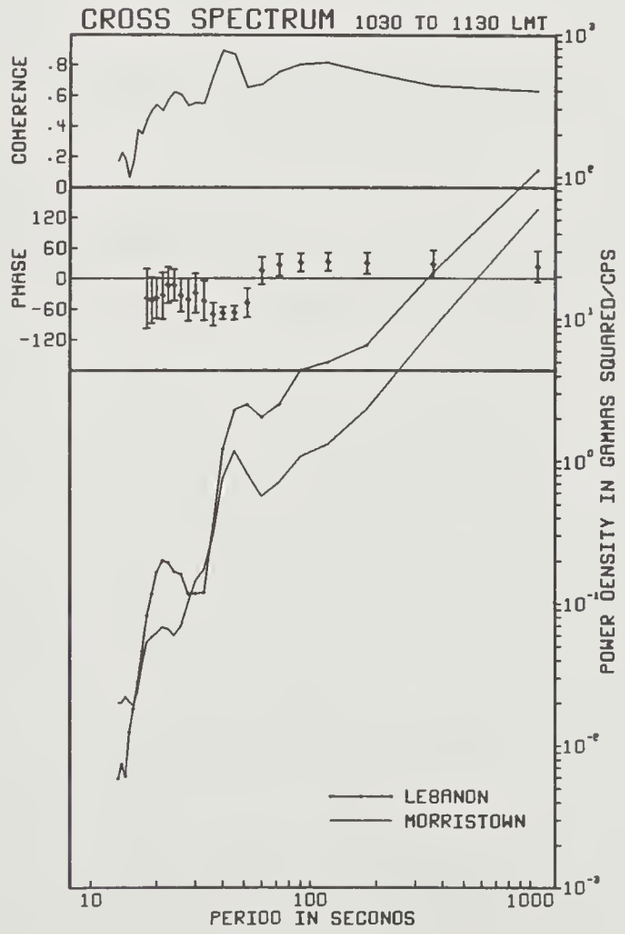

CROSS SPECTRUM 0430 TO 0530 LMT
COHERENCE
PHASE
LEBANON
MORRISTOWN
PERIOD IN SECONDS
POWER DENSITY IN GAMMAS SQUARED/CPS

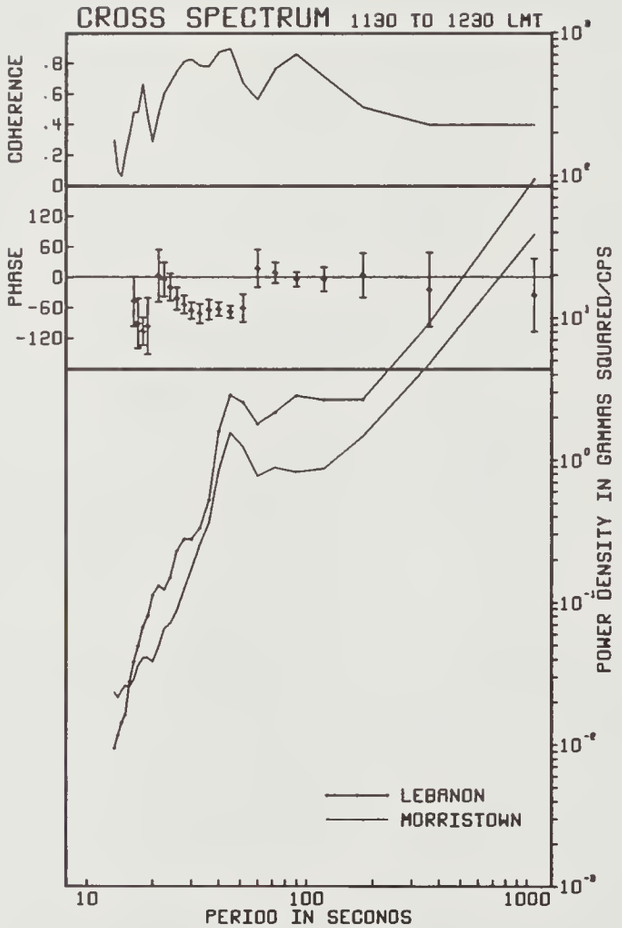

CROSS SPECTRUM 0530 TO 0630 LMT
COHERENCE
PHASE
LEBANON
MORRISTOWN
PERIOD IN SECONDS
POWER DENSITY IN GAMMAS SQUARED/CPS

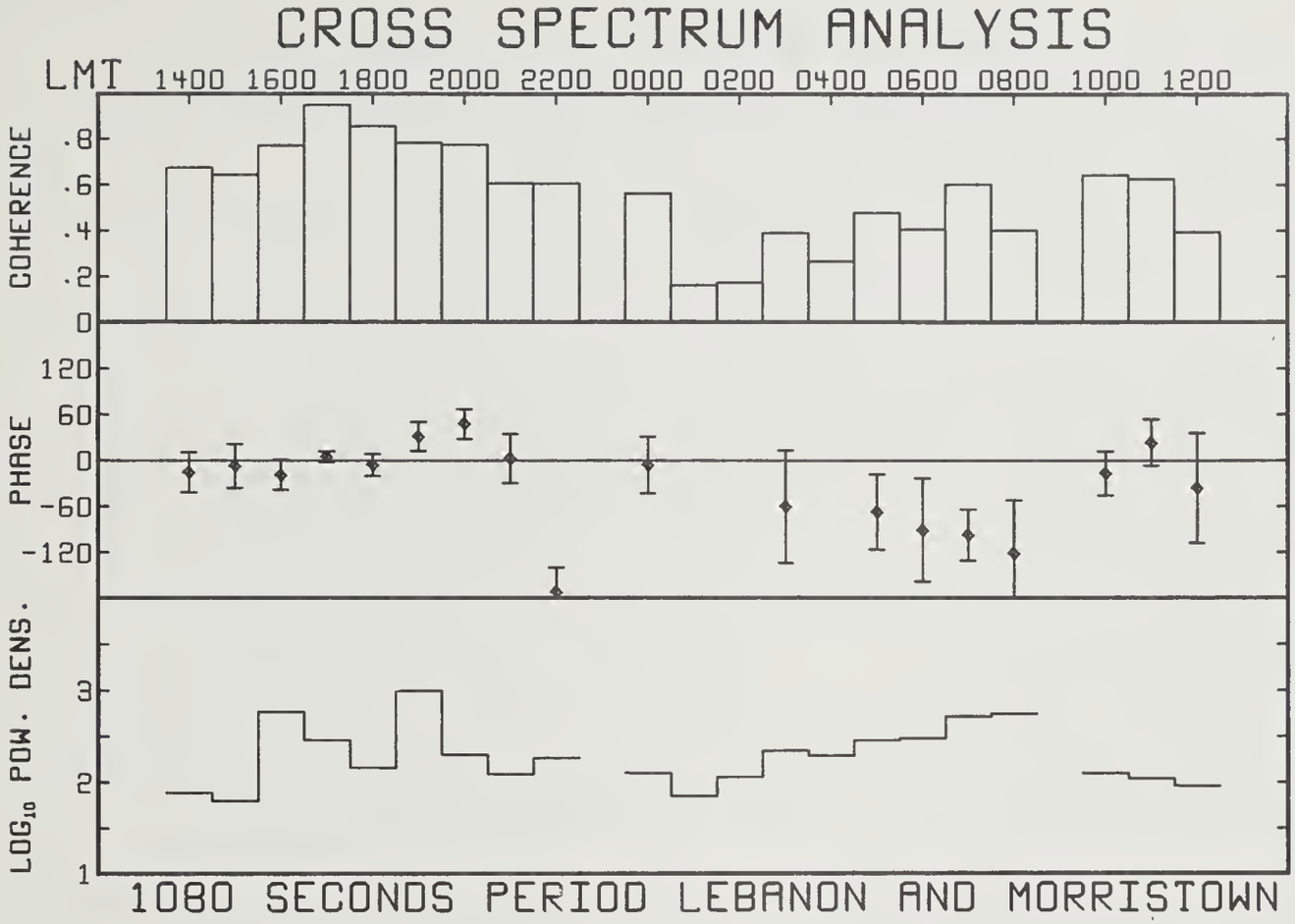

CROSS SPECTRUM 0630 TO 0730 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

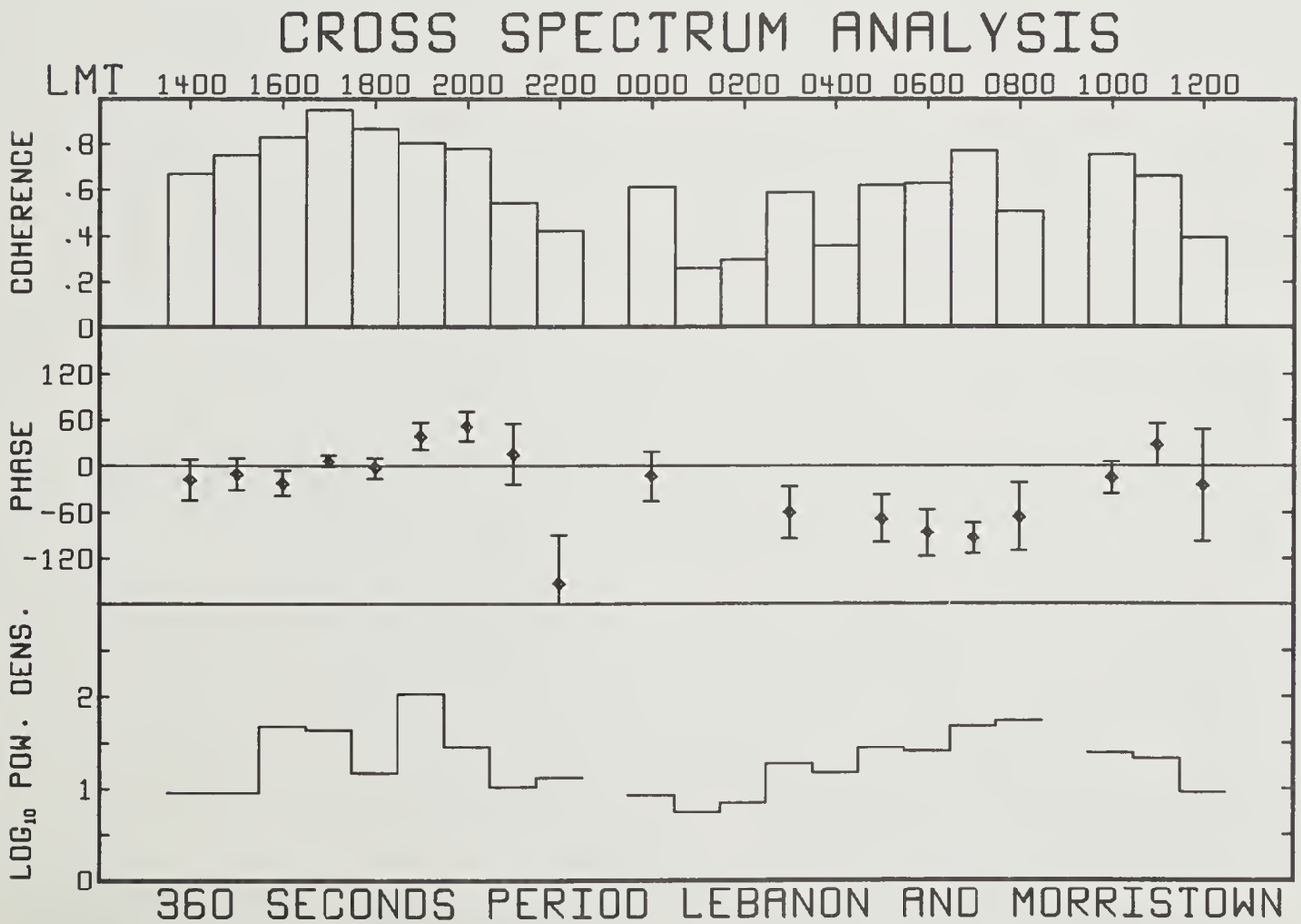

CROSS SPECTRUM 0730 TO 0830 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

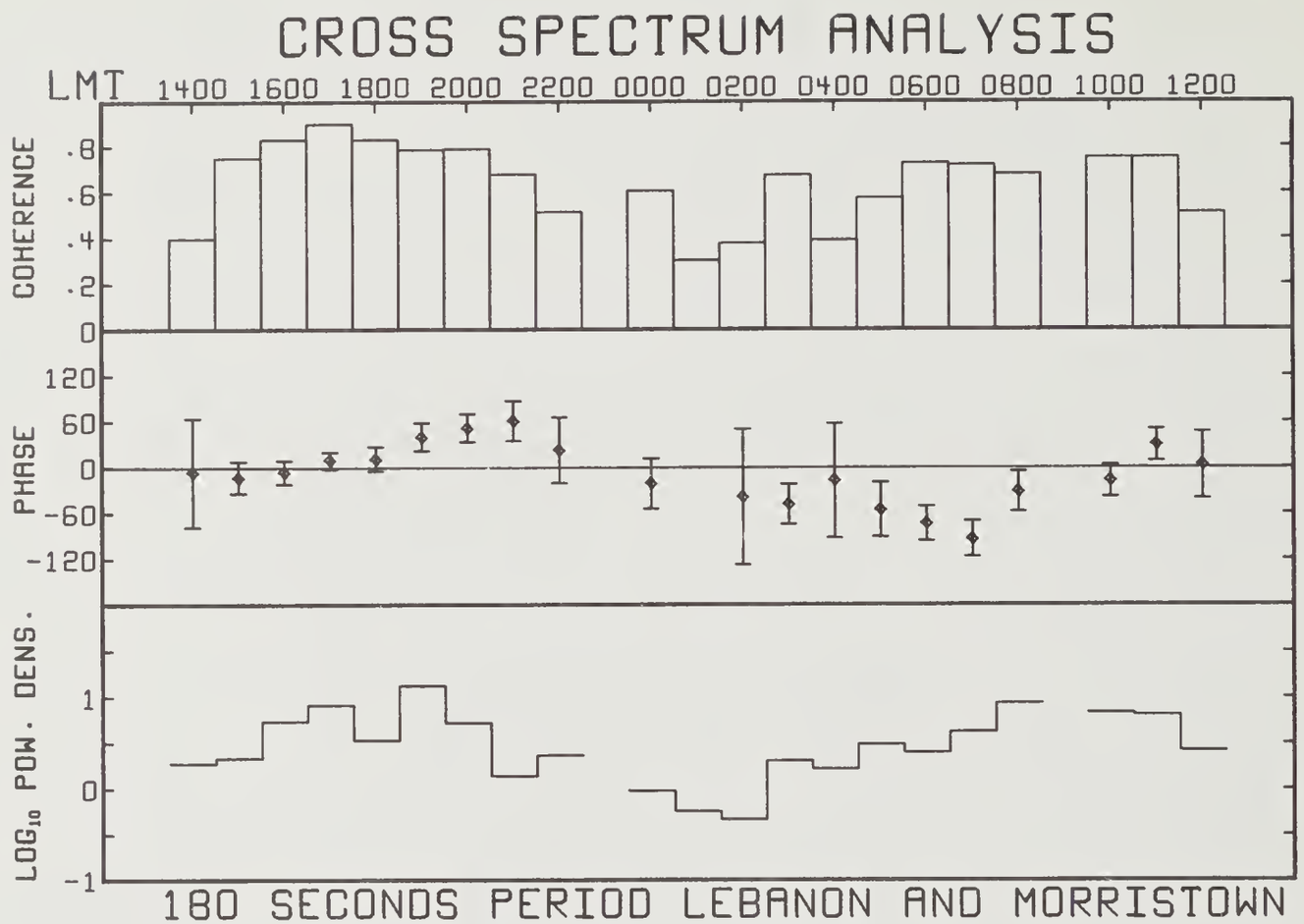

CROSS SPECTRUM 0930 TO 1030 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

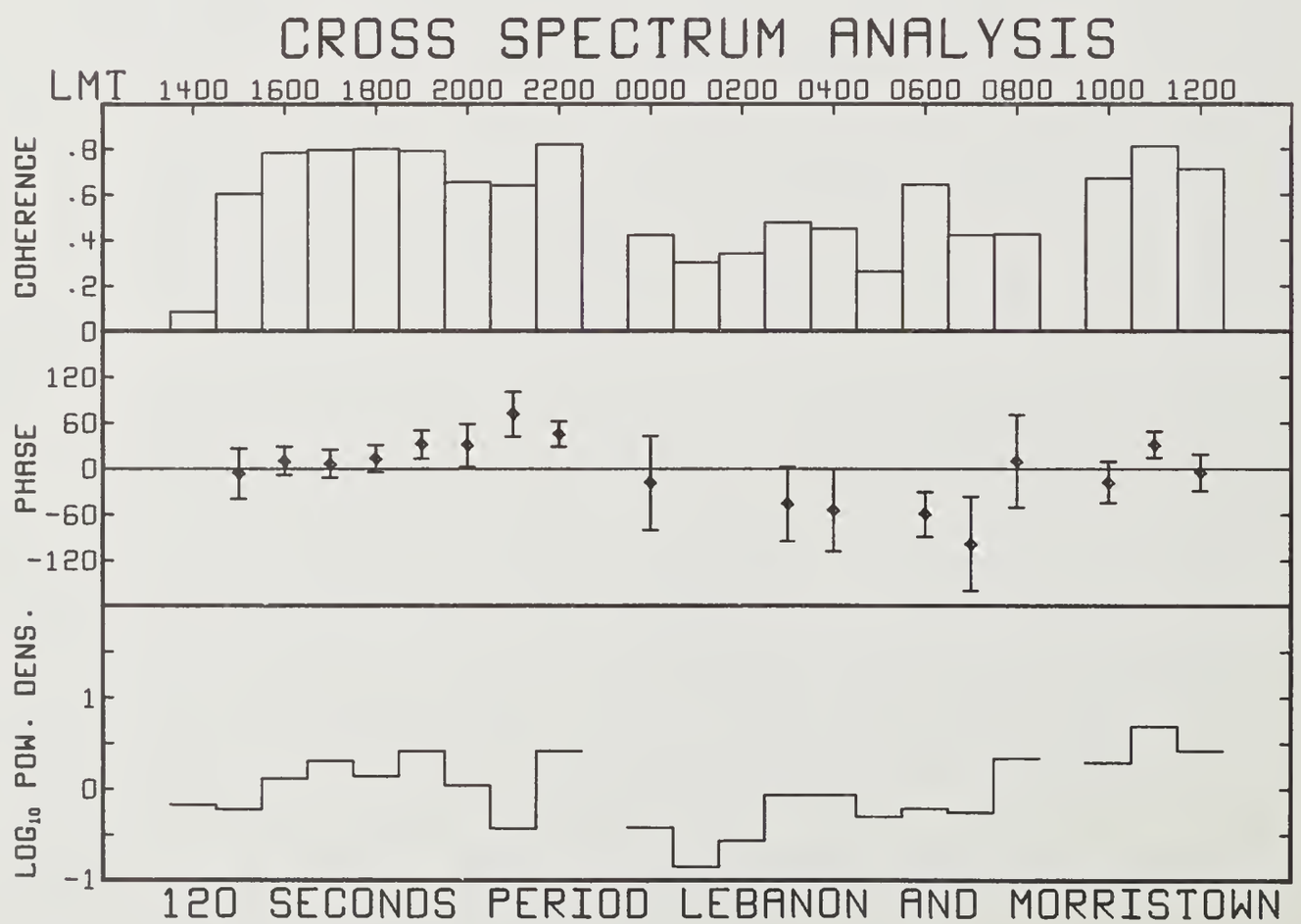

CROSS SPECTRUM 1030 TO 1130 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
MORRISTOWN

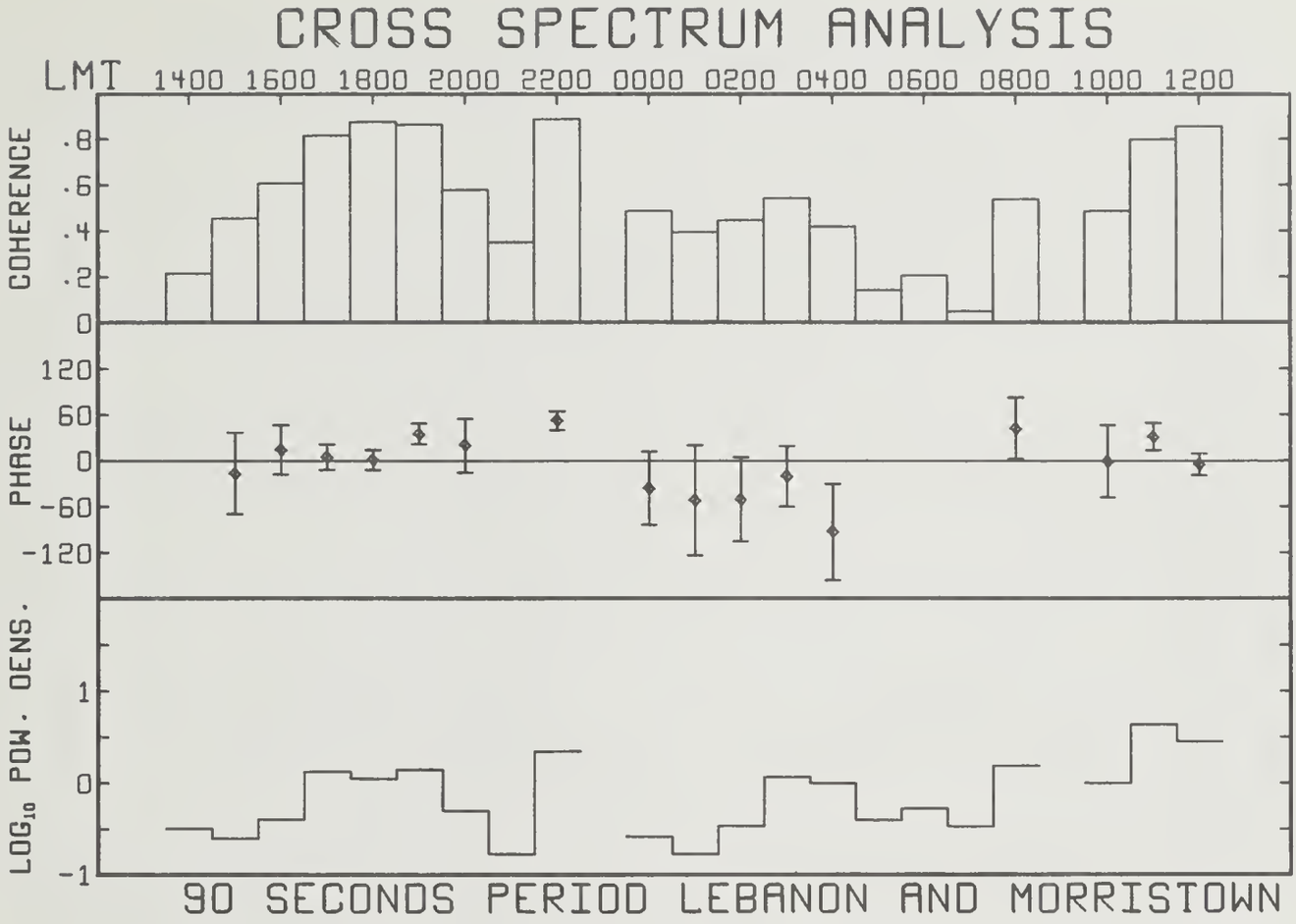

CROSS SPECTRUM 1130 TO 1230 LMT
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
MORRISTOWN
10
100
1000
PERIOD IN SECONDS

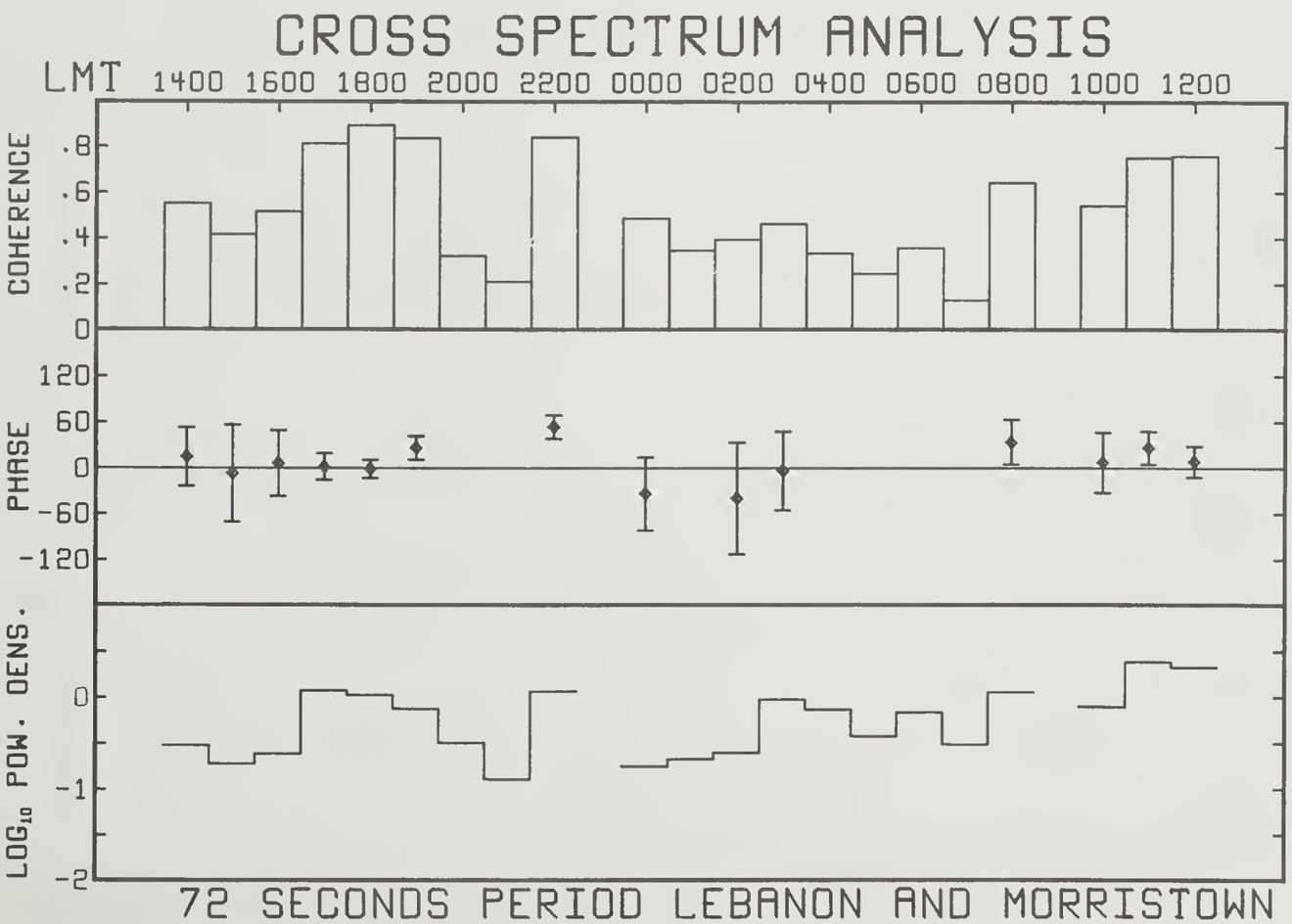

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
3
2
1
1080 SECONDS PERIOD LEBANON AND MORRISTOWN

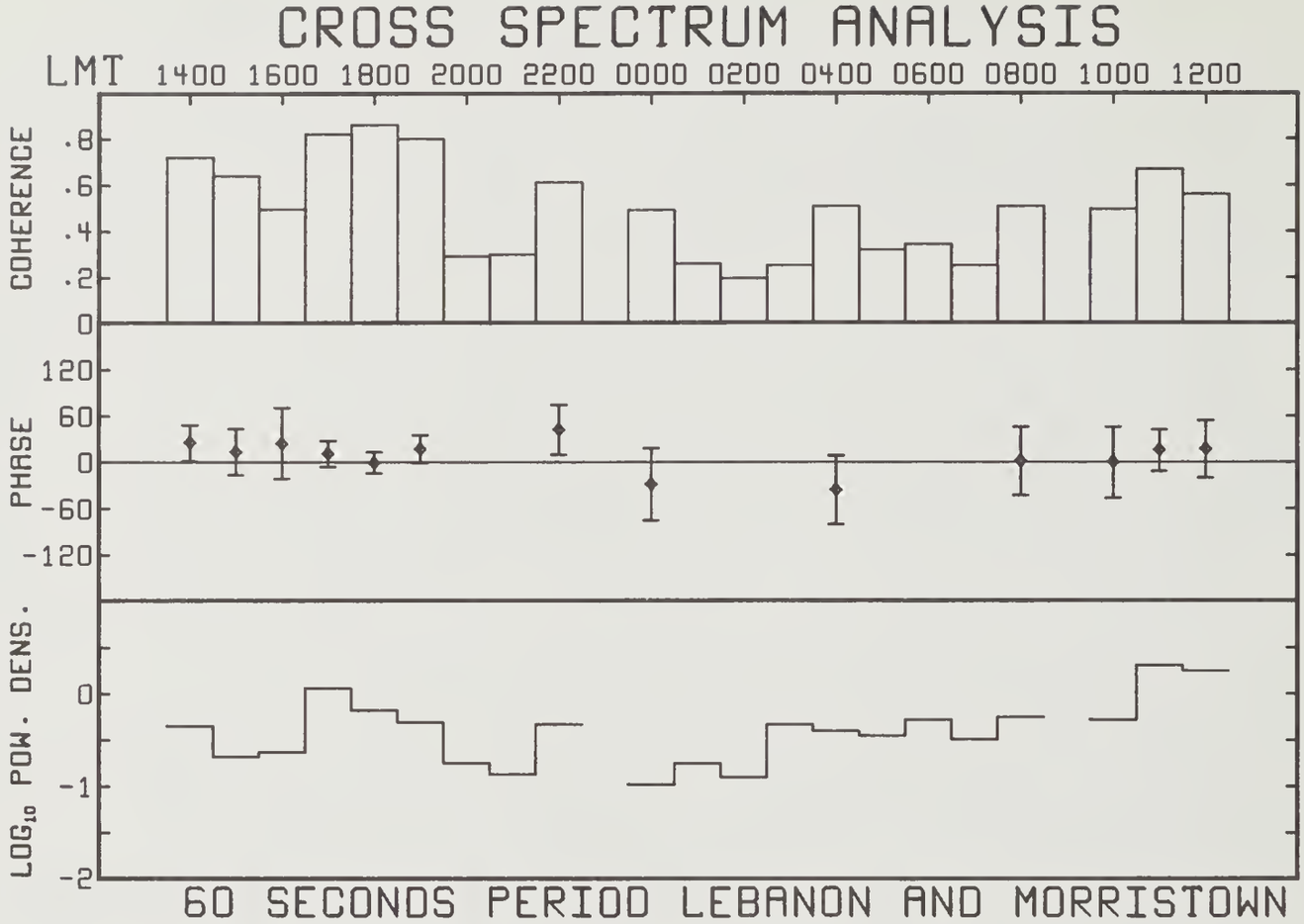

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
2
1
0
360 SECONDS PERIOD LEBANON AND MORRISTOWN

