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ЕРЕВАНСКИЙ ФИЗИЧЕСКИЙ ИНСТИТУТ
YEREVAN PHYSICS INSTITUTE

S.R.SHAHAZIZYAN

CENTRE-CONTAINING SPIRAL-GEOMETRIC STRUCTURE OF THE SPACE-TIME AND NONRELATIVISTIC RELATIVITY OF THE UNIT TIME

ЦНИИатоминформ
ЕРЕВАН — 1987

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Աշխատանքում հենվելով տարածաժամանակի կենտրոնակիր պարուրաերկրաչափական կառուցվածքին դիտարկված է երկարության և ժամանակի ոչ ունյարիմիտական կախումը տարածությունում զբաղված տեղից: Ուսումնասիրված են ժամանակի միավորի փոփոխականության փորձնական արդյունքները, որոնք բավականին լավ համընկնում են առաջարկված մոդելի պահանջներին:

Երևանի Ֆիզիկայի ինստիտուտ
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CENTRE-CONTAINING SPIRAL-GEOMETRIC STRUCTURE OF THE SPACE-TIME AND NONRELATIVISTIC RELATIVITY OF THE UNIT TIME

In this work the problem of nonrelativistic dependence of unit length and unit time on the position in the space is considered on the basis of centre-containing spiral-geometric structure of the space-time. The experimental results of variation of the unit time are analyzed, which well agree with the requirements of the model proposed.

Yerevan Physics Institute

Yerevan 1987

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С.Р.ШАХАЗИЗЯН

ЦЕНТРОСОДЕРЖАЩАЯ СПИРАЛЬНО-ГЕОМЕТРИЧЕСКАЯ СТРУКТУРА ПРОСТРАНСТВА-ВРЕМЕНИ И НЕРЕЛЯТИВИСТСКАЯ ОТНОСИТЕЛЬНОСТЬ ЕДИНИЦЫ ВРЕМЕНИ

В работе на основе центросодержащей спирально-геометрической структуры пространства-времени рассмотрен вопрос о нерелятивистской зависимости единиц длины и времени от занимаемого положения в пространстве. Исследованы экспериментальные результаты вариации единицы времени, которые хорошо совпадают с требованиями предложенной модели.

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Ереван 1987

Let us take a multicentre spiral geometry as a geometrical structure inherent in the space-time continuum. A spiral centre-containing geometry can be considered as an expansion of an Euclidean geometry, the system of axioms of which is supplemented by an axiom about the concentration point: "In a multitude of points there is a single one belonging simultaneously to all straight lines and planes" [1]. In this geometry, as straight lines are taken the whole set of logarithmic spirals which also include the Euclidean straight line and circle, and the set of planes represent themselves surfaces formed at the rotation of spirals, particular cases of which are the Euclidean plane, cone and spherical surfaces.

One of peculiarities of a spiral geometry is, that the straight line unit length is variable for an outer observer and depends on both the distance to the centre of geometry and on his location, the unit length increasing when moving off from the centre and vice versa [2]. Thus, if the hypothesis that the physical space is a spiral-geometric space-time construction is assumed to be possible, then the appraisal of the length becomes quite relative.

At present the distance from the Galactic Centre to the

Sun, according to new estimates, is 8 kpc. This is our (inner observer's) viewpoint, but the outer observer admitting our assumed unit length, will appraise the same distance much shorter than that appraised by us.

For other galaxies, for which we are outer observers, our appraised distances would, naturally, be shorter than those obtained by the inner observers of the given galaxies.

So, if the physical space is assumed to have a spiral-geometric structure, then an analogous approach to the unit time is natural, i.e. the unit time (according to the absolute measurements of an outer observer) also will depend on the distance to the centre of geometry and on its location. Thus, we can simultaneously satisfy the existence of the velocity constant, i.e. the inertial motion.

Suppose our Galaxy is a system with a single-centre spiral geometry, where the Galactic Centre is the centre of geometry.

If three similar timers were located in some point A beyond the centre and after checking the first of them was transported with nonrelativistic velocity close to the centre onto a point B, ρ distant to A, and the second timer was transported in the opposite direction onto a point C the same ρ distant to A, then, according to the absolute timer of an outer observer, the first timer would be faster than it was in the point A, while the second one would be so much slower. After some time return the timers into their previous place: the unit times, again changing, would become equal, i.e. the timing would again be synchronous. But, nevertheless, the total life time or metering of each timer would be different.

For the first timer taken nearer to the centre the total timing will be more than for that left in its place on the point A, and for the second timer - so much less. Naturally, this difference will notice both outer and inner observers.

So, in similar physical spaces relative are (depending on the place and position of the inner observer) not only the lengths, but time stretches too, which determine the physical processes. For example, the age of the Galaxy, assumed to be $12\ 10^9$ years, becomes quite relative as the observer, who is nearer the centre will evaluate it to be much older and the farther observer will say that the Galaxy is much younger.

The given spiral geometry is not bound to a single centre, but will develop as a general multicentre geometry. A spiral geometry intended to simultaneously describe the problems of mega-, macro- and microcosms must be a multicentre one. So, each galaxy is a single-centred spiral structure. But the megacosm represents itself an assembly of such structures, i.e. is a system of interacting geometry. In the microcosm, according to this approach, any elementary particle is a single--centered spiral-geometric system with its concentration point. Each pair of particles, atoms, molecules, etc., is, in fact, a locally-multicentred space-time system, which being in a macrocosm (in a galaxy) has a definite range of interaction.

Thus, when investigating some physical phenomenon, first of all, it is necessary to mention the local region of the space-time, the place of the centre of geometry encompassing the given phenomenon, i.e. to fit with the law of changing of the unit length and time and with the question of the obser-

ver's location. Examples: 1. If the Earth with its diurnal rotation is considered as a timer and the day's duration as unit time, then the geometry centre for the given timer will be that of the Galaxy and we'll be as inner observers.
2. If spring, quartz, atomic, etc. clocks are taken as timers, then we are, naturally, outer observers for them. The centre of geometry for the mentioned timers will be inside their own systems, say, for an atomic clock the centres of geometry will be those of elementary particles comprising the atom.

