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Cosmic Influences on Physicochemical Properties of Aqueous Solutions Exposed to Various Non-Contact Stimuli—Pilot Phenomenological Research Study

Igor Jerman, Linda Ogrizek, Jonatan Pihir*, Mateja Senica

Water Research Department, BION, Institute of Bioelectromagnetics and New Biology, Ljubljana, Slovenia
Email: *jonatan.pihir@bion.si

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Abstract

Recent studies have reported changes in the physicochemical properties of water following non-contact exposure to living systems. As these effects cannot be attributed to thermal influences, they remain largely unexplained within the framework of conventional electromagnetic field theories, although there exist explanations stemming from quantum electrodynamics. From the lack of clear identification of a fundamental influencing factor, we term the putative mechanism responsible for these phenomena Low Energy Ion Reactions (LEIR), according to our research and other studies, it appears that the non-thermal influence acts primarily on ions. To explore in greater depth the LEIR stemming from the said influence, which originates mainly from organisms, the presented pilot study examined how three cosmic factors—geomagnetic field oscillations, lunar illumination, and solar activity (sunspots)—modulate LEIR detection in the exposed aqueous receiver solutions versus unexposed ones. Using ultraviolet spectroscopy and physicochemical assays, we analyzed the correlation between the effect sizes of 19 experiments of water exposed to organisms (vs. control) and the said cosmic influences across three pH gradients. Results demonstrate: 1) LEIR-associated effects covary with multiple, concurrently varying cosmic parameters; 2) a notable pH-dependent polarity, where acidic and alkaline solutions frequently show opposing responses to identical distant influences. These findings underscore the necessity of rigorous and more systematic, physics-driven research into non-contact aqueous interactions, particularly regarding water's dynamically ordered phases (e.g., coherent domains) and their role in mediating and expressing LEIR effects.

Subject Areas

Physics of Living Systems, Physical Chemistry, Water Science

Keywords

Low Energy Ion Reactions (LEIR), Non-Contact Aqueous Interactions, Non-Thermal Influence, Geomagnetic Oscillations, Ap Index, Sunspots, Moon Illumination, Physicochemical Parameters, UV Spectrometry, Biological Sources

1. Introduction

Research Area

Over recent decades, studies across disciplines have reported alterations in water's physicochemical properties following non-contact exposure to diverse agents. These include:

- Configuring signals transfer via mediated substrates (e.g., glass-encapsulated homeopathic preparations) [1] [2],
- Classical electromagnetic (EM) or static magnetic fields [3] [4],
- Biological sources (e.g., operator intention in biophysical systems) [5],
- Putative unconventional working devices (e.g., orgone accumulators) [6] [7].

While EM fields offer a partial explanatory framework, certain effects—particularly those occurring without direct energy transfer or under shielding conditions—resist conventional interpretation. From the lack of clear identification of the influencing agent, we provisionally term it a non-thermal influence and the mechanism responsible for its detection in water *Low Energy Ion Reactions* (LEIR). One possible interpretation, which remains hypothetical, is that LEIR may involve changes in the dynamical ordering of aqueous systems, potentially mediated by coherence-like effects in water under specific biological or physicochemical constraints. It is well established that long-lived quantum coherence can occur in highly ordered biological systems at biological temperatures, such as photosynthetic pigment-protein complexes, where structural correlations and strong electronic coupling stabilize coherent dynamics [8] [9]. Comparable coherence-based mechanisms have also been discussed in other specialized biological contexts, including *magnetoreception* [10] [11], *olfaction* [12], *enzyme catalysis* [13], *etc.*

Nevertheless, experimental observations of non-thermal influences on human physiology reported by independent groups [14]-[16] motivate further investigation into whether weak, transient, or environmental fields-dependent ordering phenomena in water could contribute to the observed effects. To foster wider acceptance and deeper inquiry, we must develop a rigorous, empirically grounded framework that both explains the observed phenomena and yields testable predictions for these elusive yet potentially consequential effects.

