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FREQUENCY MODULATION OF THE CHANDLER WOBBLE

N. Pejović and S. Šegan

Department of Astronomy, Mathematical Faculty, University of Belgrade, Studentski trg 16, Belgrade, Yugoslavia

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SUMMARY: The spectral analysis of the ILS polar motion data in the interval 1900-1980 are accomplished. The obtained results are discussed and compared with the results of the other authors and with ours, as well. We may conclude that two resonant frequencies in the Chandler wobble do not exist, but only one modulated.

1. INTRODUCTION

The existance of the 14-month period in the polar motion is still an open question. The variability of the Chandler period has been controversial for almost an entire century. The great number of autors, including Chandler himself, have assumed that the Chandler period is either multi-component, or variable in time (Chandler 1892, Kimura 1918, Hattori 1949, Melchior 1957, Colombo and Shapiro 1968, Gaposchkin 1972, Sekiguchi 1972, 1976, Carter 1981, Dickman 1981, Pejovic 1983, 1988, Vondrak 1985, 1988). There are other autors claiming that the Chandler wobble has a single period (Newcomb 1892, Pedersen and Rochester 1972, Ooe 1978, Okubo 1982). In this paper we came to the conclusion that only one phase modulated Chandler frequency exists.

2. COMPARISON OF THE POLAR MOTION SPECTRA

Aalgorithm for the Fourier transform (FT) was used to calculate the spectra of ILS polar motion data (Yumi and Yokoyama 1980). The whole interval (1900 - 1980) was devided into four subintervals, namely: 1900-1920, 1920-1940, 1940- 1960 and 1960-1980. This subdivision was done in such a way to analyse especially the dubious 1920-1940 subinterval. We did not apply windowing to suppress sidelobes. An attempt with the Parsen window to polar motion data showed a severe decrease of amplitudes of both the Chandler and annual term with respect to nonwindowed data. Therefore, it is clear that windowing gives the largest weight to the data in the center of the interval. The amplitude of the polar motion was extremely small especially in the some our subintervals.

The polar motion spectra are shown in Fig. 1, 2 and 3. The spectra of the four analised subintervals for the x component are presented in Fig. 1, and for the y component are presented in Fig. 2. In all of the shown spectra there are two peaks dominating at the Chandler and annual frequencies. It is clear that the amplitude of the Chandler term is distinctly smaller in subinterval 1920-1940 then in other subintervals (Fig. 1b, 2b). In the Table 1 are given parameters of the Chandler wobble with additional subinterval 1940-1980. We can see from this table relatively good agreement of the periods in all of the