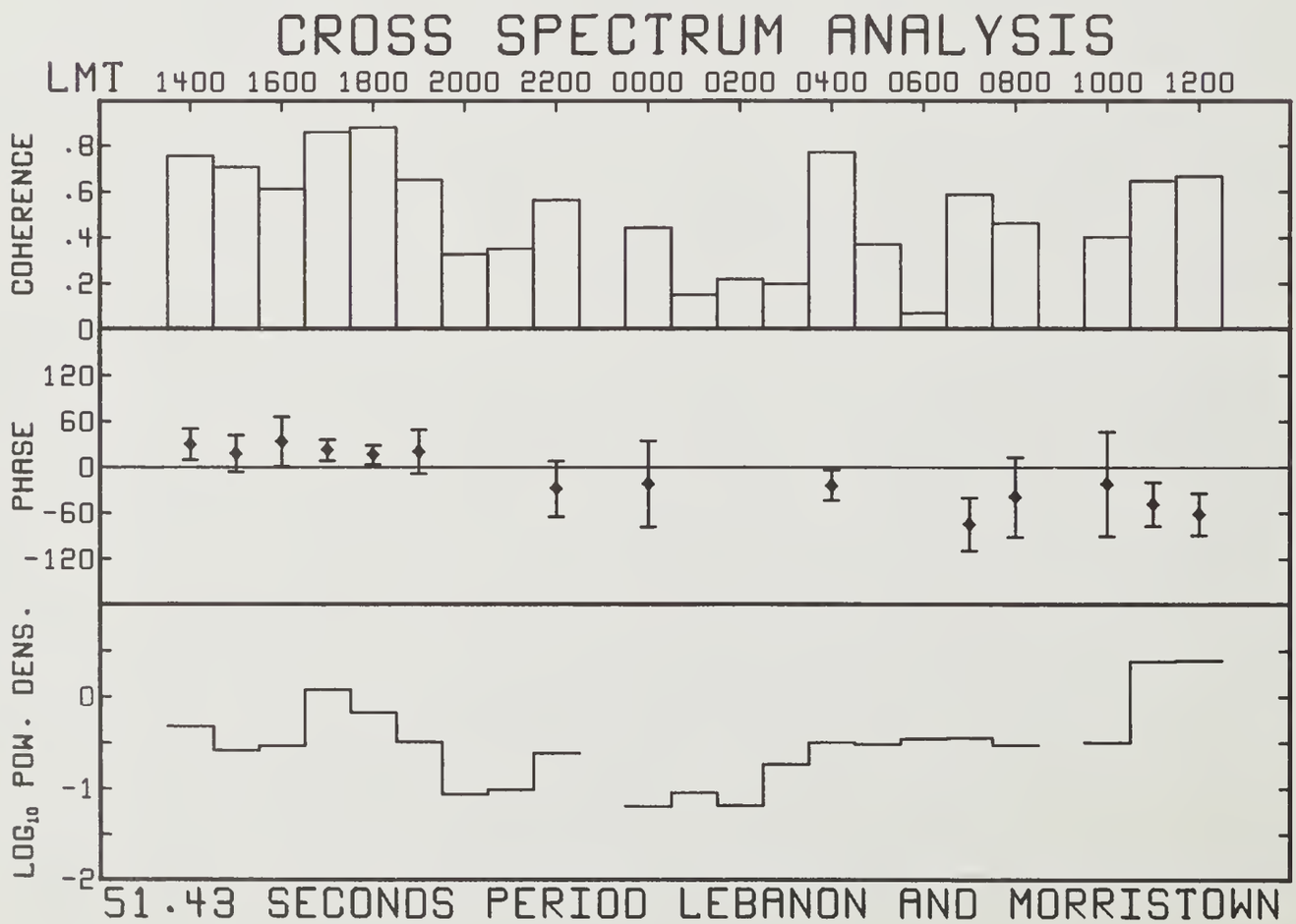

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
1
0
-1
180 SECONDS PERIOD LEBANON AND MORRISTOWN

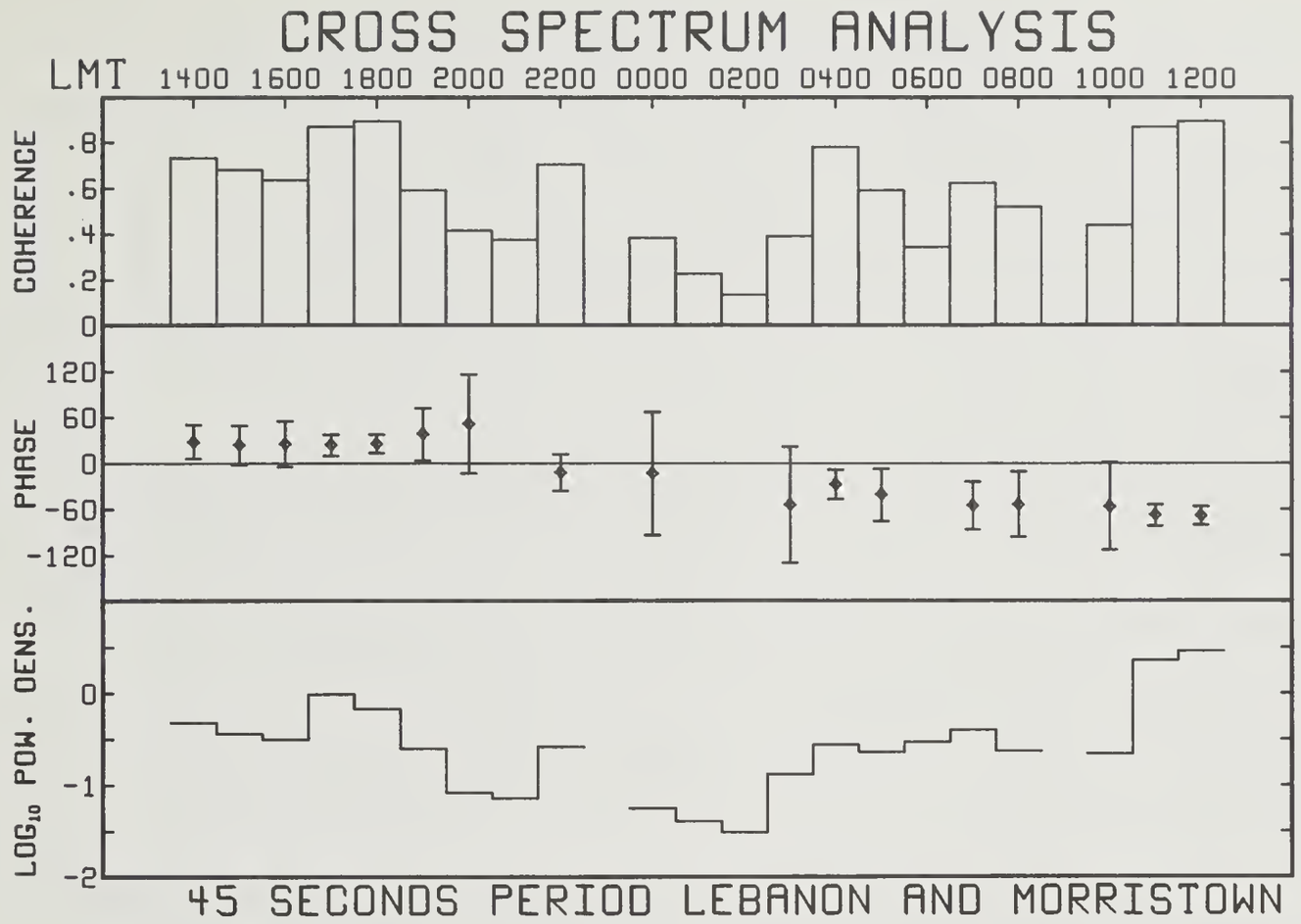

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
1
0
-1
120 SECONDS PERIOD LEBANON AND MORRISTOWN

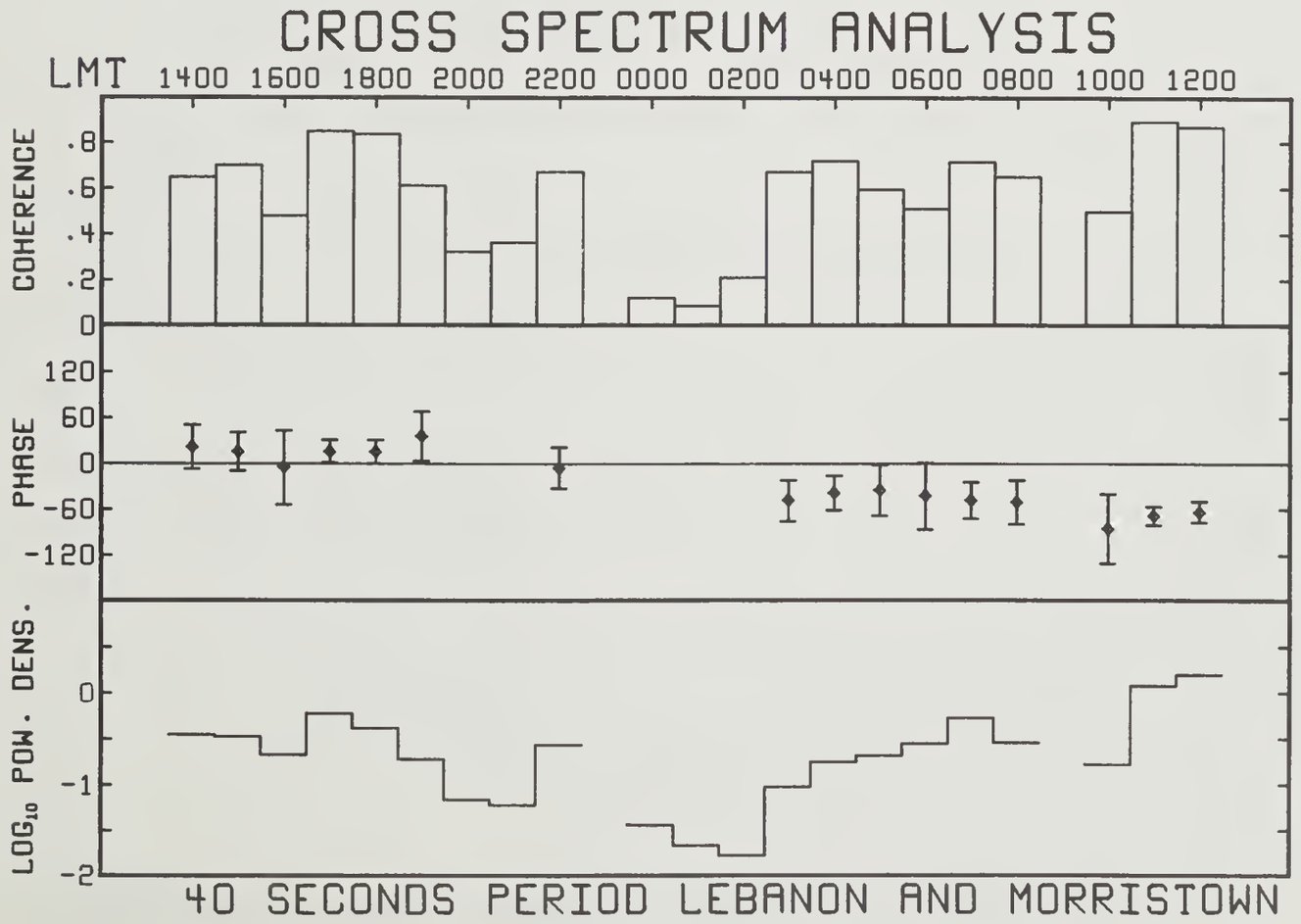

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
1
0
-1
90 SECONDS PERIOD LEBANON AND MORRISTOWN

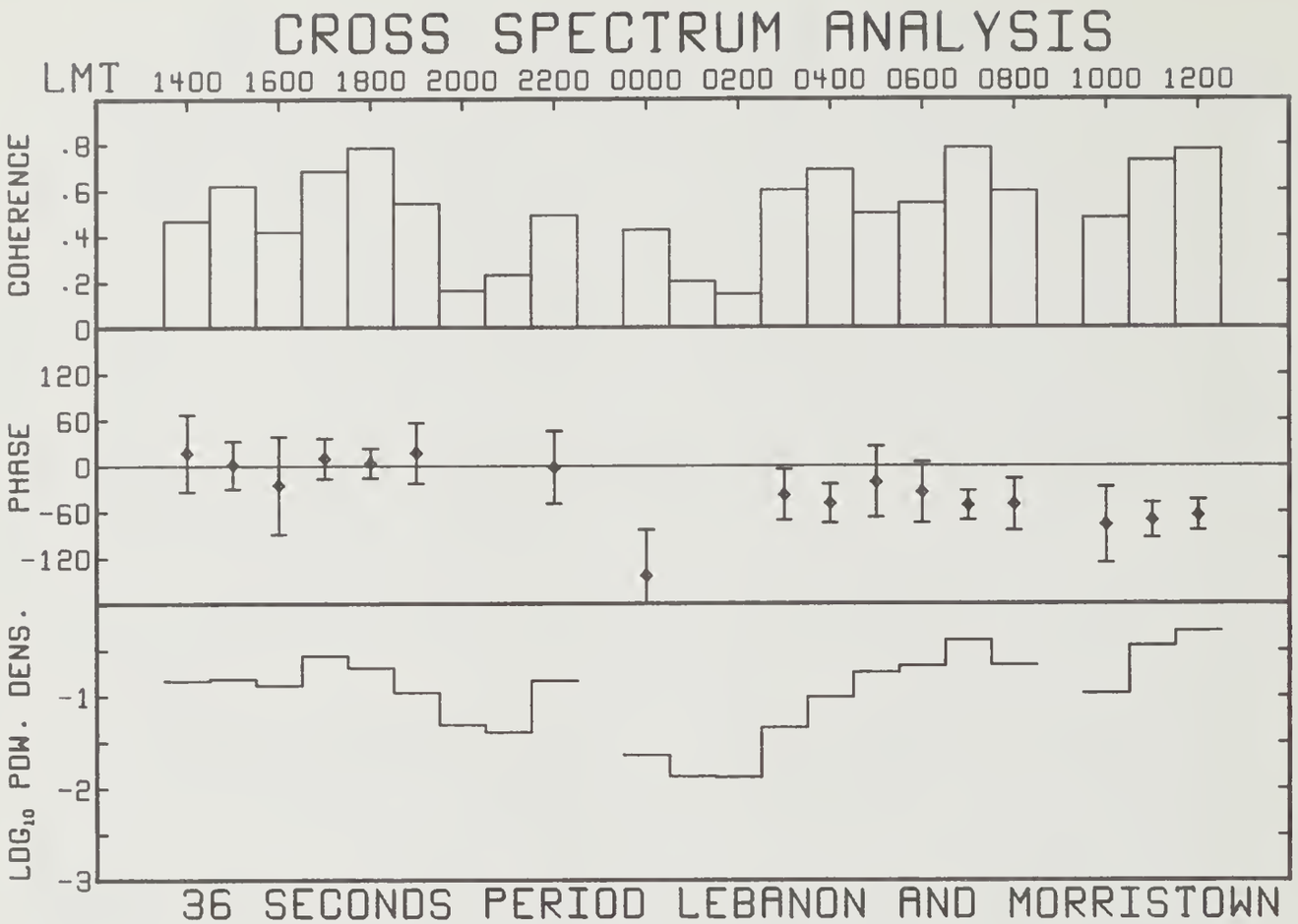

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
72 SECONDS PERIOD LEBANON AND MORRISTOWN

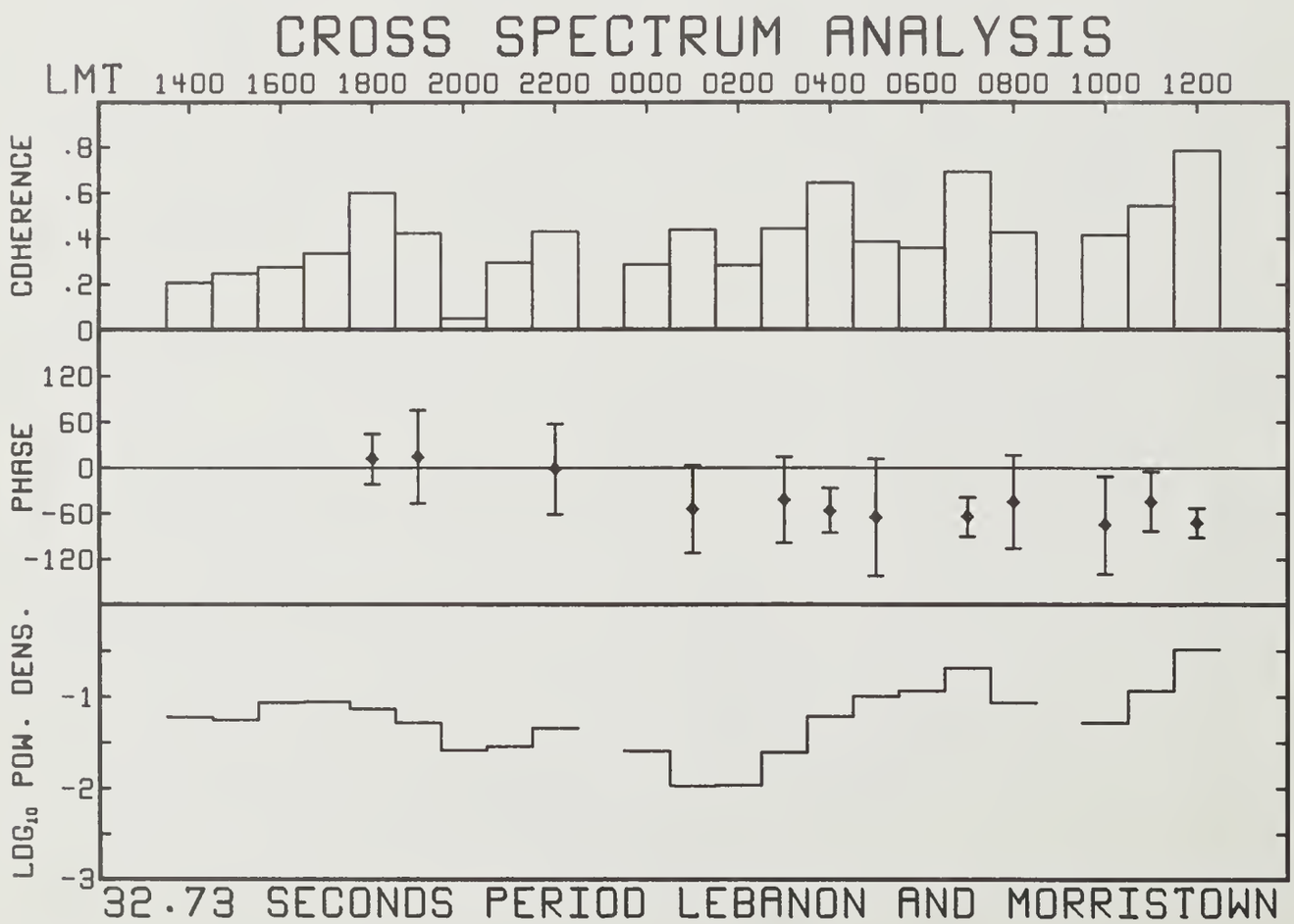

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
60 SECONDS PERIOD LEBANON AND MORRISTOWN

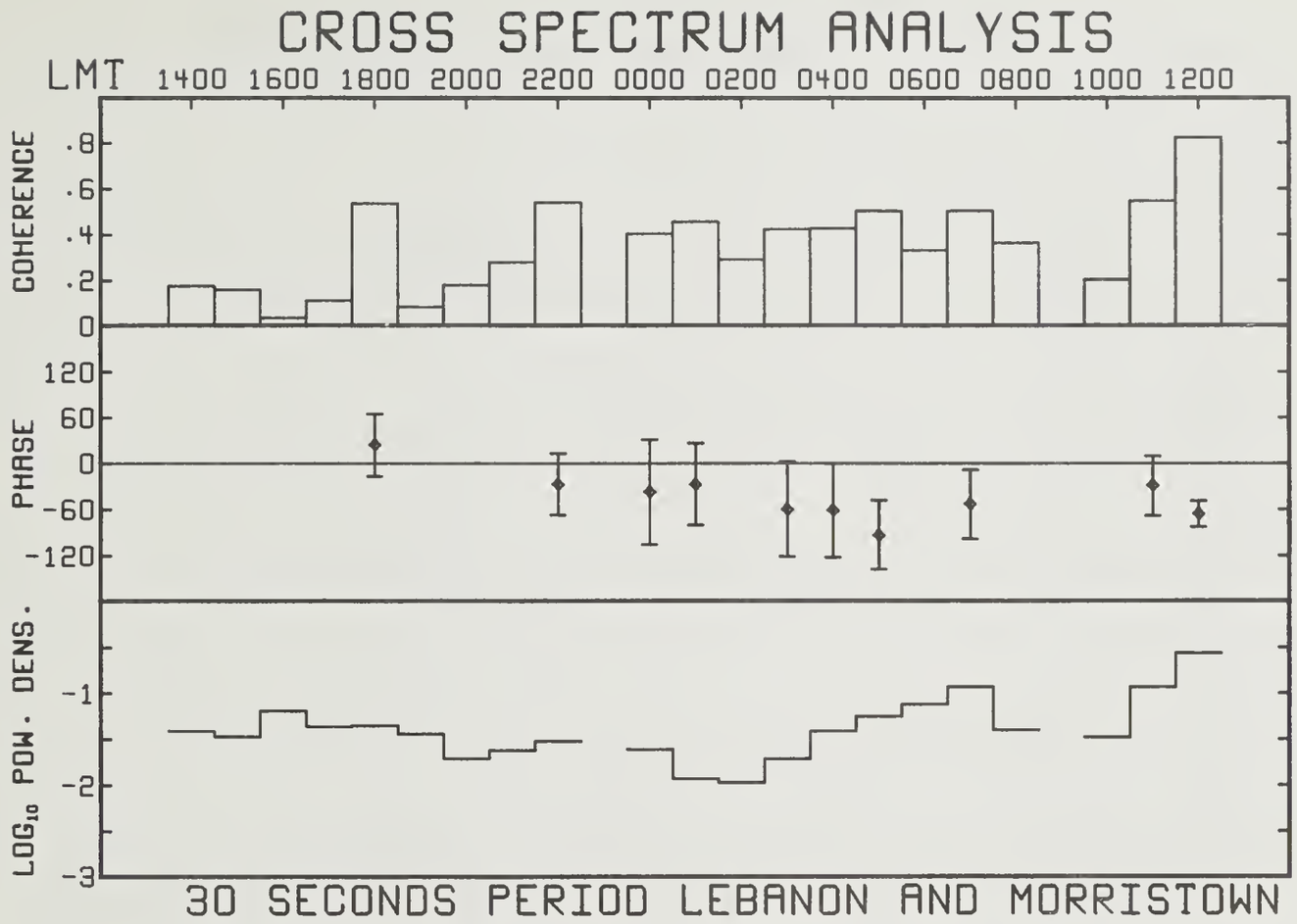

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
51.43 SECONDS PERIOD LEBANON AND MORRISTOWN

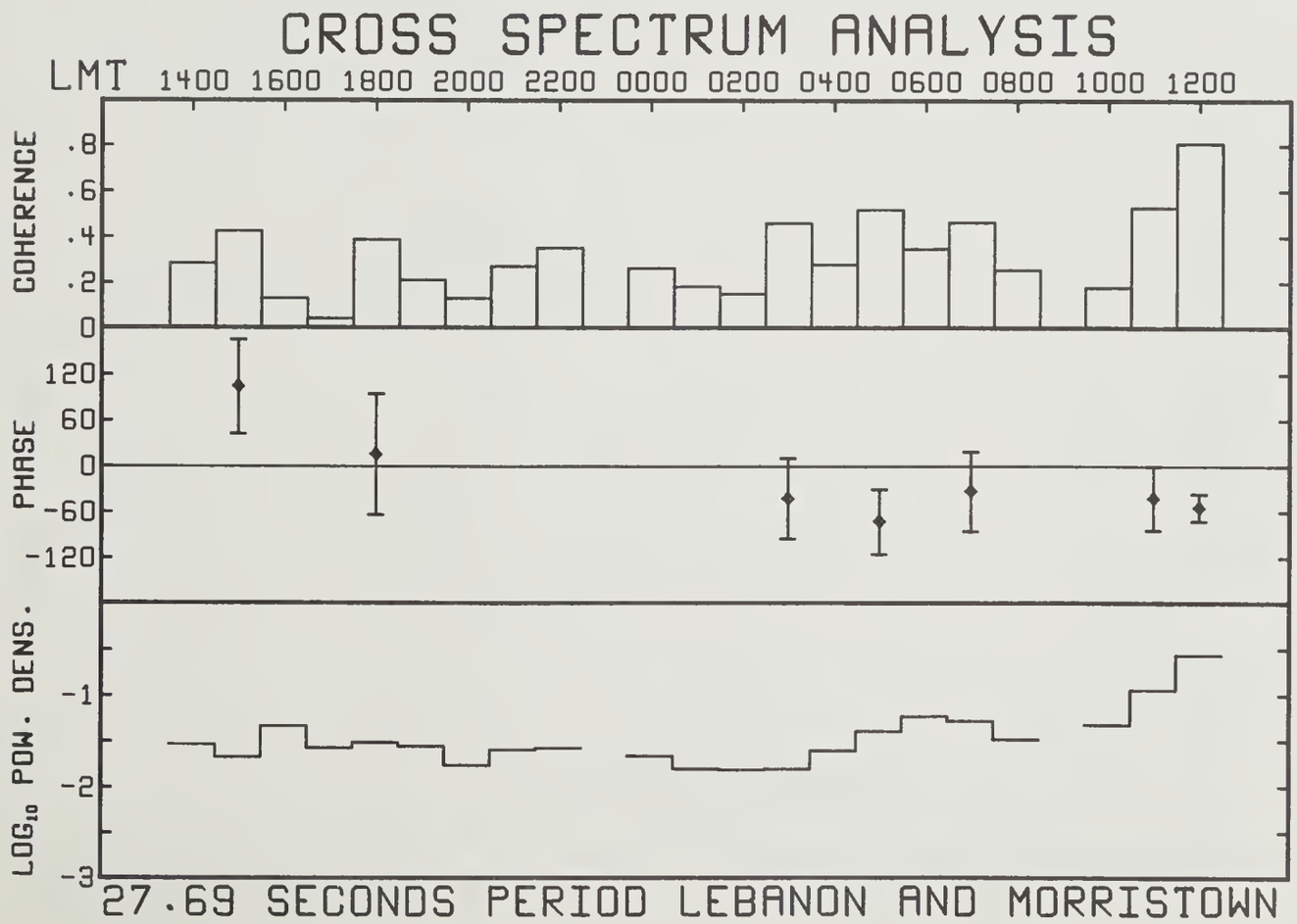

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
45 SECONDS PERIOD LEBANON AND MORRISTOWN

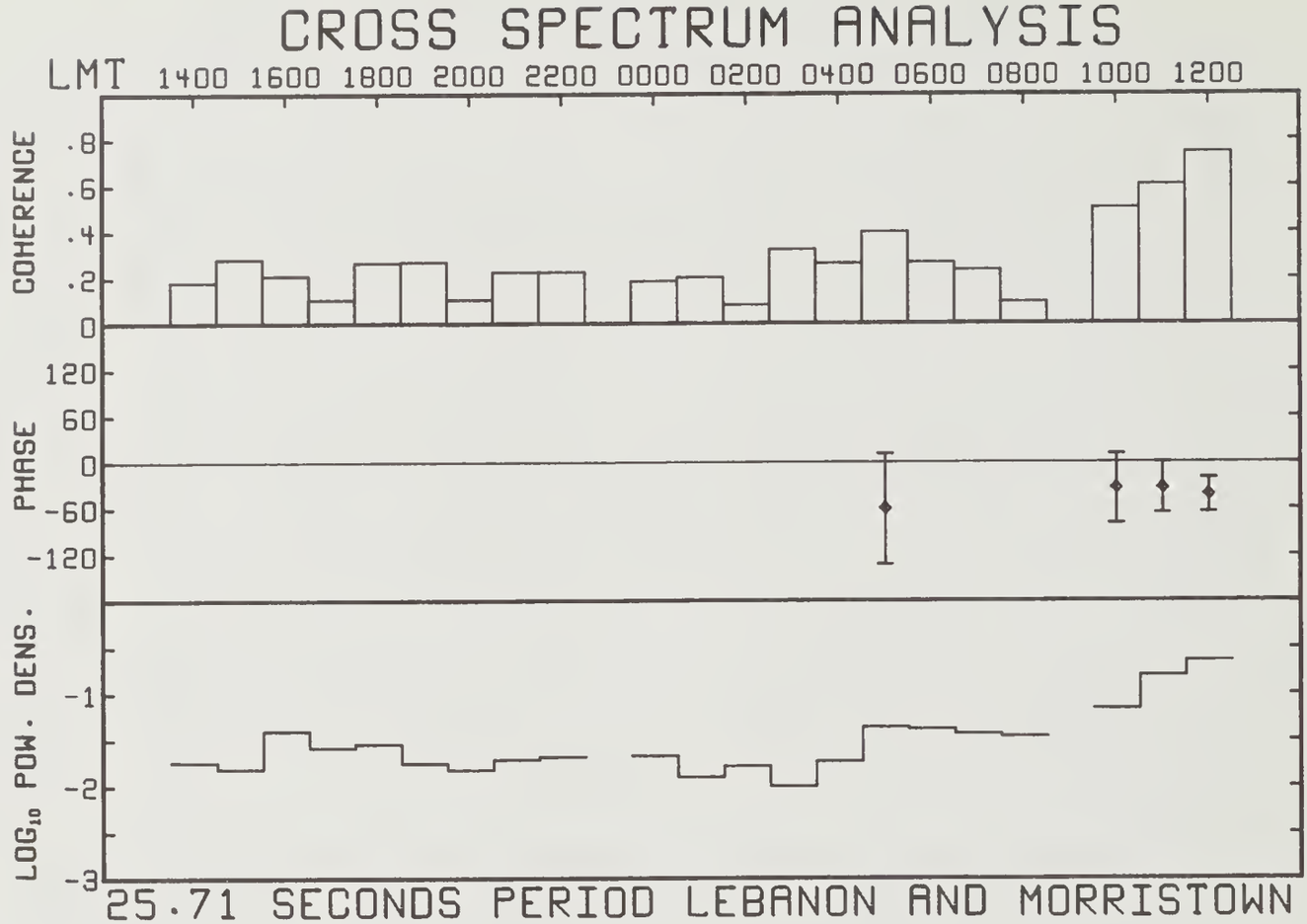

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
40 SECONDS PERIOD LEBANON AND MORRISTOWN

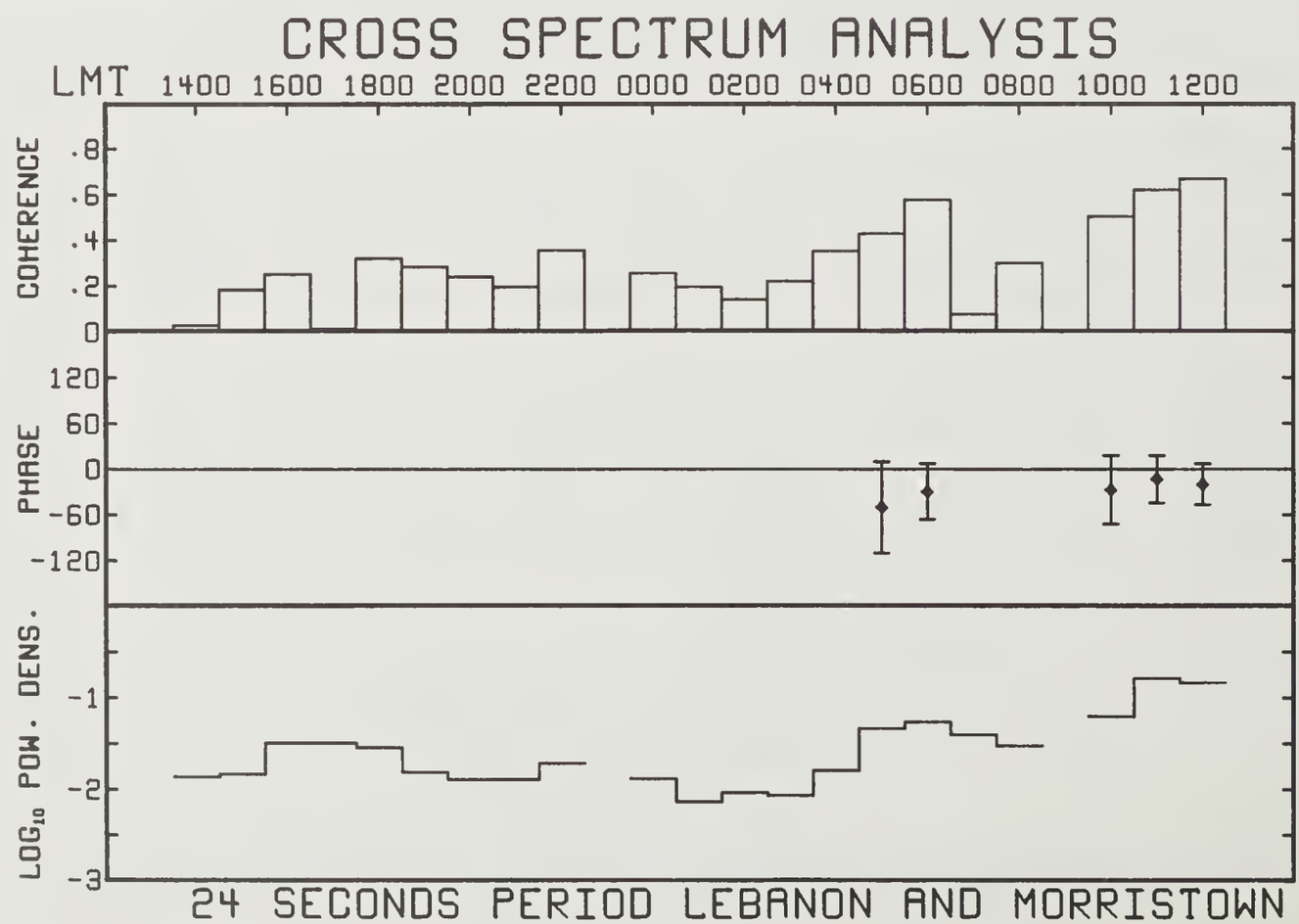

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
36 SECONDS PERIOD LEBANON AND MORRISTOWN