At such tratment, it is natural to assume that the length of the day is variable and depends on the Earth's location in the space. When radially approaching the Galactic Centre, the unit time (length of the day) must become shorter, and when moving off - it must become longer. Such variation of time can be releaved by an atomic clock, because it as a local system for the given physical process (rotation of the Earth on its axis), with definite approximation, is an absolute timer for the outer observer.

Not yet calculating all possible reasons for both general deceleration of the rate of rotation of the Earth and annual variation, let us estimate according to the laws of only spiral geometry the increase and decrease of the length of the Earth's days, depending on the distance to the Galactic Centre.

Using the law for the unit length [2], we'll find the growth of the unit length $\Delta\rho$

$$\Delta\rho = \frac{\rho^2}{L} \qquad (1)$$

where ρ is the conditional unit length, L is the distance between the Galactic Centre and the Earth (in the system of an outer observer).

The ratio of the growth of conditional unit length to the unit length must be equal to that of the growth of the conditional unit time to the unit time for the given point in the space, and these ratios will be equal to that of the unit length to the distance between the Galactic Centre and the Earth

$$\frac{\Delta\rho}{\rho} = \frac{\Delta t}{t} = \frac{\rho}{L} \qquad (2)$$

Hence, it follows that when we have the increase in the length of the day Δt for some stretch of time and know the way ρ the Earth have passed in that stretch of time, then, using the formula (2) we can with great accuracy determine the distance L between the Galactic Centre and the Earth before the latter's displacement

$$L = \frac{\rho \cdot t}{\Delta t} \qquad (3)$$

Since as a result of general motion the Earth approaches the Galactic Centre by $\rho = 3\ 10^{13}$ cm a year and the conditional unit time $t = 86400$ s and the mean increase in the length of the day $\Delta t = 0.001$ s [3], then the distance between the Galactic Centre and the Earth for the given period of time, from the point of view of an outer observer, will be $L = 2.592\ 10^{21}$ cm = 0.864 kpc.

It is natural that this distance is much larger for an inner observer and can even be equal to 8 kpc.

From 1955 on, when atomic time scale was introduced, it became possible to investigate variations in the rate of rotation of the Earth which was discovered still in the beginning of the century. Up to now there is no comprehensive description for the sources of variation in the rate of rotation of the Earth. For more details in this field see refs.[4], [5], [6] according to which three types of variations in the length of the day can be pointed out.

Thus, using the recent rather accurate experimental results [3], we'll explain variations in the length of the day under the governing laws of spiral geometry of the space-time.

1. Secular Deceleration

The secular variation in the length of the day from 1963--1972 calculated by A. Stoyko [7], N. Sidorenkov [8] and L. Morrison [9] makes on the average 1.5 ms in a century. The discrepancy with the value deduced from solar eclipses (+2 ms in a century) L. Morrison explains by the decrease in the constant of gravitation, G.

Secular deceleration of rotation of the Earth from Darwin's times is mainly explained by tidal friction and was calculated by Taylor's method of geophysical data - the method of the tidal-wave-energy dissipation. However, using new cotidal maps of the Ocean, drawn by K. Bogdanov, N. Pariisky et al. [10], Pariisky et al. [11] obtained separate values for lunar and solar torques. According to estimations of these authors, the comparison of the result of the ocean tide effect with astronomical definitions of secular variation in the angular rate of rotation of the Earth indicates to the existence of a mechanism of acceleration of the Earth by 1.36 10^{-8}.

It follows from R. Newton's analysis of observations of ancient solar and lunar eclipses [12], that the effect of forces of tidal friction 1000 years ago was twice as higher as now. Many authors have suggested various hypotheses [6] for forces of non-tidal nature, e.g., such as: a) the Earth's core-mantle electromagnetic cohesion suggested by T.U. Yukutaki b) the hypothesis about the variation in the gravitation constant, suggested by Dicke, etc. If a planet with a hard core and without tidal friction is cinsidered, from the viewpoint of spiral geometry the secular deceleration of the planet (secular increase in the length of the day) can be explained only by the solar system's slow moving off the centre of geometry (the Galactic Centre), and the acceleration - by radial approaching.

For the Earth, the rotation of which is affected by both tidal friction and the liquid core, all the factors act in aggregate. And that is why, depending on the direction of motion of the solar system off the Galactic Centre, the variation in the length of the day will be different. For instance, one may prove that 1000 years ago the solar system radially moved in the direction off the Galactic Centre and hence, the total effect of deceleration of rotation was twice as higher as now. And the existence of the above mentioned mechanism [11] of the Earth's acceleration by 1.36 10^{-8} is explained by the fact that together with tidal deceleration there is also an acceleration effect due to radial motion of the solar system to the Galactic Centre at the rate of $V_1 \approx 11.2$ km/s. And as it is known, the Sun itself moves relative to remote stars in the direction of $l'' = 57^\circ$ and $b'' = 22^\circ$ at the rate of $V = 19.5$ km/s, which radially makes $V_2 = 9.9$ km/s. As it is seen, there is good agreement between V_1 and V_2.

2. Irregular Variations

Irregular variations in the rate of rotation of the Earth (fig.1) take place at unequal intervals of time, are of different values and signs with no observable mechanism, and may exceed the tidal variations of angular rate of rotation of the Earth for a century. The mean characteristic value is assumed to be 0.1 ms/year. They are yet of unknown nature [4].

The most probable reasons for irregular variations, at present, are:

a) The processes taking place in the core of the Earth. But there arose serious difficulties both when explaining the nature of variations during the last two centuries and when estimating the energy of core-crust interaction.

b) Mechanical and electromagnetic interactions on the core-mantle interface.

c) Long-period variations and drift of the geomagnetic field to the west.

d) Eddy in the core, convection current of matter in the mantle.

e) Variations in the inertia moment due to processes of recrystallization of rocks under the Earth's crust.

f) Atmospheric currents and irregular tidal effects.

g) Horizontal flow of masses of water in the atmosphere (evaporation and rainfalls).

h) In recent years the hypothesis on the solar origin of irregular variations in the length of the day was more frequently appealed to [5], trying to connect these phenomena with variations in the activity of the Sun.

The abrupt variations in the rate of rotation of the Earth, indicated still by W. Munk and G. Macdonald [4], also are points at issue.