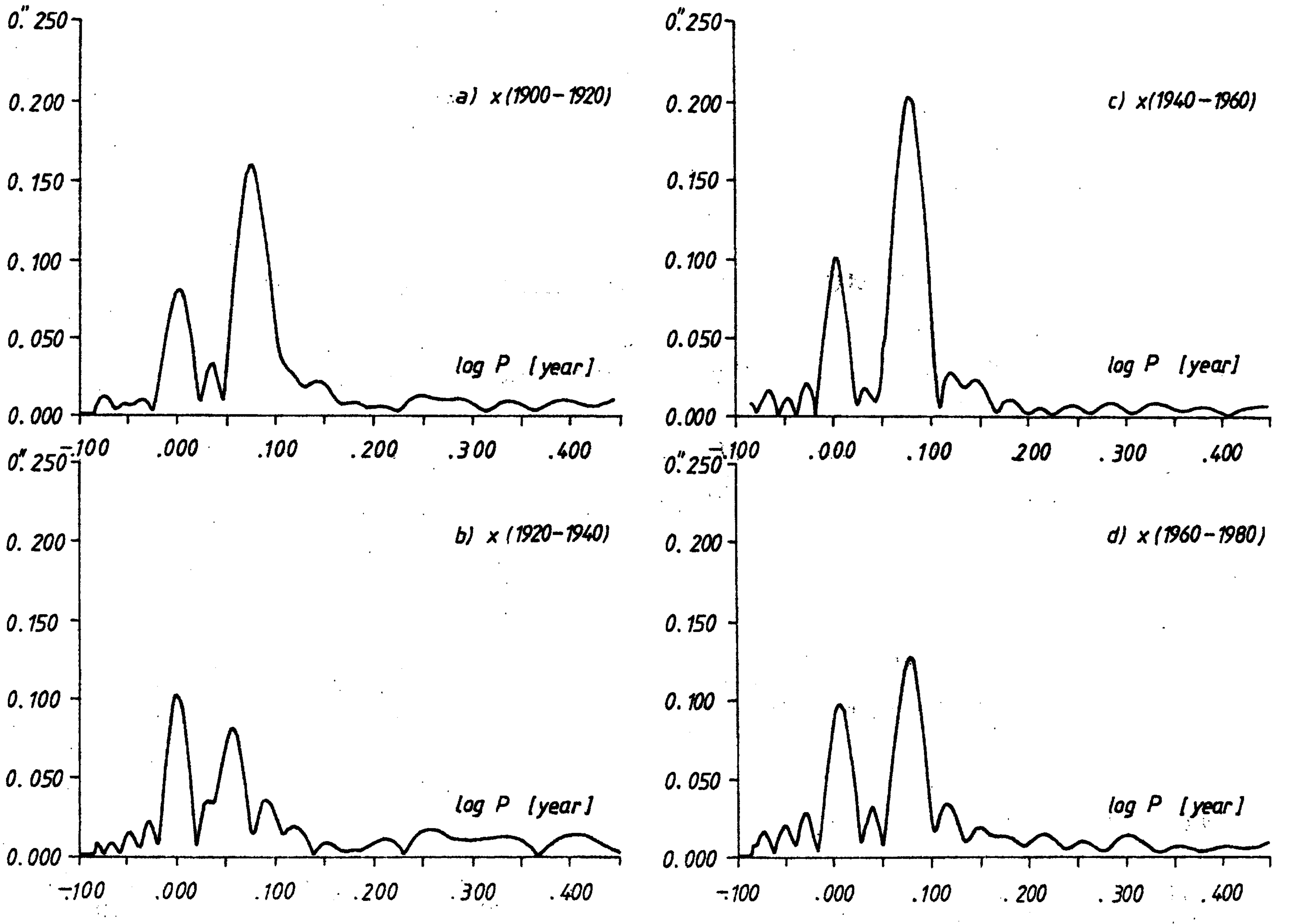

Fig. 1. **Spectra of the x component of polar motion for the four subintervals.**

Table 1 **Parameters of the Chandler wobble - P, A, Φ denote the period, amplitude and phase.**

	x component			y component		
Interval	P(day)	A(″)	Φ(°)	P(day)	A(″)	Φ(°)
1900-1920	434.375	0.162	22.5	434.375	0.165	294.4
1920-1940	415.625	0.081		416.562	0.076	
1920-1940	434.375	0.015	233.6	434.375	0.016	145.2
1940-1960	434.375	0.207	137.1	434.375	0.208	46.5
1960-1980	434.375	0.129	135.9	434.375	0.136	46.1
1940-1980	434.375	0.169	136.4	434.375	0.173	46.3