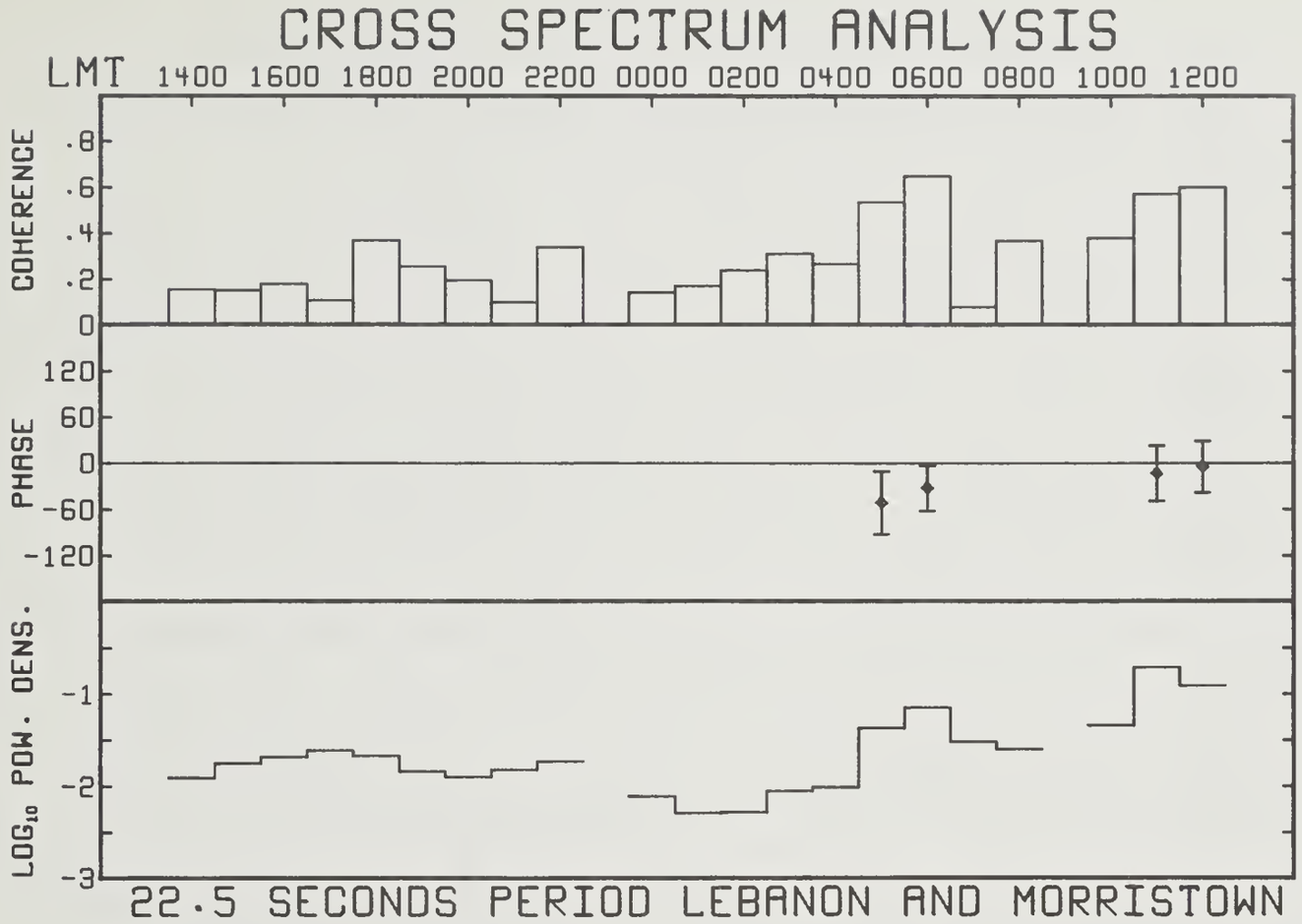

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
32.73 SECONDS PERIOD LEBANON AND MORRISTOWN

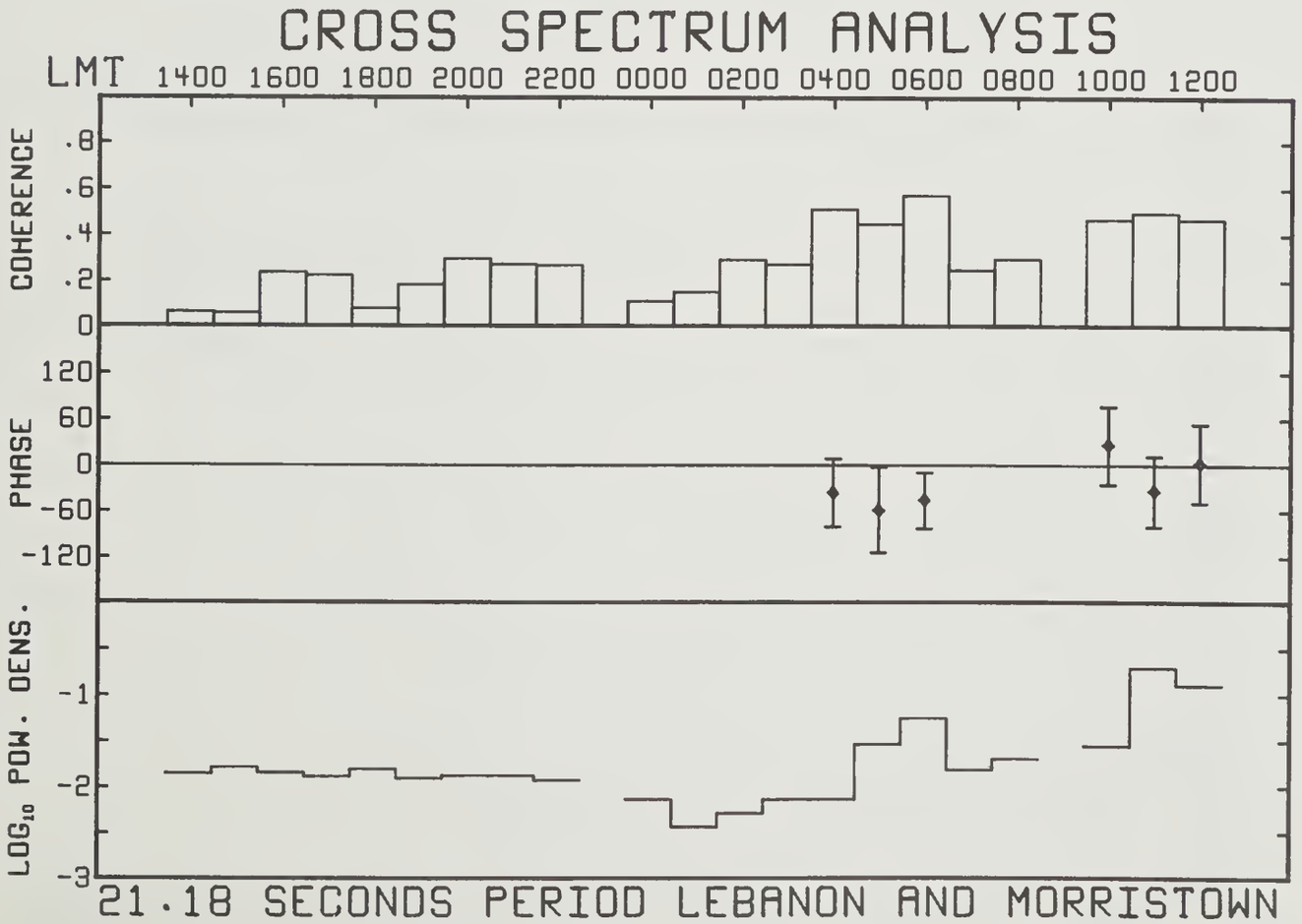

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
30 SECONDS PERIOD LEBANON AND MORRISTOWN

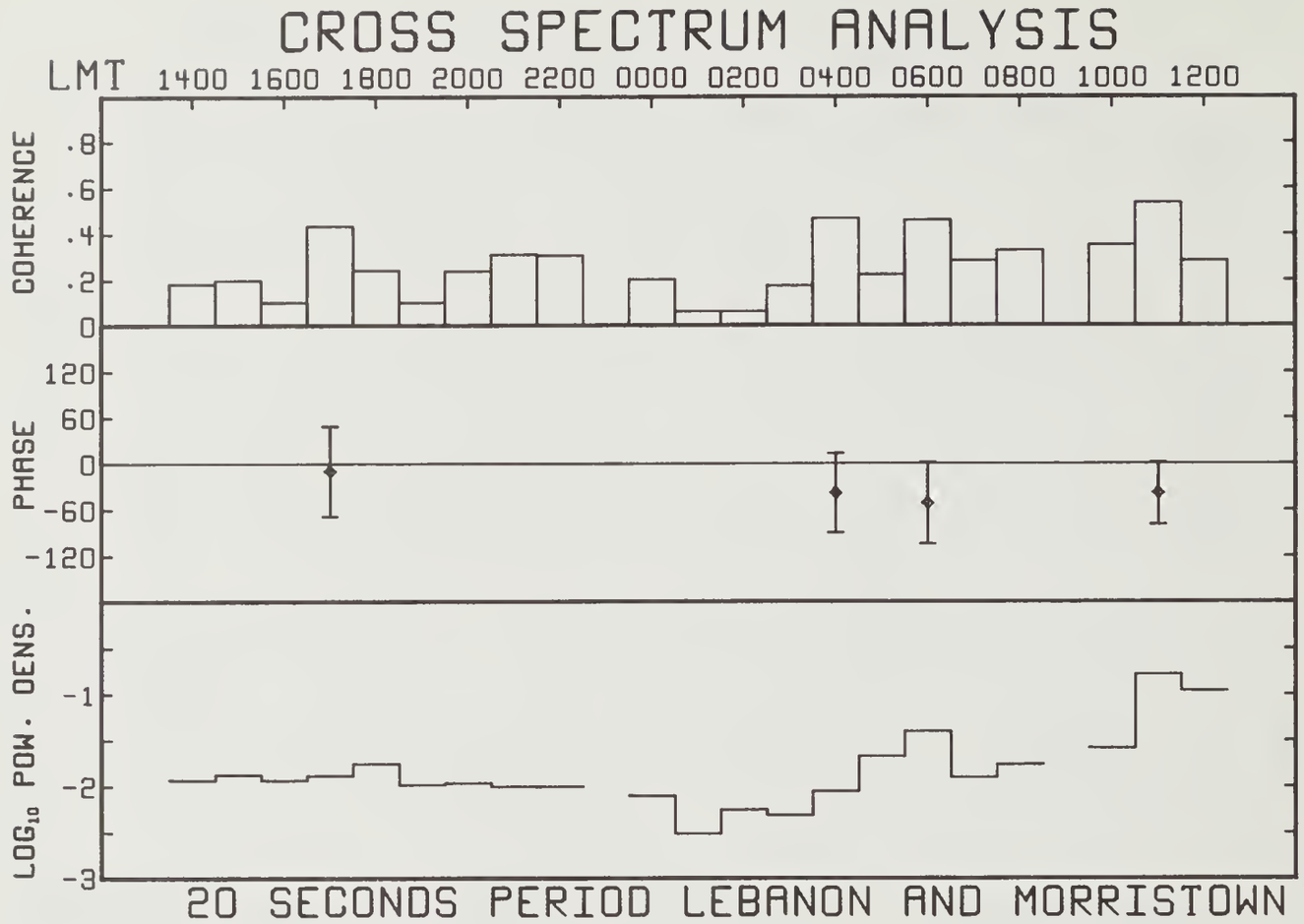

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
27.69 SECONDS PERIOD LEBANON AND MORRISTOWN

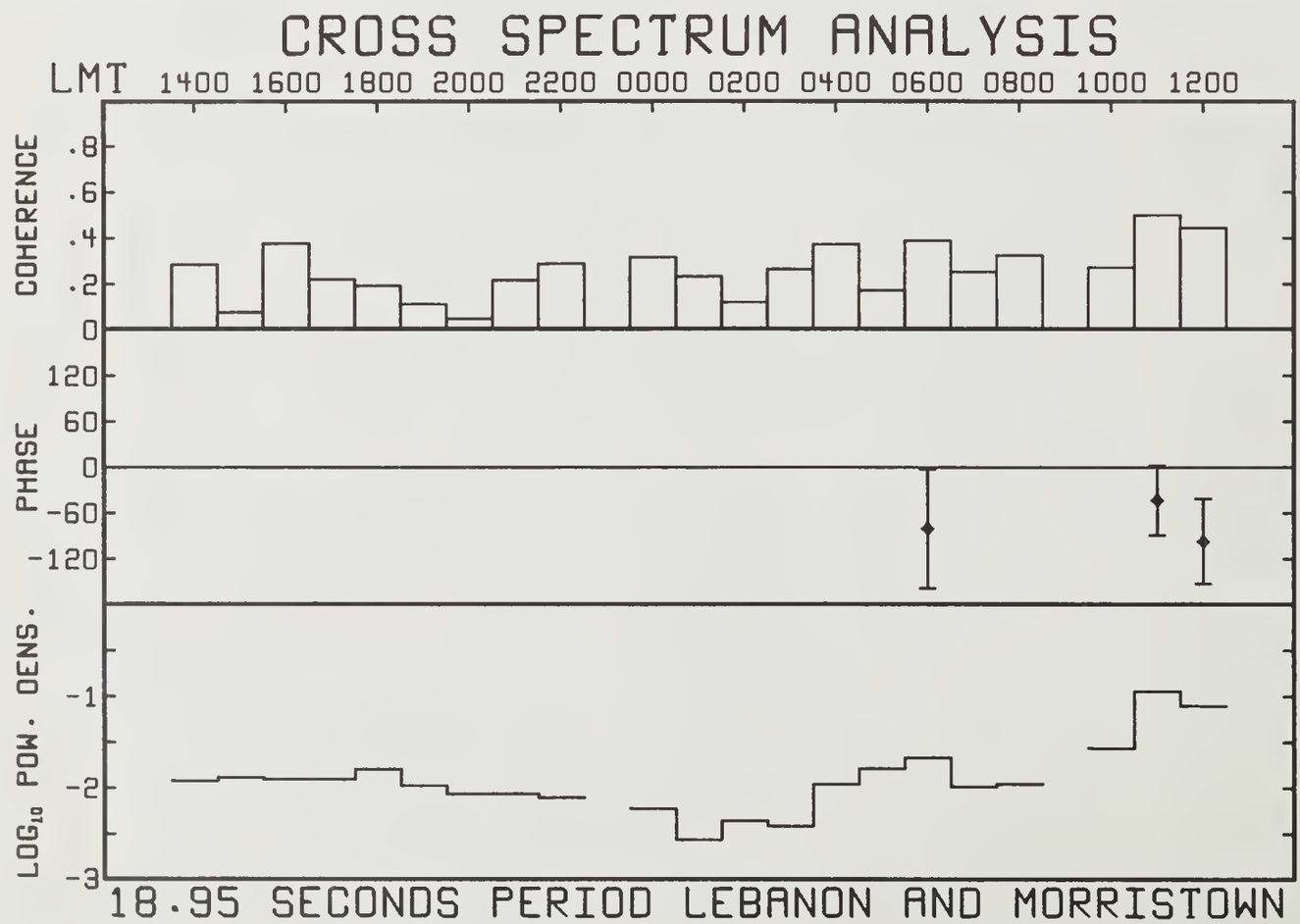

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
25.71 SECONDS PERIOD LEBANON AND MORRISTOWN

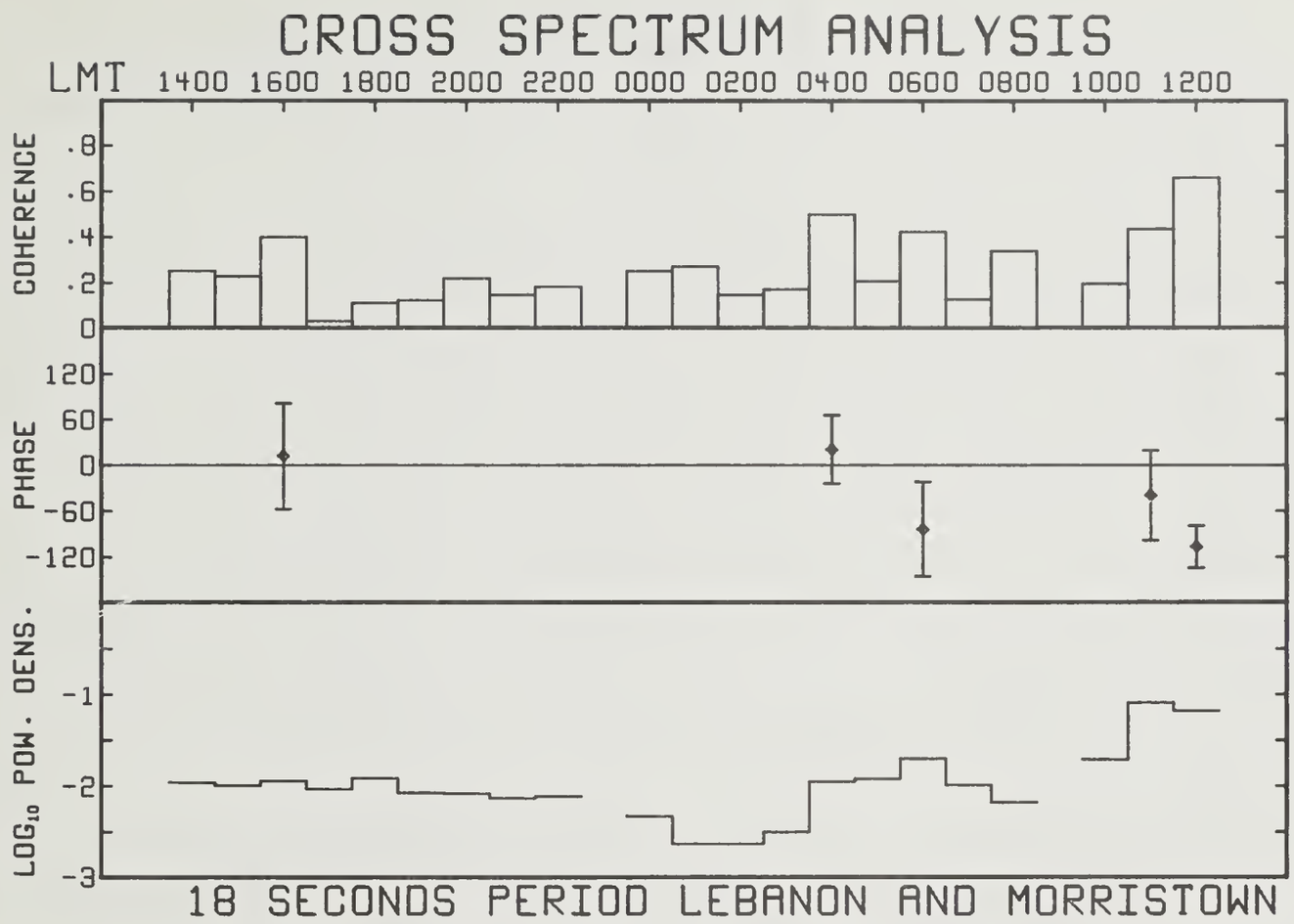

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
24 SECONDS PERIOD LEBANON AND MORRISTOWN

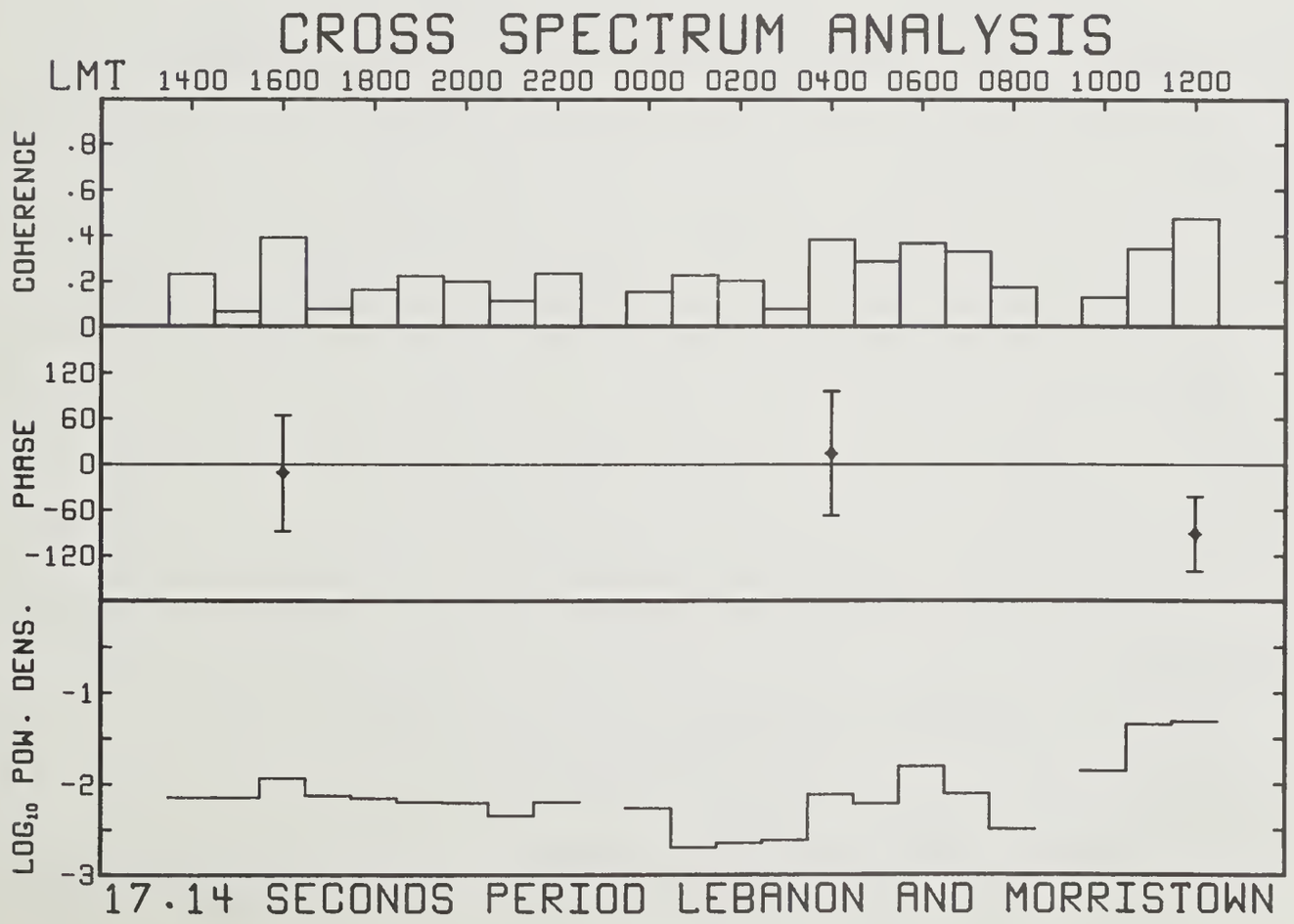

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
22.5 SECONDS PERIOD LEBANON AND MORRISTOWN

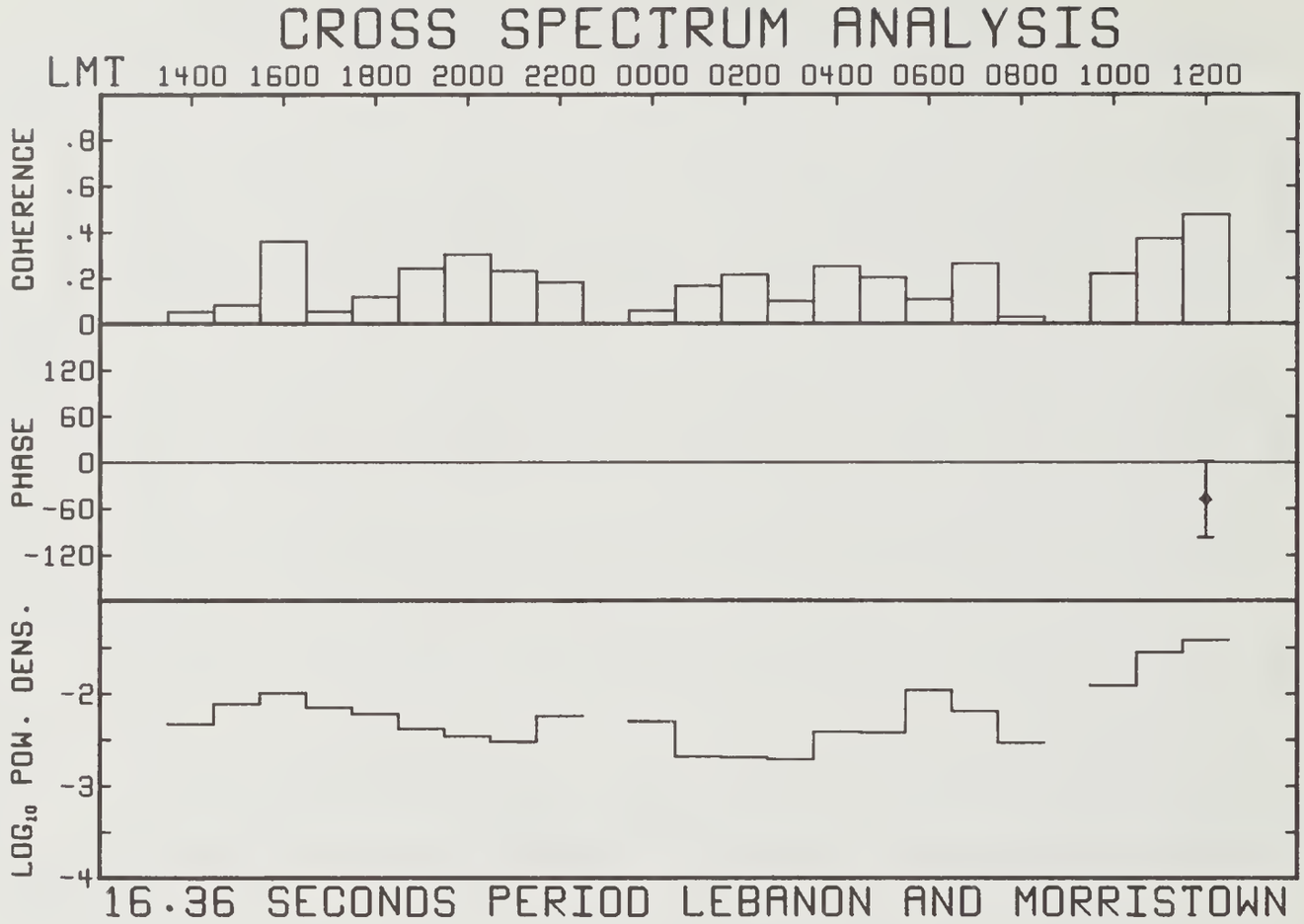

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
21.18 SECONDS PERIOD LEBANON AND MORRISTOWN

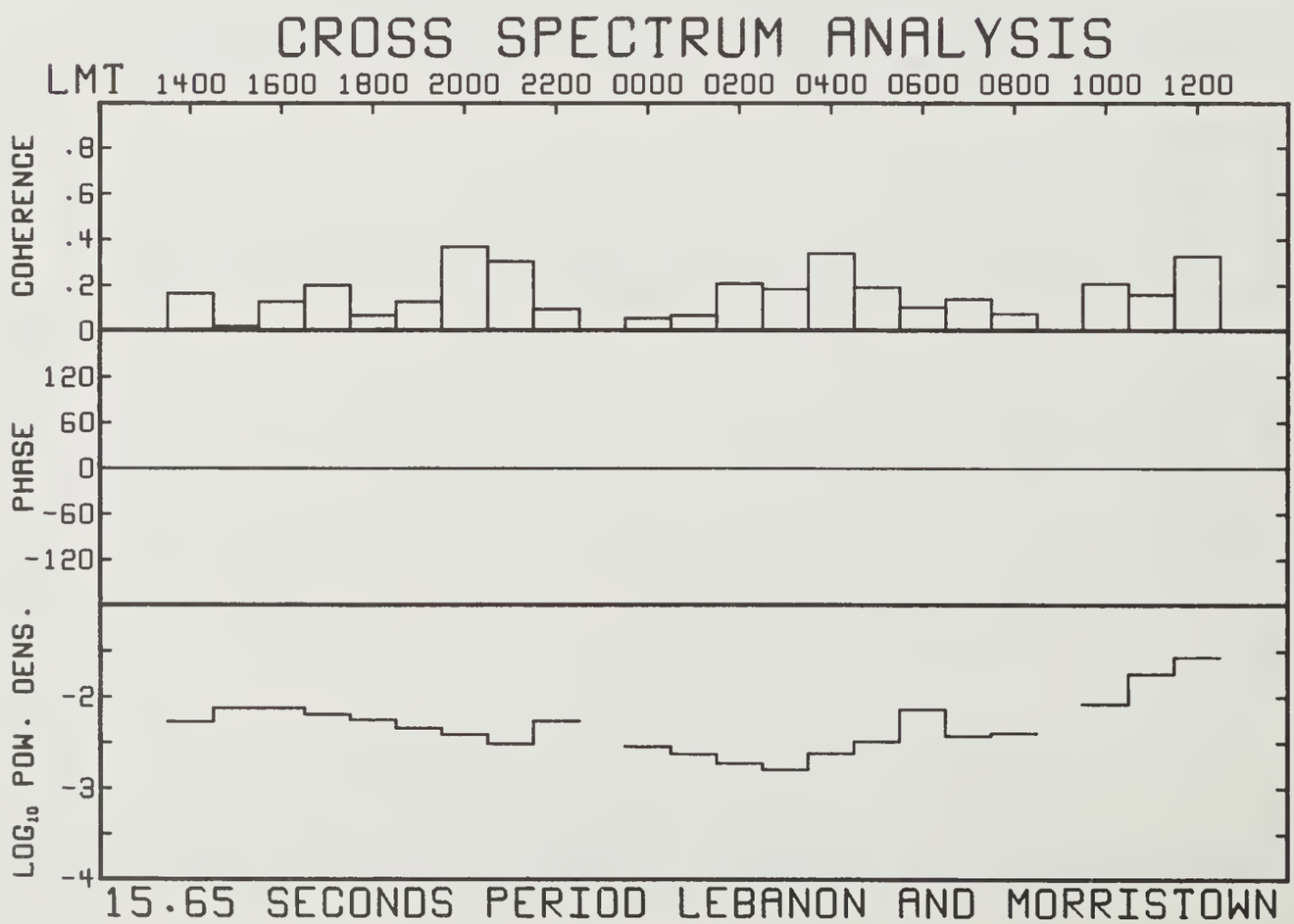

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
20 SECONDS PERIOD LEBANON AND MORRISTOWN