Quantum Electrodynamics and Water Coherence

Within the framework of quantum electrodynamics (QED) for water, as developed by Del Giudice, Preparata, and Vitiello [17]-[21], many apparently anomalous water-based phenomena arise from weak electromagnetic oscillations (or from non-measurable, but non-zero scalar and vector potentials, as in the Aharonov-Bohm effect, as mentioned below) that perturb the phase coherence of water's coherent domains. The empirical Zhadin effect and its theoretical extension via Liboff's ion cyclotron resonance (ICR) model further demonstrate that suitably tuned static and alternating magnetic fields, even if weak, can dramatically enhance ionic currents in water solutions, lending strong support to the QED coherent-domain concept [22]-[25]. Moreover, the Aharonov-Bohm effect [26] illustrates how variations in the electromagnetic scalar and vector potentials—without classical force effects—can induce phase shifts in quantum oscillators. Applied to water, this suggests that changes in the magnetic vector potential $\boldsymbol{A}$ can modulate the phase of coherent-domain oscillations and thereby alter macroscopic water properties, even in regions where the local E and B fields are completely absent. This effect deals with the fact that electromagnetic potentials directly define the phase of oscillation of electrical charges [26], as it occurs in coherent water domains [27]. The phenomenon may also apply to coherent domains of a higher hierarchical order, as already assumed in in-depth studies on coherent domains in water and organisms [28] [29]. This feature, which is based on wave-phase matching, could interact significantly with changes in the potential $\boldsymbol{A}$ of the environmental magnetic field, which, based on the fundamentals of quantum field theory, specifically QED, can also have a non-local effect on phase correlation, meaning it can act at a long distance.

Non-Local and Context-Dependent Effects

This is in harmony with emerging experimental evidence suggesting that LEIR phenomena may exhibit context-dependent non-local characteristics. Within the framework of quantum field theory, these effects can be interpreted through macroscopic EM-phase correlations. While such correlations in condensed matter are often discussed in terms of entanglement, in the specific context of dissipative aqueous systems, they are better characterized as long-range phase-locking between coherent domains [25].

Some experiments [30], and theoretical considerations based on the Preparata-Giudice QED model indicate that certain effects of this kind may be at least partially independent of the distance between the influencing source and its receiver, provided a shared phase-reference is maintained. However, proximity-dependent outcomes [31] confirm that classical attenuation over distance profiles remains significant. This apparent duality—wherein LEIR simultaneously displays localized and non-local attributes—aligns with quantum vacuum hypotheses [32]-[34] proposing superfluid-like behavior in fundamental fields. In relativistic quantum field theory, the ground states are intrinsically entangled; tracing over a spatial region yields an area-law divergent entanglement entropy, signaling correlations that extend across arbitrary distances [35]. While highly unconventional if not parascientific models (e.g., torsion fields [36], scalar waves [37]) exist, the present study focuses on testable theoretical considerations anchored in quantum field theory. There are also claims of entropy-reducing ("negentropic") effects [7] [38]-[40]; an ordering effect is otherwise stated also for coherent domains in liquids [41]. In our model, we propose that the aqueous matrix of coherent domains is stabilized by mineral ions such as silica and bicarbonate (see Section 2.1.1). This dynamic structure, comprising many basic (100 nm) coherent domains [25], represents a networked effective interaction area (S). This collective area compensates for the minuscule magnetic flux ($\Phi = \int B \cdot dS$) of weak cosmic fields, enabling the system to transcend the limits of individual coherent domains.

Historical and Empirical Background

Considerable research has been conducted on LEIR in the broad sense presented here, particularly regarding so-called biofield or bioenergy therapies [31] [42]. These studies tackle primarily influences stemming from organisms. There are also studies reporting a noticeable influence of various cosmic or environmental factors on LEIR. The study of these influences may deepen LEIR phenomena understanding. In the following, we will present some of these past studies and their findings. Due to insufficient scientific support for this kind of research and the resulting lack of developed general methodology and terminology, the cited authors have used different names and concepts. In this work, we consider them as different expressions of the broadly understood phase correlation phenomena, stamped as LEIR.

