

Electric Pendulum Sensor (Experimental Identification of Pendulum at Rest)

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ABSTRACT

Background: Science works according to the scheme: hypothesis-prediction-deny-reject the hypothesis. The rejection of the hypothesis is based on direct observation data, respectively, experiment. In the case of experiments with the pendulum, an association is made between different astronomical events that take place during (around) the experiment (conjunction, eclipse, opposition, etc.) and the unexpected results, namely: the eclipse effect, the moon-solar effect, the Syzygy effect, etc. We built experiments in the period around (duration) of some astronomical events and following the analysis of the collected data, unexpected results (anomalies) were highlighted. The systemic analysis of the results of the experiments highlighted three interacting subsystems as parts of a complex system that will facilitate the experimental identification of the pendulum. Objectives: Identifying the structure, organization and non-gravitational functions of the pendulum in rest. **Method(s):** Experimental identification. c) **Results:** Structure, organization and non-gravitational functions of the pendulum in rest. **Conclusion:** The pendulum in rest fulfills the conditions of a non-gravitational sensor (electric, magnetic, electromagnetic, etc.).

Keywords: pendulum, experiment, effect/anomaly, identification, paradigm, RLC, perturbation.

INTRODUCTION

The research of the transformation of the matter in the Universe is based on direct and indirect observation programs (experiment). The objectives of the indirect observation programs are usually achieved with the help of a "test body". The design, collection of observation data as well as the analysis of the test results are based on the interaction paradigm of the test body in accordance with the purpose and objectives of the experiment. A pendulum through its structure, organization and functions processes various signals, carriers of information. The information related to the experiment is complex and is established, collected and analyzed according to the design (construction) paradigm of the experiment. In physics, a physical system capable of vibrating when it is removed from its equilibrium position is called an oscillator. Such physical systems are frequently used in indirect observation (experiment), namely: in mechanics (mechanical oscillator), in electricity (series RLC circuit), in solid state physics (vibration of an atom in the crystalline network) [1-3,9-10 11-17, 19-22]. For a "test

body", any signal, other than the useful signal (expected according to the paradigm) represents an anomaly. As a rule, such a signal indicates that not all the information processed by the test body is found as part of the paradigm of construction, data collection and analysis of the experiment results. The pendulum being a physical system is a causal system. The analysis of a system is carried out with the help of models deduced and verified through successive experimental tests. It is required that, starting from the observations on the mechanical oscillator system, a new model should be identified based on which new experiments can be designed that can confirm or deny the model. No model, however simple or sophisticated, is valid unless its predictions are consistent with direct, retrospective, indirect (experimental) observational data. From this point of view, observations and experimental trials are fundamental in the field of natural and technical sciences. The first stage of identifying the structure, organization and functions refers to the knowledge acquired by the experimenter through the physical understanding of the examined process. The purpose of completing this stage is to outline a structure of the model, which simplifies the identification algorithm. A priori information is the basis for establishing objectives, goals, experiment design strategy, data collection, analysis of results and validation of the identified model. The less a priori information there is, the greater the risk of failure in obtaining a usable model. The a priori information, supplemented with the information obtained on the basis of own experiments, allows the adoption of a certain structure for the model that facilitates the identification.

The Newtonian-Keplerian Construction Paradigm of The Pendulum Experiment

The design of the experiments, the collection of data and the interpretation of the data of direct and indirect observation, respectively, are done, as a rule, in relation to the recognized specific scientific hypotheses. Within the scheme of the solar system (mathematical model) proposed by Kepler, Newton considers centrifugal forces as the effect of Earth's rotation in free space. Since in this hypothesis the centrifugal force is identified with the force of gravity, namely:

$F_{cf} = \frac{mv^2}{R} = G$, and $v = R\omega = R \frac{2\pi}{T}$ the result is $G = ct \cdot \frac{m}{R^2}$ and $g = \frac{ct}{R^2}$, where v and T are speed, the period respectively of rotation of a planet around the Sun, R is the radius of the trajectory (approximated with a circumference) and g is the gravitational acceleration [20].

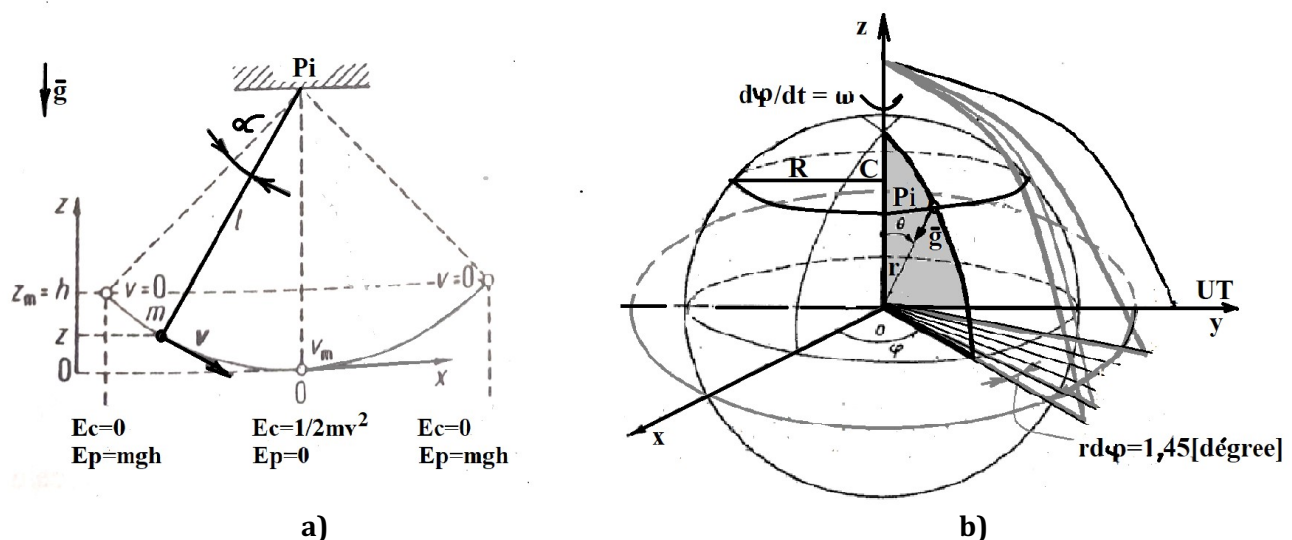


Figure 1. a) The pendulum in oscillation; b) Experiment construction paradigm

Each characteristic of the movement (distance from the equilibrium position - angle α , speed v ,) is repeated, approximately exactly after an oscillation duration T (period). According to the Newtonian model, a material point m moves relative to a reference system that is in accelerated motion under the influence of a force F with relative acceleration, a_{rel} . According to Newton's second axiom, $F = m \cdot a_{rel}$ results:

$$m \mathbf{a}_{rel} = \mathbf{F} + [-m \mathbf{a}_A - m \dot{\boldsymbol{\omega}} \times \boldsymbol{\rho} - m \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \boldsymbol{\rho}) - 2m \boldsymbol{\omega} \times \mathbf{v}_{rel}] \quad (1)$$

where: $-m \boldsymbol{\omega} \times (\boldsymbol{\omega} \times \boldsymbol{\rho}) = -m (\boldsymbol{\omega} \cdot \boldsymbol{\rho}) \boldsymbol{\omega} + m \omega^2 \boldsymbol{\rho}$ - centrifugal force and $-2m \boldsymbol{\omega} \times \mathbf{v}_{rel}$ - Coriolis force and, $\mathbf{v}_{rel}$ - relative speed.[1].