From the viewpoint of the spiral-geometric model of the space-time, the irregular variations can be interpreted to be the result of the Sun's irregular revolution around the Galactic Centre. The Sun and most of the surrounding stars revolve around the Galactic Centre at the rate of about 250 km/s. If assumed, that the Sun's orbit is not an ideal circle, but has quite irregular small deviations, then just these deviations will manifest themselves as irregular variations.

Studying the irregular variations in the length of the Earth's day (fig.1), one can affirm that from 1850-1985 there was a radial component in the Sun's revolution around the Galactic Centre, which was less than ± 9 km/s.

3. Seasonal Variations

The characteristic rate of these variations is 1 ms/year, the minimal value of which falls within July 20-28.

The following are suggested as reasons for these variations:

a) redistribution of rainfalls (now rejected),

b) the annual variations in the direction and rate of winds,

c) the "tidal" effect of the Earth's core (further its contribution *was shown to be insignificant*),

d) the contribution of other factors (variations in vegetation, amount of subsoil waters, etc.,

e) Dicke's hypothesis on variations in the constant of gravitation (it gives rise to doubt after the experimental results obtained by Shapiro).

Thus, only an atmospheric phenomenon - the effect of zonal winds on the surface of the Earth is now thought of as possible and the main reason for seasonal variations. But, proceeding from the fact that it is practically impossible to describe and evaluate the effect of atmospheric motion on the surface of the Earth, the given description is particularly of a qualitative character. As W. Munk and G. Macdonald have mentioned, "Thus, the problem of annual variations in the length of the day is not definitively solved" [4].

And now let us consider that problem from the point of view of the spiral-geometric model.

As the Earth periodically approaches and moves off from the Galactic Centre, owing to its annual rotation, by 2 a.u., the dependence of the length of the day on the Earth's position will be expressed in terms of the expression (2)

$$\Delta t = \frac{\rho \cdot t}{L}$$

where Δt is the difference between the length of days; ρ is the displacement - a conventional unit time (length of the day); L is the distance between the Earth and the Galactic Centre before displacement (relative to the outer observer's system).

Let us examine the projection of the motion of the Earth on the straight line the Galactic Centre-the Sun, assuming for the time being that the orbit of the Earth is a circle and the straight line the Galactic Centre-the Sun has no radial displacement relative to the centre of the Galaxy. It will read (1 - cos φ), the curve of which is plotted in fig.2 (curve 2). As reference point is taken the remotest one on the orbit. That is the reason why the minimum on the curve falls within the middle of the year. But in reality, due to the fact that the 1st of January does not correspond to the remotest point, the minimum fits approximately to the 23rd of July.

But, taking into account that the Sun itself can be radially moving, the total motion will look like that shown in fig.2 - curve 1 - the Sun departs at the rate of $V = 3$ km/s, curve 3 - the Sun approaches at the rate of $V = -3$ km/s. As it is seen from fig.2, in the first case the minimum of the curve is shifted to the left for several days, and in the second case it is shifted to the right for the same number of days. It is natural that the shift of the minimum depends on the mean rate of radial motion of the Sun. When the Sun during a year (the turning year or the turning point) changes the direction of its radial motion, the minimum of the curve is not shifted. Only half medium of the curve will be changed -

- it will either widen or become narrower depending on the direction of passing through the turning point. Thus, if all the above mentioned reasons for variations in the length of the day are ignored, then, according to the given approach, the distributions of annual variations in the length of the day for each year will look like the curves shown, and must fit with each other within ± 5-10 days. However, all the reasons mentioned above, which contribute into the variations in the length of the day by about 30% and which are by their nature irregular phenomena even during a year (meteorologic changes, atmospheric flows, winds, etc.) do not coincide with each other year after year. Then the total contribution will manifest itself as harmonics imposed on the distribution curves of the main periodical motion of the Earth and of the irregular motion of the Sun. However, as the contribution of other possible reasons makes from 20 to 40% of the value due to the motions, then, as seen from fig.3 where the leveled distributions of variations in the length of the day for different years are compared, the central parts of the curves and their minima have fitted quite well. But the ends of the curves are irregularly shifted because of different directions of motion of the Sun and different summary harmonics.

Let us separately consider the distribution for different years using the results of rather reliable measurements which are represented as averages for each 5-day period, the accuracy being 0.05 ms, and which are published in annual bulletins [3]. (The accuracy of atomic time scale at the sea level is 10^{-12} s).

For an example let us consider the distribution of daily variations in 1985 (fig.4a), where each point indicates five days and the reference point is taken to be the 1st of January, the variations in time are expressed in milliseconds.

On the same scale there is shown the average annual distribution of the length of the day which results from the joint motion of the Earth and the Sun (fig.4b, bottom curve), according to which one can affirm that 1987 is the turning point of the Sun's radial motion, i.e. in the next year it will either change the direction of its motion or retain its radial distance to the centre of the Galaxy. The other curve (fig.4, top) shows the contribution of various causes independent on the motion. It is obtained by the deduction of curves a) and b), fig.4 . As to the results of 1983 (fig.5), one can state that the Sun moved in the direction to the Galactic Centre at an average radial rate of $V \approx -8$ km/s, and the distribution minimum fell within the 3rd of August. In 1981 (fig.6) $V \approx -4$ km/s and the minimum coincided with the 26th of July. In 1980 (fig.7) $V \approx 0$, minimum - the 22nd of July. In 1979 (fig.8) $V \approx -6$ km/s, minimum - the 20th of July. But, when in 1977 $V \approx +2$ km/s, the minimum coincided with the 20th of July (fig.10).

Imposition of harmonics corresponding to the seven years mentioned above (fig.11), shows that the factors not caused by the motion of the Earth (zonal winds, redistribution of rainfalls, etc.) do not coincide for different years.

In fig.12 the "seasonal" variations in the length of the day are shown from 1967 to 1985. The bottom curve shows the

the total variation in the length of the day, each point standing for a 5-day period [3]. The upper curve is the mean value of the level of seasonal variations caused by the motion of the solar system, and also by tidal and other effects.