Even the first systematic scientific researcher of non-thermal and non-mechanical influences stemming from organisms, Ludwig von Reichenbach (1788-1869), described numerous experiments regarding the influences—which he termed "Odic emanations"—in his multi-volume work *Researches on Magnetism*, *Electricity*, *Heat*, *Light*, *Crystallization*, *and Chemical Attraction in Their Relation to the Vital Force* (1845-1867). He found that these emanations interacted with external, cosmic, and environmental factors, particularly lunar phases, atmospheric pressure, storms, and even sunspots [43] [44]. Furthermore, by correlating subjective reports with changes in magnet orientation, Reichenbach maintained that Earth's magnetism interacted with the human body's "Odic field". He regarded this as evidence that the planet's magnetic field was one of the "cosmic" factors shaping or modulating the researched phenomena. Regarding the geomagnetic field influence on organisms, there are also very recent positive findings [45]. In light of these findings, it can be said that, for most of its evolutionary history, life has evolved within Earth's geomagnetic field—a field that, among other functions, shielded the biosphere from solar wind and cosmic radiation [45]-[47].

However, research into cosmic influences has not been limited to organisms, as understanding their impact on inanimate systems is also significant. Giorgio Piccardi (1895-1972) was a pioneer in this type of systematic scientific investigation. Although constrained by the methodological limitations of the period, these long-term observations provided some of the earliest evidence suggesting that water-based physicochemical systems may exhibit sensitivity to weak cosmophysical influences [48]. In large standardized series, including 714 polymerization tests of acrylonitrile in water and parallel tests of bismuth oxychloride precipitation, Piccardi observed repeatable daily fluctuations that could not be attributed to normal laboratory variables. These fluctuations showed some similarity to Piccardi's chemical P test that also worked as an indicator of solar-terrestrial activity [49]. Reaction rates varied depending on whether samples were placed inside a copper shield, outside it, or exposed to a weak 10 kHz field, but the largest fluctuations followed a common temporal pattern under all conditions [49]. He even developed a special barometer of his own design—a sealed glass device, based on mercury in a partially evacuated sealed glass bulb, which he named a scale-buoy—he detected repeatable influences. These findings provided early evidence that water-based physical-chemical processes may be sensitive to weak fluctuations in the electromagnetic or geomagnetic environment [39] [50].

Accordingly, he developed standardized "chemical tests" to examine these time-dependent changes and emphasized their reproducibility across independent laboratories, even under stable temperature, pressure, and humidity. In this way, he introduced the notion of "spatial influxes", referring to external cosmic-geophysical factors acting on water systems, a concept relevant to contemporary interpretations of LEIR phenomena [50].

After the Second World War, similar research, although not on such systematic and meticulous scale, was performed by immunologist Alexander Rothen [51] [52]. He found that interaction between large molecules, such as those involved in immunological and enzymatic reactions, may take place through a field of specific long-range forces extending over 200 Å, a distance many times greater than that calculated for the interaction of small molecules. To his surprise, this reaction was modified with solar activity, even if the experiment was shielded from solar electromagnetic irradiation. Rothen's use of an oriented magnetic field—whose efficacy depended critically on alignment—suggests that the observed circadian modulation that could not arise from direct solar irradiation was provoked by coupling to the ambient geomagnetic field (or its associated vector potential, $\boldsymbol{A}$) as it varies over the day.

A scientifically validated connection can be found even in meticulous forestry research, which stipulates variations in wood properties (shrinkage linked to water loss and relative density) in function of the moon phase at the date of tree falling. This phenomenon has long been considered by science as mere superstition; however, it was found to be real [53]-[56]. Regarding lunar influences, we can also reference a recent important study that reports a strong correlation between solar eclipses at various locations worldwide, across different years, and changes in evaporation and surface tension of water [57]. These changes were absent on days without a solar eclipse and were not associated with variations in temperature, pressure, or humidity in the environment [39] [50].

Cosmic influences working on water systems present also a significant part of Volkamer's finding [58]-[62]. He measured the oscillations of possible cosmic influences with highly sensitive differential scales and found that it fluctuated often in correlation with lunar phases, solar activity (including sunspot cycles), and even eclipses. While avoiding astrology, Volkamer's view suggests that celestial bodies and cosmic events produce detectable influences, bridging astronomical and biophysical phenomena. He speculates that this is a matter of mass effects (undefined subtle matter effect) detected on these highly sensitive scales, but it may well be a demonstration of influences that are a manifestation of LEIR effect based on phase correlations of coherent oscillations in water and electromagnetic potentials of cosmic influences.