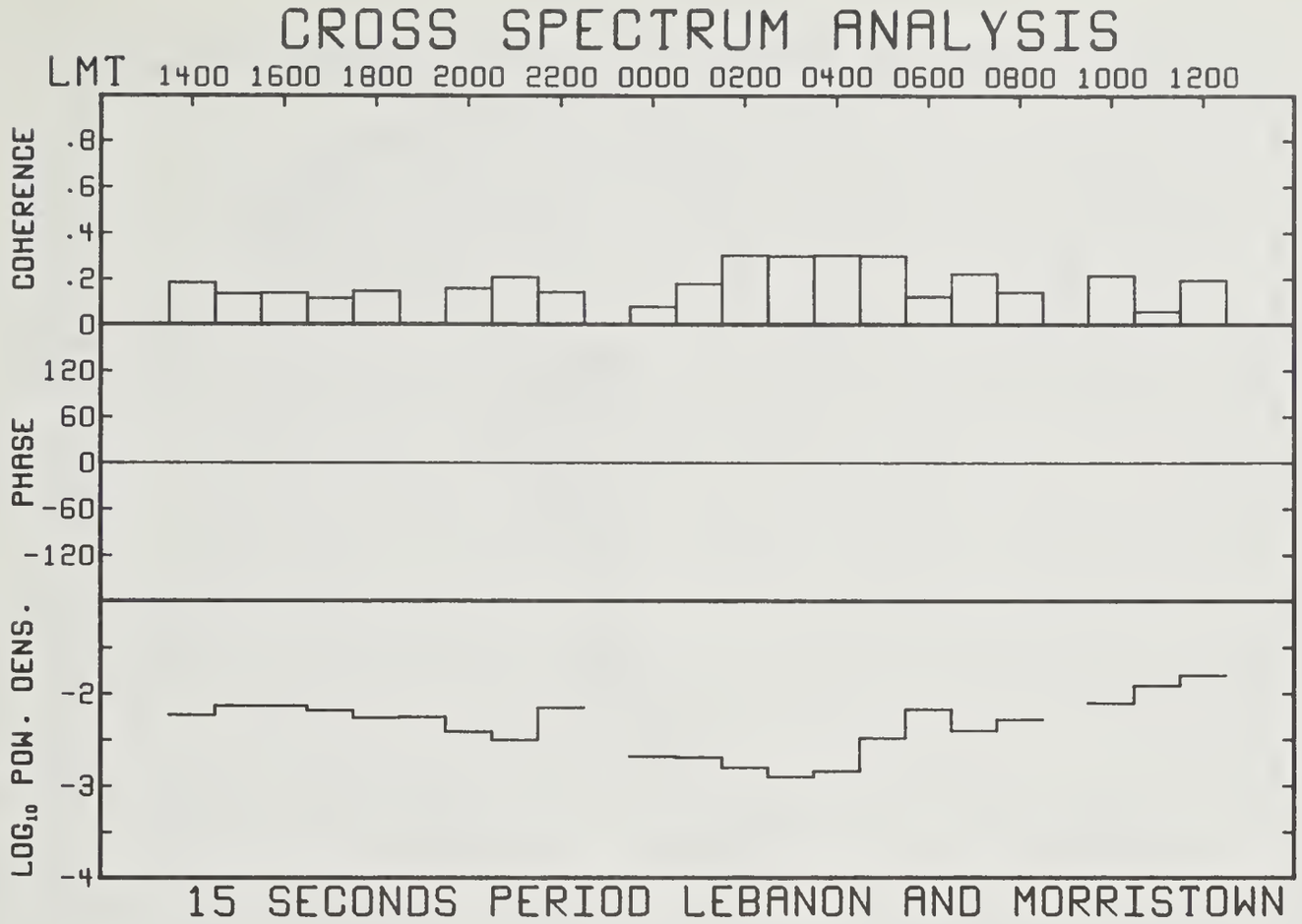

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
18.95 SECONDS PERIOD LEBANON AND MORRISTOWN

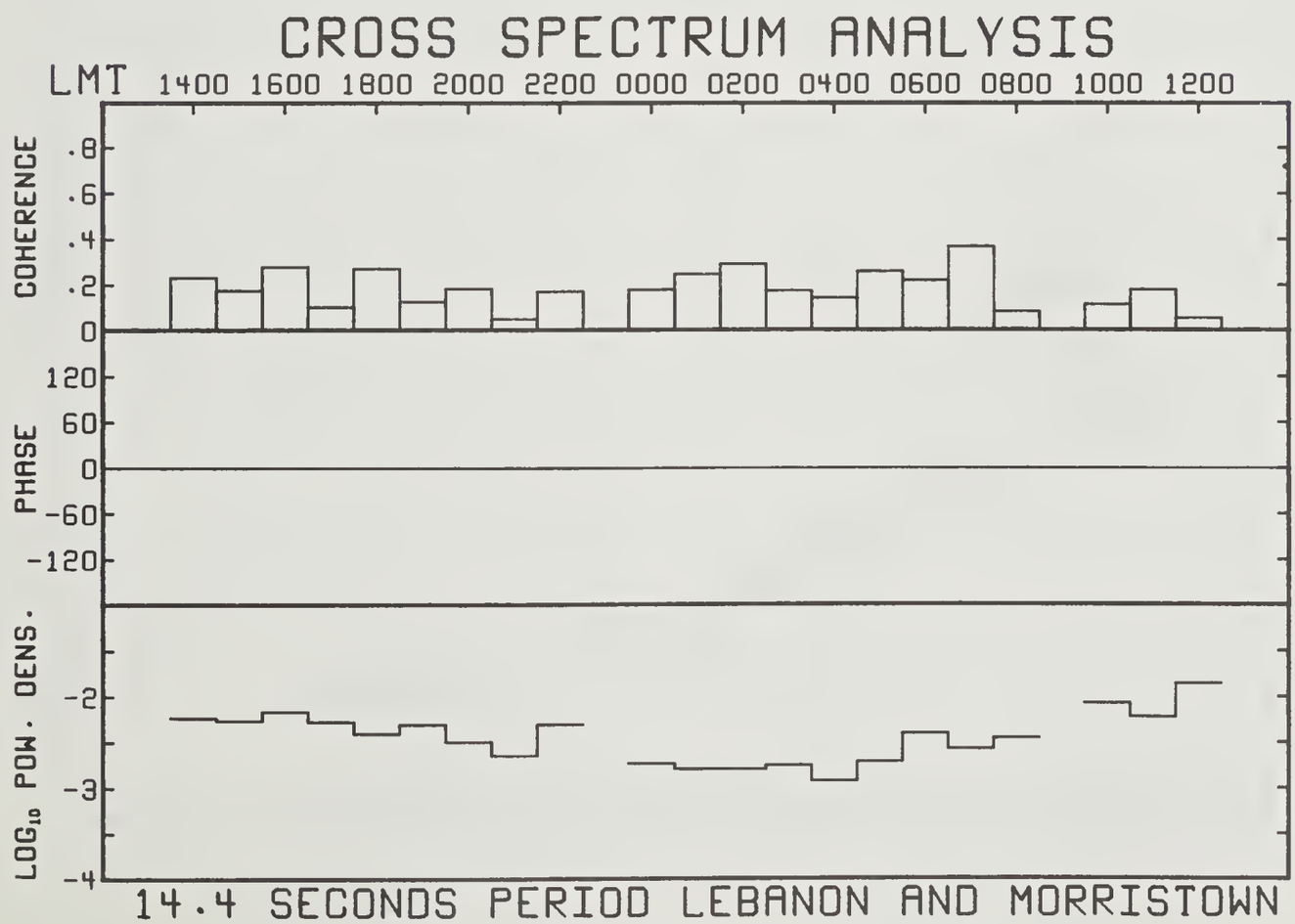

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
18 SECONDS PERIOD LEBANON AND MORRISTOWN

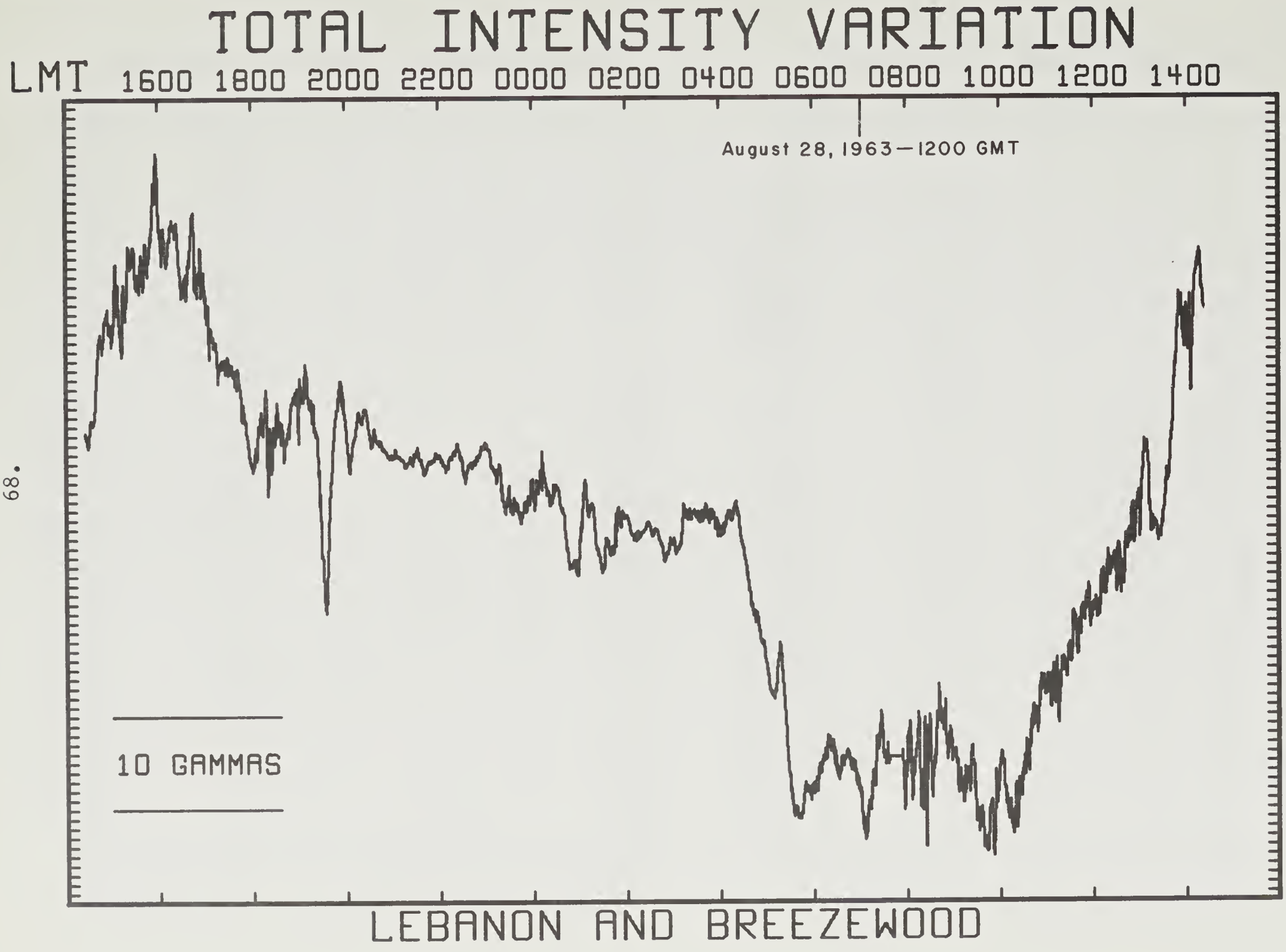

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-1
-2
-3
17.14 SECONDS PERIOD LEBANON AND MORRISTOWN

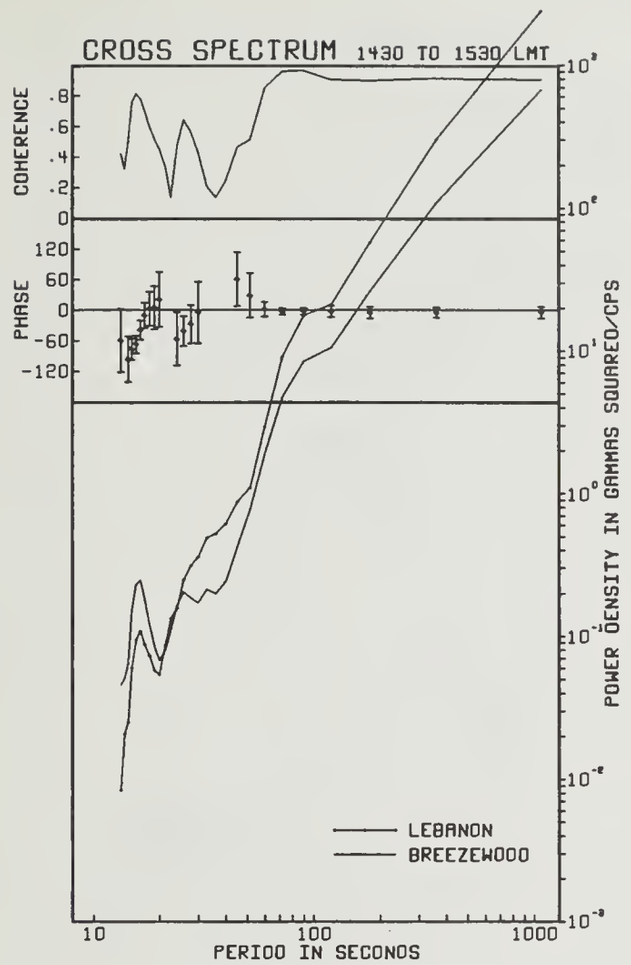

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
16.36 SECONDS PERIOD LEBANON AND MORRISTOWN

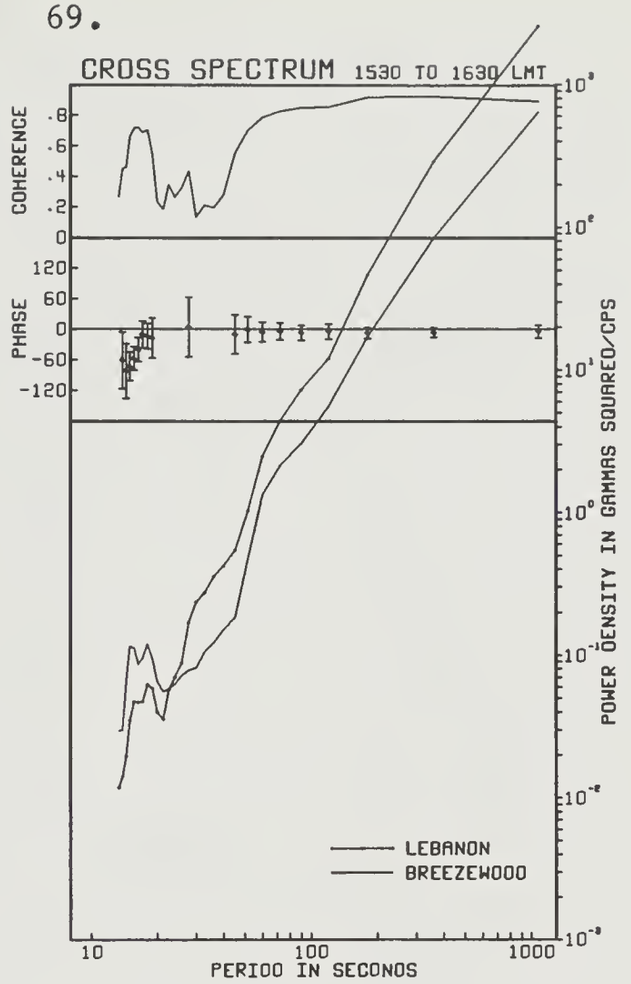

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
15.65 SECONDS PERIOD LEBANON AND MORRISTOWN

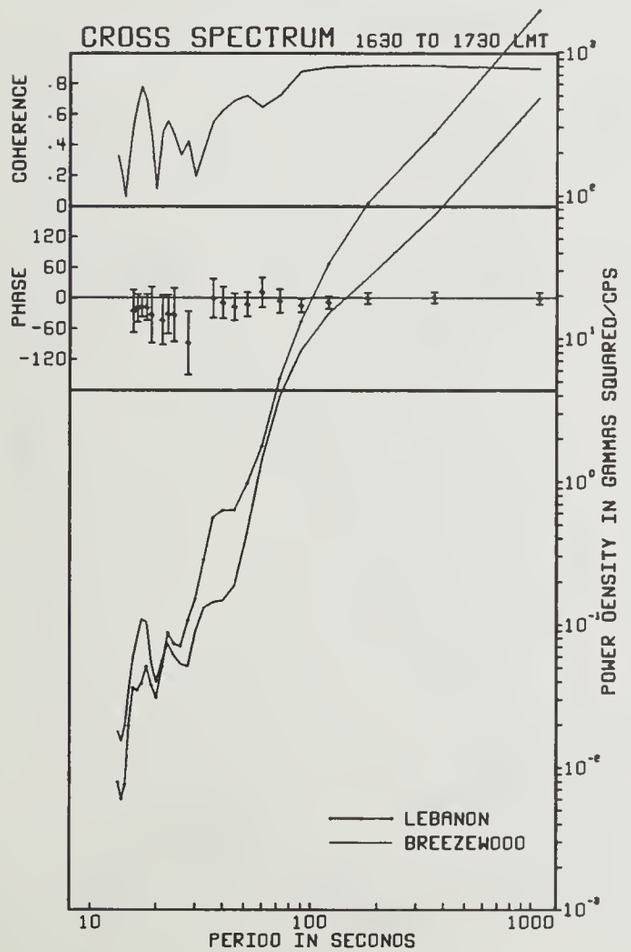

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
15 SECONDS PERIOD LEBANON AND MORRISTOWN

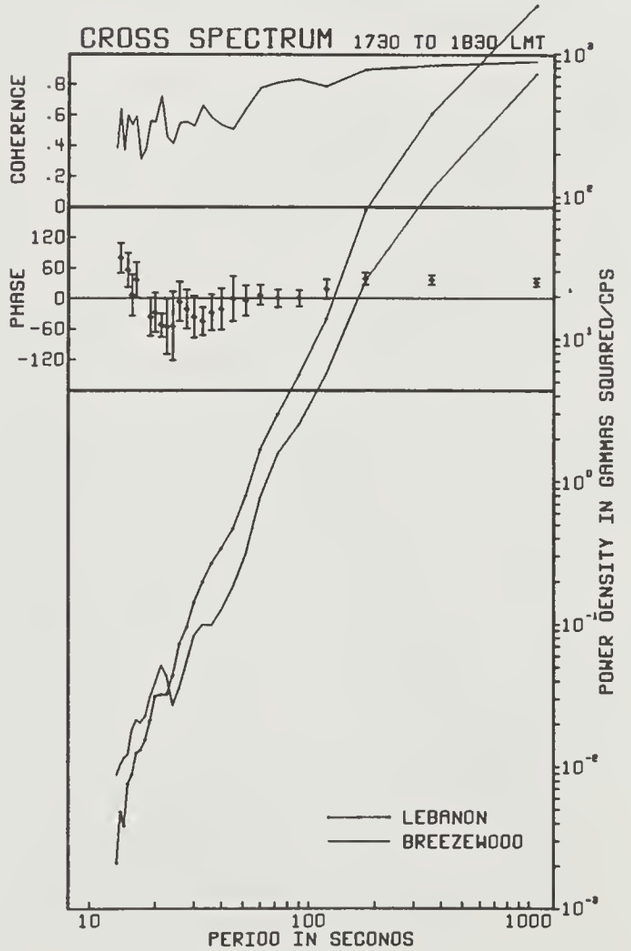

CROSS SPECTRUM ANALYSIS
LMT 1400 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
-2
-3
-4
14.4 SECONDS PERIOD LEBANON AND MORRISTOWN

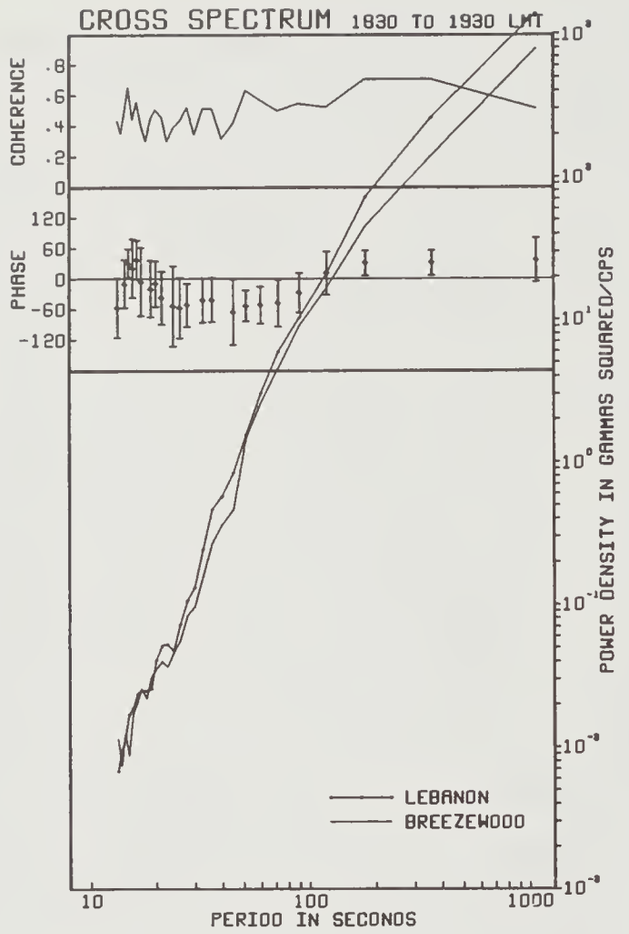

TOTAL INTENSITY VARIATION
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400
August 28, 1963—1200 GMT
10 GAMMAS
LEBANON AND BREEZEWOOD

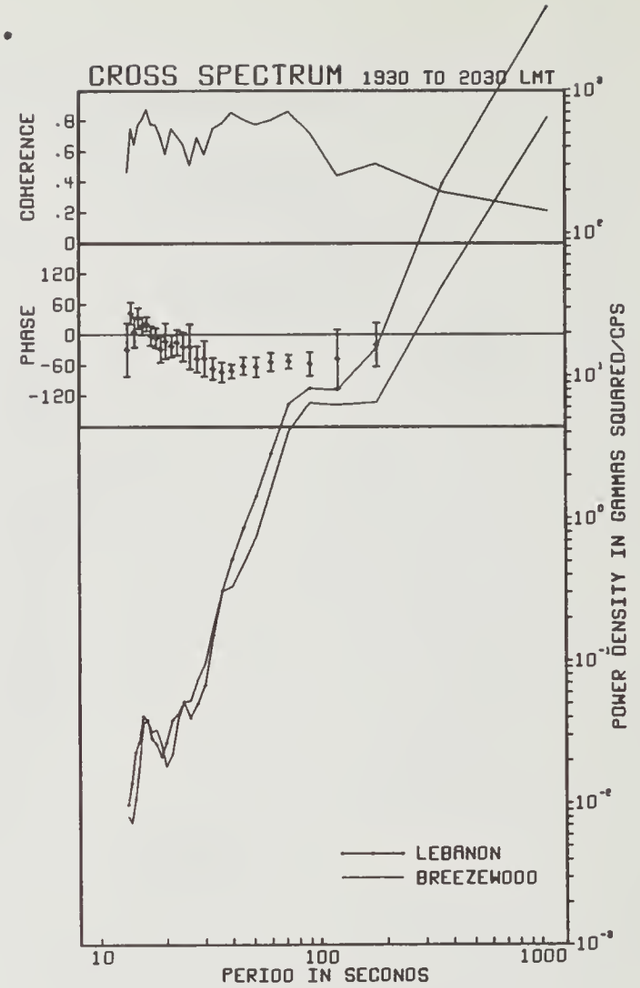

CROSS SPECTRUM 1430 TO 1530 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

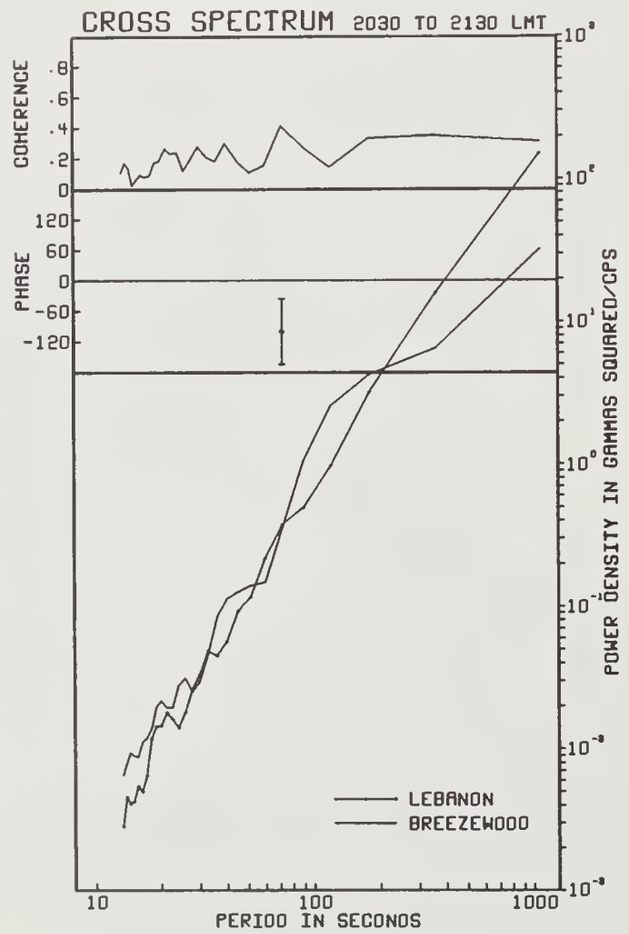

CROSS SPECTRUM 1530 TO 1630 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

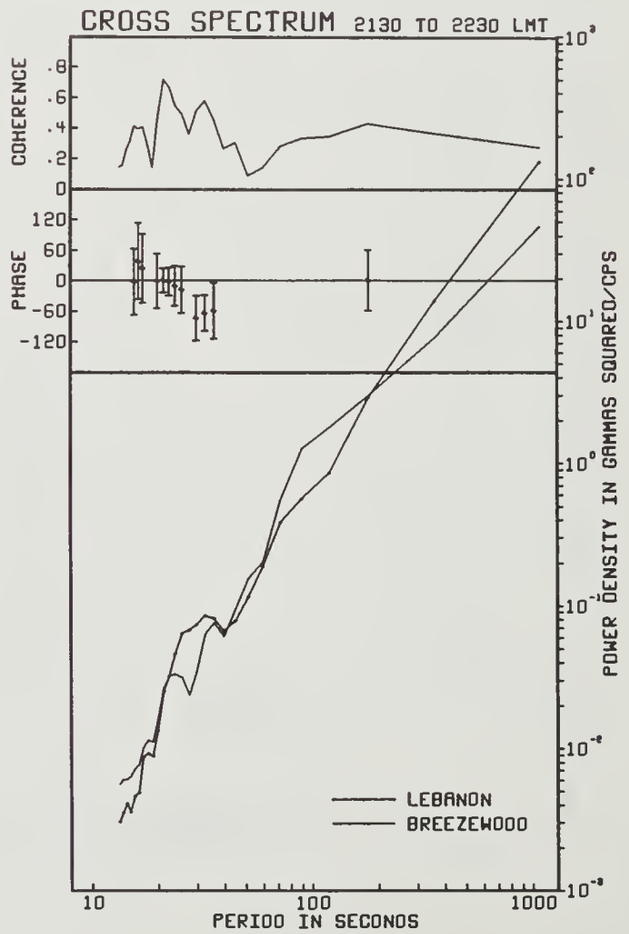

CROSS SPECTRUM 1630 TO 1730 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

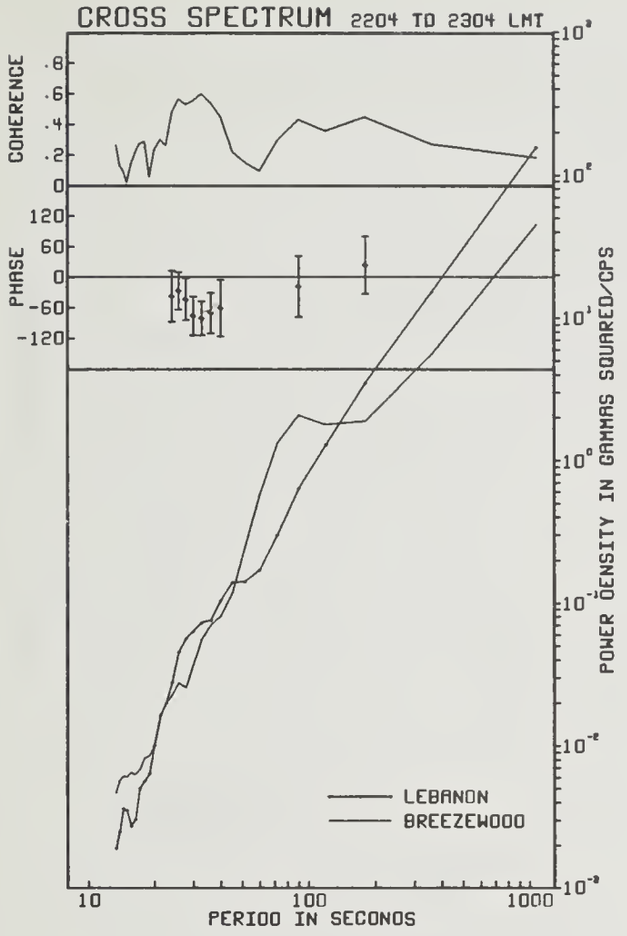

CROSS SPECTRUM 1730 TO 1830 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