For final confirmation of the viewpoint suggested, it is proposed to determine by analogous measurements the annual variations in the rotation period of other planets or, which is more desireable, of their satellites. According to this model we must expect variations in the sidereal equatorial periods of rotation of planets and their satellites. Their minima of annual (seasonal) variations must coincide with that of the Earth (the day of the shortest distance to the Galactic Centre). The factor due to the total motion of the solar system will have similar effect on other planets too, while the other effects which are due to a liquid core or the atmosphere of a planet will show up in their own way. But for the satellites of a planet which have no liquid cores and atmospheres, and especially when they are of small sizes, the variations in the period of rotation will be caused only by their revolution around the Sun, and occasional ones - due to irregular radial motion of the Sun to the Galactic Centre. Thus, in accordance with the expression (4) we may expect the following annual variations in the period of rotation of the planets and their satellites: for Mars - 1.56 ms; Phobos - 0.5 ms; Deimos -1.9ms; Jupiter - 2.15 ms; satellites of Jupiter: IV - 87 ms, IX - 3.9 ms; Neptune 10 ms; Mercury - 34.7 ms, etc. Such high-precision measurements are now possible and actual, since the existence of such data, their comparative analysis with those of variations in the length of the Earth's days will provide new chances for more precise calculation of a series of values which was a difficult task to do earlier.

It is quite interesting that in favour of this model speaks also the fact [13] that there is observed a dependence of the rotation rate of globular clusters on the distance to the Galactic Centre.

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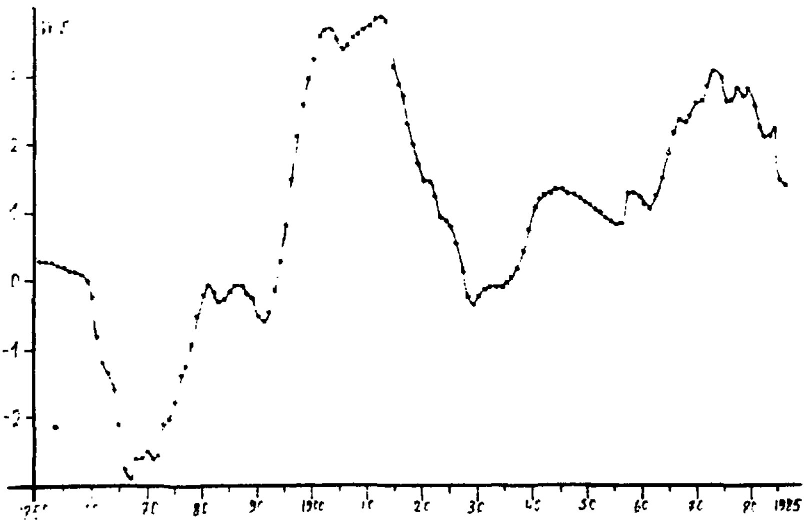

Fig. 1

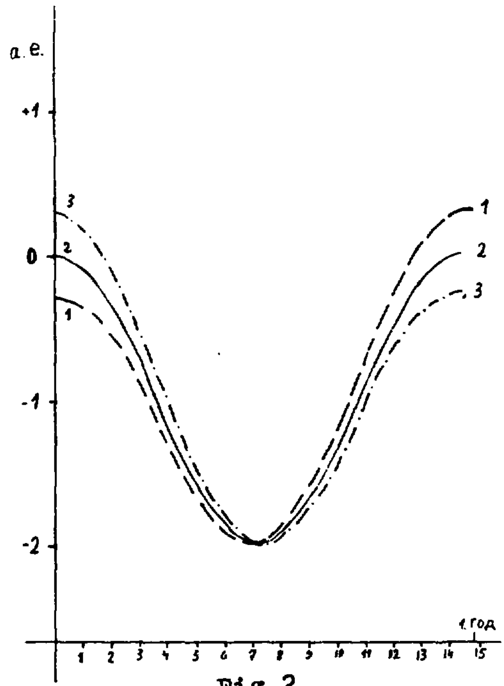

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Fig.2

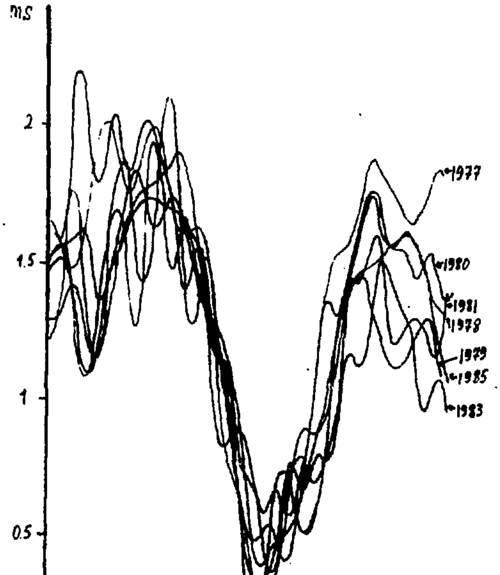

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Fig.3

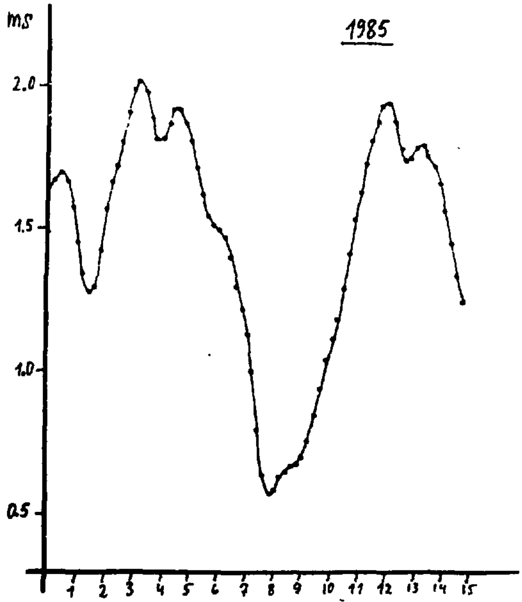
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Fig.4a