In the conditions in which a pendulum (mass m , length l , suspended at point P_i moves relative to the plane (and in the plane) of the disk that rotates with $\omega = \text{const.}$ around C , results: the acceleration of the disk $\mathbf{a}_A = 0$, the acceleration angular $\dot{\omega} = 0$ and $\boldsymbol{\omega} \cdot \boldsymbol{\rho} = 0$. For launch angles of the pendulum $\alpha \ll l$, the Coriolis force has the module $m \omega^2 (R + l)$ with related components. In the hypothesis of neglecting the weight of the mass m , then in equation (1) F represents the force (tension) in the pendulum wire. The relative acceleration $\mathbf{a}_{rel}$ has the tangential component $l \ddot{\alpha}$. From the equality of the moments in both terms of relation (1) written in relation to the suspension point P_i , the oscillation equation of the pendulum mass (concentrated in a material point m) results in the form:

$$m l^2 \ddot{\alpha} = m \omega^2 [- (R + l) l \alpha + l^2 \varphi]$$

or

$$\ddot{\alpha} = \omega_0^2 \alpha \quad \omega_0 = \omega \sqrt{R/l} \quad [1] \quad (2)$$

with its own pulsation, $\omega_0 = \omega \sqrt{R/l}$ [1], Figure 1 a, b.

Data Collection and Analysis of Measurement Results

The establishment of the data that is collected (processed) as well as the interpretation of the measurement results are based on the Newtonian paradigm of the pendulum experiment. To solve equation (2), methods are used to approximate the oscillation parameters in a single plane of the pendulum under the conditions in which the pendulum is considered a conservative system. For example, the method of small oscillations uses the development in Taylor series of the potential energy equation of the pendulum $E_p = mgz$ around the equilibrium position 0 to approximate the oscillations. Through this development, $z \approx x^2 / (2l)$ is obtained (the second-order term of the Taylor series) and then, from $E_p = mgz$, it results

$$E_p \approx \frac{mgx^2}{2l} \quad (3)$$

namely, a non-linear (parabolic) dependence ($\sim x^2$) of the potential energy of the horizontal elongation pendulum, x (generalized coordinate, $q = x$), fig. 1.a. The simple pendulum is considered a typical example of a harmonic oscillator because it oscillates not too far from the equilibrium position. If the equation (2) of type $(\ddot{q} + g(q, \dot{q})) = 0$ cannot be associated with the energy conservation theorem, then it means that there is a damping due to q' or an excitation

or a combination of the two. In this case $\ddot{q} + g(q, \dot{q}) = 0$ is approximated with an equation of the form

$$\ddot{q} + g(q, \dot{q}) + \epsilon f(q, \dot{q}) = 0 \quad (4)$$

where, ϵ - small dimensionless parameter that can be introduced artificially. The solutions of the associated equation (4) show that the non-linear effects on the mechanical pendulum manifest themselves twice, namely: a) the anharmonicity of the potential generates additional harmonics and, b) the non-isochronism of the oscillations for not very weak amplitude (A. Gibaud, A. and Gibaud. H., *Etude des effets non linéaires observés sur les oscillations d'un pendule simple*, 1999) [1,14]. The methods of approximating the oscillations, through the mathematical formalism used, belong to the category of geometrical-mathematical formalisms used over time to save the models recognized at a given moment (the geometric artifices of the geocentric model of Ptolemy versus, the heliocentric model Aristarch's, and others related to the formalisms of modern theories of gravity). Thus, by approximating solutions, the "anomalies" are eliminated and the model is saved through these mathematical artifices. On the other hand, some researchers analyze the measurement results using different "effects" recognized in science. Maurice Allais considered that the rotation of the major axis A of the precession ellipse by an angle (azimuth) φ with respect to the direction Y (the direction of the launch of the pendulum mass) is caused by the Airy effect and the Coriolis effect, namely

$$\Omega = \frac{d\varphi_{\text{Airy}}}{dt} + \frac{d\varphi_{\text{Cor}}}{dt} = \mp p(1 - a^2/16l^2) \cdot \frac{3}{8} \cdot \frac{A}{l} \cdot \frac{a}{l} - \omega_{\text{Earth}} \cdot \sin(L) \quad (5)$$

where, ω_{Earth} -rotation speed of the terrestrial globe, L- latitude of the place of the pendulum, fig.3a. Considering some constructive changes (for suspension, short length of the rod, high density of the grain mass) of the paraconical pendulum, it was considered that the rotations of the major axis A of the precession ellipse can be attributed only to the Coriolis effect (for mechanical reasons, without a thorough scientific justification). According to M. Allais, under these conditions, the angular speed of the major axis A is calculated with the relation, namely:

$$\omega = d\varphi/dt \approx \omega_{\text{Cor}} \approx - \omega_{\text{Earth}} \sin(L) \quad (6)$$

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$$\omega = d\varphi/dt \approx \omega_{\text{Cor}} \approx - \omega_{\text{Earth}} \sin(L) \quad (7)$$

It was appreciated that the rotations of the paraconical pendulum highlight (especially around/during the eclipse) an angular velocity of the plane of oscillation of the pendulum ω much higher than relation (5) anticipates, namely:

$$\omega = \omega_{\text{Cor}} + \omega_{\text{Allais}} = - \omega_{\text{Earth}} \cdot \sin(L) \pm k \sin[2(\chi - \varphi)] \quad (8)$$

where χ - axis on the south direction S_x of the rectangular coordinate system related to the Earth of the suspension point of the pendulum S_{XYZ} , φ - latitude, Figure. 2a.