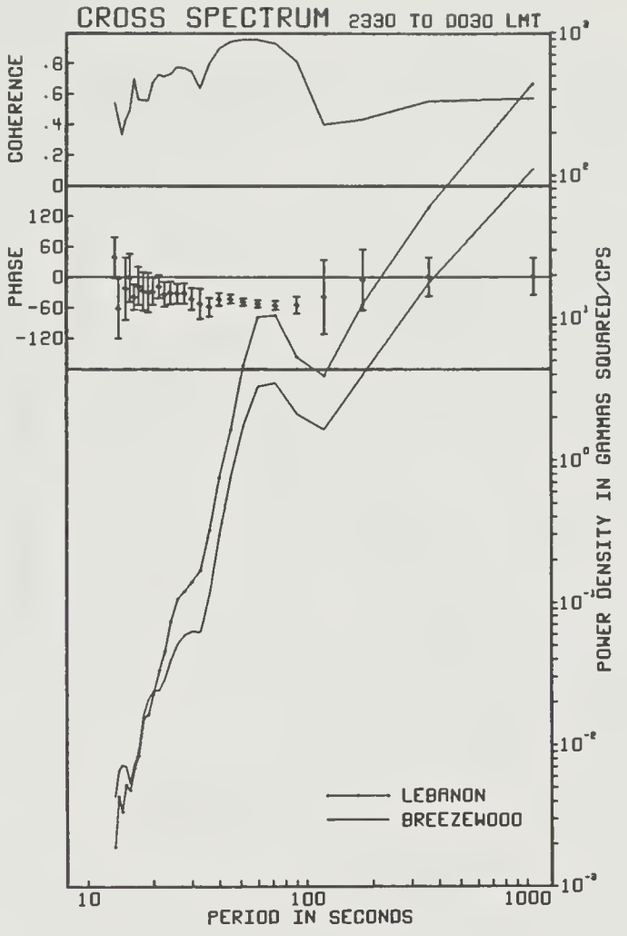

CROSS SPECTRUM 1830 TO 1930 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
BREEZEWOOD
PERIOD IN SECONDS

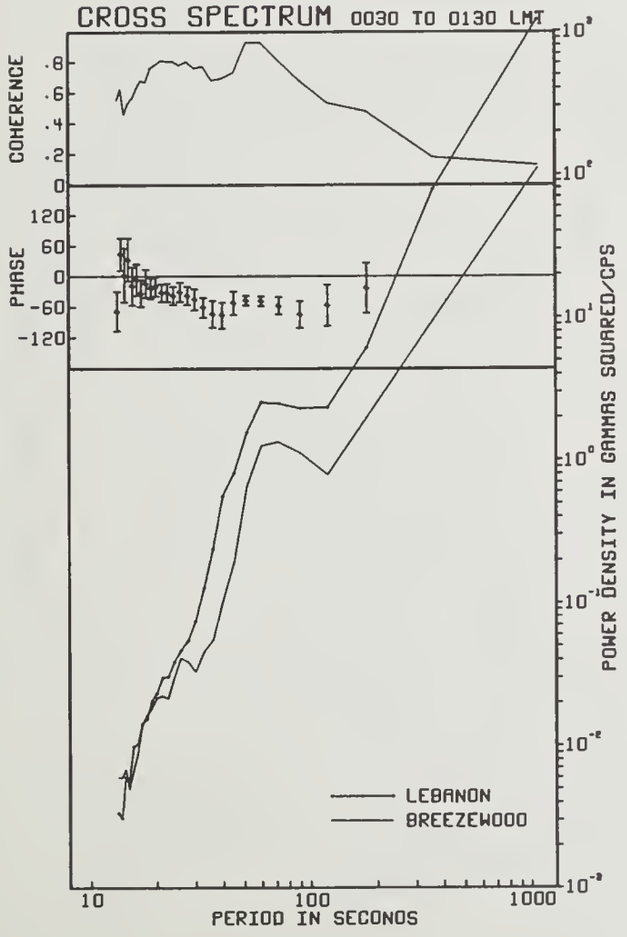

CROSS SPECTRUM 1930 TO 2030 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
BREEZEWOOD
PERIOD IN SECONDS

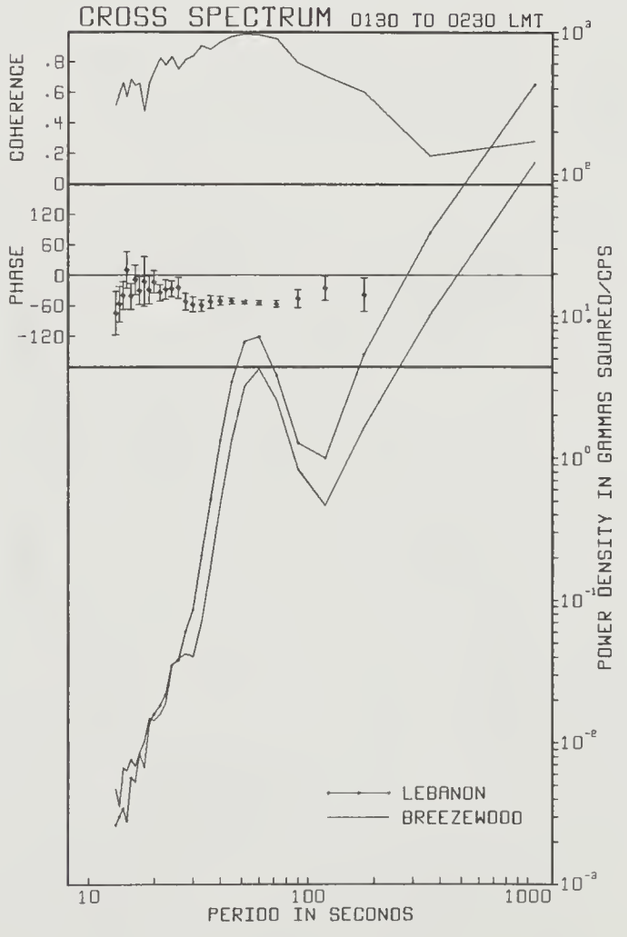

CROSS SPECTRUM 2030 TO 2130 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
BREEZEWOOD
PERIOD IN SECONDS

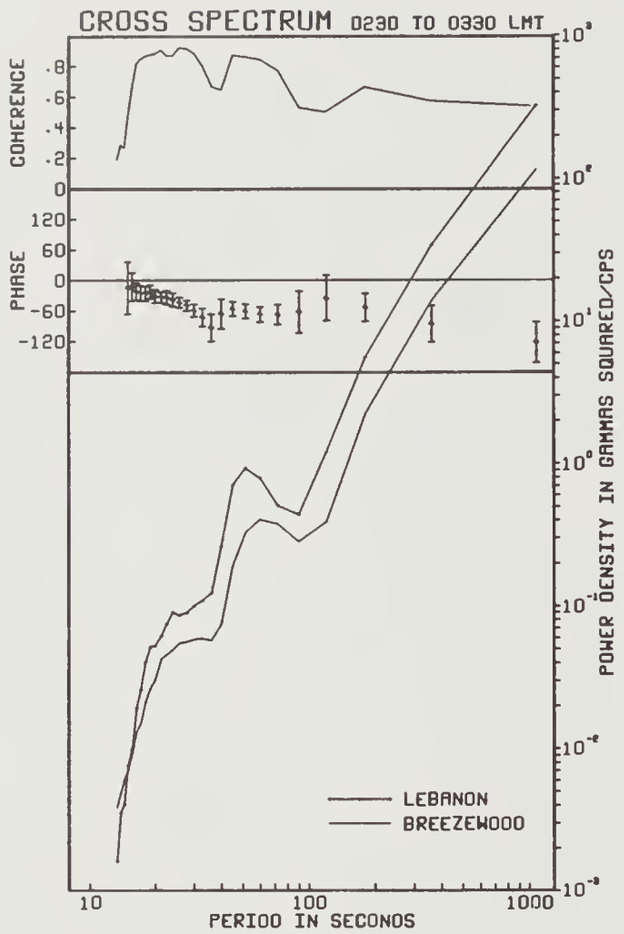

CROSS SPECTRUM 2130 TO 2230 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
BREEZEWOOD
PERIOD IN SECONDS

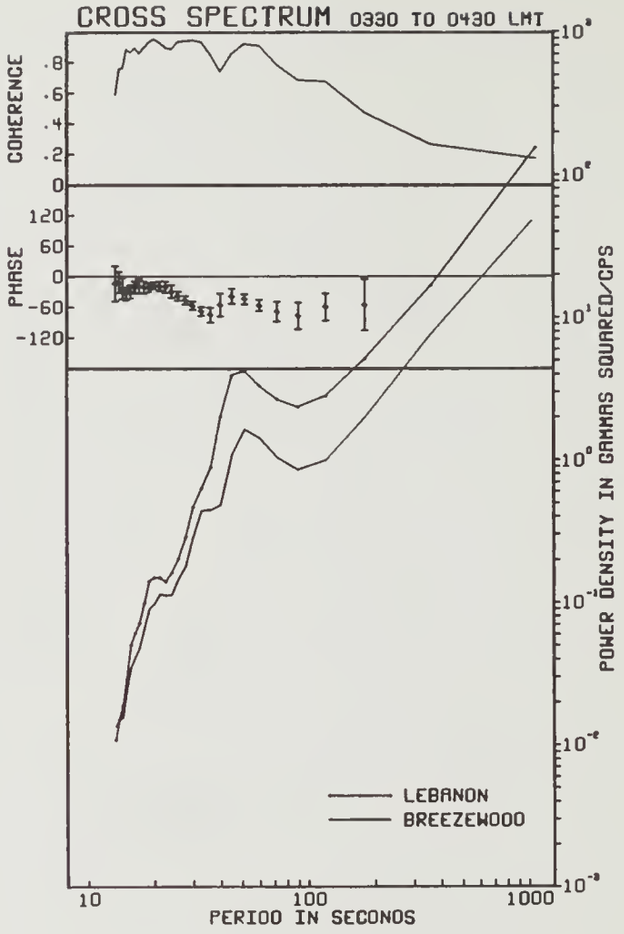

CROSS SPECTRUM 2204 TO 2304 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
BREEZEWOOD
PERIOD IN SECONDS

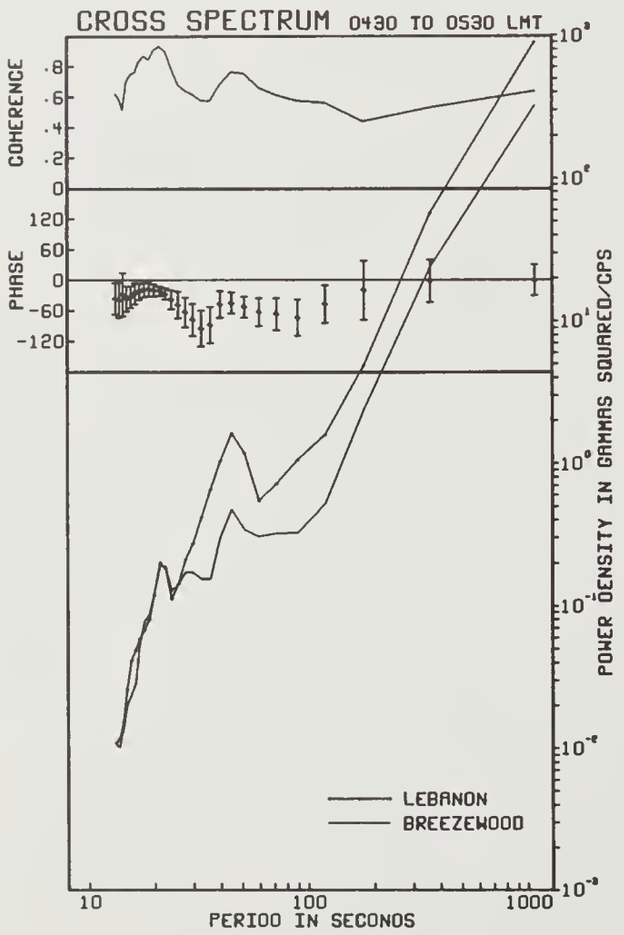

CROSS SPECTRUM 2330 TO 0030 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
BREEZEWOOD
PERIOD IN SECONDS

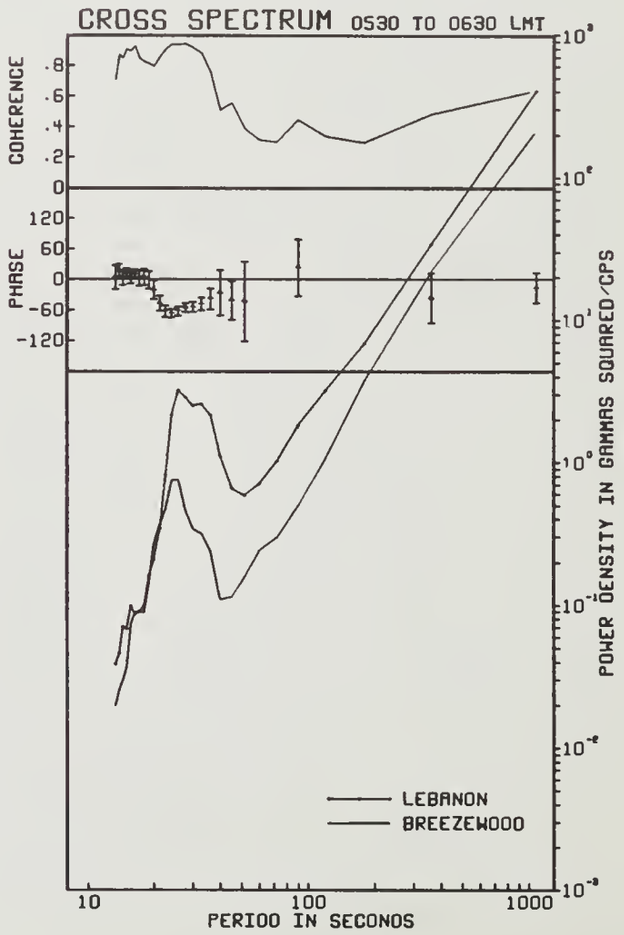

CROSS SPECTRUM 0030 TO 0130 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
BREEZEWOOD
PERIOD IN SECONDS

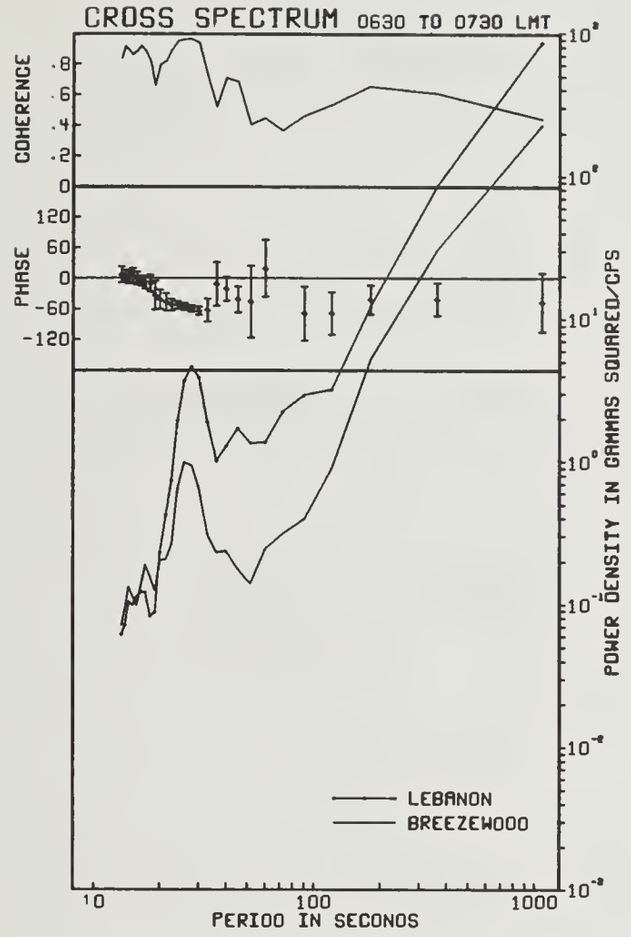

CROSS SPECTRUM 0130 TO 0230 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
BREEZEWOOD
PERIOD IN SECONDS

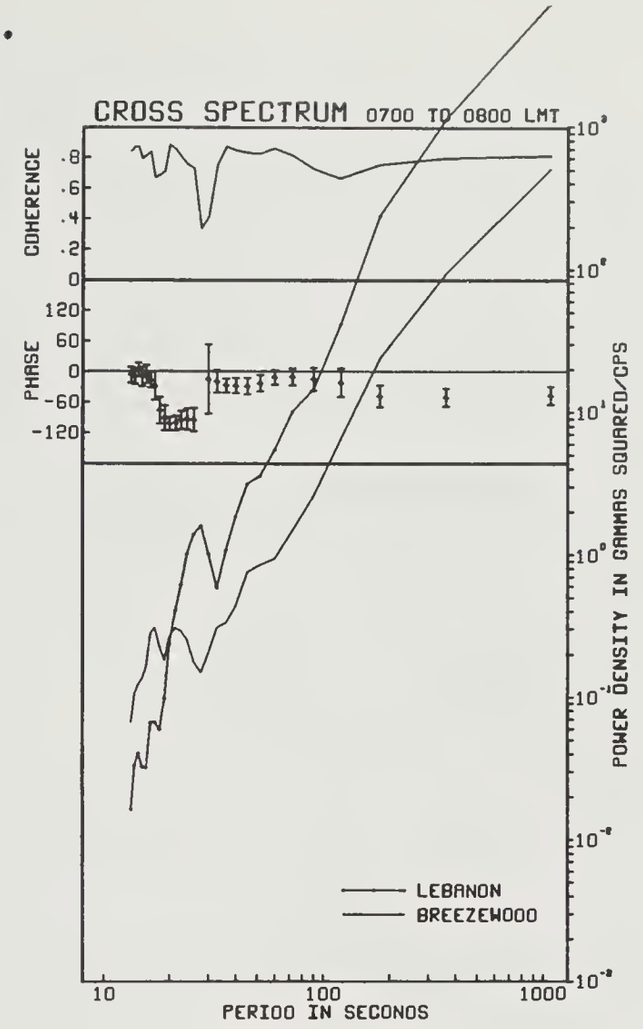

CROSS SPECTRUM 0230 TO 0330 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

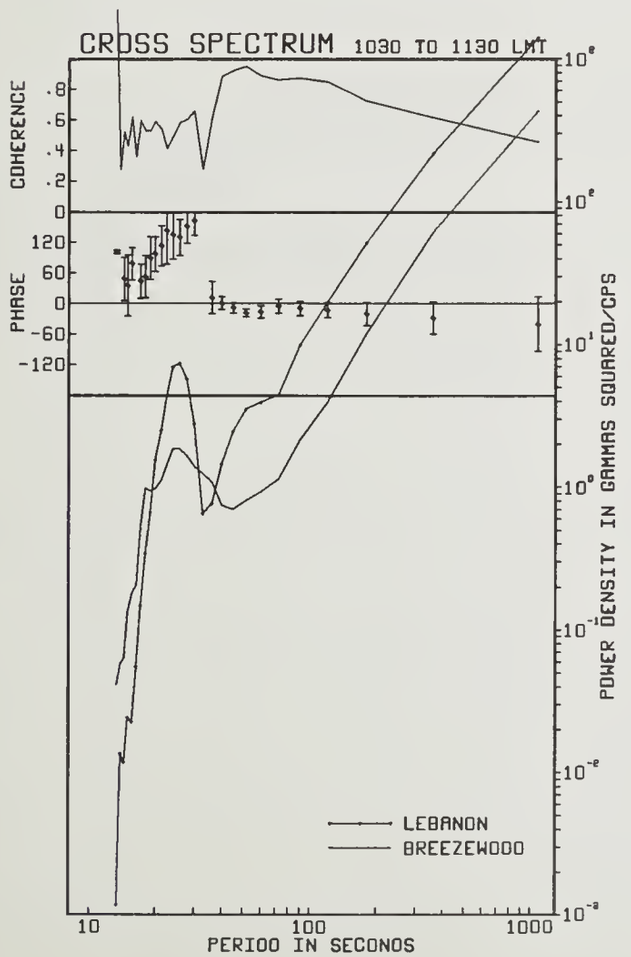

CROSS SPECTRUM 0330 TO 0430 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

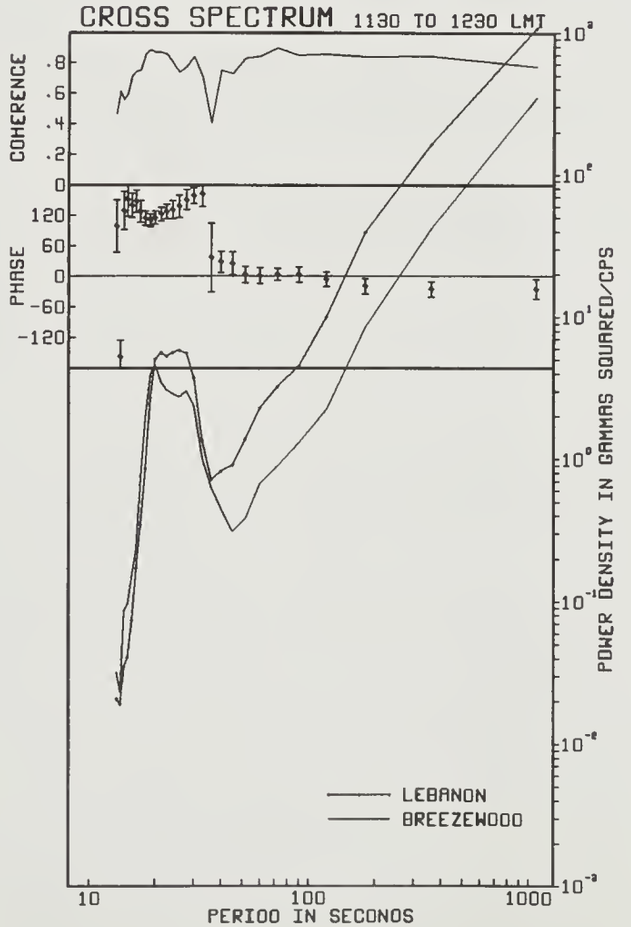

CROSS SPECTRUM 0430 TO 0530 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

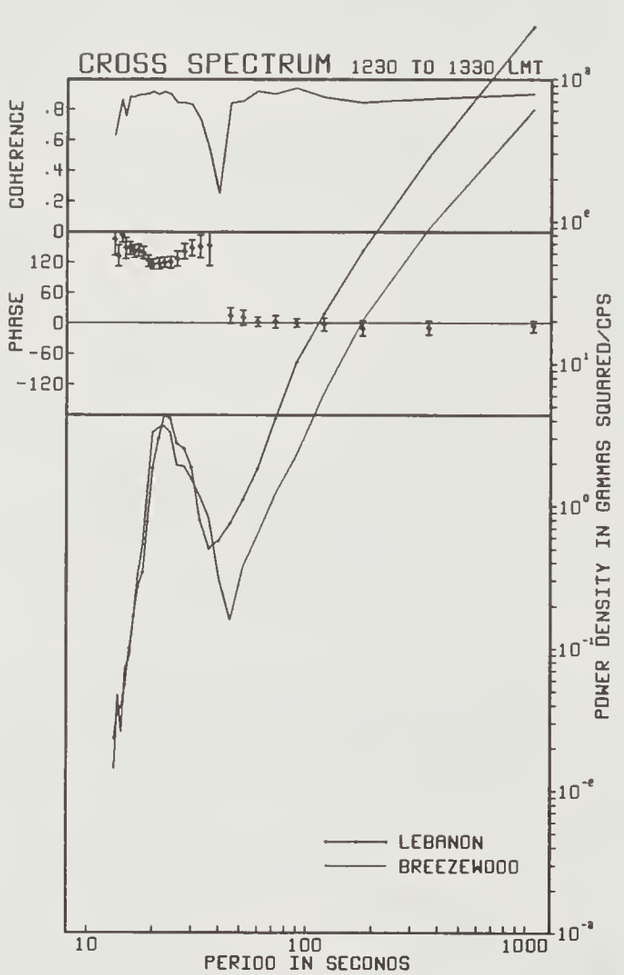

CROSS SPECTRUM 0530 TO 0630 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

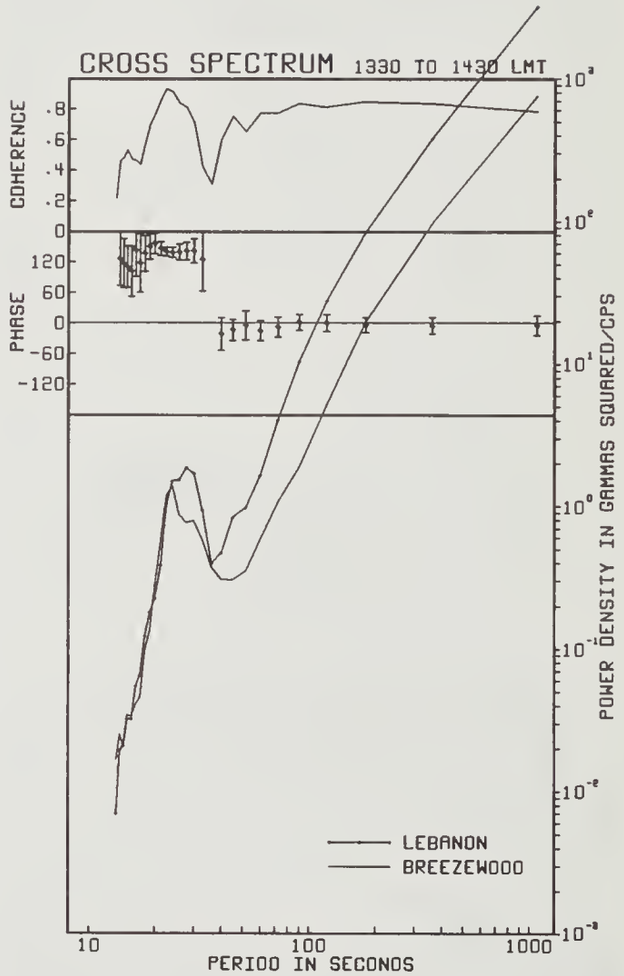

CROSS SPECTRUM 0630 TO 0730 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

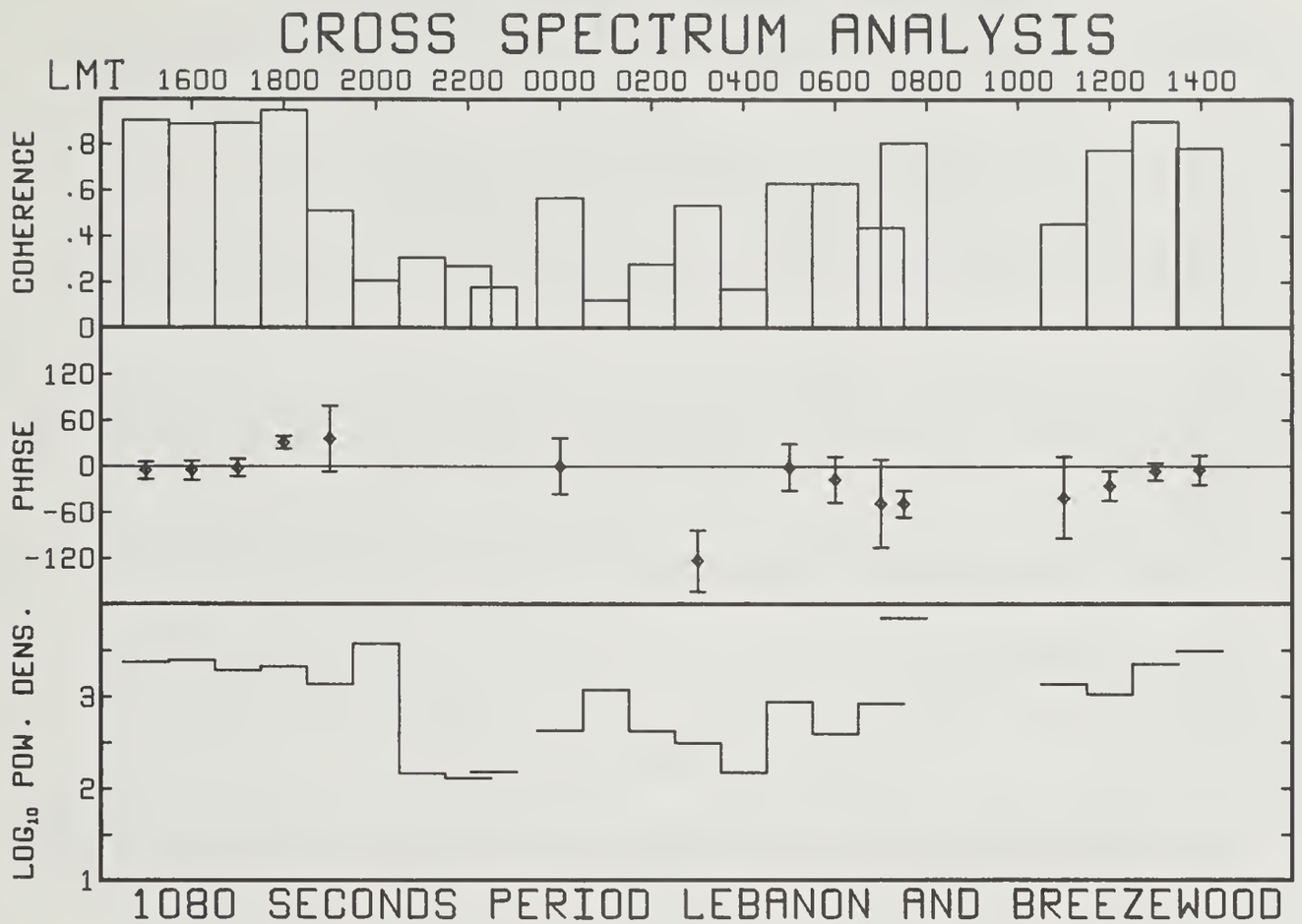

CROSS SPECTRUM 0700 TO 0800 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

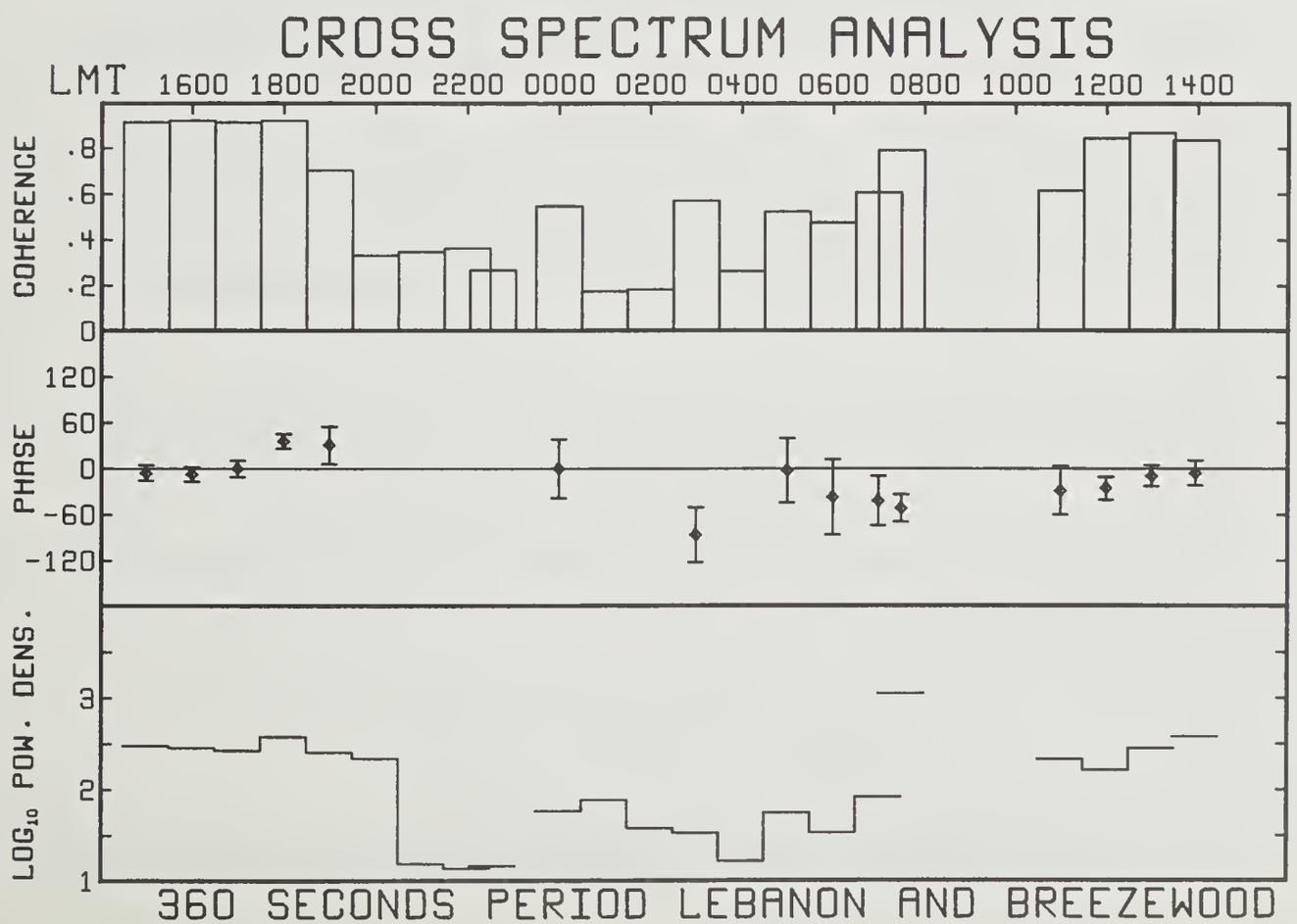

CROSS SPECTRUM 1030 TO 1130 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