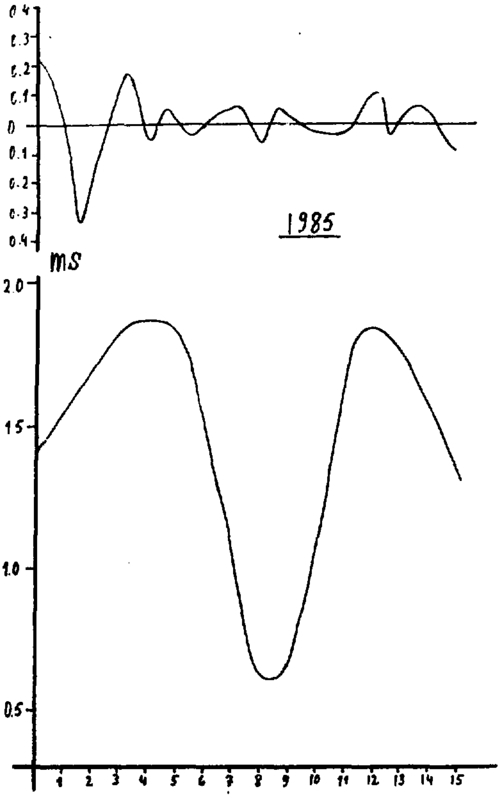
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Fig.4b

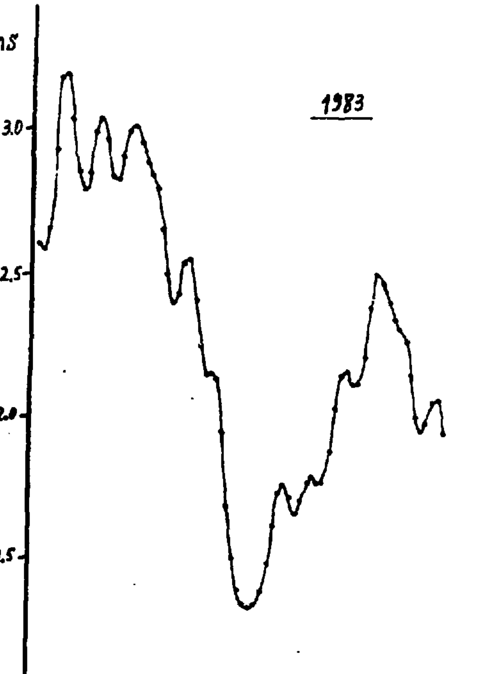
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Fig.5a

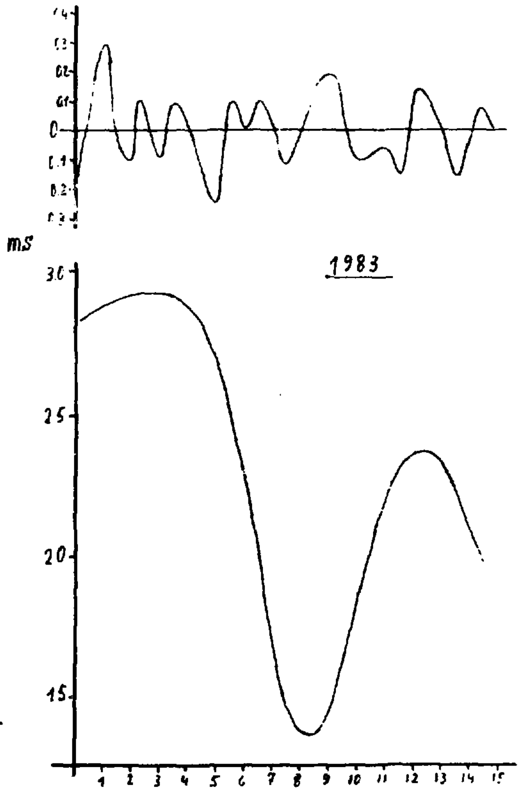
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Fig.5b

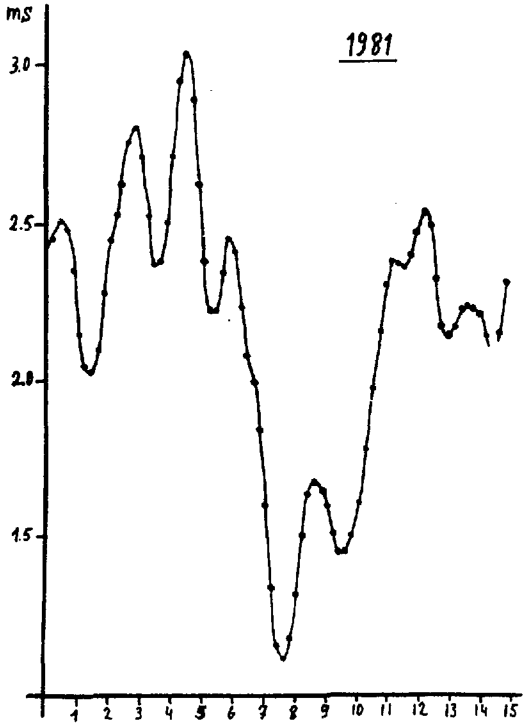

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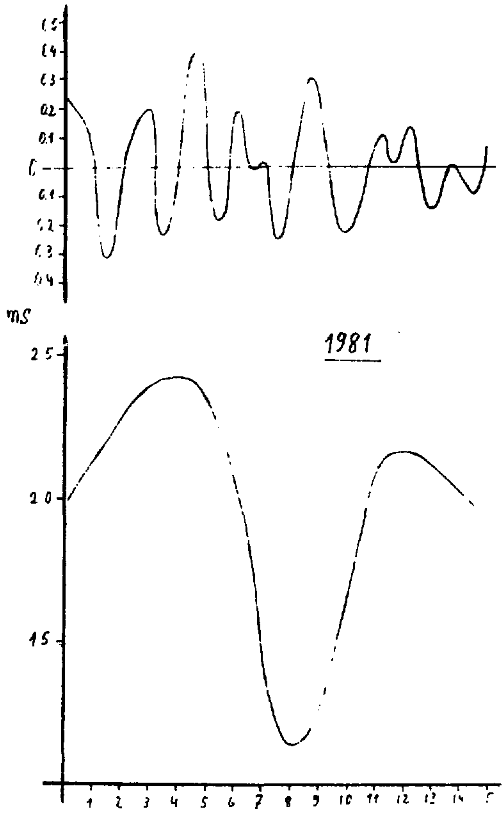
Fig.6a