According to M. Allais, the increase in angular velocity, $\omega_{\text{Allais}} = \pm k \sin [2 (\chi - \varphi)]$, would be due to the "eclipse effect", without specifying the nature of k (the disturbance). To explain the variable values of the measured azimuth Maurice Allais appeals to the following effects: the Foucault effect, a return effect due to suspension, the random influence of the spherical ball and a periodic influence ["Doit-on reconsiderer les lois de la gravitation?", Perspectives X, 1958]. Pendulum disturbances are more obvious if the experiment takes place around or during astronomical events. These unexpected results (anomalies) are often presented as custom "effects" that occur during astronomical events (eclipse effect, moon-solar effect, syzygy effect,...) [23, 25]. The specialized literature highlights contradictory results for experiments with the pendulum; some confirm the presence of "effects" other experiments deny them [17, 19]. It is surprising the great effort made to satisfactorily describe the experimental data based on the mechanical oscillator model and not to find new models, more appropriate and in agreement with the observational data [16]. Although they contain information with the highest physical consistency, most often, the unexpected results of pendulum measurements are not subject to a systematic analysis. The Van der Willigen judgment, "in experiments on the Foucault pendulum, at least in the experimental sphere people always stop precisely at the point that the real difficulties start." is as valid as ever.

Verification of the "Effects" of the Pendulum

The experiments carried out around (during) some astronomical events (Horodnicul de Jos/Suceava, Romania) respectively, abroad (Turkey, Malaysia...,) confirmed the presence of some "effects" in the dynamics of the pendulum [25-26]. Starting from 2018, experiments were also built in Voinesti /Iasi with the pendulum in the gravitational paradigm with the aim of verifying the "effects" highlighted in the literature, Figure 1.b. The paraconical pendulum (built and donated by Prof. Olenici, D.) has a length of 5.24 meters, a mass of 7 (seven) kilograms, the launch plane of the bob is close to the meridian (magnetic) plane of 80 degrees, the initial launch amplitude is 460 millimeters (angle of launch $\alpha = 5.2$ sexagesimal degrees). A series of the experiment has duration $S = 35$ minutes and 5 (five) measurement results at seven-minute intervals (R1-R5), $R_0 = 0$ being the reference value in processing the results. The final hour and minute of each 35-minute series are shown on the abscissa of the graph (universal time), and on the ordinate are shown the results of the azimuth measurements in sexagesimal degrees, Figure 2. The analysis of the measurement results (R1,...,R5) highlights the following, namely: a) the magnitude of the azimuth of the major axis of the precession ellipse in relation to the launch direction shows large variations during and around some astronomical events (begin, maximum and end of eclipse, the position in relation to the horizon line of the bodies on the celestial sphere in the area close to the ecliptic, transit, etc.); b) there is a correlation (in the universal type) between the variation of the magnitude of the azimuth and the rotation of the bodies on the celestial sphere in apparent movement from east to west with respect to the position of the meridian plane of the place of the experiment. c) changing the direction of the azimuth oscillation plane in relation to the launch plane, within a series and respectively, between series (09h51m, 14h10m, 17h21m..., fig 2b) during the experiment. It is also confirmed the variation of the oscillation period both during a series, as well as its variation throughout the duration of the experiment [19, 22].

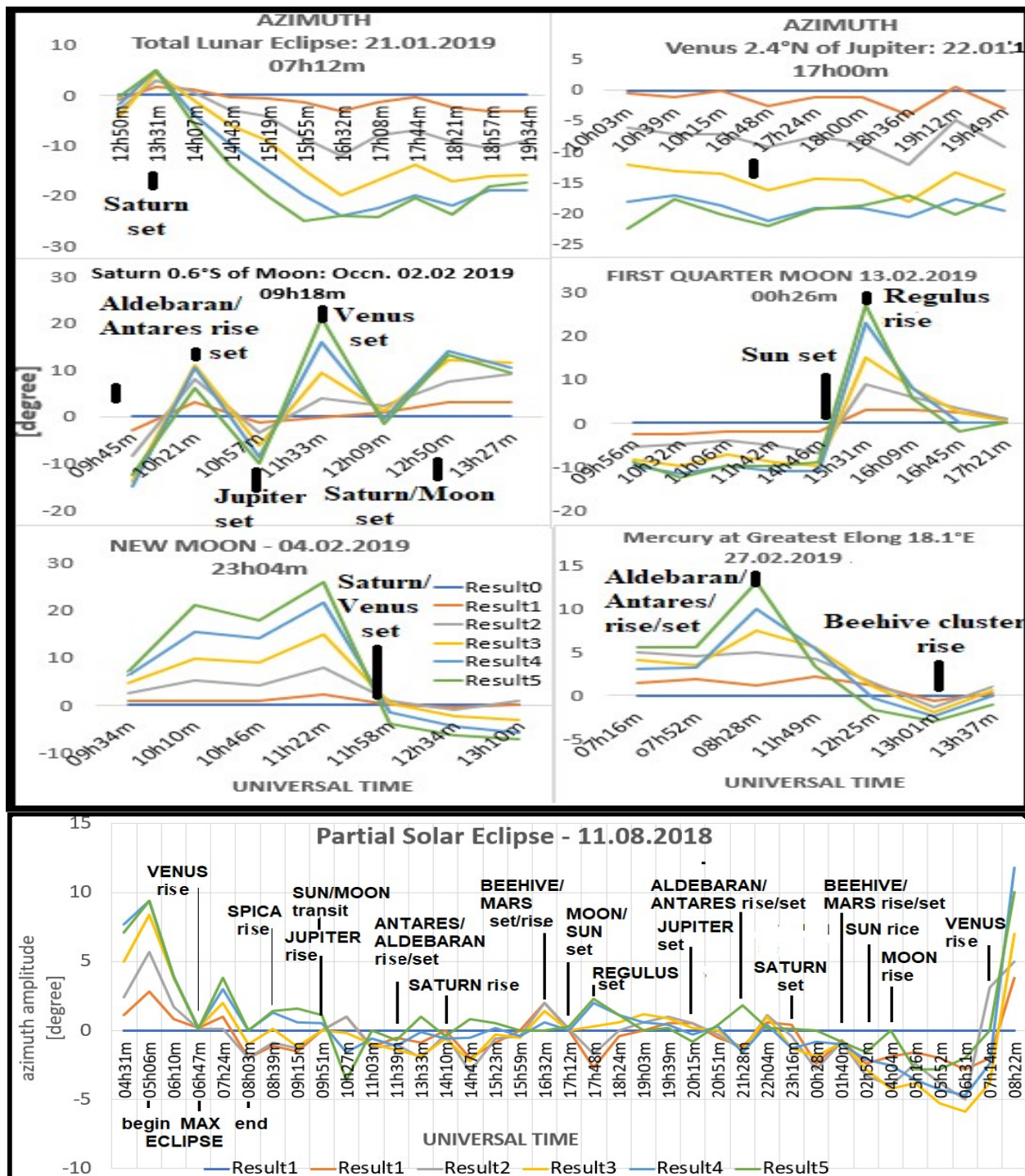


Fig. 2. Diagram with the variation of the azimuth and the position of the celestial bodies (Voinesti/Iasi, Romania location).