Objectives and Setting of the Present Study

The investigation into cosmic influences presented here emerged as part of an extended study exploring the effects of various living sources' influences on the physicochemical properties of water. We monitored three cosmic factors in parallel: 1) the geomagnetic field oscillations, 2) sunspot activity, and 3) moon illumination. All three factors tackle the environmental magnetic field and may either directly or indirectly change amplitude and phase of the field within 1 - 100 nT. These also generate perturbations in the vector potential $\boldsymbol{A}$ and may interact with phase-sensitive systems, such as coherent water domains in organisms, donor solutions, and receiver solutions.

The diagram below (Figure 1) illustrates an experimental situation in which

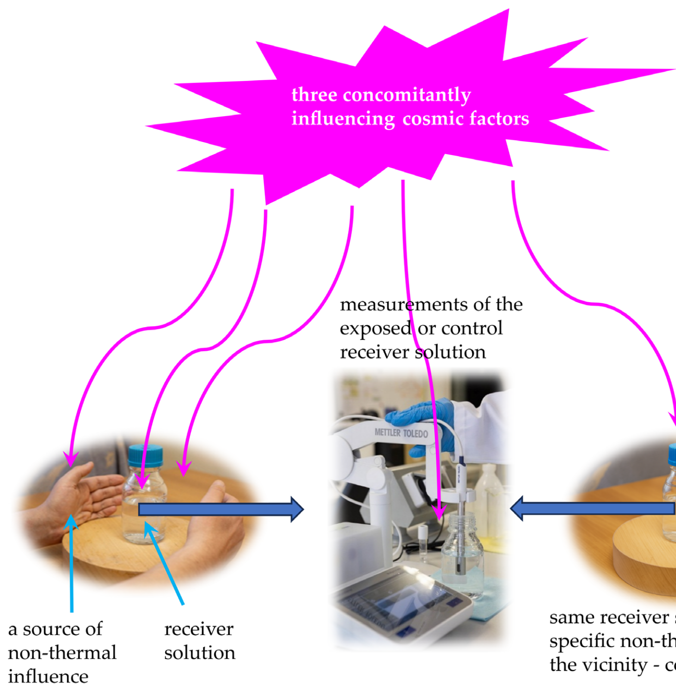

Figure 1. Experimental situation in which we investigated the influence of three simultaneously acting cosmic factors on measurements of various living sources of non-thermal influence on the physical and chemical parameters of the receiver solution. See the text above for more details.

we investigated the interferences of three simultaneously acting cosmic factors on measurements of various non-thermal influences stemming from organisms or specifically treated water on the physical and chemical parameters of receiver solution. These experiments always included simultaneous measurements of unexposed solutions from the same source (control). In the present paper, we report on how the monitored cosmic factors influence the measurement difference between the living source exposed solution and control (unexposed) solution.

In this pilot study, we were primarily interested in whether cosmic factors would have any discernible effect on the differential (exposed vs. unexposed) measurements of four different water parameters (*i.e.*, their effect sizes, Cohen's d). Our objective was not to investigate the direct influence of cosmic factors on the intrinsic physicochemical properties of water. Rather, our focus was to examine whether such external factors could influence—*i.e.*, potentially interfere with—the measured physicochemical parameters of the receiver water under the specific experimental conditions employed.

Given the assumed fundamental similarity between various living sources, and the predicted effect of the latter on the phase correlation of water domains, and the fact that the monitored cosmic influences also predominantly affect magnetic field oscillations and their vector potential, our null hypothesis assumed noticeable differences between the properties of control and organism-exposed receiver liquids. Based on the aforementioned ICR theory, which assumes different magnetic (AC and DC) conditions for different ions to change their ionic state [24], we expected a difference between acidic and basic receiver liquids, as one is dominated by hydronium ions and the other by hydroxide ions.