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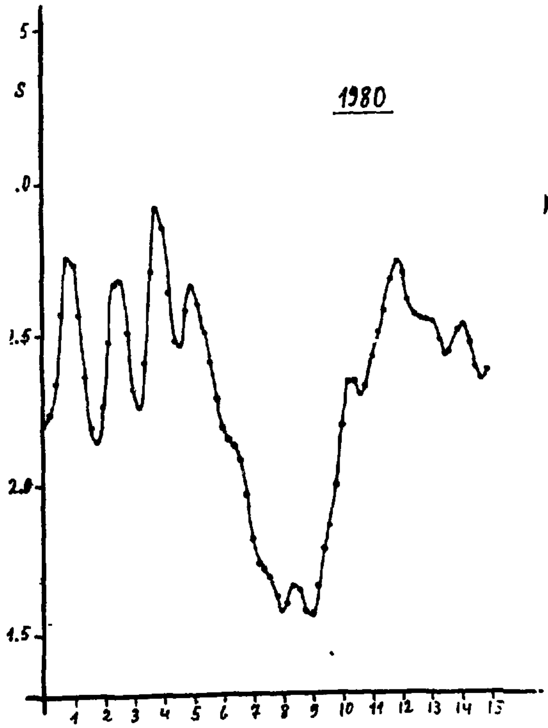
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Fig.7a

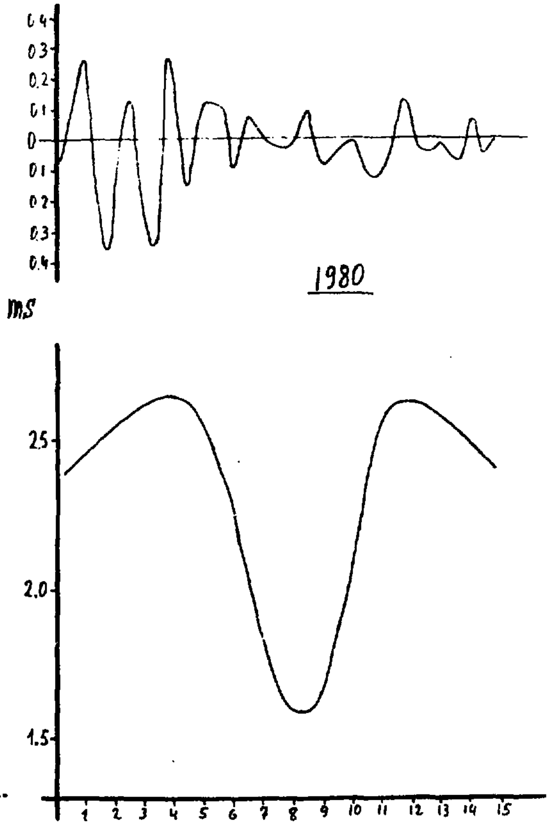

0.4
0.3
0.2
0.1
0
0.1
0.2
0.3
0.4
1980
mS
2.5
2.0
1.5
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15

Fig.7b

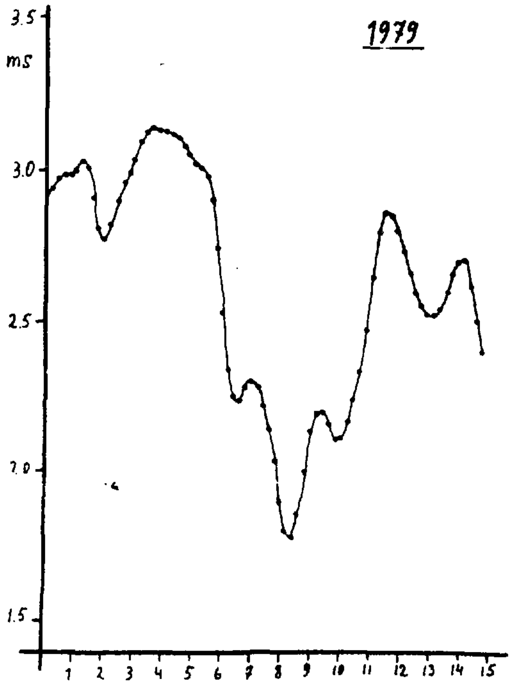

1979
ms
3.5
3.0
2.5
2.0
1.5
1 2 3 4 5 6 7 8 9 10 11 12 13 14 15

Fig.8a

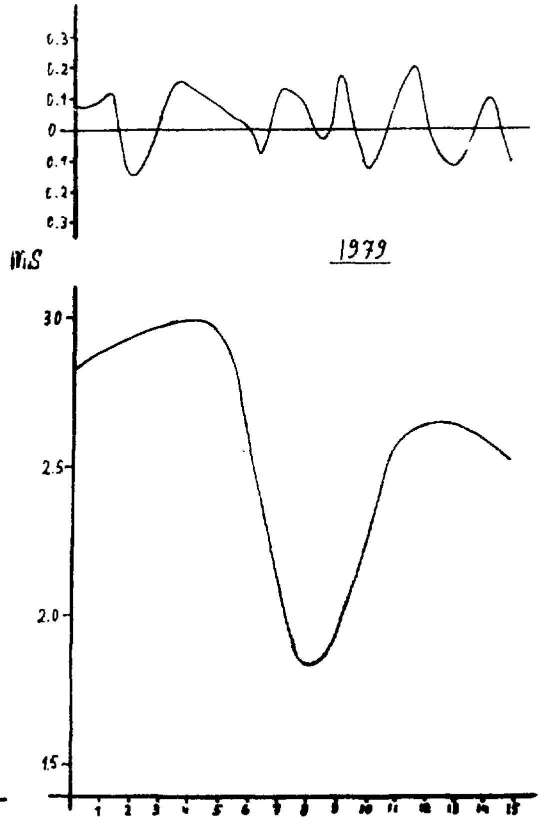
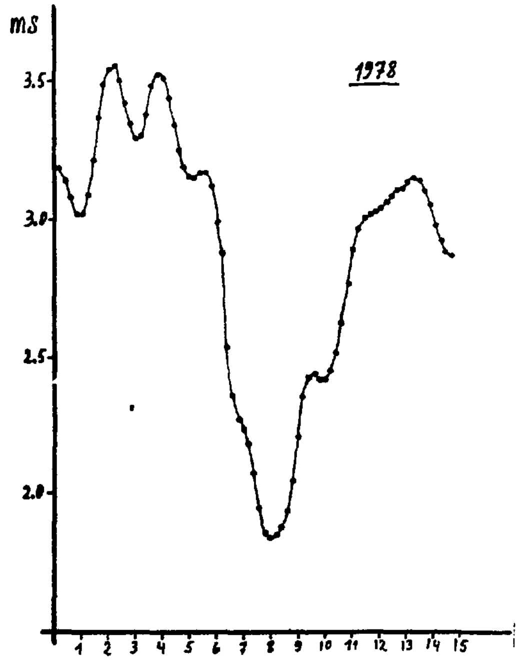
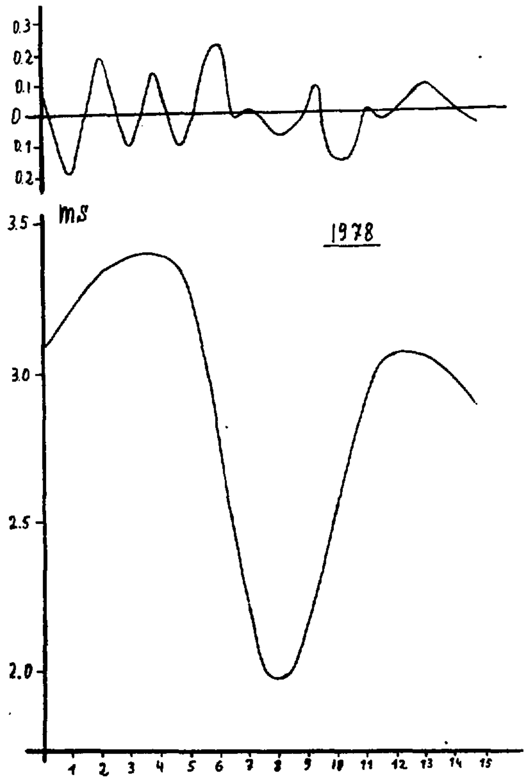