Considerations Regarding the Research of The Pendulum Model

Attempts to resolve the difference between the predictions of the theory of gravity and the observational data found in the use of the relationship (mathematical artifice $F = G(M + m)m/r^2$ instead of the law of gravitational attraction, $F = G(M + m)m/r^2$, either in experimental verifications for the power of r (Cavendish, J.C. Maxwell, Plimpton and Lawton, 1936 Williams,

Faller and Hill, 1971) The exponent 2 that intervenes in the relationship of the fundamental law of universal attraction was established by Newton by appealing to Kepler's third law $T^2 R^3 = \text{ct.}$ (Based on a mathematical model, without physical consistency) [24]. Following the more precise repetition of Cavendish's experiment (who did not publish his results) -they established these limits between 2.00005 and 1.99995 (J.C. Maxwell). In 1971, Williams, Faller and Hill specified the limits 2.0000000000000003 and 1.9999999999999997, so that the correction of the exponent as well as of the Keplerian-Newtonian interaction model was abandoned. This first stage prior to identification (referring to the knowledge acquired by the experimenter through the physical understanding of the examined process) is not complete if it does not take into account the system versus model relationship. The pendulum being a physical (technical) system is a causal system. By system is meant a grouping of object species characterized by multiple connections with the outside and interactions between the component parts. From a practical point of view, natural systems and especially technical ones have practical utility if they possess the following properties: stability (returns to the equilibrium that preceded the disturbance), controllability (the phenomena that occur in the system are determined by large causes and can be observed by large effects), observability (the evolution of effect sizes is determined by the evolution of cause sizes), robustness (the property of preserving, within specified limits, a certain quality when its parameters/system or structure changes within admissible limits), adaptability (the property of to acquire new qualities through changes in the structure and parameters) and, identifiability (the property that allows, based on the quantities - causes and the quantities - effects, to determine the structure and parameters of the system). No theoretical model, however simple or sophisticated, is valid unless its predictions are consistent with observational data. The abundance of anomalies/"effects" in different areas of science reflects the early stage of its development or the fact that the respective research is not takes place at an interdisciplinary/transdisciplinary level. The mechanical oscillatory model is understood as a representation of the essential aspects of a system of masses in interaction with reversible, conservative (isolated) processes. The systemic analysis (summary) of the results of the respective own experiments, from the literature, leads us to the conclusion that the mechanical oscillator system does not (strictly) meet the conditions of observability, respectively, controllability during the experiment (if we refer only to these properties observed and claimed in the literature). The properties claimed as non-compliant are properties related to an open system. In mechanics, energy was defined as the capacity of a system to perform mechanical work. In a broader framework, philosophy considers energy as a quantitative measure of the movement of matter. Any physical system can also be investigated as a thermodynamic system. The energy of a thermodynamic system, such as that of the Earth, changes depending on the transfer of momentum, electric, magnetic, mass, entropic from/with the medium [5,11]. The analysis of a system is carried out with the help of analytically deduced models and verified by experimental tests.

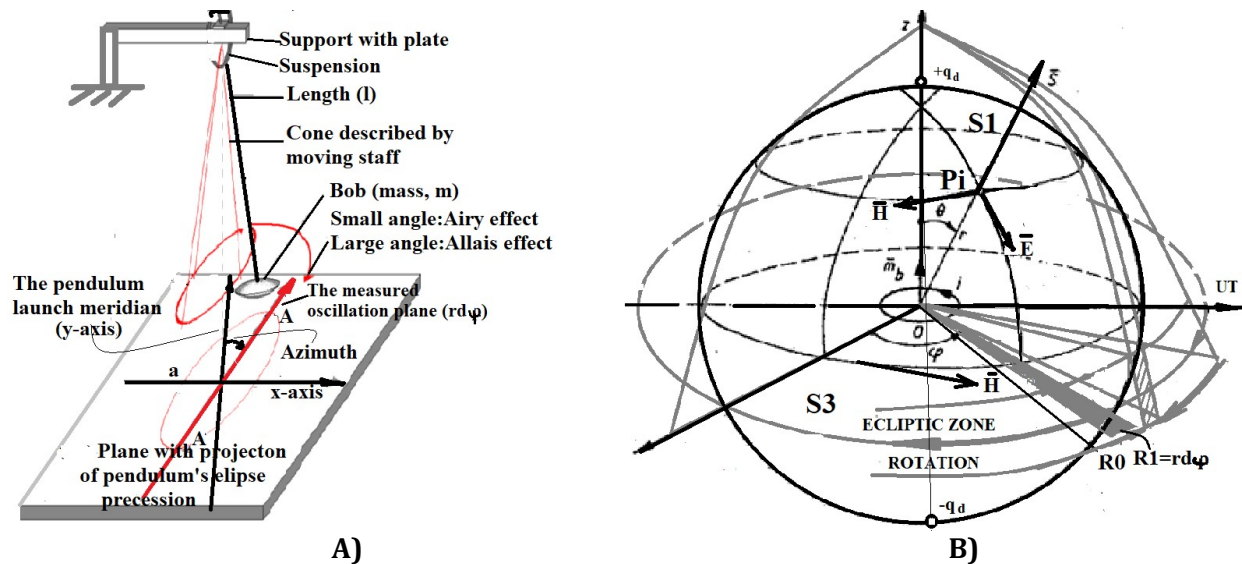


Figure 3. a) Scheme with the constructive and dynamic elements (precession ellipse) of the pendulum; b) Scheme with the pendulum subsystems (S1), with electromagnetic field parameters $\vec{H}$, $\vec{E}$ respective, the Poynting vector $\vec{S}$; the location of the experiment P_i (S2) characterized by the electrical parameters of the material, namely electrical conductivity σ , electrical permittivity ϵ and, respectively, magnetic permeability μ and, respectively, the disruptive mobile subsystem of the bodies (S3) that interact non-gravitationally with the Earth's dipole ($+q_d$, $-q_d$) respectively, the magnetic moment component of the Earth's electromagnetic field, $\vec{m}_b$.

The a priori information, supplemented with that obtained on the basis of own experiments, facilitates the process of experimental identification by adopting a certain complex structure for the physical pendulum, namely: pendulum subsystem S1, subsystem P_i (experiment area), disturbing subsystem S3 (celestial sphere) [5, 9, 10], Figure 3 a, b.

METHOD

The experimental method of identifying the physical complex pendulum system is used. The method allows the choice of a research strategy, namely: a) analysis and verification through own experiments of the "effects" highlighted in the specialized literature, (see, above, 1.3). b) the construction of experiments in the non-gravitational interaction paradigm that allows the precise definition of the complex open pendulum physical system (boundaries, inputs, outputs, variables, etc.) and a precise formulation of the problem of the observed non-gravitational anomalies. The main objective of the experimental method is to highlight the (non-gravitational) disturbances of **the pendulum at rest**. The purpose of the method is to identify the structure, organization and non-gravitational functions of the pendulum at rest.