Figure 1 also reflects our assumptions about the potential impact of cosmic factors. Namely, these factors, mostly via their $\boldsymbol{A}$ and V (electric scalar potential) fields, could differently affect the organisms with their complex and highly organized coherent water domains [63] vs. the control donor with much simpler coherent domains. Here, we emphasize once again that in all experiments, the control receiver solution (of the same origin and composition) was simultaneously exposed to the same cosmic factors as the organisms-exposed solution. Therefore, we can speak of *the influence of these factors on the differential measurements of non-thermal living beings' influences and not on the solution itself*. We examined the statistical correlation between the standard effect size (Cohen's d) for each non-thermal exposure situation and the corresponding cosmic influences, with Ap index and sunspot activity represented by exposure-period averages, and lunar illumination represented by the percentage of the lunar disk illuminated at 12:00 on the day of measurement. The analysis encompassed three measurement types: electrical conductivity, pH, and relative UV absorption.

Given the variety of living sources used in our study, our primary goal was to see whether statistically significant correlation results would show themselves, indicating similar properties, a common thread, although one of these sources was only remotely (indirectly) connected to organisms (non-contact transfer of molecular information from *Arnica Montana* solution). Demonstrating such general characteristics would provide a compelling rationale for more systematic, targeted studies and could indicate the direction of further research. It would also support our assumption that the non-thermal influence of organisms involving LEIR has a single fundamental nature, regardless of its specific source—an idea implicitly endorsed by many of the studies cited earlier.

Although we are dealing with a complex experimental system (3 sources of cosmic influences, diverse organisms, three measurement techniques, and three different receiver types of the measured solution regarding pH), we believe that we can draw certain conclusions from the detected influence of cosmic factors, which will not yet represent definitive laws or mechanisms of operation but may meaningfully influence the formation of advanced theoretical models comprising the living state and its biophysical foundations. They can also guide further experiments in discovering the nature of LEIR regarding water and non-thermal influence of organisms.

We should also note that we used three types of receiver liquid (water solution) in our experiments, corresponding to three pH values: mildly alkaline, neutral, and mildly acidic, as we assumed that LEIR of water exposed to the non-thermal influence of organisms, especially considering ICR theory, would act on ions in the solution. It is known that the hydronium ion is the agent of acidity and it has also been the subject of ICR theory validation experiments [64]. Regarding the interaction of cosmic factors, we assumed that any different or even opposite effect on the differential measurements of physicochemical parameters would provide guidelines for further in-depth theoretical modeling of both LEIR and its connection with magnetic field oscillations or potential fields ($\boldsymbol{A}$ and V).

2. Materials and Methods

2.1. Material and Devices

As outlined in the Introduction, this research utilized various organisms as non-thermally influencing sources. We examined the following: bioenergy healers (B) [65], tired ordinary individuals (H) [65], germinating seeds under optimal conditions (G+), germinating seeds under stressful conditions (G−), yeast cultures growing under optimal conditions (Y+), and yeast cultures under severe stress (Y−).

We also examined homeopathic remedies in three potencies. Since these remedies were the subject of LEIR research, we did not directly examine their impact on water parameters. Instead, we studied their "information transfer" to the receiver solutions (as always, in three pH variations) indirectly, via the bottle glass and simultaneous mechanical agitation [66].

In all these experiments, receiver solutions for all three pH variations were placed on the bench as controls. For more details on the experimental setup, refer to **Table 1**, and for essential information regarding the experimental procedure, refer to **Table 2** [66]-[68].

Table 1. This table provides an overview of all researched non-thermal influence sources used in the experiments (N = 19; each situation paired with control for one Cohen's d value) performed with receiver solutions at three different pH-types (3 × N). Each experiment (N) comprised 18 technical replicate measurements per experimental situation. These replicates were used to calculate one Cohen's d per situation and pH condition; the independent units in the correlation analysis were therefore the 19 exposure situations, not the individual replicate measurements. These 19 effect size values are derived from an underlying dataset of 684 individual measurements (19 comparisons × 18 replicates × 2 experimental situations) for one pH-type. Therefore, the total number of measurements including all three receiver solutions (for 3 pH types) is 2052.