0.3
0.2
0.1
0
1979
ms
3.0
2.5
2.0
1.5

Fig.8b


ms
1978
3.5
3.0
2.5
2.0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
Fig.9a


0.3
0.2
0.1
0
0.1
0.2
3.5
ms
1978
3.0
2.5
2.0
1
2
3
4
5
6
7
8
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11
12
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14
15
Fig.9b

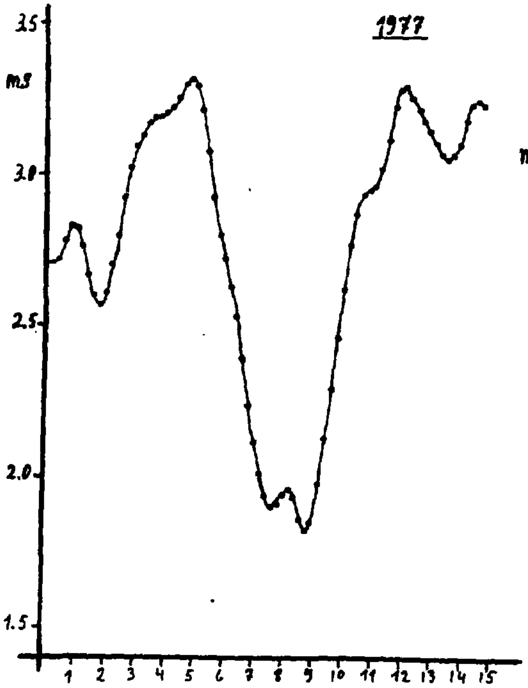

Fig.10a

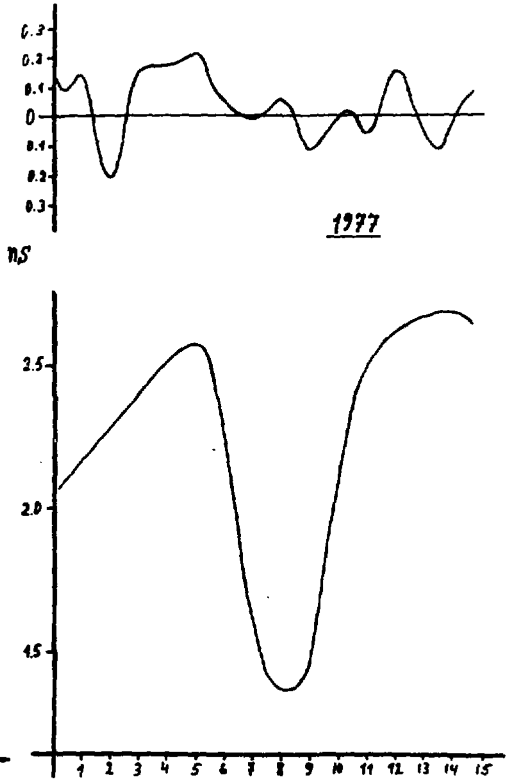

Fig.10b

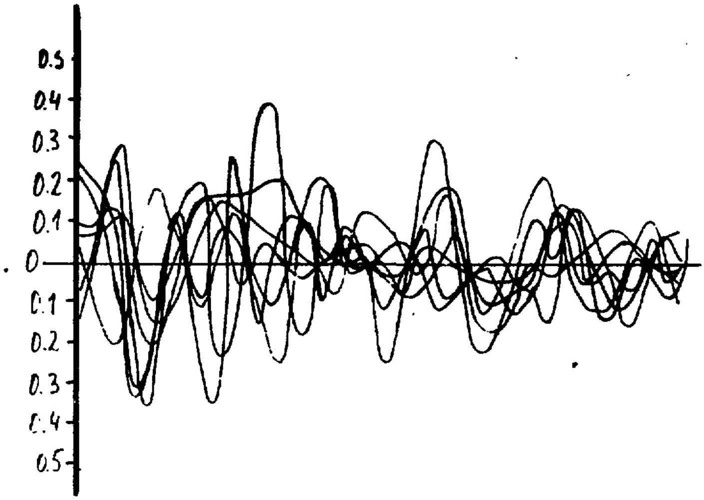

Fig.11

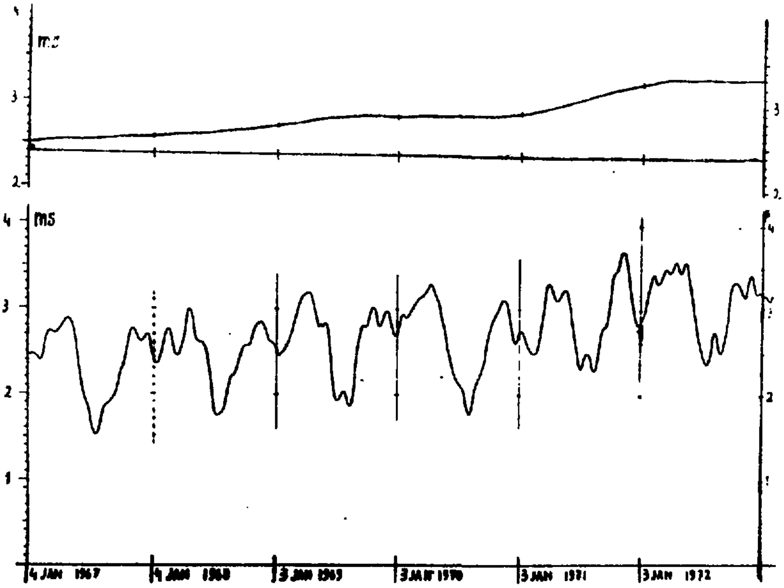

Fig.12a

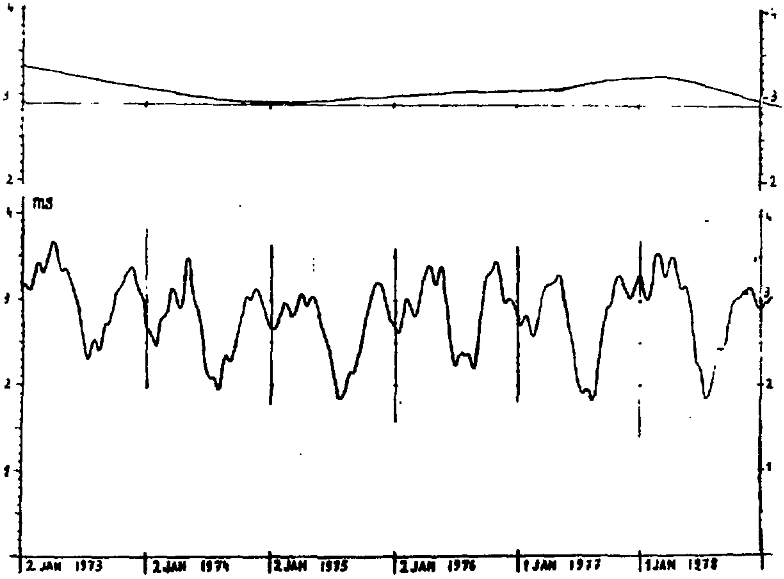

Fig. 12b

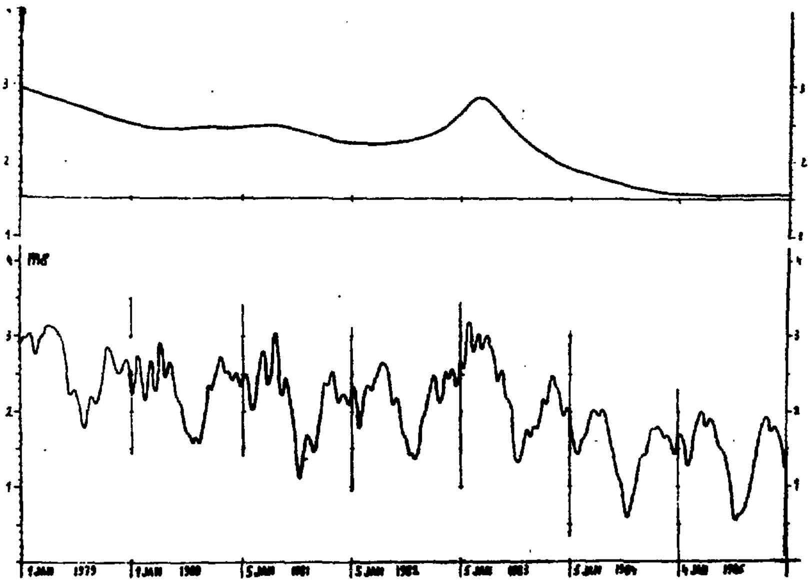

Fig. 12c

FIGURE CAPTIONS

Fig.1 Variations in the length of the day from 1850-1985.

Fig.2 Projection on the straight line the Sun-the Galactic Centre of the total annual motion of the Earth and the Sun. The curve 2 shows the case when the Sun is stationary relative to the Galactic Centre. The curves 1 and 3 correspondingly show the cases when the Sun departs from and approaches the Galactic Centre at a rate of 3 km/s.

Fig.3 The leveled annual variations corresponding to different years.

