ON THE 160 MINUTE OSCILLATION

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ABSTRACT. Solar velocity data collected at Izaña (Tenerife) over the years 1980 - 1985 have been used to search for the 160 minute oscillation. The peculiar behaviour of the ninth harmonic of a day, in amplitude and phase, suggests the existence of a solar signal with a 160.02 $\pm$ .01 minute period, which can be interpreted as a g-mode.

1. INTRODUCTION

The existence of the 160^m oscillation is one of the subjects of interest in heliosismology. Since its first detection in 1976 (1),(2), a great deal of work has been devoted to it; at present, its solar origin and long coherent time seem established (3). When analyzing the solar line of the sight velocity data, collected with an optical resonant scattering spectrometer over the period 1980-85, searching for solar g modes, some peculiar behaviour in the ninth harmonic of a day was noticed, which lead to the present work.

2. ANALYSIS

It has been found in the spectral region 25 to 125 μHz, which contains daily harmonics from the third to the tenth, that the ninth harmonic, and only this one, was at noise level in the period 1984-85.

In a first step 1981,82,84 and 85 series have been analyzed, in such a way that all of them covered the same epoch of the year and, moreover, frequency resolution was the same:0.15 μHz (85 days).

Figure 1 shows the daily harmonics power profile, which is the power contained under each harmonic peak, for the considered series. The behaviour of the third harmonic can be ignored because it can be weakly affected by the daily detrending method. The main common feature to the four graphs, is the exponential decrease in power as the harmonic degree increases. For the 1981-82 period not only are the power profiles identical but the integrated power under all the harmonics differs by less than 0.1%. In the second epoch, 1984-85, there is a sudden decrease

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in power precisely in the ninth harmonic; both profiles are similar but the integrated power is 25-30% lower than in the first period.

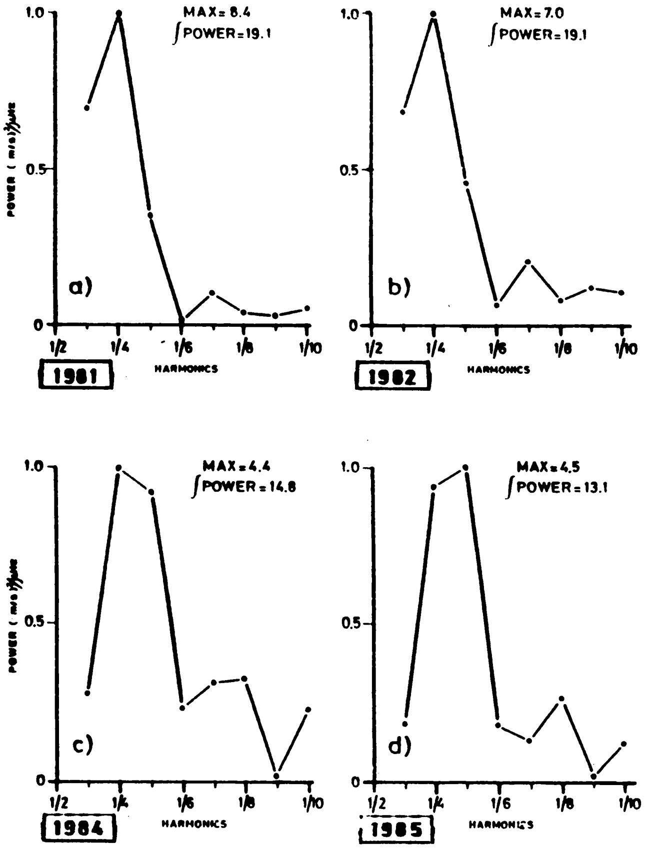

Figure 1. Daily harmonics power profile corresponding to the four yearly considered series. Each point represents the power under a particular harmonic; the integrated power for all of them and its maximum individual value are shown, in (m/s)**2/ μHz.

Somehow, there has been a decrease in power between the two epochs, which is associated with the decrease in the ninth harmonic of a day. Therefore we can think on the following working hypothesis: the presence of a signal with period very close to 160^m produces a interference phenomena with the ninth harmonic of a day that is destructive in 1984 and 1985.