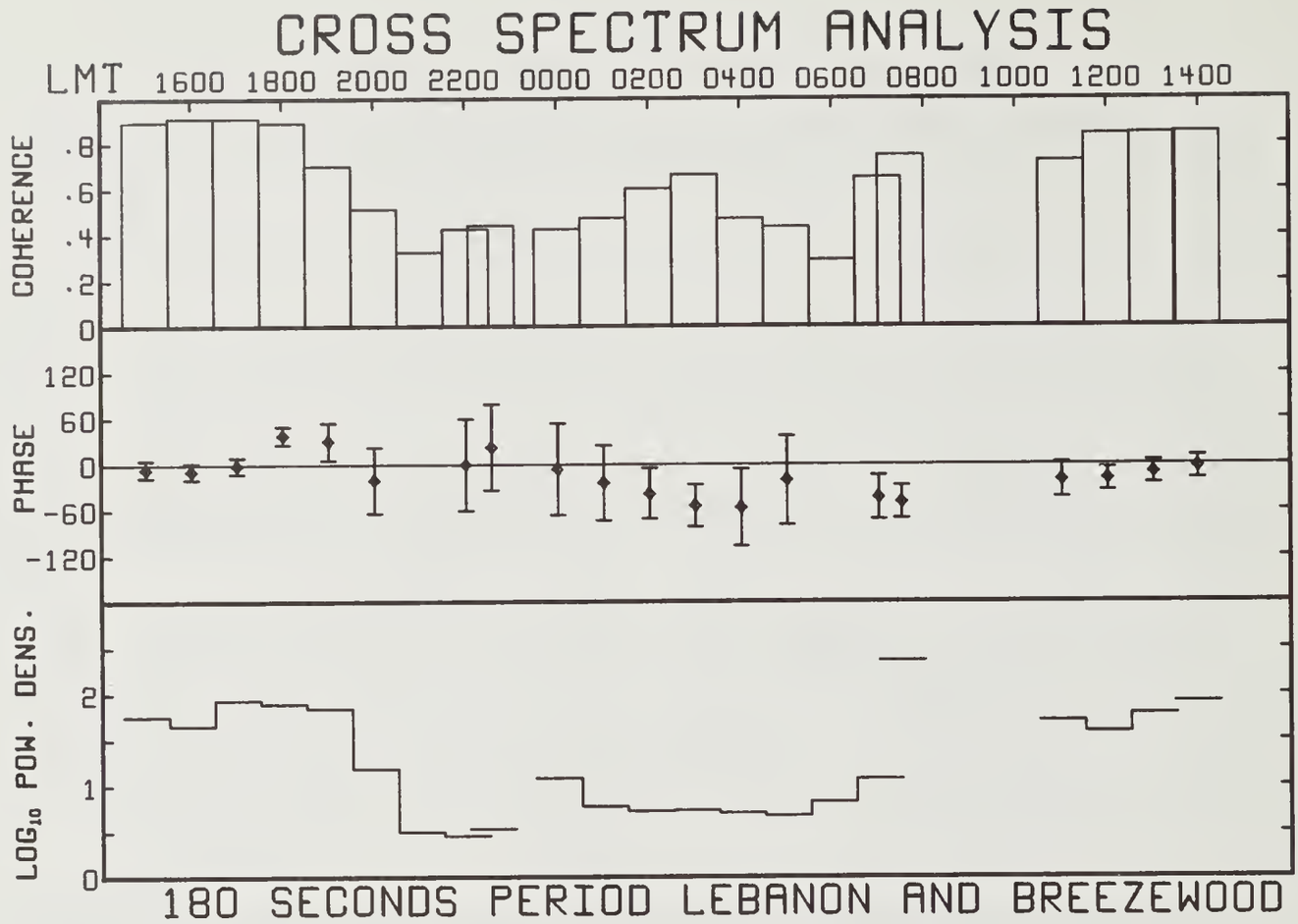

CROSS SPECTRUM 1130 TO 1230 LMT
COHERENCE
PHASE
POWER DENSITY IN GAMMAS SQUARED/CPS
PERIOD IN SECONDS
LEBANON
BREEZEWOOD

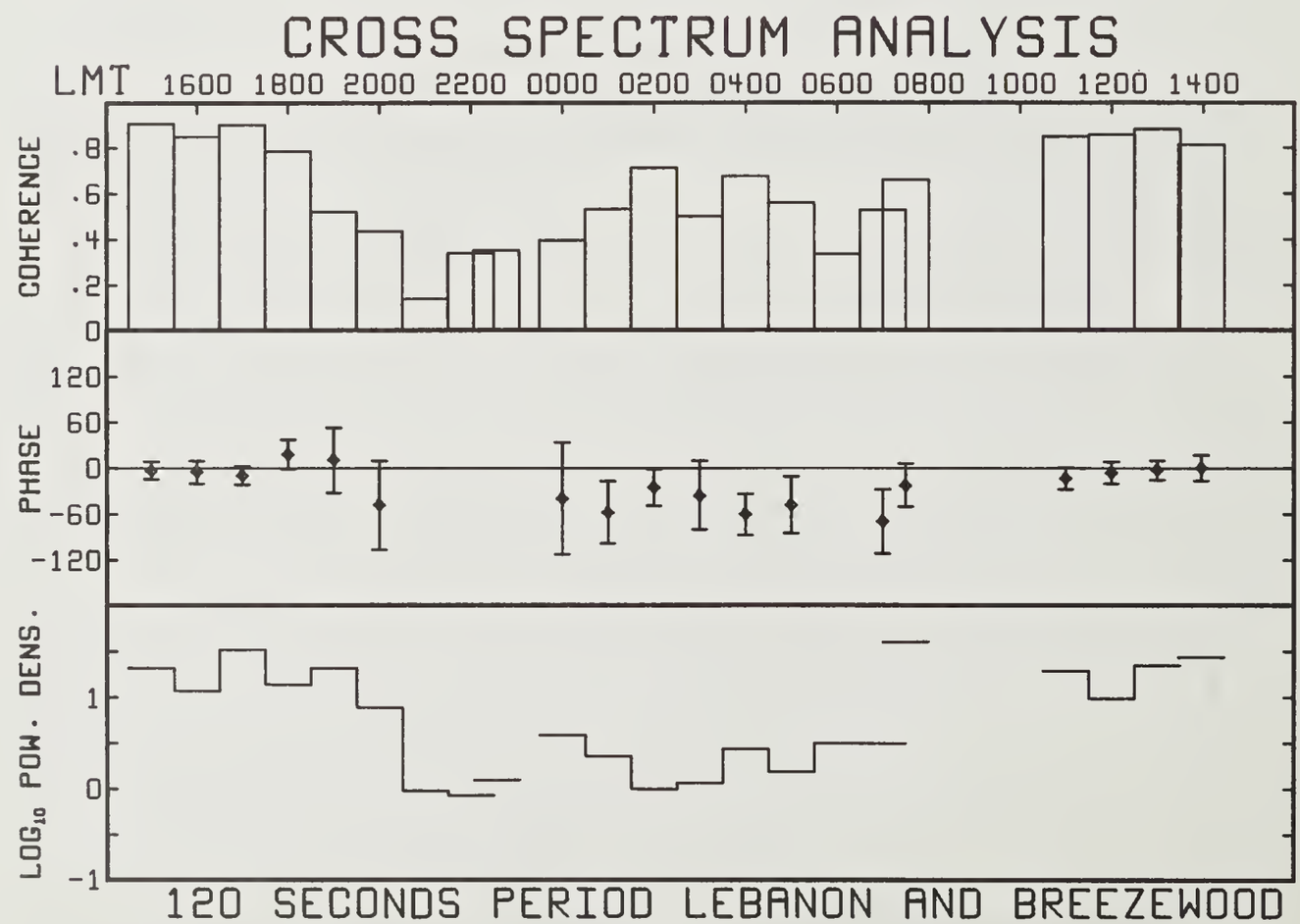

CROSS SPECTRUM 1230 TO 1330 LMT
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
BREEZEWOOD
10
100
1000
PERIOD IN SECONDS

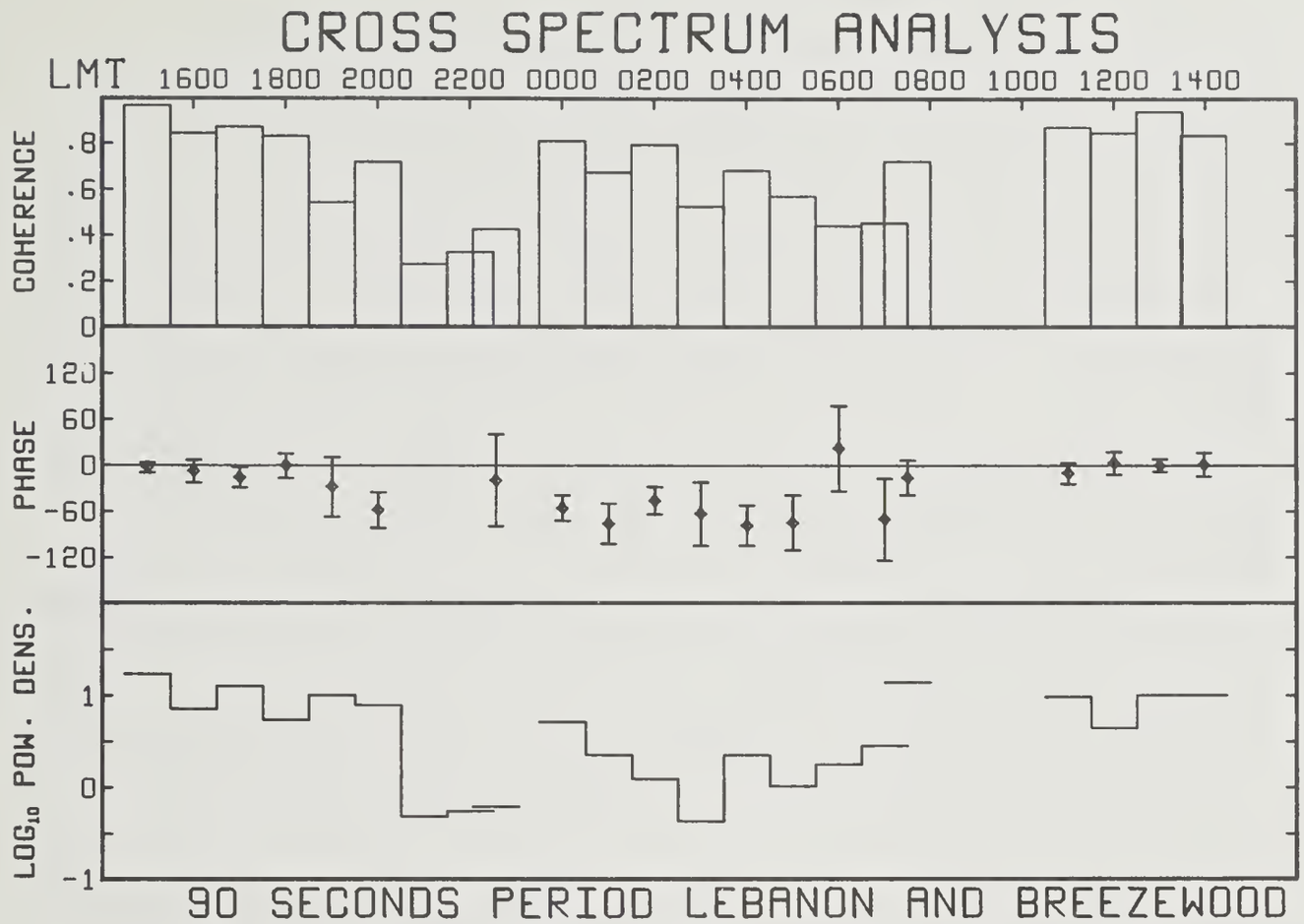

CROSS SPECTRUM 1330 TO 1430 LMT
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
POWER DENSITY IN GAMMAS SQUARED/CPS
LEBANON
BREEZEWOOD
10
100
1000
PERIOD IN SECONDS

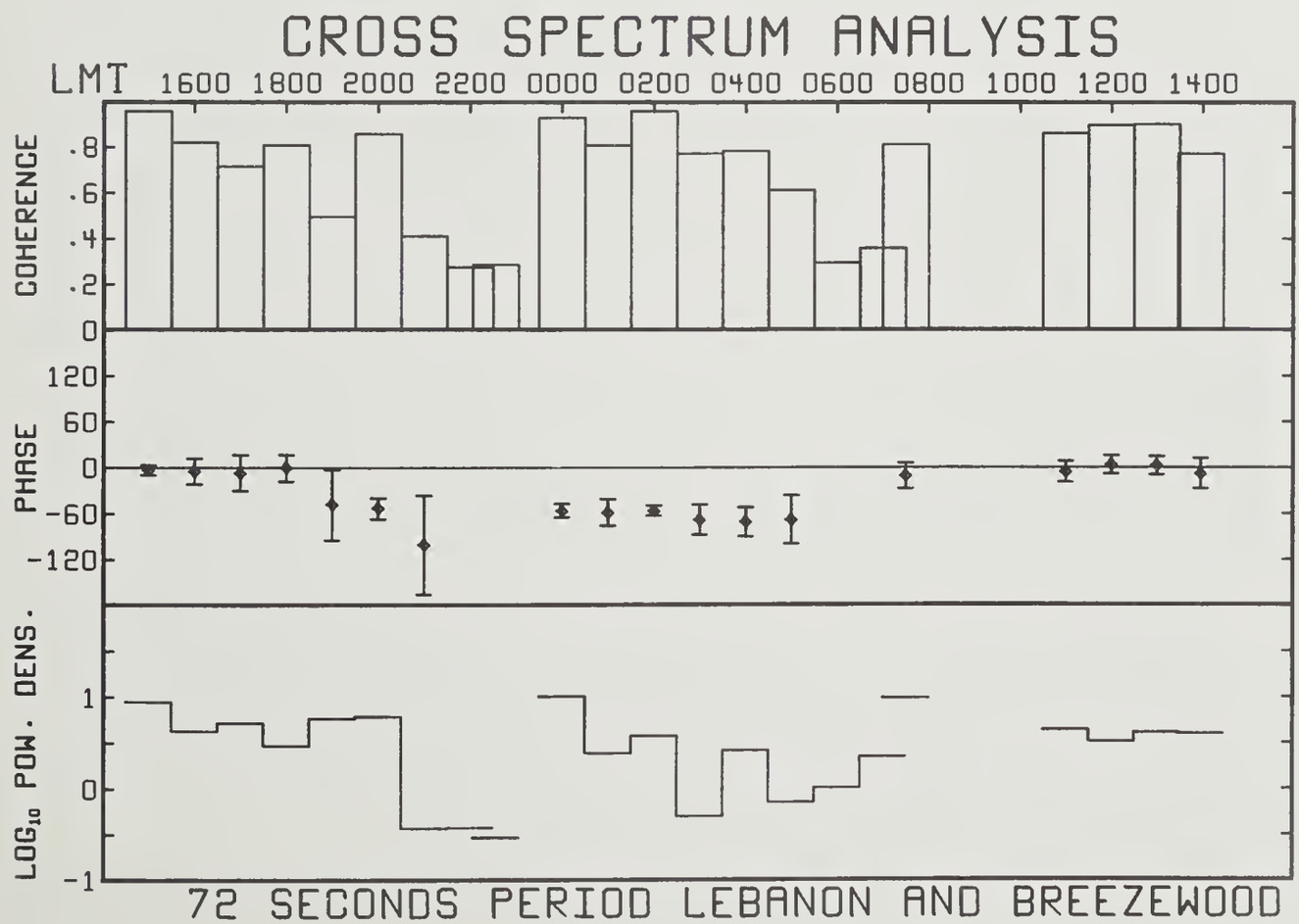

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
3
2
1
1080 SECONDS PERIOD LEBANON AND BREEZEWOOD

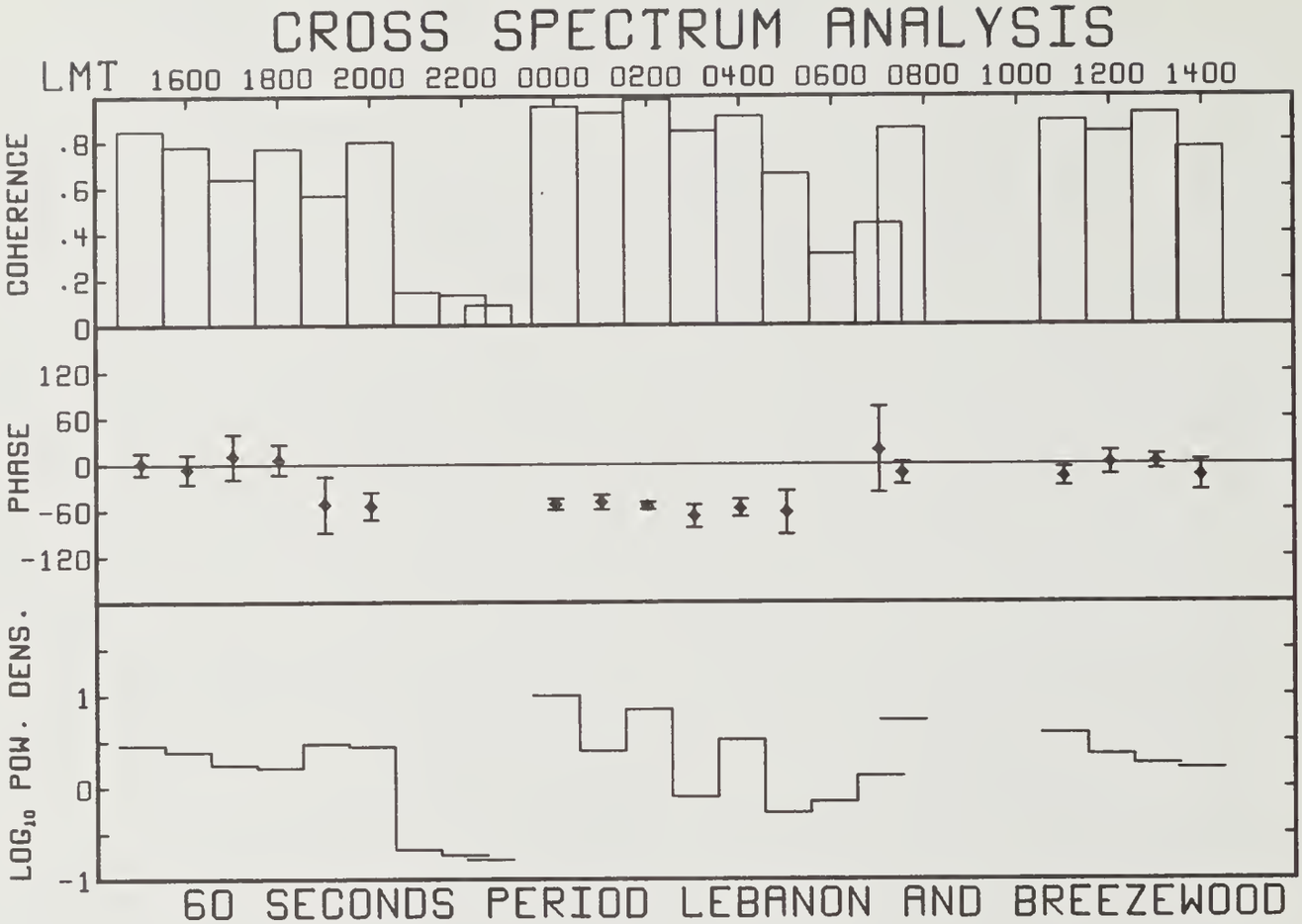

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
3
2
1
360 SECONDS PERIOD LEBANON AND BREEZEWOOD

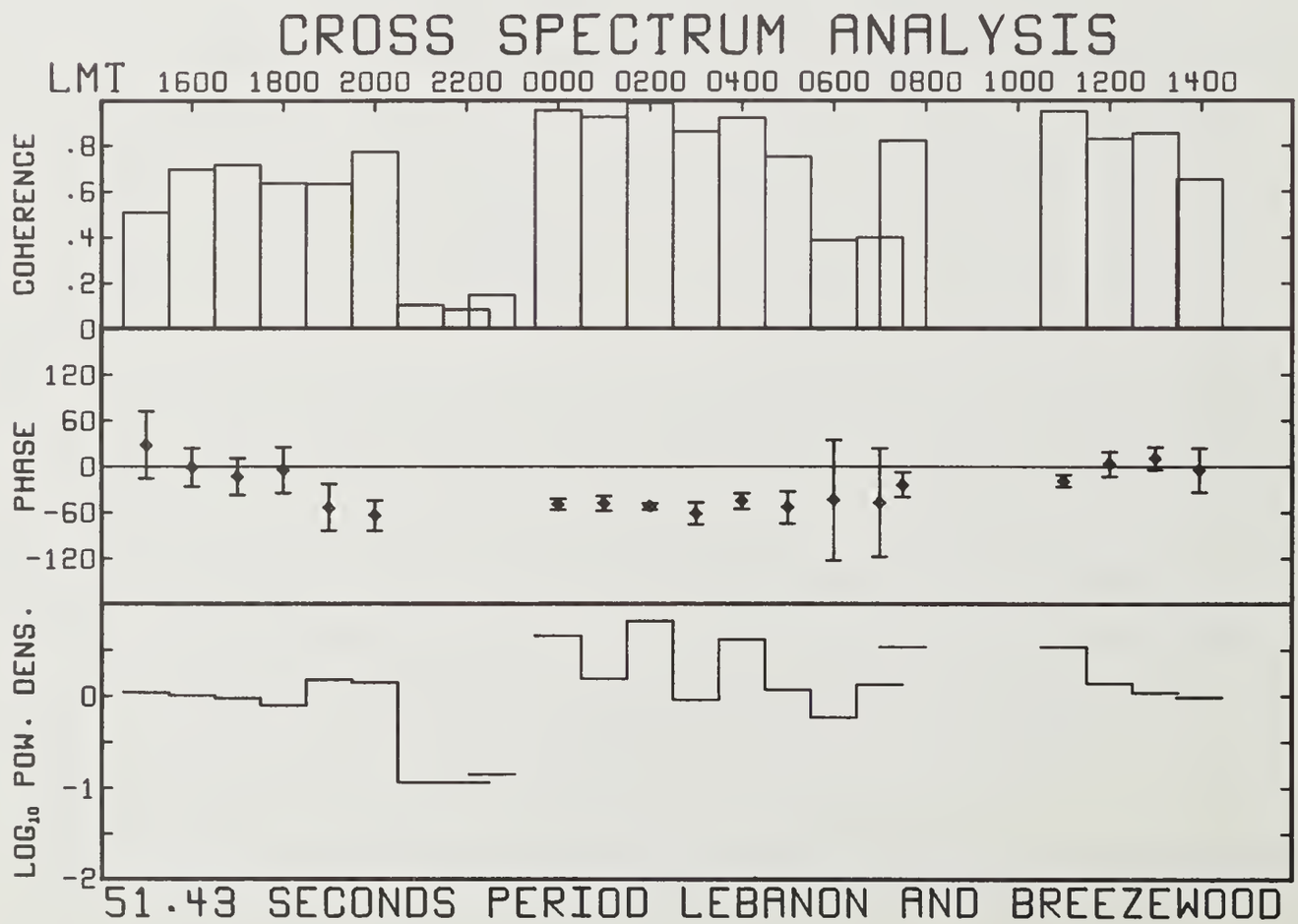

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
2
1
0
180 SECONDS PERIOD LEBANON AND BREEZEWOOD

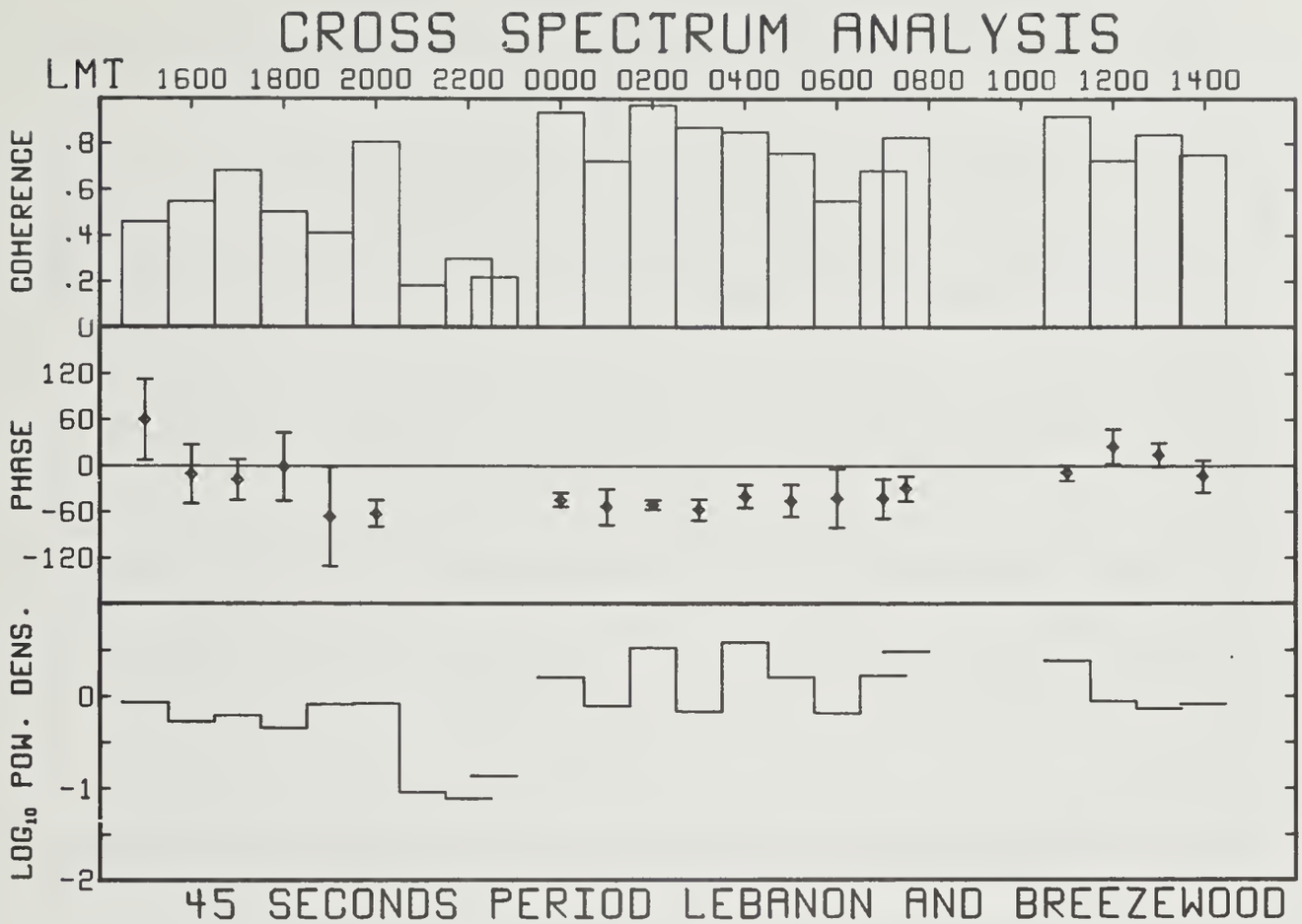

CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
1
0
-1
120 SECONDS PERIOD LEBANON AND BREEZEWOOD


CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
1
0
-1
90 SECONDS PERIOD LEBANON AND BREEZEWOOD


CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
1
0
-1
72 SECONDS PERIOD LEBANON AND BREEZEWOOD


CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
1
0
-1
60 SECONDS PERIOD LEBANON AND BREEZEWOOD