Fig.4 Annual variations in 1985. Each point corresponds to a 5-day period in milliseconds. The accuracy of the measurement is ±0.5 ms (curve a). Curve b, bottom: annual variations due to the total motion of the Earth and the Sun, and due to the tidal friction of the Moon. Curve b, top: the total harmonics caused by "other" factors.

Fig.5 Annual variation in the length of the day in 1983.

Fig.6 Annual variation in the length of the day in 1981.

Fig.7 Annual variation in the length of the day in 1980.

Fig.8 Annual variation in the length of the day in 1979.

Fig.9 Annual variation in the length of the day in 1978.

Fig.10 Annual variation in the length of the day in 1977.

Fig.11 Imposition of harmonics corresponding to the seven years mentioned in figs.5-10.

Fig.12 Variations in the length of the day according to 5-day data [3] a) from 1967 to 1972; b) from 1973 to 1978 and c) from 1979 to 1985.

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С.Р.ШАХАЗИЗЯН

ЦЕНТРОСОДЕРЖАЩАЯ СПИРАЛЬНО-ГЕОМЕТРИЧЕСКАЯ СТРУКТУРА ПРОСТРАНСТВА-ВРЕМЕНИ И НЕРЕЛЯТИВИСТСКАЯ ОТНОСИТЕЛЬНОСТЬ ЕДИНИЦЫ ВРЕМЕНИ

(на английском языке, перевод Г.А.Папяна)

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