Non-thermal influence sources	Situation label	N	Experimental situation
Human	B	4	solution was exposed to the therapist healing radiation
	H	4	solution was exposed to the fatigued human radiation
	C	4	solution was exposed to the empty room ambient (control)
Germination	G+	2	solution was exposed to the growth of Lepidium sativum seeds
	G−	2	solution was exposed to the growth of Lepidium sativum seeds which were inhibited by using saline solution
	C	2	solution was exposed to the same environmental conditions only (control)
Yeast	Y+	2	solution was exposed to an optimally proliferating yeast culture
	Y−	2	solution was exposed to a highly proliferating yeast culture that was poisoned and started to die due to a highly toxic concentration of NaOCl
	C	2	solution was exposed to tap water subject to same environmental conditions only (control)
High dilution transfer signal	D6	1	non-contact transfer of the 10 - 6 diluted of *A. montana* granules into receiver solution
	C30	1	non-contact transfer of the 10 - 60 diluted of *A. montana* granules into receiver solution
	C200	1	non-contact transfer of the 10 - 400 diluted of *A. montana* granules into receiver solution
	C	3	non-contact transfer of the untreated globules of the same composition and size for control situation

2.1.1. Water Used for the Receiver Solutions

FIJI water was selected as the non-thermal impact receiver medium due to its prior successful use in studies regarding the influence of bioenergy therapies on water properties [69]. Its low bicarbonate molarity, natural minerals, and electrolytes provide a more complex composition than distilled water, and no evidence suggests that these minerals would interfere with the assessment of LEIR-induced effects.

Original Fiji Water

We used FIJI water, sourced from a protected artesian aquifer in Fiji and naturally enriched with minerals and electrolytes. Its analysis as of March 2023: 140 mg/L of bicarbonate, 18 mg/L of calcium, 9 mg/L of chloride, 0.3 mg/L of fluoride, 13 mg/L of magnesium, 16 mg/L of sodium, 85 mg/L of silica and 0.5 mg/L of sulfate. Total dissolved solids: 220 mg/L. The declared pH was 7.61.

Further Processing of FIJI Water to Attain Three Targeted Receiver Solutions

The study investigated LEIR effects on solutions with three pH levels: mildly acidic (pH 5.5), neutral (pH 7), and mildly alkaline (pH 8.5). Citric acid (Sigma-

Aldrich, Merck KGaA) was used to achieve acidic and neutral pH, while sodium hydroxide (Fluka, Honeywell Research Chemicals) was used for the alkaline pH.

2.1.2. Measurement Devices and Methods

The following physicochemical methods and spectroscopy were used to assess the impact of the different sources on the water solutions and were used to measure the specific effects of the selected sources on the receiver solution:

- Electrical conductivity,
- pH,
- The relative absorption across the UV (190 - 400 nm).

The physicochemical parameters were measured using a SevenExcellence™ S470 from Mettler-Toledo (Greifensee, Switzerland) for pH and conductivity. To ensure the reliability of our detections, we conducted simultaneous temperature measurements. This is particularly important for conductivity measurements, as they are sensitive to temperature changes, but it is also relevant to other measurement methods. Each measurement was conducted in a separate beaker. The observed, investigated, and considered measurement drift for these two devices is as follows: ±0.05 for pH; as for the conductivity measurements, the double steel pole cell with a built-in temperature probe virtually eliminates errors in the measurements.

For the UV absorption spectroscopy measurements, a Nanocolor® UV/VIS II spectrophotometer from Macherey-Nagel (Düren, Germany) was utilized, with a wavelength range of 190 - 1100 nm and a 50 mm quartz cuvette cell. The accuracy of the measurements is within a range of plus or minus one nanometer (wavelength) and 0.003 of relative absorption. To obtain spectroscopic data, we employed a zero solution to zero the instrument for the solvent in which the compound was dissolved. Each measurement was conducted in a dedicated cuvette utilized consistently throughout the experiment.

2.1.3. Source of Data for Cosmic and Environmental Forces

To evaluate the correlation coefficients, the environmental factors are presented. The following environmental factors were considered: geomagnetic activity (Ap index, also referred to as Ap), sunspots, and moon illumination (moon), which were also analyzed in more detail.

Sunspots and Ap index data were obtained from the website of the GFZ Helmholtz Centre for Geosciences, Germany [70]. Sunspots are quantified using the relative sunspot number (R), a standardized measure that accounts for both individual sunspots and sunspot groups [71]. Geomagnetic field oscillations, characterized by the daily Ap index, are a 3-hourly planetary amplitude index representing global geomagnetic activity, derived from measurements of the horizontal component of the magnetic field at majority of mid-latitude stations [72].