CROSS SPECTRUM ANALYSIS
LMT 1600 1800 2000 2200 0000 0200 0400 0600 0800 1000 1200 1400
COHERENCE
.8
.6
.4
.2
0
PHASE
120
60
0
-60
-120
LOG10 POW. DENS.
0
-1
-2
51.43 SECONDS PERIOD LEBANON AND BREEZEWOOD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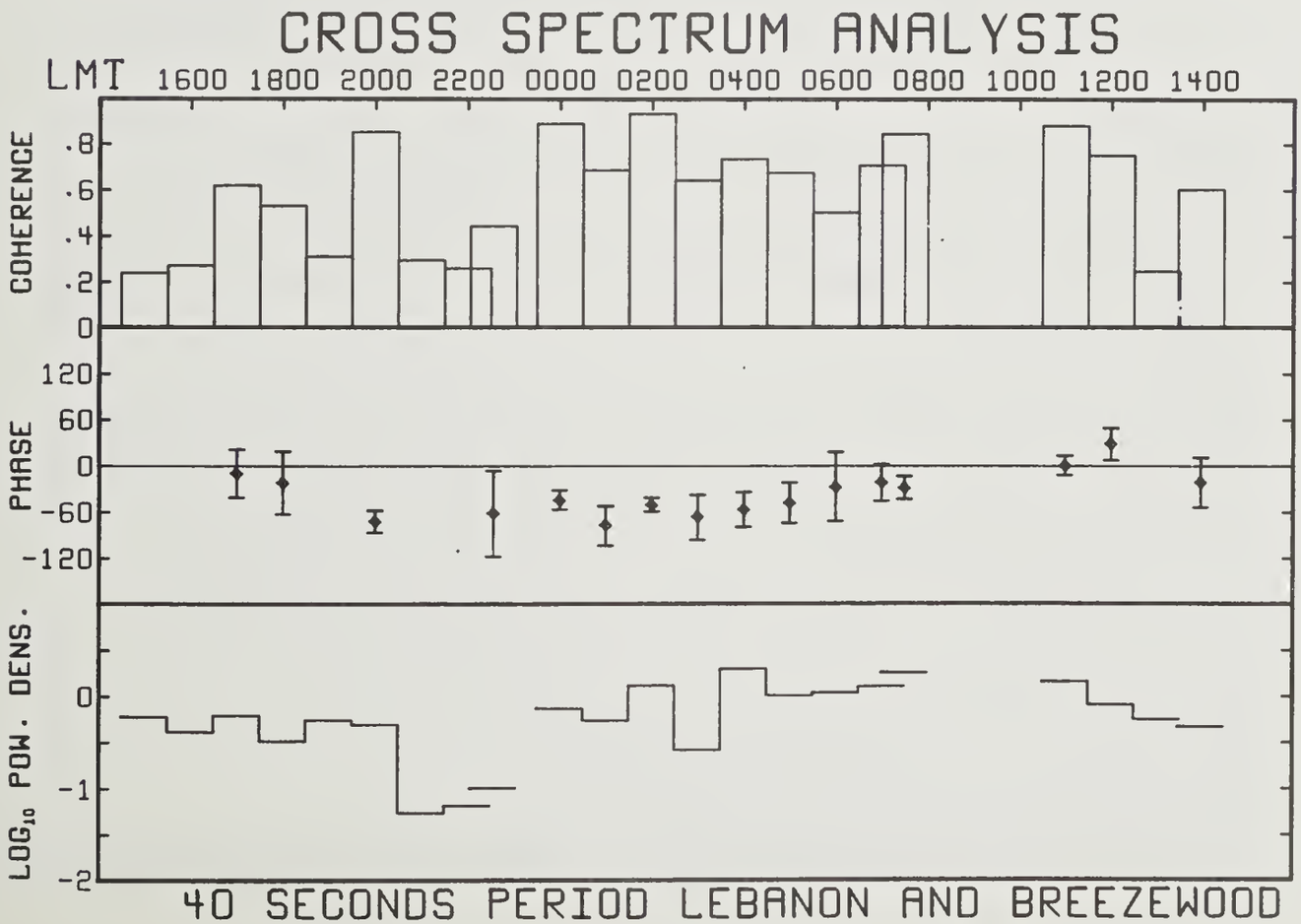
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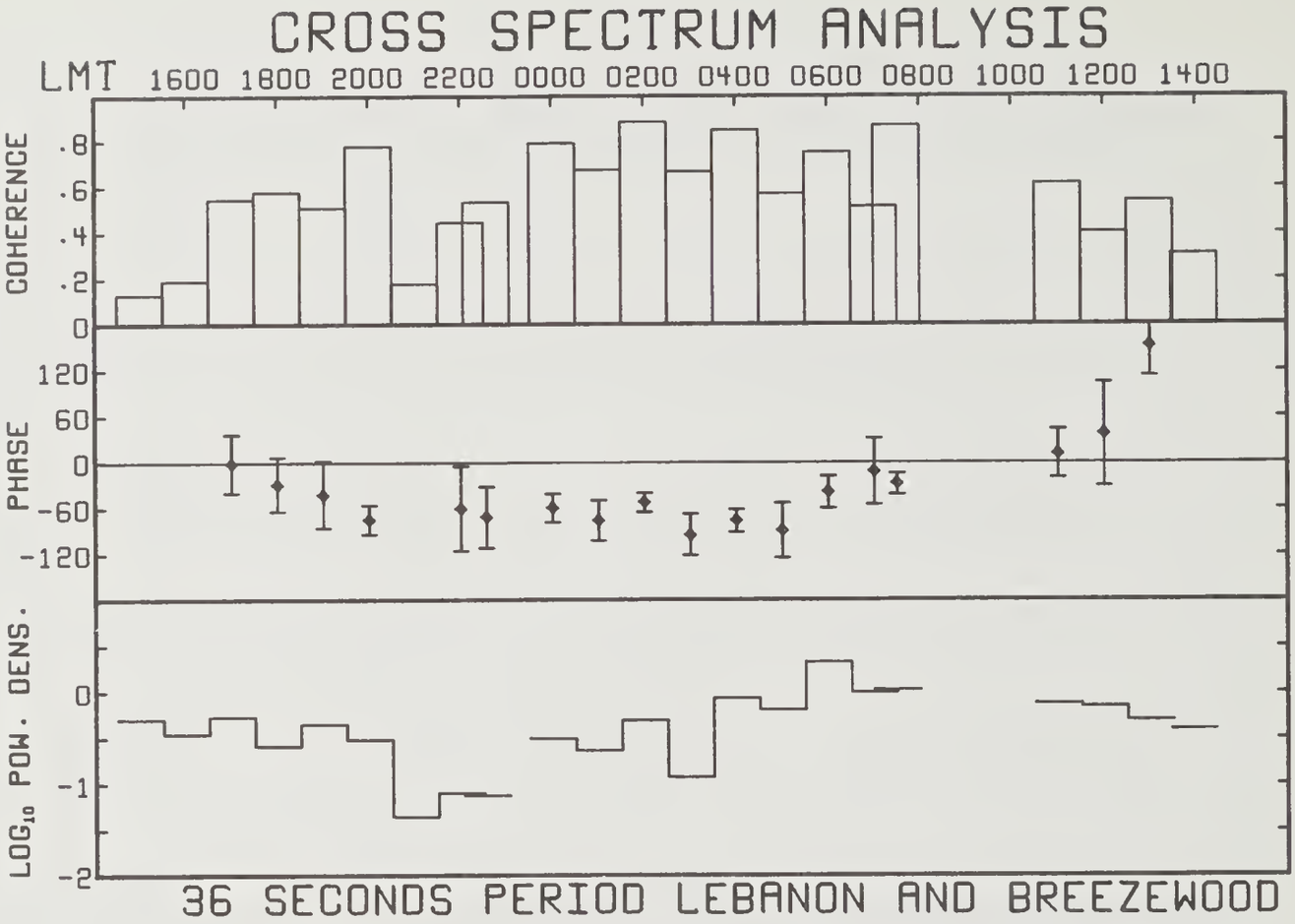
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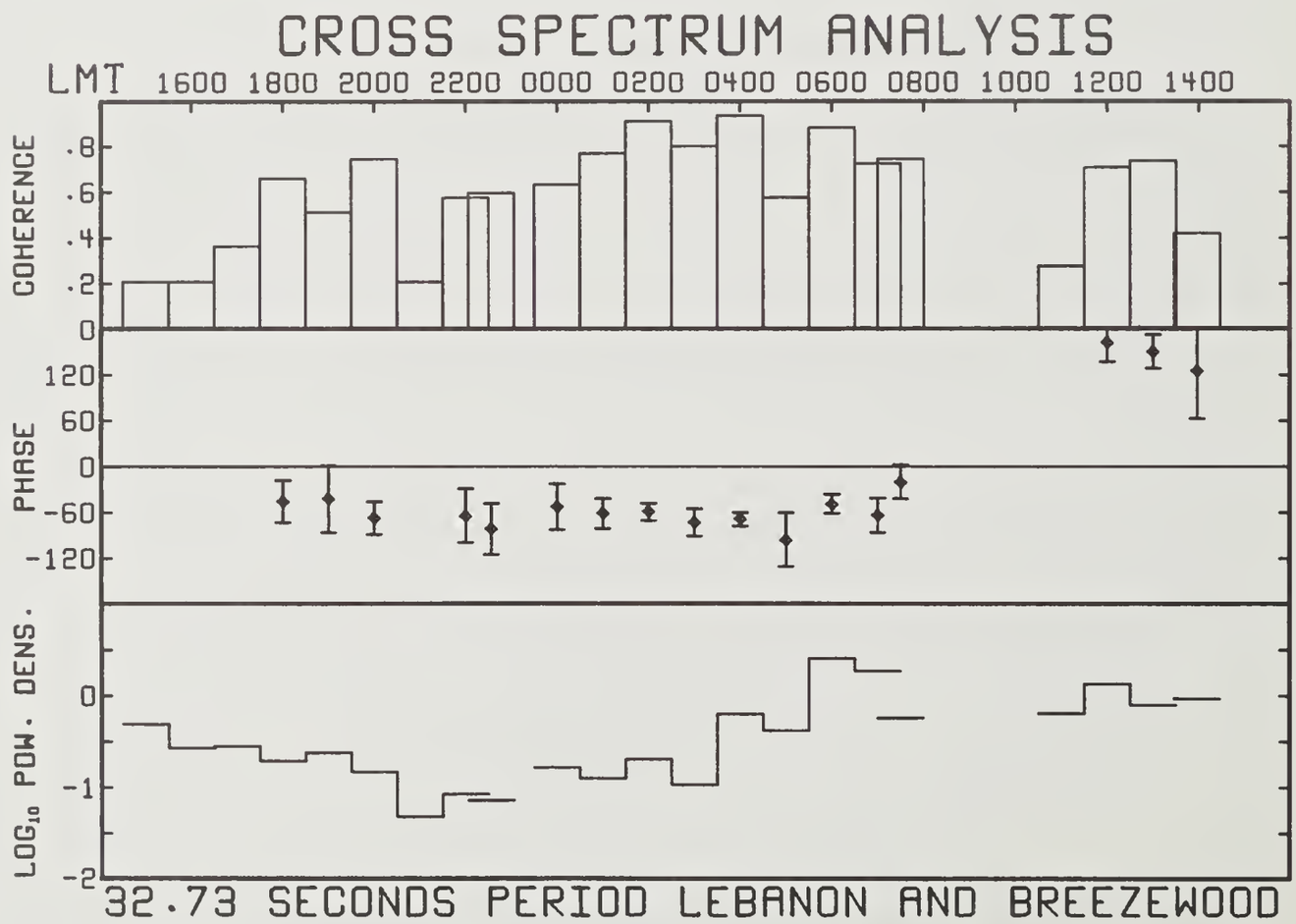
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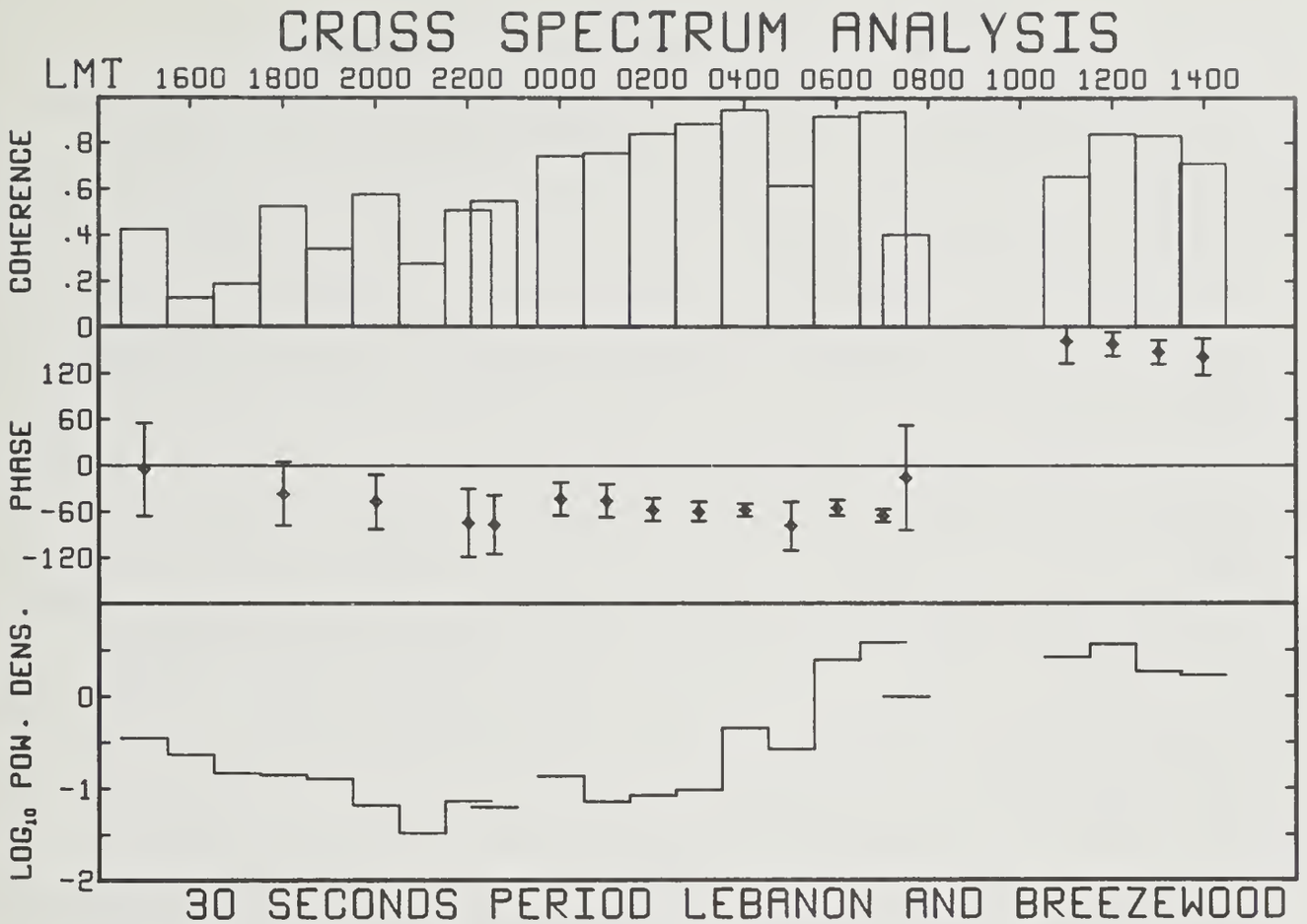
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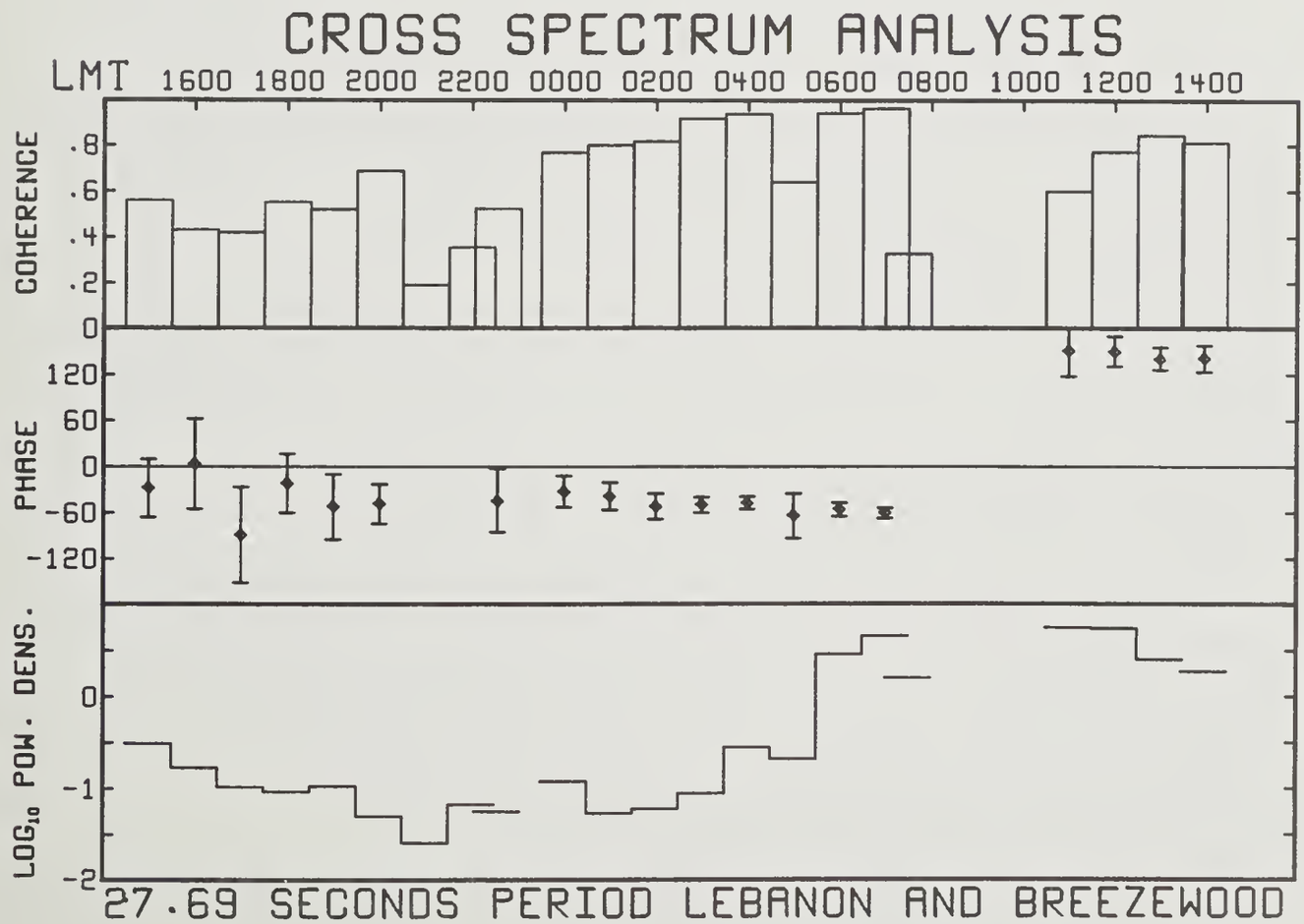
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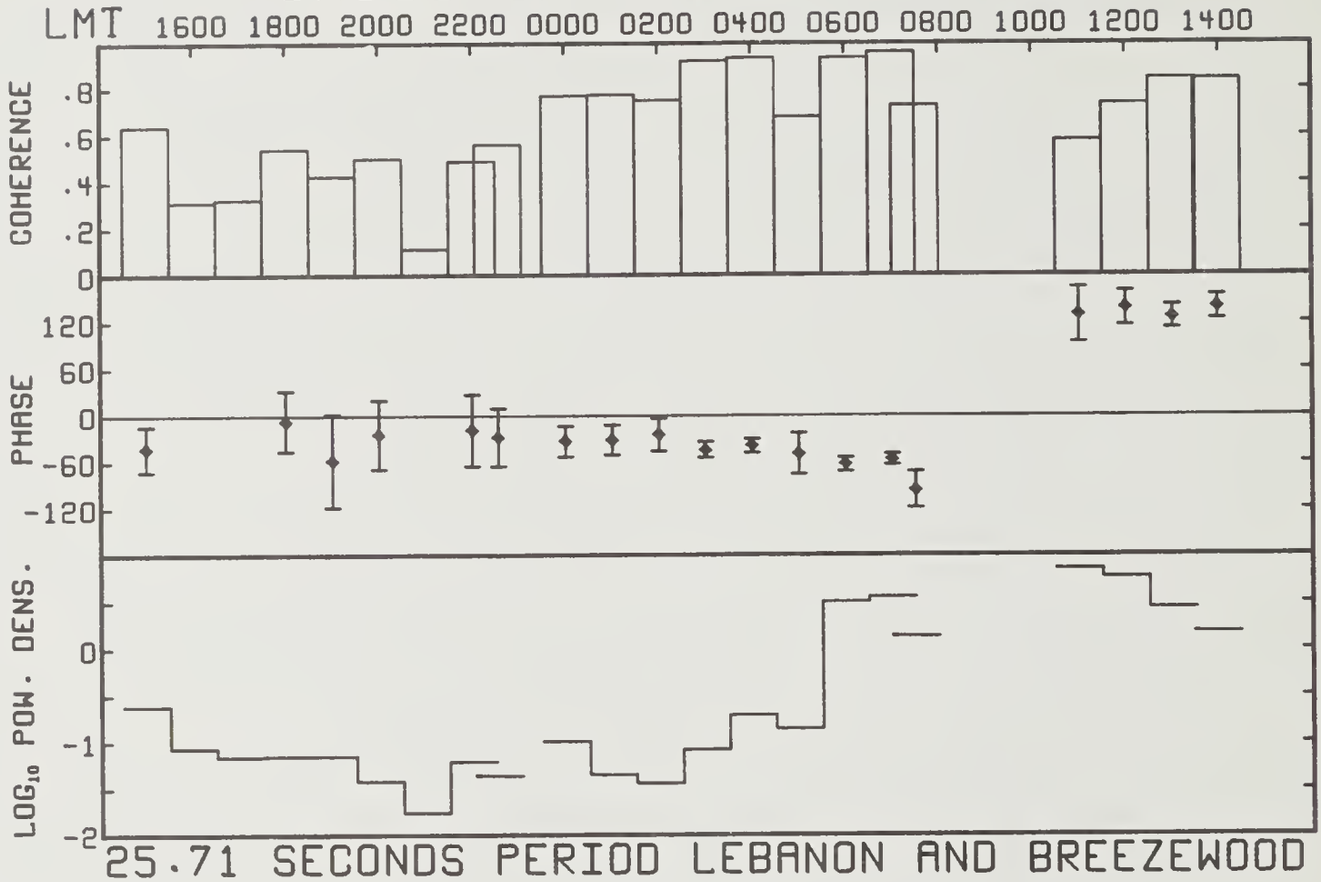
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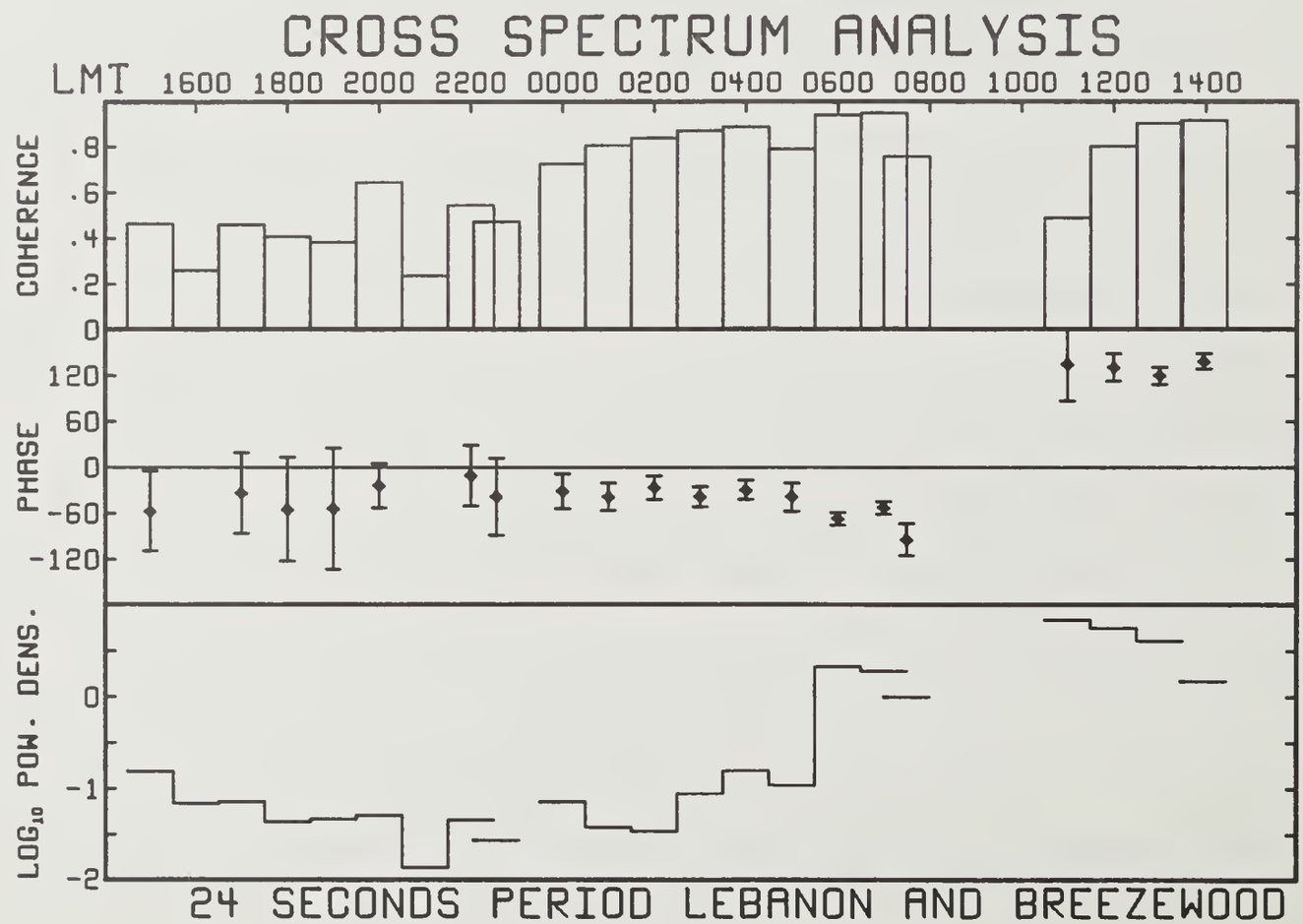
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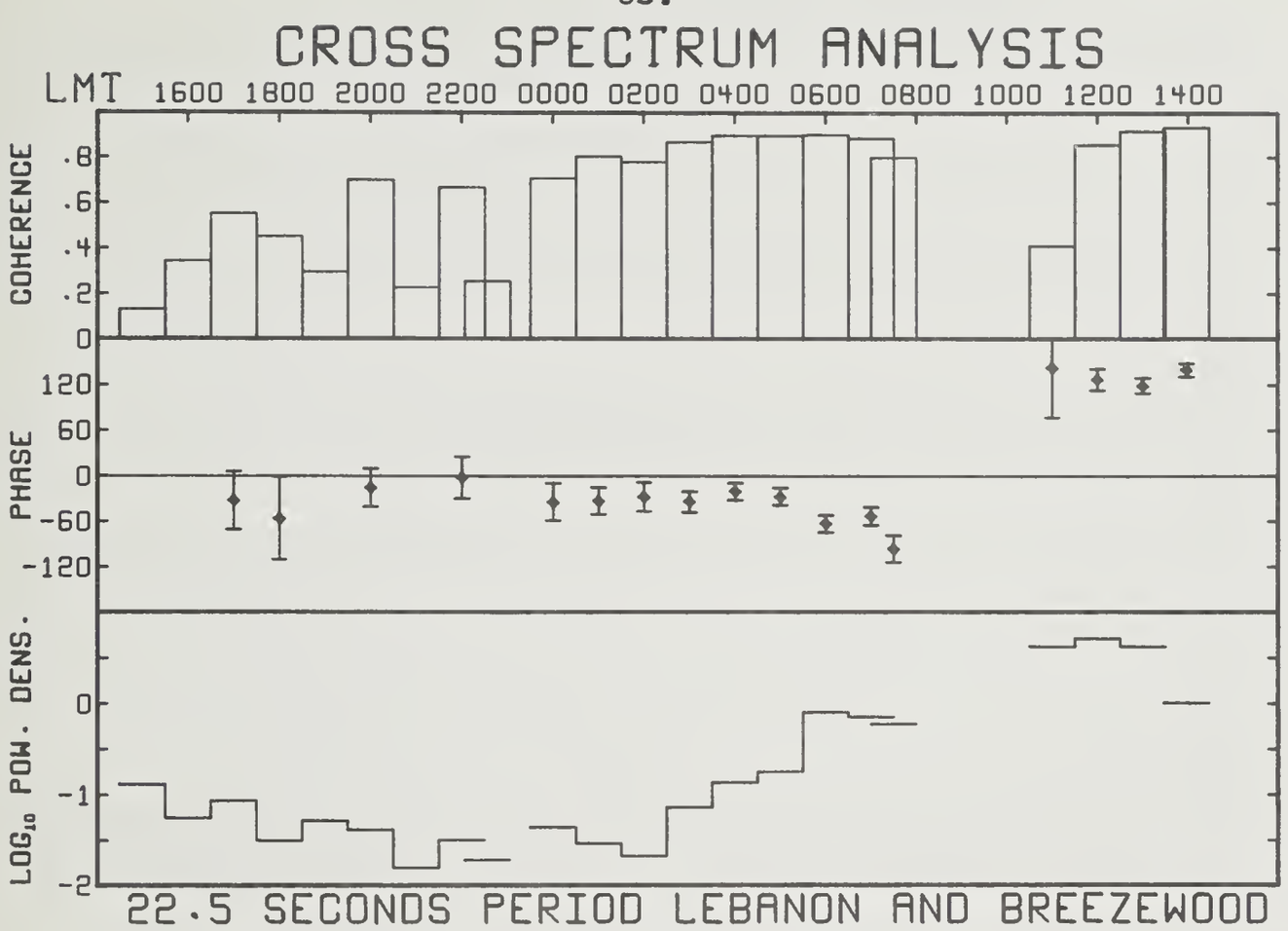
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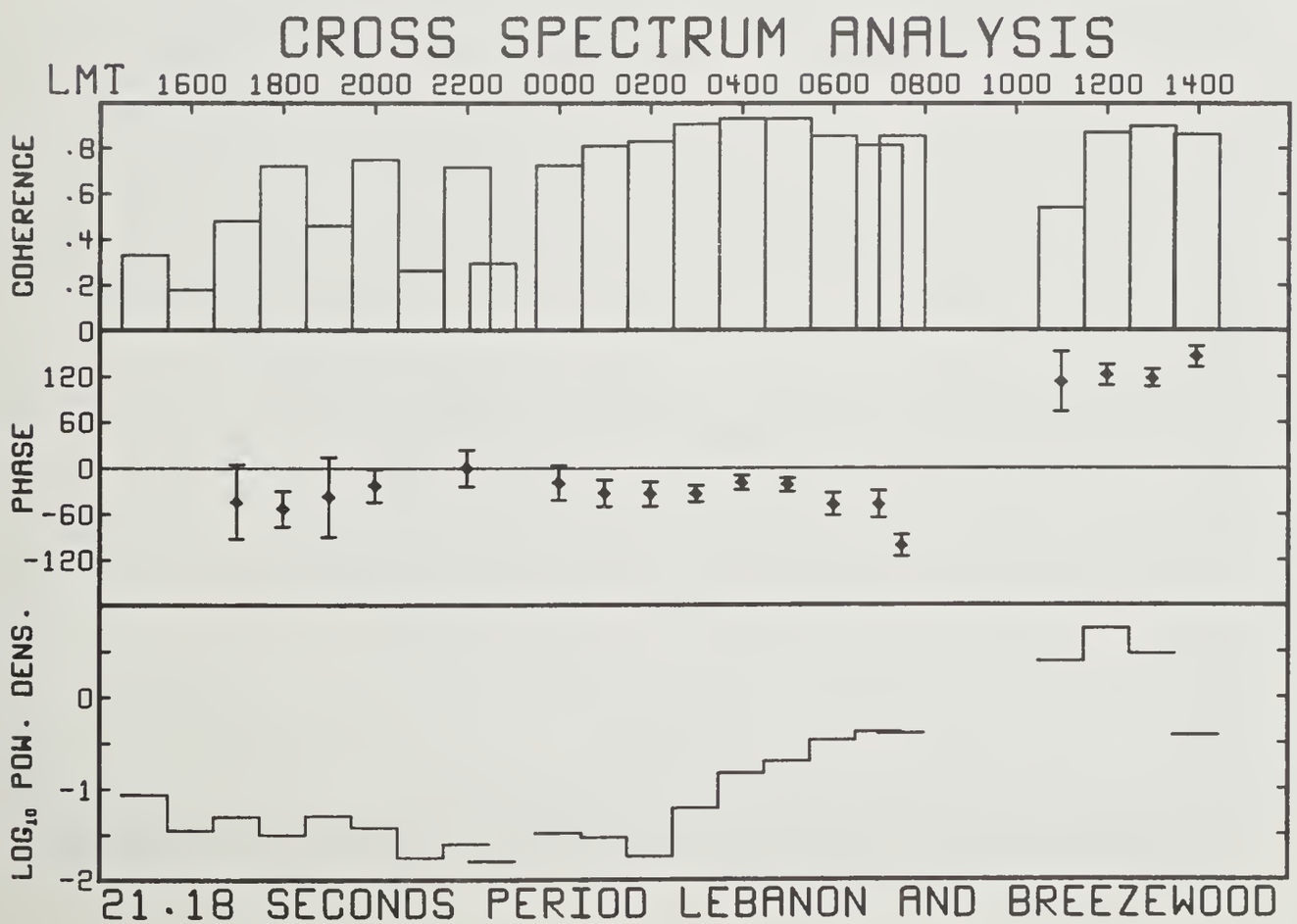
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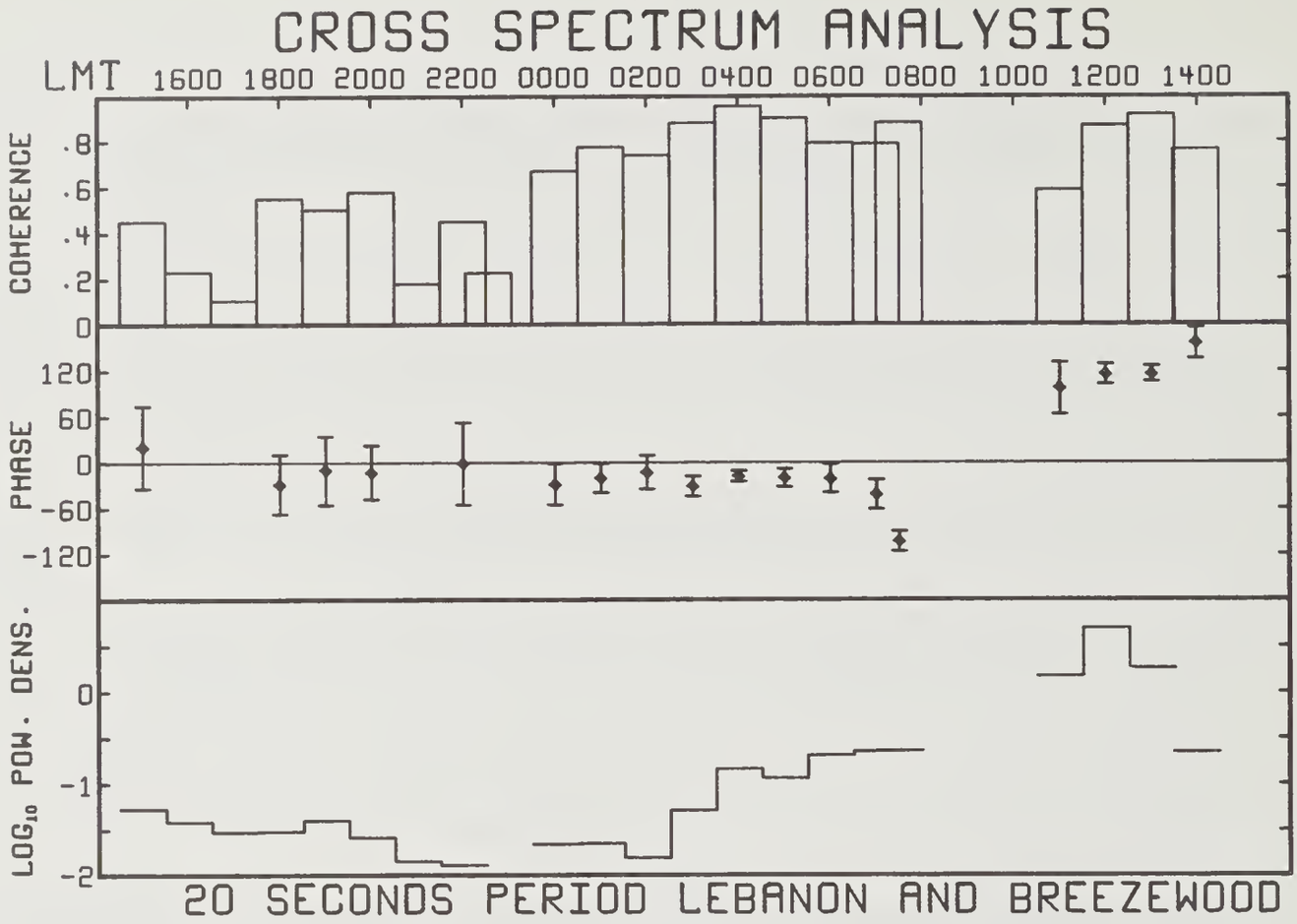
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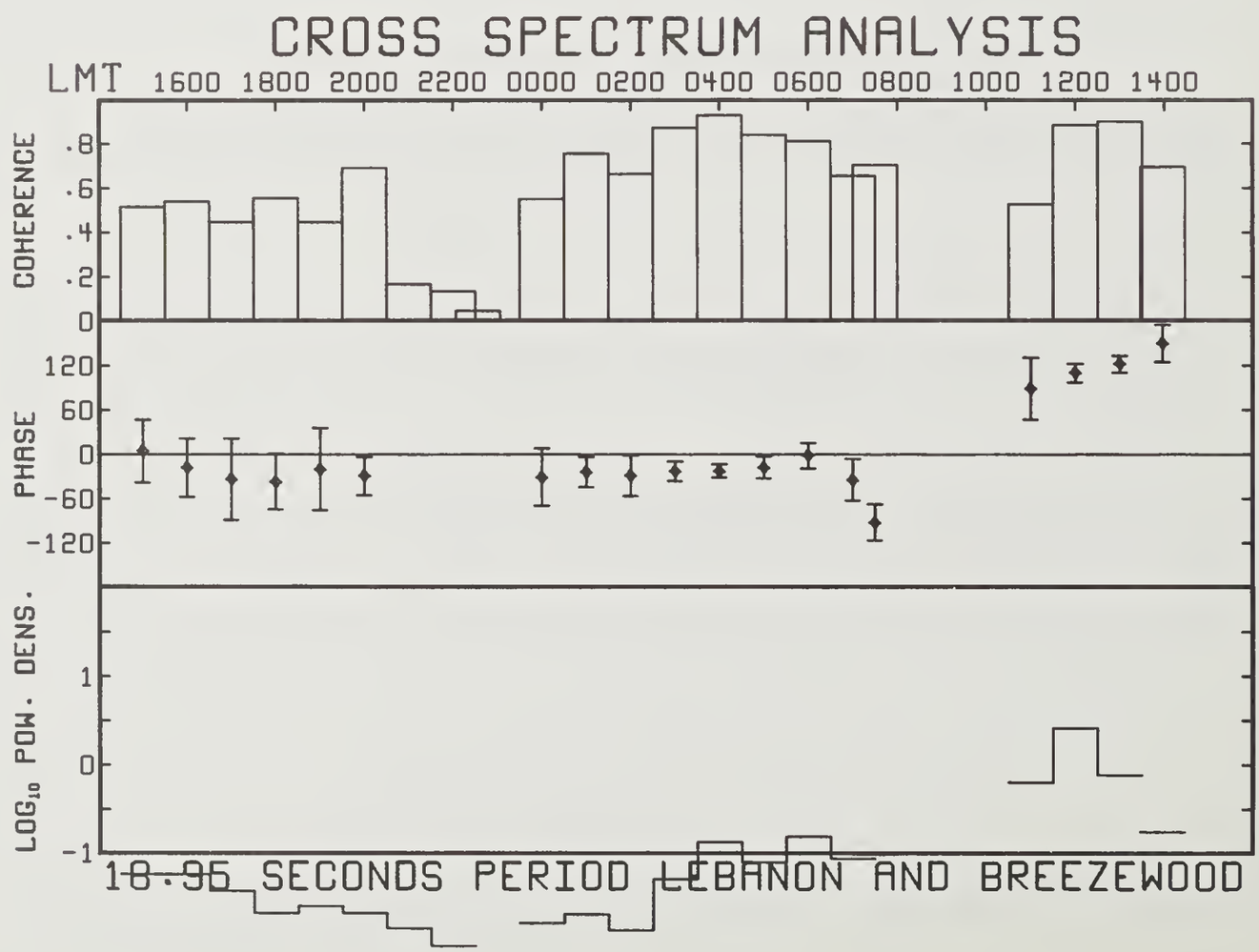
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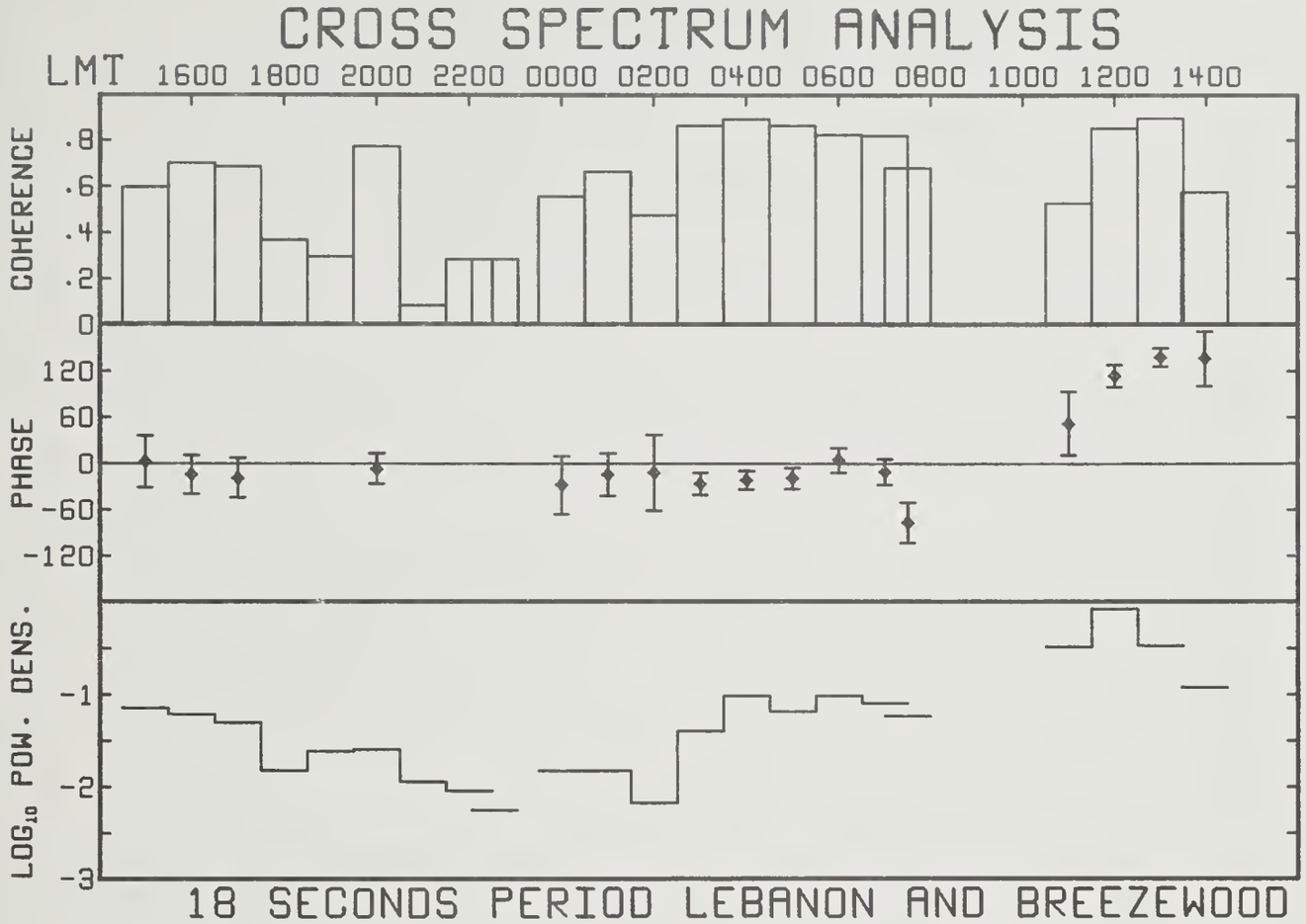
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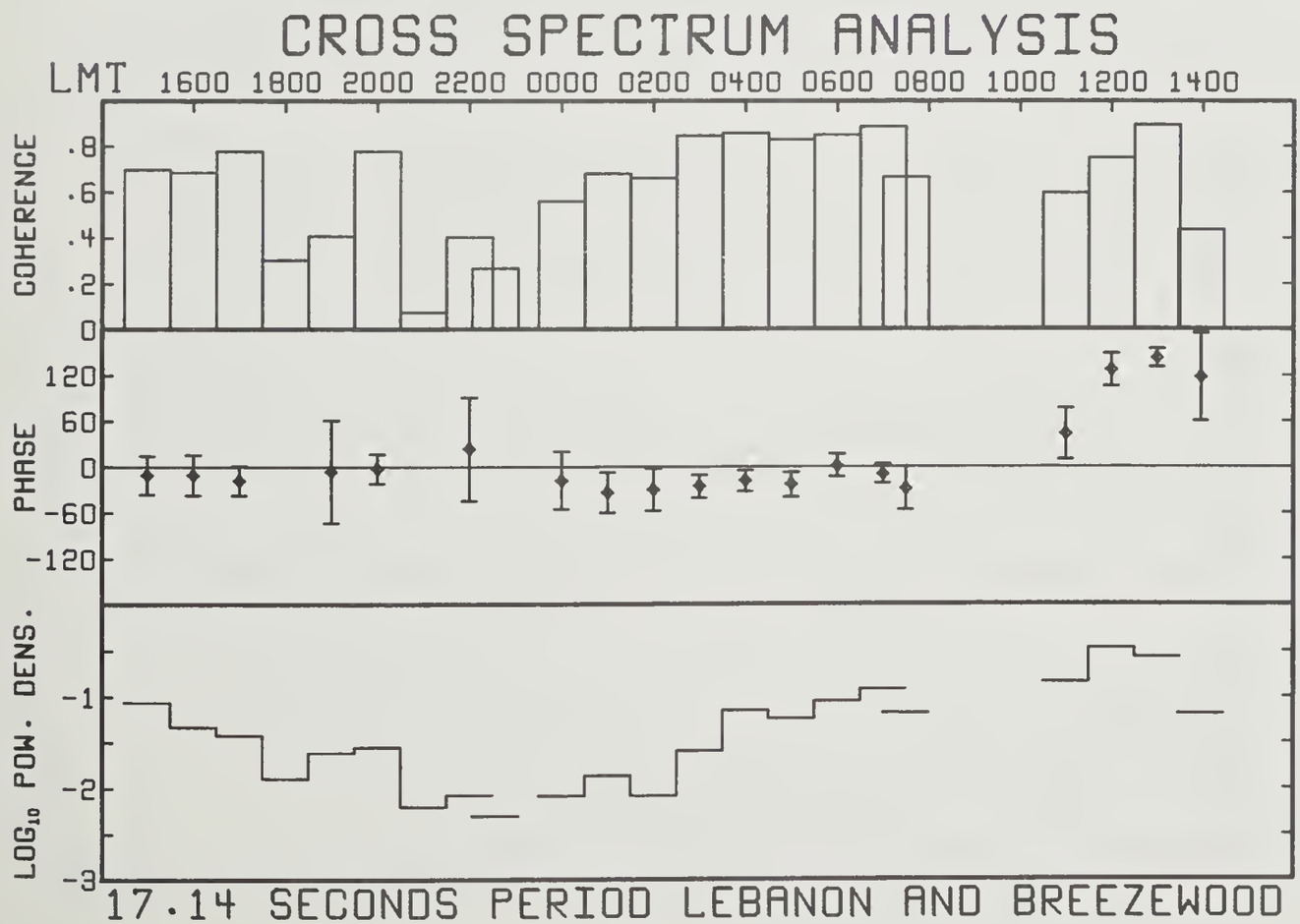
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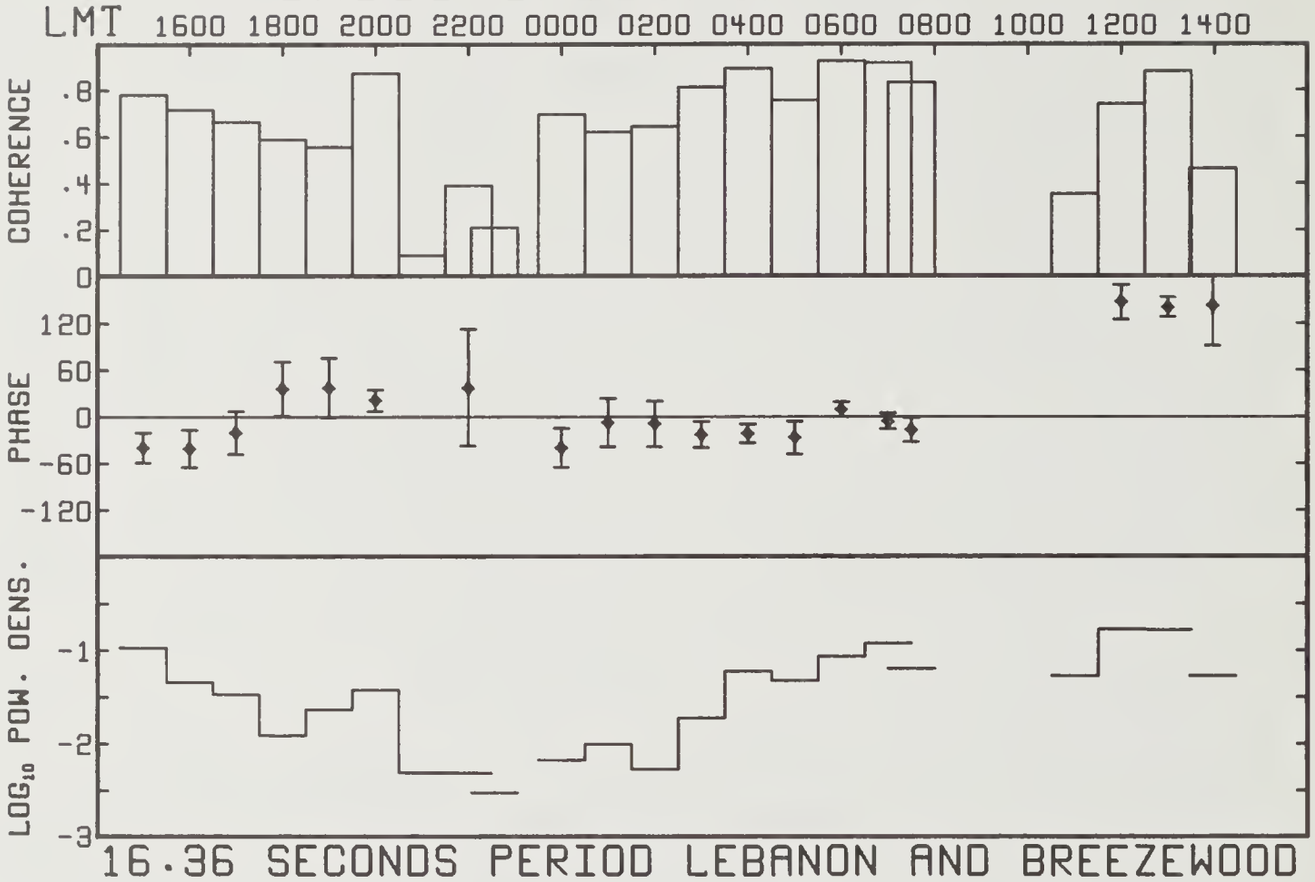
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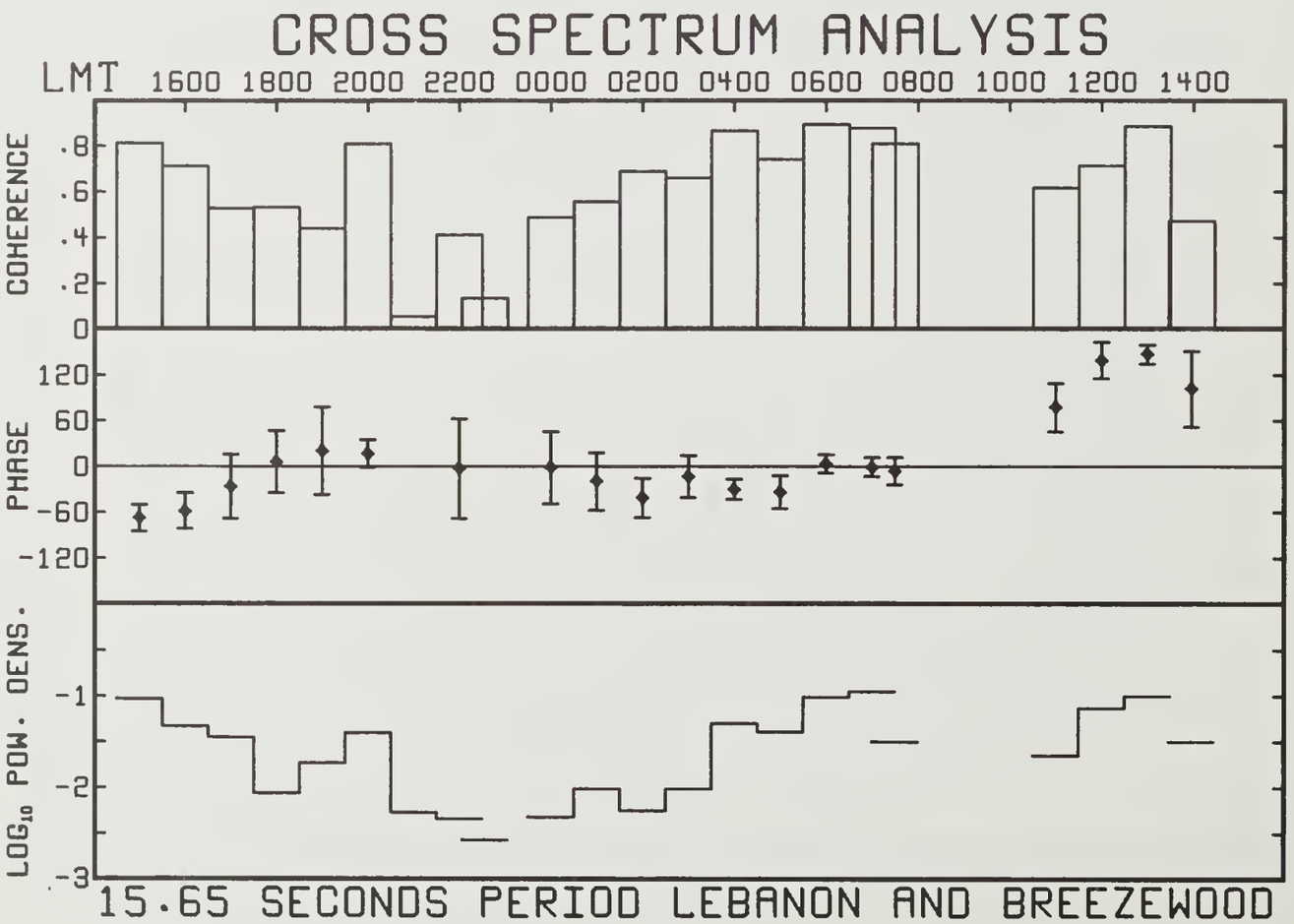
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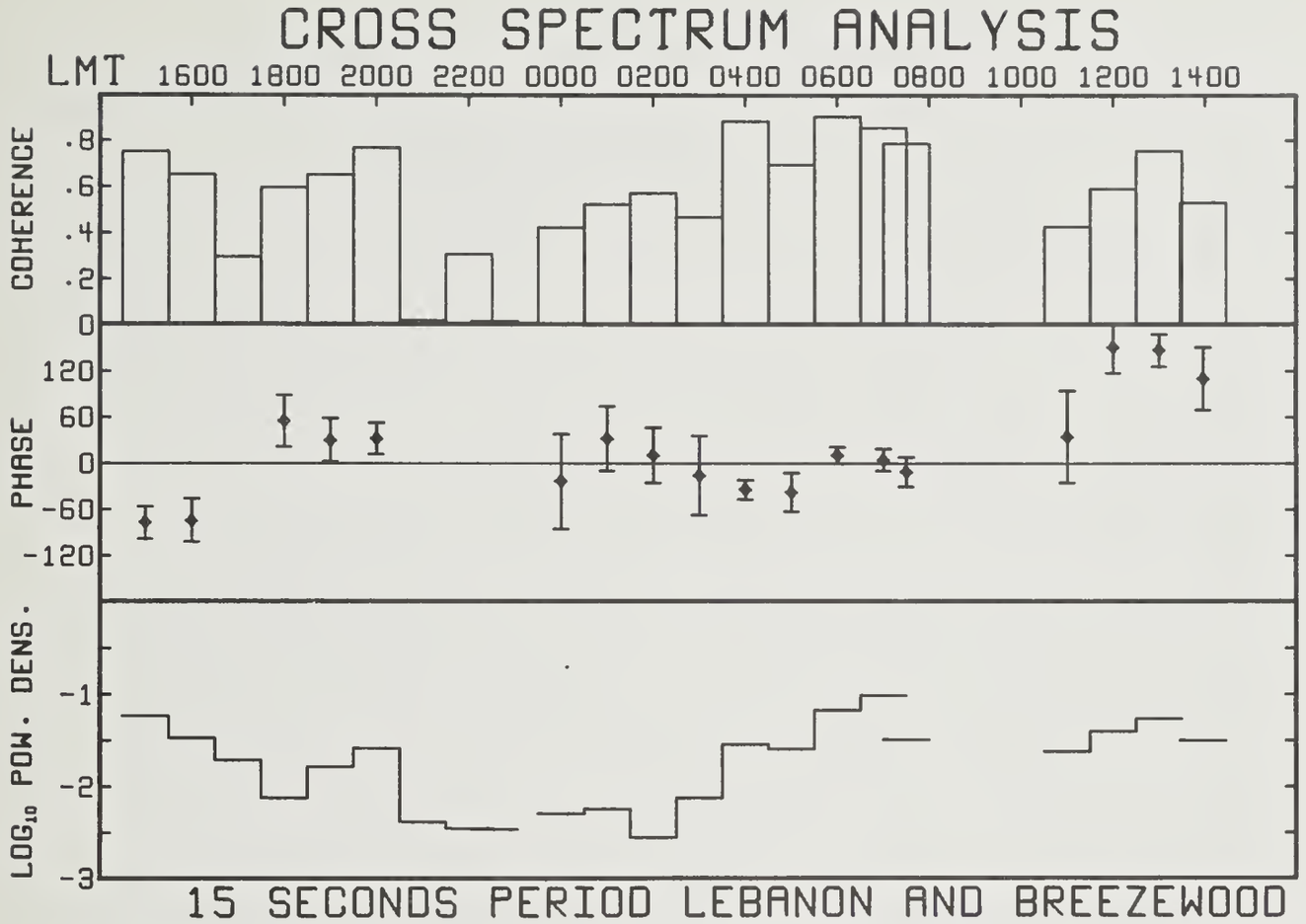
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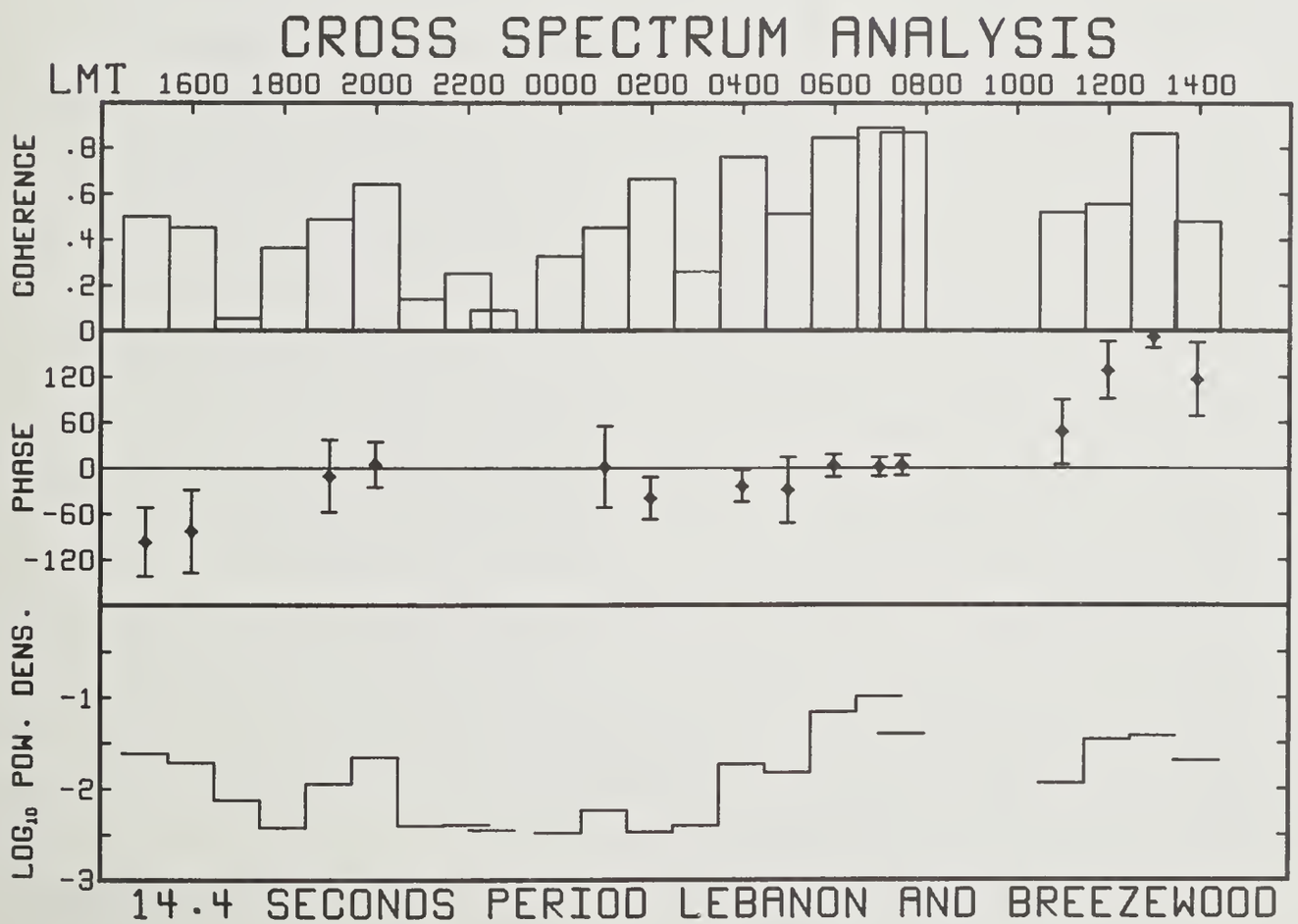
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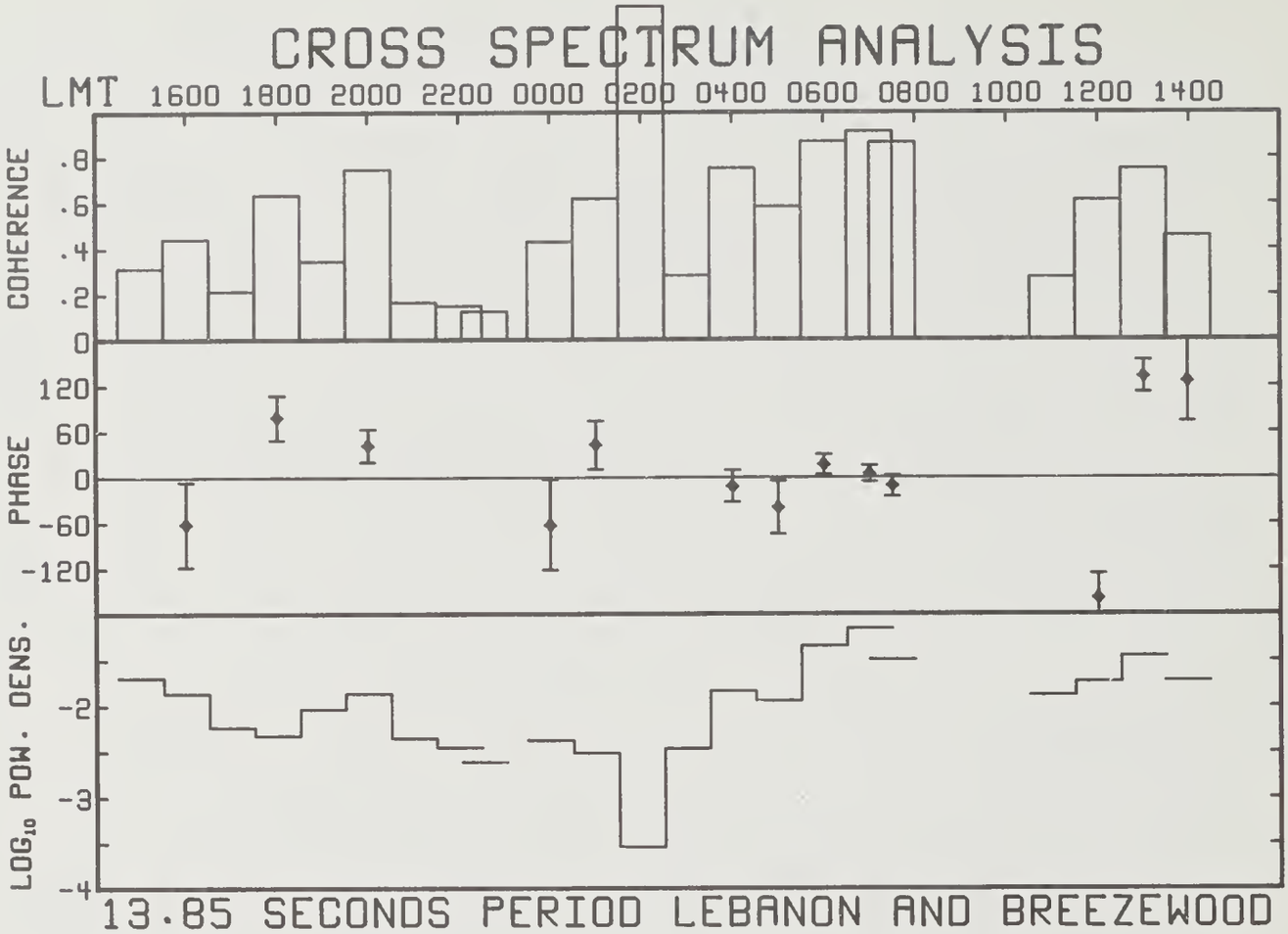
14.4 SECONDS PERIOD LEBANON AND BREEZEWOOD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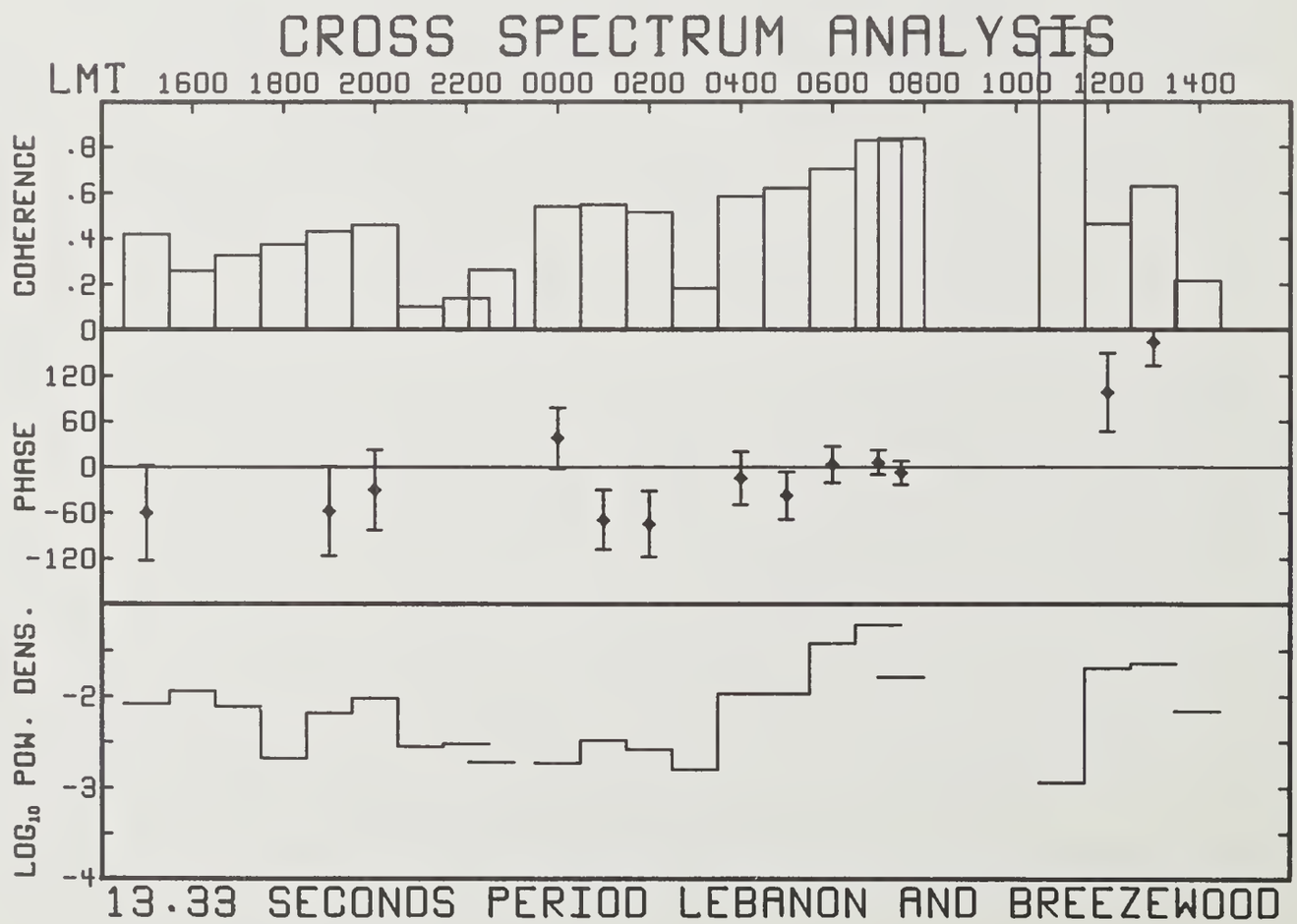
13.85 SECONDS PERIOD LEBANON AND BREEZEWOOD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13.33 SECONDS PERIOD LEBANON AND BREEZEWOOD