EXPERIMENTAL IDENTIFICATION OF THE PENDULUM SYSTEM

In a second stage of identification, experiments were also built under the hypothesis of non-gravitational interaction of the pendulum in Voinești/Iasi - on eclipse days from 2021-1022, and in Horodnic/Suceava - on eclipse days from the fall of 2022 and from 05.05.2023. The objective of the experiments was to verify the hypothesis of the existence of a link (correlation) between the dynamics of the pendulum ("effects") and the non-gravitational situation of the

three subsystems of the complex pendulum based on a priori information [2, 7, 10, 12 – 14]. In synthesizing the interaction hypothesis above, it was considered that there is a common impedance Z (be it a simple section of conductor), a transfer impedance and a certain type of dipole as elements that also allow the conduction coupling of the complex pendulum physical system, Figure 2 a, b [10, 13, 18] .

The Modern (Non-Gravitational) Paradigm of Constructing the Experiment

Based on the brief considerations above, experiments were designed first in Voinesti/Iasi, then in Horodnic/Suceava in the paradigm of the presence of a common impedance Z between the "disturber" (celestial sphere), 1, and the "disturbed" (pendulum respective, P_i), Figure 4.

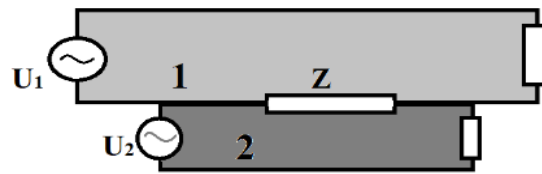


Figure. 4. Scheme of the conduction (galvanic) coupling between two circuits with common impedance

In the nongravitational coupling paradigm, a current

$$I = -d q/dt \quad (9)$$

created by the disturbance source (circuit 1) produces a voltage drop on the common impedance Z that overlaps the useful signal from circuit 2, constituting a disturbing element. The voltage drop produced by the current I (on the ohmic resistance R and the inductance L of the electric circuit) is calculated in the time domain, namely:

$$U(t) = R i(t) + L di(t)/dt \quad (10)$$

respectively, in the field of frequency according to the relationship

$$U(\omega) = I(\omega)Z(\omega) \quad (11)$$

where, $I(\omega)$ is the effective complex value of quantity i . In the case of comparable powers between the two circuits, the current in circuit 2 can in turn cause a disturbance in circuit 1, fig. 4.

Data Collection and Processing

According to Mach's principle, both data on the parameters of the precession ellipse and data related to the non-gravitational interaction of the pendulum were collected. According to the purpose of the work, only the results of non-gravitational measurements at rest pendulum are analyzed. Dielectric relaxation (dispersion) represents the dynamic response of matter to the application of an electric field E . For an RC series electric circuit it is convenient to use the information given by the impedance

$$I(\Omega) = V(\Omega) / Z(\Omega) \quad (12)$$

where $Z(\omega) = 1/Y(\omega)$ is the admittance.

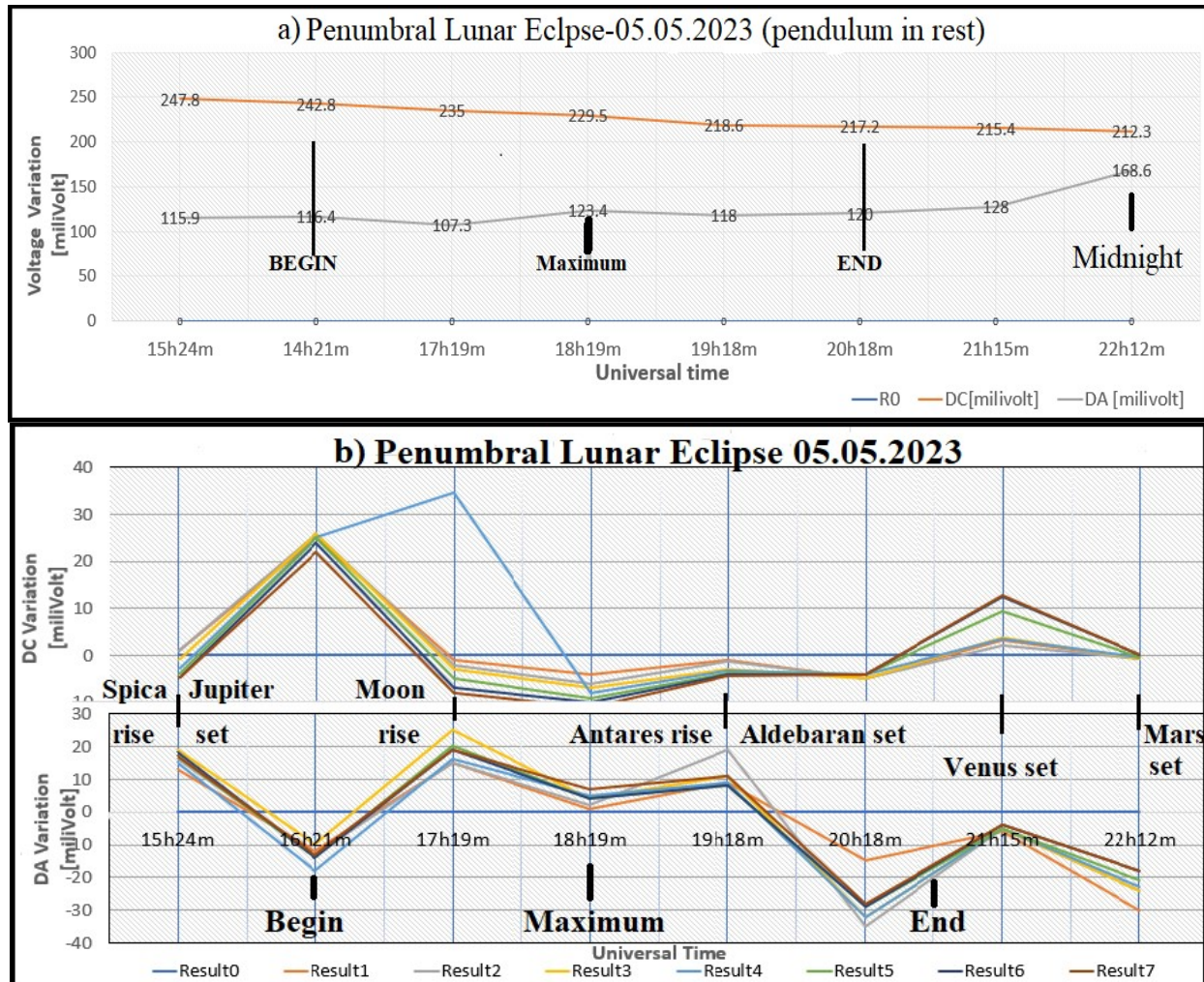
Consequently, additional data were collected regarding the non-gravitational interaction, namely; the direct current voltage, $U(t)$ and the alternating current (polarization) voltage $U(\omega)$. For the pendulum and their installation see: Confirmation of 24 h 50 min Lunar Periodicity, Apparently Inexplicable by Classical Factors, in Precession of Allais Pendulum, January 2022, *Journal of Modern Physics* 13(12):1598-1634, Appendix A. for more details. Digital multimeters connected to the computer were used for automatic voltage measurement (with the pendulum grounded). The experiment is composed of n series, each series with a duration of 49 minutes (Horodnic location experiment) respective, with a duration of 35 minutes (Voinesti location experiment). The results of the measurements of a series are averaged, successively at intervals of seven minutes (R_{m1} - R_{m7}). For each measured parameter, the difference between the averaged values of the series (R_{mi}) and the reference value, R_{ref} , is calculated, namely: $R_{mi} - R_{ref} = R_i$, $i = 1-7$, where $R_{ref} = R_0$ (electric voltage of the pendulum at rest at the beginning of the series). The processed results (R_1 - R_7) are represented on the ordinate of the diagrams, corresponding to the beginning of each series, in universal time. We present the average of the voltage measurements during one minute before the pendulum was launched into mechanical oscillation, namely the reference value of the experiment series R_0 , Figure 5. a. and Figure 6. The variation of the voltages, $R_{mi} - R_0$, during of the experiment (which are not the subject of analysis in this paper) also show in Figure 5. b. and Figure 7.