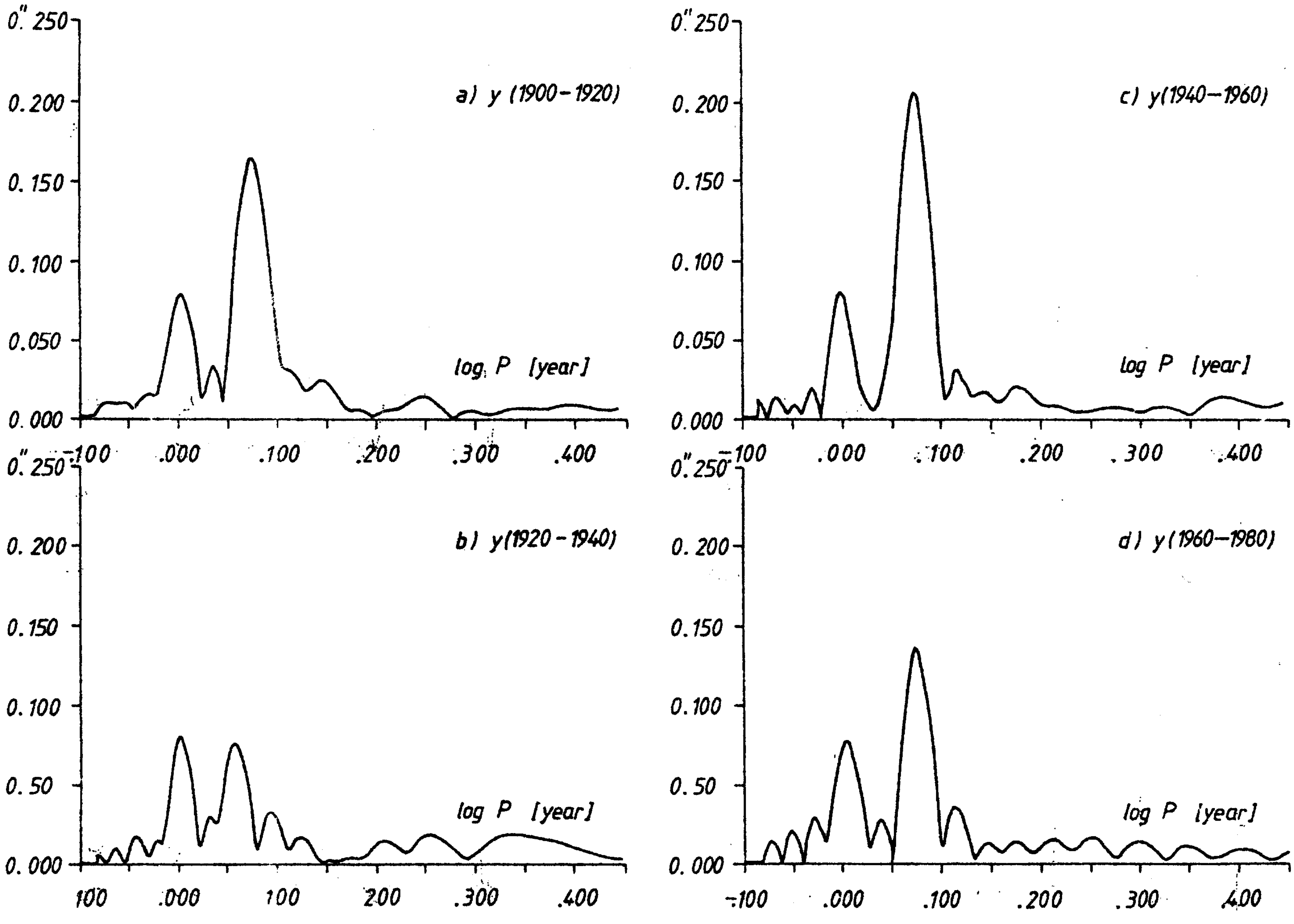

Fig. 2. Spectra of the y component of polar motion for the four subintervals.

Table 2. Parameters of annual polar motion - P, A, Φ denote the period, amplitude and phase.

	x component			y component	
Interval	P(day)	A(")	Φ(°)	A(")	Φ(°)
1900-1920	365.250	0.079	238.8	0.077	162.4
1920-1940	365.250	0.102	238.9	0.081	150.4
1940-1960	365.250	0.103	239.1	0.081	152.4
1960-1980	365.250	0.098	245.0	0.079	162.9
1900-1980	365.250	0.095	240.4	0.078	157.0