Assuming this hypothesis, it is expected that if the harmonic phase is changed, it will appear with a power that will fit the exponential profile in a similar way as in 1981 or 1982. Performing such analysis, (4) the existence of a signal at, precisely, the ninth harmonic frequency which produced a destructive inteference phenomena was probed.

However, to deduce the existence of a solar coherent signal, one must study the phase behaviour at this particular frequency; in previous works (3) a linear phase variation was reported, interpreted as the existence of another signal with period slightly different from 160^m.

Considering now the whole set of data available from July 1980 to September 1985, for each annual series the phase and amplitude at the frequency 104.16 μHz (160^m) have been computed with a unique time reference: 1^{st} April 1980 at 0^h G.M.T.

3. RESULTS

Results are presented in Table I and the phase values plotted in Figure 2. The phase variation shows a linear behaviour with a phase jump of, precisely, 180° degrees between 1982 and 1983. Straight line fits with apropriate weights (the phase errors) were separately performed for the 1980-82 and 1983-85 epochs. They give us the slope values 37 and 35.6 min/year which coincide within the errors (±0.8min/year).

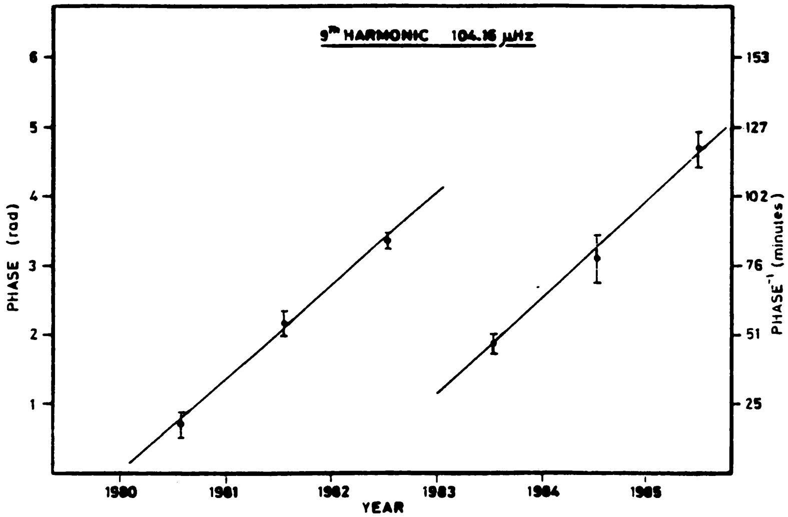

Figure 2. Phase variation of the ninth harmonic of a day over the period 1980-1985. The phases are obtained for each annual series by means of a sine wave fitting procedure; the six annual series have the same time reference: 1^{st} April 1980 at 0^h G.M.T.

From the mean slope value, the 160^m period was corrected and a definitive value was found to be 160.02±.01 minutes. Linear fits significance are not too high because of the number of points available, but it must be noticed that this result is in perfect agreement with independent observations from different sites (Crimea, Stanford and

South Pole) and with different instruments. Other sources able to produce similar effects were investigated without success.

TABLE I

YEAR	PHASE (rad.)	$PHASE^{-1}$ (min.)	AMPLITUDE (cm/s)
1980	0.7±.2	18±5	25
1981	2.2±.2	56±5	11
1982	3.6±.1	91±2	19
1983	1.8±.1	46±2	26
1984	3.1±.3	79±7	5
1985	4.7±.2	119±5	7

Phase and amplitude values of the ninth harmonic over a six years period, (1980-1985).

4. CONCLUSIONS

From the peculiar behaviour of the ninth harmonic of a day in the period 1984-85, the existence of some interference phenomena at that particular frequency has been shown. The linear phase variation of this harmonic in the period 1980-85, can be explained in terms of a solar signal with minimum coherence time of 6 years, and whose period is found to be not 160^m, but $160^m.02 \pm .01$, in agreement with previous and independent observations. The phase jump between 1982 and 1983 is still not well understood.

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