A New Results Analysis Paradigm

In relation to the purpose of the analysis, a certain reality can include various systems (mechanical, electromagnetic, chemical, etc.), correlated or not. Achieving the proposed goal for the system is achieved through the contribution of the human operator (as part of the environment) who works with the various components of the system. According to the hypothesis of the Newtonian theory of gravity, the centrifugal force is the result of the rotation of the Earth in an absolute (matter-free) space. In Newtonian mechanics, transformations are conservative, reversible, not allowing qualitative transformations of interacting bodies. According to the (hypothetical) structure of the proposed complex physical system, a new paradigm is needed to analyze the measurement results in accordance with the proposed purpose, namely: the identification of non-gravitational interactions. Mach considers that a place in the Universe is characterized by physical laws due to the interaction with all the matter (bodies) in the Universe. Maxwell, on the other hand, optimizes the physical consistency of Mach's paradigm by hypothesizing that the transmission of electromagnetic interactions would be due to stresses that are not related to deformations of the substance and that can propagate even in free space (in a vacuum). Completing Maxwell's equations written in scalar form with the equations of the laws of matter allow the complete determination of an "electromagnetic system". Mach's hypothesis has a physical consistency superior to the paradigm proposed by Newton, in that the physical laws of the place are not related only to mechanics, but are the result of all interactions with matter in the Universe. In the spirit of Maxwell-Mach's principle, the same effects observed in a body (physical system) can be explained both by the rotational movement of the body in relation to the stars of the entire universe (immovable celestial sphere), and by an overall movement of the celestial sphere in around the body (physical

system) considered immobile. The new paradigm analyzes the results in the first version (fixed terrestrial globe respectively, apparent rotation of the celestial sphere), Figure.3. b.

The analysis of the results is based on the Mach-Maxwell paradigm of interaction of bodies with all matter in the Universe, in particular with the position of bodies on the celestial sphere in diurnal movement from east to west, Figure 3. b.



Figures.5. The diagram with the results of the DC and DA voltage variation: a) pendulum at rest); b) pendulum in oscillation ((Horodnic/ Suceava, Romania location))

DC voltage variation analysis (pendulum at rest)

The voltage variation from the value of the series before the beginning of the eclipse $R_0=247.8$ [milliVolt] to the minimum at midnight respectively, $R_0=212.3$ [milliVolt] can be approximated as being linear. The measured alternating voltage indicates the presence of an oscillating electric circuit with elements of equivalent electrical structure type RC, RL respectively, RLC. A multiplication of the output voltage with the factor v_0 is observed, $U_E = v_0 U_D$ which indicates that the pendulum can be assimilated to a linear voltage amplifier (voltage source controlled by voltage) [1]. The analysis of the measurement results indicates that the variation of the voltage

in relation with the position of the celestial bodies during the experiment. There are big differences between R_0 , figure 5a and R_1 - R_7 , Figure 5b. The DC voltage at the beginning and end of the eclipse, respectively, the sunrise/set of the Moon/Sun, is highlighted. The variations show a minimum between the sunrise/set of the Moon/Sun and the end of the eclipse (and during the time when Antares and Aldebaran are on the horizon, which overlaps with the end of the eclipse), fig.5. b. As in the case of the pendulum at rest, the measurement results indicate that the oscillations of the electrical circuit are undamped (excited). This multiplication of the voltage is much more evident in a summary analysis of the results of the measurements during the experiments (the pendulum in mechanical and electrical oscillation) from the year 2022 (Voineti location), Figure 7.