Table I

Station	Geographic Latitude	Geographic Longitude	Distance from Lebanon	Recording Interval From	Recording Interval To
Lebanon, N. J.	39° 53' N	74° 32' W			
Morristown, Ohio	40° 03' N	81° 04' W	565 km	8/24/63 1815 GMT	8/25/63 1802 GMT
Breezewood, Penn.	40° 00' N	78° 15' W	318 km	8/27/63 1900 GMT	8/28/63 1930 GMT
Plattsburg, N. Y.	44° 43' N	73° 15' W	552 km	7/28/63 0450 GMT	7/28/63 2125 GMT
Hoffmans, N. Y.	42° 54' N	74° 06' W	341 km	8/22/63 2325 GMT	8/23/63 2325 GMT

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Davidson, M.J. and J.R. Heirtzler, "Spatial coherence of geomagnetic rapid variations" (in press)

Goodman N.R., On the joint estimation of the spectra, cospectrum, and quadrature spectrum of a two dimensional stationary gaussian process, New York University Engr. Stat. Lab. Sci. Paper No. 10, 1957

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Palisades, N.Y.

2a REPORT SECURITY CLASSIFICATION

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2b GROUP

3 REPORT TITLE

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4 DESCRIPTIVE NOTES *(Type of report and inclusive dates)*

Technical Report

5 AUTHOR(S) *(Last name, first name, initial)*

Heirtzler, James, R., and Davidson, Maurice J.

6 REPORT DATE	7a TOTAL NO. OF PAGES	7b. NO. OF REFS
August 1967	90	5

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9a ORIGINATOR'S REPORT NUMBER(S)

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13 ABSTRACT

As part of a program of a systematic study of the variation of rapid geomagnetic activity over small distances rapid fluctuations of the total field intensity were recorded with pairs of magnetometers. Recordings were made at three pairs of stations for one day at each of the three station pairs.

DD FORM 1 JAN 64 1473

Unclassified

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
Geomagnetic Field Spectra Synoptic Measurements						

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1 Army Research Office
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1 U. S. Army Beach Erosion Board
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1 Attn: Research Center Library

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2 National Research Council
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