The moon illumination data was calculated using the Python programming language with the Python library Skyfield [73]. Moon luminosity is defined as the percentage of the moon's disk illuminated by the Sun, irrespective of the waxing or waning phase, although we acknowledge that the lunar phase itself may carry additional significance.

The magnetic field measurements showed fluctuations of approximately 10 nT per geomagnetic observatory when experiments were conducted [74].

2.1.4. Experimental Environmental Controls

All receiver solutions used in the experiments were pre-equilibrated to the laboratory ambient temperature for a minimum of 12 hours to ensure thermal stability and gas equilibration (degassing).

The samples were stored in places with relatively low EM pollution. Care was taken to ensure that all samples were subjected to very similar (if somewhat variable) ambient EM noise. Its maximal value throughout measurements was registered at the average frequency of 50 ± 1.5 Hz; its average value of magnetic flux intensity was 22.6 ± 3 nT. This ELF field was almost the same in all directions. We also measured the static (geomagnetic) magnetic field in the laboratory rooms, whose flux density (B) values were horizontal vector (H) = 23 μT, vertical vector (V) = 21 μT and total 3D vector 31 ± 3 μT [68].

2.2. Experimental Protocol

The experimental protocol varied for each source. Since the experimental details are not primary to this paper, only the basic conditions of the experimental setups for each source are presented (see **Table 2**). Detailed descriptions of the protocols can be found in previous publications (Bioenergy: [65]; HD: [66]).

Table 2. This table provides an overview of the receiver solution's exposure time and its distance to the source.

Non-thermal influence sources	Time of exposure	Placement of receiver solution vs. influence source
Human (B, H)	5 minutes	10 cm from each palm
Control (C)	5 minutes	exposed to the empty room ambient
Germination (G+, G-)	48 hours	on a plastic tray surrounded with seeds in water
Control (C)	48 hours	on a plastic tray surrounded with water
Yeast (Y+, Y-)	30 min	bottles with the receiver solution immersed in yeast culture
Control (C)	30 min	bottles with the receiver solution immersed in water
High dilution transfer signal (D6, C30, C200)	24 hours	bottles with the receiver solution placed inside the bottle with dissolved granules belonging to different said potencies of *Arnica Montana*
Control (C)	24 hours	bottles with the receiver solution placed inside of the bottle with placebo granules

2.2.1. Blinding

The experiment was conducted in a double-blind manner to ensure objectivity and rigor. Both the scoring group and the data analysis group were blinded to the experimental conditions to eliminate potential bias. Samples corresponding to different experimental situations (exposures and controls) were randomly labeled with letters A, B, and C, resulting in labels ranging from A1 to A18, and similarly for B and C. An assistant prepared the solution samples, filled them into bottles, and labeled them. A researcher repositioned the bottles. The specific experimental conditions associated with each bottle were only revealed after the analysis.

2.2.2. Sequential Process Management

The pouring and measuring procedures were performed systematically but in a variable order to minimize potential systematic measurement errors caused by gradual, even slight, shifts over time. This approach was employed to account for gradual changes in measurement values over time, which, if unaddressed, could result in misleading statistically significant differences in pairwise comparisons.

2.2.3. Measurement Protocol

For physicochemical measurements, solutions were poured from bottles into separate beakers for each parameter (conductivity, pH, and temperature), following the variable-order method described in Section 2.2.2. For UV relative absorption measurements, solutions were placed into a 50 mm quartz cuvette. All solutions (control included) for all influence sources were diluted to 50% ethanol and tapped 15 times using an automated device at 4 Hz before being poured into the cuvette; the zero solution was not tapped.

2.3. Statistical Analysis of the Results

To assess the interference of various cosmic and environmental factors on the LEIR detection of non-thermal influences, we analyzed influences including sunspots, Ap index (daily averaged planetary A-index of geomagnetic activity), and moon illumination (in percentage of decrement/increment). Correlations were conducted using Cohen's d from each of the three types of receiver solutions. We employed Spearman's rank-order correlation coefficient (r_s) [75]. The resulting p-values were subsequently corrected for multiple comparisons using the False Discovery Rate (FDR) approach via the Benjamini-Hochberg procedure.

3. Results

3.1. Overview of Correlations between Cosmic Influences

Table 3 presents the Spearman rank-order correlations (r_s) among cosmic influences.