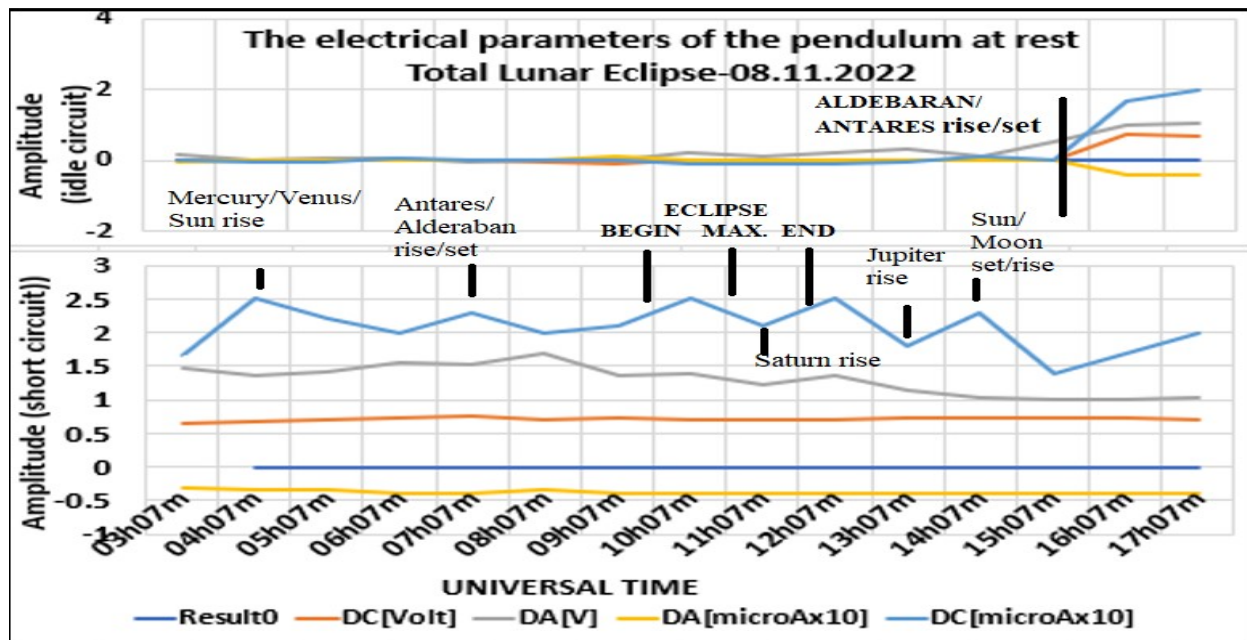


Figure 6. The variation of the amplitude of the voltage parameters and the intensity of the continuous DC current, respectively, alternating current DA at the Pi location (idle circuit), respectively for the grounded pendulum (Horodnic/ Suceava, Romania location)

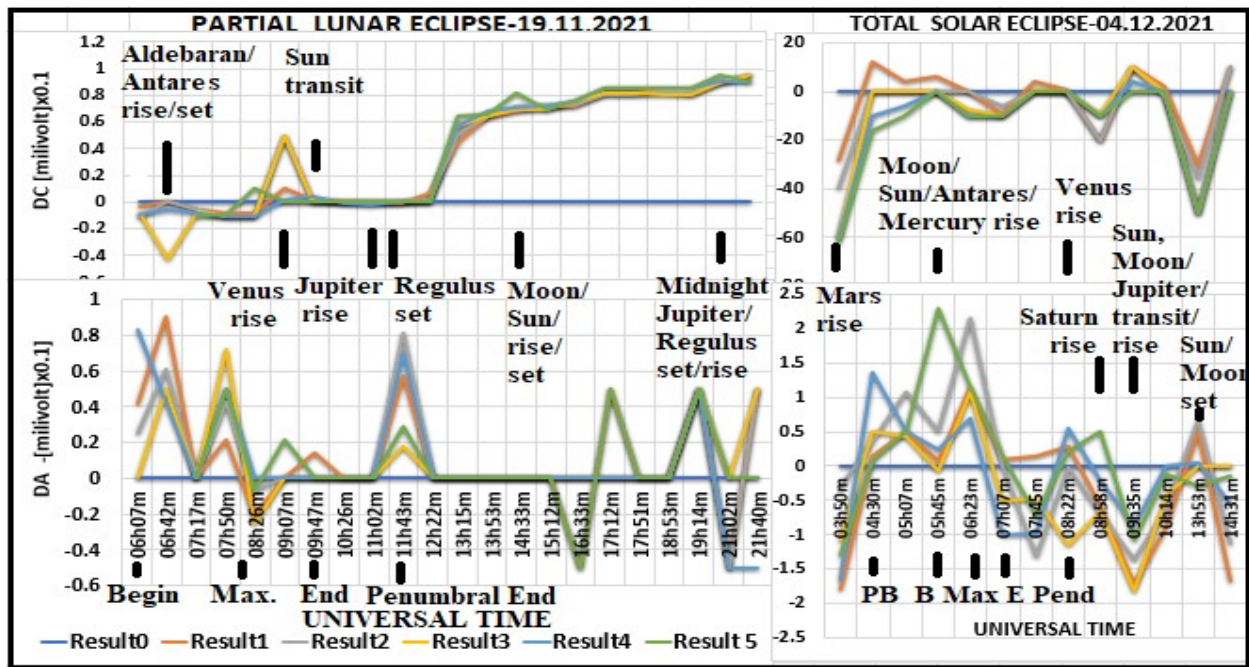


Figure 7. The variation of the amplitude of the voltage parameters during the experiment (Voinesti/Iasi, Romania).

DISCUSSIONS

- 1) In the process of development, testing and refinement of the wire pendulum model, "effects" were researched, neglecting the nature of "disturbances" because, according to the experiment construction paradigm, the mechanical oscillator is considered an isolated physical system.
- 2) The analysis of the results of the voltage measurements in the case of the pendulum at rest highlights: a) the existence of some areas with different physical properties (atmosphere - the respective air dielectric, earth - conductor) in which there are different potential drops due to the same current $I(\omega) = (V(\omega)) / Z(\omega)$; b) the presence of a mixed series oscillating electric circuit (direct current, respectively, alternating current). Voltage variation $V(\omega) = Z(\omega) I(\omega)$, where

$$Z(\omega) R = j (L \omega - 1/C \omega) \quad (13)$$

it highlights alternating current in the pendulum, a fact that leads to the representation of the pendulum by equivalent mechanical elements m and the respective electrical elements, namely: ohmic resistance R , resistors inductance L (electric coil) and capacity C (capacitor).