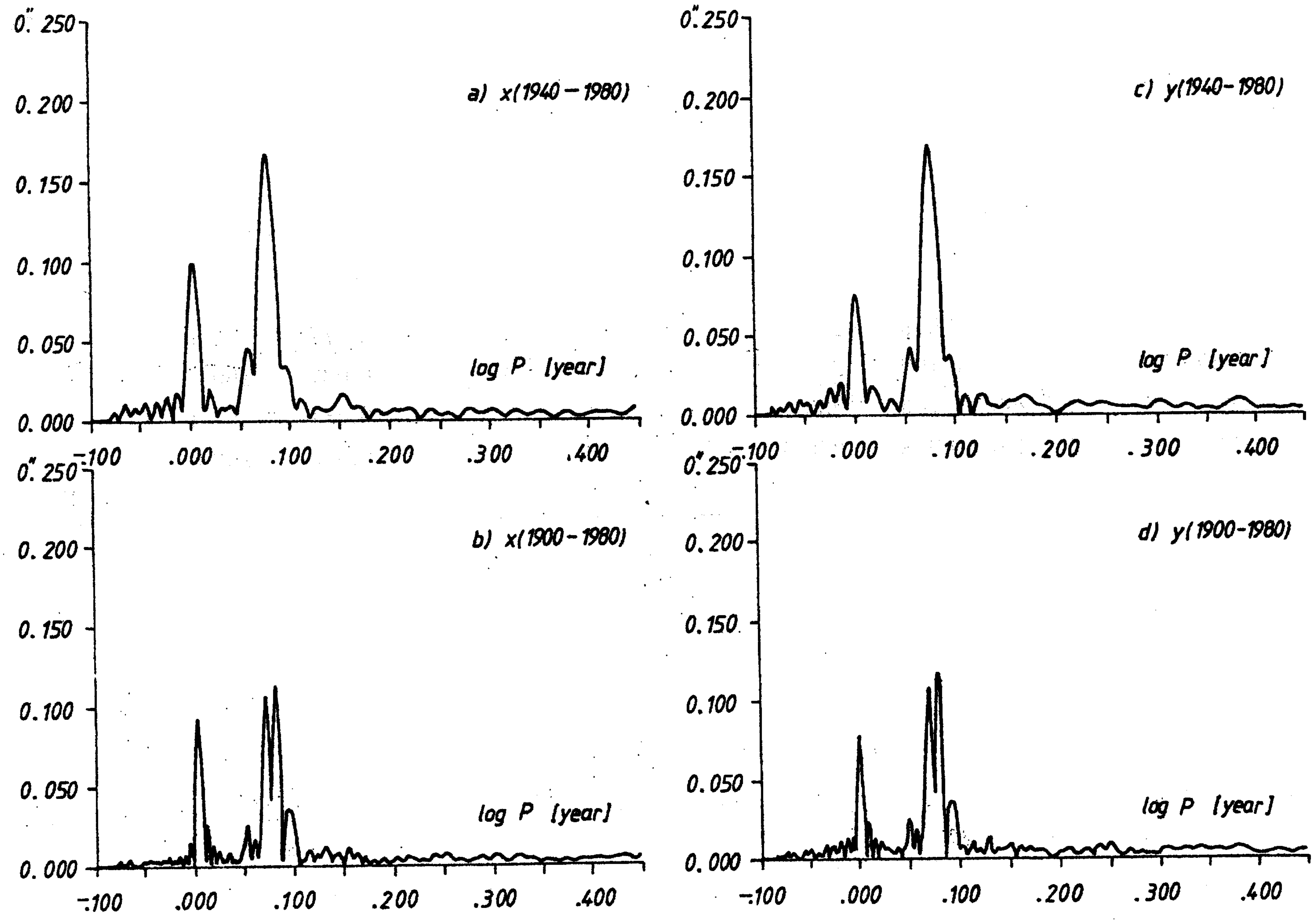

Fig. 3. **Spectra of polar motion for subinterval (a, c) and for the whole interval (b, d).**

subintervals except in the dubious (1920 – 1940) one, in which the period of Chandler term is considerably smaller, as well as its amplitude. The Table 1 give us a possibility to notice the rapid change of the phase of Chandler term in the dubious subinterval.

The Table 2 ilustrate good agreement of the parameters of annual wobble for x and y coordinates in the all five subintervals as in the Table 1.

The spectra for subinterval 1940-1980 are presented in Fig. 3a and 3c for x and y components, respectively. For the whole interval 1900-1980 the spectra of the polar motion are shovn in Fig. 3b, 3d. This are our previously obtained results (Pejović 1983). Comparing the spectra of the whole interval with the spectra of subintervals it is clear that the Chandler peak is a single in all of the subintervals but it is split into two parts only in the whole interval. We can conclud that the splitting is a result of taking into account the dubious subinterval which has a rapid change of th e phase. Vondrák (1985, 1988) emplasized an important fact that change in phase causes the change in frequency of Chandler wobble. This interrelation was confirmed in our paper (Pejović 1990). Because of that we came to the conclusion that it is not the question of two but of only one frequently modulated Chandler wobble.

3. DISCUSSION

Pedersen and Rochester (1972) showed that the process by wich the polar motion is randomly altered is not a stationary one, in the statistical sense.

The annual peaks are quite consistent with one another, while the spectra in the Chandler region are very dissimilar. The lack of resemblance is strong evidence that the random inputs to the Chandler wobble constitute a highly non-stationary process. Okubo (1982) in this extended analysis attempted to slove the existing problem. According to his conclusion Chandler wobble is not stationary and the mean value of the fluctuating Chandler period is 435 days.

By analysis of the amplitude and phase of Chandler wobble Pejović (1985) confirmed results of Guinot (1972, 1982) and Dickman (1981) that the amplitude of Chandler wobble is the harmonic function of time but on the contrary its phase is stable except during 1920-1940. This rapid change of the Chandler phase was considered by many authors as random until Vondrak (1985) analysing a long time interval (1860-1985) was confirmed this change and descovered a new one 1870-1890. It seems that what for Pedersen and Rochester (1972) and Okubo (1982) was a randomly fluctuating Chandler wobble, for Carter (1981), Vondrak (1985, 1988) and Pejović (1988, 1990) was frequently modulated.

4. CONCLUSION

According to the results received by the spectral analysis of the polar motion it can be concluded that one single Chandler peak is obtained if subintervals are taken into account. But, the Chandler peak is splitted if the whole interval was analysed. It becomes clear that this splitting is a consequence of the inclusion of jast that dubious subinterval. As this subinterval has a rapid change of phase which causes change of the frequency, we conclude that it is not the question of two, but only one, frequently modulated Chandler wobble.

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ФРЕКВЕНТНА МОДУЛИСАНОСТ ЧЕНДЛЕРОВОГ КЛИМАЊА

Н. Пејовић и С. Шеган

Институт за астрономију, Математички факултет Универзитета у Београду, Студентски трг 16, Београд, Југославија

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Оригинални научни рад

Извршена је спектрална анализа ILS података поларног кретања на интервалу 1900 - 1980. Добијени резултати су дискутовани и упоређени, како са резултатима других аутора, тако и са нашим ранијим резултатима. Може се закључити да не постоје две резонантне фреквенције у Чендлеревој нутацији, већ само једна модулисана.