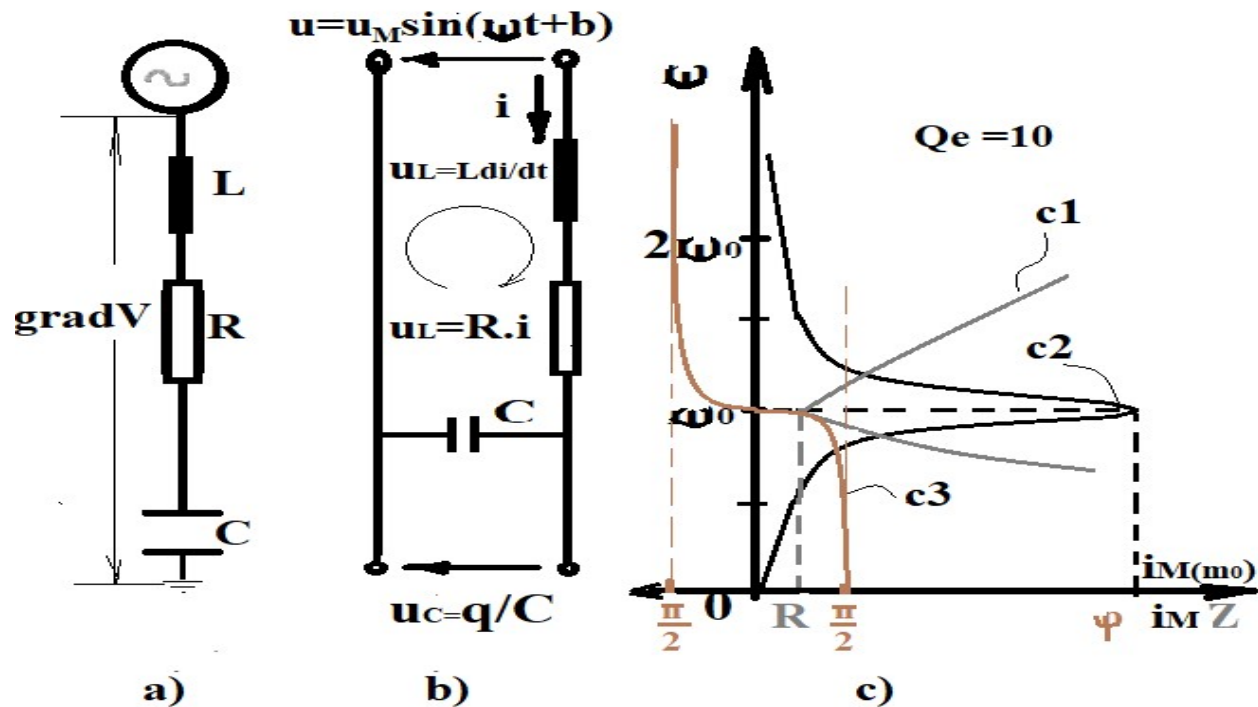


Figure 6. a) The series oscillating electrical circuit of the pendulum, RLC; b) Electrical diagram of the series RLC circuit; c) The frequency dependence of the impedance (c1), the resonance behavior of the current in the alternating current RLC series circuit (c2) and the variation of the phase shift between current and voltage (c3)

With $R, C, L = \text{constant}$, the equations $u = Ri$, $u = C \dot{q}$, $N \phi = Li$ are linear equations, where q is the amount of electric charge. Oscillation in permanent mode imposes the condition of constancy of the electric loads $L_0 = \text{const.}$, $C_0 = \text{const.}$, $G_0 = 1/R = 0$ and a well-determined angular frequency ω_0 for a certain period of operation of the electric circuit of the pendulum. The existence of idle voltage oscillations indicates a device whose $u-i$ characteristic has a positive slope ($du/di = r > 0$) and the presence of short-circuit oscillations highlights the positive conductance of the pendulum circuit ($di/du = g > 0$). For the resonance frequency $\omega_0 = (LC)^{-1/2}$ the impedance is $Z(\omega_0) = R$ and the phase resonance and the mode appear here simultaneously. This fact is characteristic of the RLC series electric oscillating circuit. The circuit can oscillate freely with

$$\omega_e = \omega_0 \sqrt{1 - CR^2/(4L)} \quad (14)$$

This value deviates from ω_0 the more R is higher; for

$$R > \sqrt{L/C} \quad (15)$$

proper oscillations are no longer possible. The measurements indicate a non-stationary voltage oscillation regime in direct relation with the position of the interacting celestial bodies. In the case of resonance $\omega = \omega_0$:

$$|U_L|/|U| = |U_C|/|U| = \sqrt{L/C}/R = Q_r \quad (16)$$

where, Q_r is the quality factor of the series oscillating circuit. The quality factor highlights how optimal the resonance is and thus how selective the oscillating circuit is. Its inverse is the loss factor, $d_r = 1/Q_r$ [1]. The specialized literature experimentally highlights the variability of the conduction current J_c , the displacement current, J_D and the potential gradient, $\text{grad } V$, at the earth's surface depending on the universal time and the place of measurement, a fact also highlighted by the results of the experiment analyzed in the paper, Figure 5.a, Figure 6 [6, 7].

3) For the network in Figure 6. b, Ohm's law and Kirchhoff's laws apply and the following relations result:

$$L \frac{di}{dt} + Ri + u_c = u_k \quad (17)$$

$$C \frac{du_c}{dt} = i \quad (18)$$

From the relations (17-18) we obtain the linear equation of order 2 which completely describes the input-output behavior of the RLC circuit of the pendulum, namely:

$$LC \frac{d^2 u_c}{dt^2} + RC \frac{du_c}{dt} + u_c = u_k \quad (19)$$

With the help of the matrix-vectorial description we condense linear differential equations (17, 18) in a single vectorial differential equation of order 1, as follows:

$$\begin{bmatrix} \frac{di}{dt} \\ \frac{du_c}{dt} \end{bmatrix} = \begin{bmatrix} -\frac{R}{L} & -\frac{1}{L} \\ \frac{1}{C} & 0 \end{bmatrix} \begin{bmatrix} i \\ u_c \end{bmatrix} + \begin{bmatrix} \frac{1}{L} \\ 0 \end{bmatrix} u_k \quad \text{cu vectorul la momentul initial} \quad \begin{bmatrix} i(t_0) \\ u_c(t_0) \end{bmatrix} \quad (9)$$

The dynamic RLC behavior of the pendulum for a moment $t \geq t_0$ is completely defined if it is known, the initial value of $u_c(t_0)$, $i(t_0)$ and the input size $u(t)$ for $t \geq t_0$. With these elements you can calculate the magnitudes of the current $i(t)$ and the voltage $u(t)$ that characterizes the "state" of the pendulum network.

Thus, the measurement results are in the category of predicted (expected) results in the new paradigm of the experiment. The conditions of observability and controllability are fulfilled by the non-gravitational pendulum system at rest.

Electrical and magnetic recordings contain numerous frequencies, some of which are simply noise and others are of geophysical interest.

CONCLUSION

- a) The pendulum in rest fulfills the conditions of a "test body" for the processing of physical (peri)terrestrial signals in that:
- b) being small, its presence changes as little as possible the state that exists in its absence in the environment;

- c) placed at the interface of the atmosphere with the earth's surface, it can interact with the fields in the environment (close respectively, distant) and highlight when there is a disturbance of the balance between the coupled fields (electric, magnetic, electromagnetic);
- d) at rest highlights "coupled" fields (electric, electromagnetic,...) so that the energy stored in these fields varies simultaneously (mainly) with the position of some mobile parts of the complex physical system, namely: the relative position between Pi (equator , poles, position on the hemisphere) and the diurnal position (day-night, sunrise - sunset; transit,...) of celestial bodies (respectively, of systems of celestial bodies in conjunction, eclipse, opposition,...) on duration of the experiment;
- e) has the structure, organization and functions of an electronic control device of the non-gravitational interaction.

AUTHORS' CONTRIBUTION

Dumitru Crivoi: Designer of the experiments in the non-gravitational and gravitational paradigm, responsible for the acquisition of electrical data, responsible for the analysis of the measurement results and the overall exploitation of data, responsible for the design and writing of the article.

Dimitrie Olenici: co-organizer of experiments, responsible for the acquisition and analysis of measurement results in the gravitational paradigm, main designer of designer of laboratory and pendulum.

RESEARCH DIRECTIONS

Completion of the analytical identification of the pendulum system and the construction of experimental validation experiments of the new paradigm of construction of experiments.

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