Table 3. This table presents Spearman rank correlation coefficients (r_s) among cosmic influences for the days of measurement. Two p-values are provided: the raw (nominal) p-value and the p-value adjusted for multiple comparisons via the FDR method. Statistical trend is highlighted in magenta ($p < 0.09$).

Cosmic factors	Spearman correlation		
	r_s	p-value	p-value$_{FDR}$
Sunspots: Ap index	0.156	0.248	0.248
Sunspots: Moon	0.244	0.067	0.201
Ap index: Moon	−0.185	0.169	0.248

No statistically significant or high correlations were found among the three observed cosmic factors after the FDR correction. While the observed cosmic parameters were not significantly correlated and may therefore be treated as statistically independent predictors, they were not experimentally isolated; consequently, the present analysis identifies differential covariation patterns rather than strictly isolated causal effects.

3.2. Cosmic Influences on Conductivity Measurements

Figure 2 presented below illustrates the correlation results between cosmic influences and Cohen's d values of physicochemical measurements, derived from conductivity parameters, across all sources (N = 19). All three cosmic influences exhibit a positive correlation with the sources measured in a receiver acidic solution, with the influences of Ap (geomagnetic fluctuations) reaching a nominal statistical trend prior to FDR correction. Notably, sunspots exhibit a negligible correlation ($r_s = 0.014$), effectively decoupling them from this trend. Conversely, a negative correlation is observed in the alkaline receiver solution concerning cosmic influences (sunspots, Ap and moon). Among these, the sunspot influence shows statistical significance ($r_s = -0.564$, $p = 0.012$, $p_{FDR} = 0.036$). In the neutral receiver solution, correlation values are very low and display a trend similar to that of the acidic solution.

The results indicate that acidic ($r_s = 0.435$, $p = 0.063$, $p_{FDR} = 0.189$) and basic

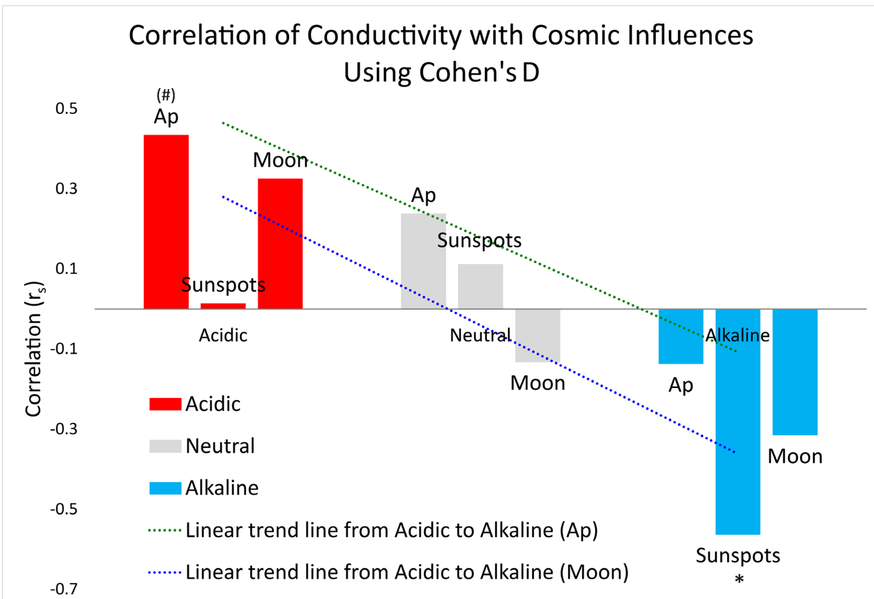

Figure 2. Correlation of conductivity with cosmic influences (Ap index, sunspots, moon illumination) in three pH-types of receiver solutions. Bars represent acidic (red), neutral (grey), and alkaline (blue) solutions. The y-axis shows Spearman's correlation coefficient (r_s). Statistical significance is indicated as follows: *: $p < 0.05$; #: $p < 0.09$ (a trend-level significance prior to FDR correction). N = 19 for all correlations. Cosmic parameters varied simultaneously under natural conditions; effects shown represent covariation rather than the isolated causal influence of a single factor.

solutions are the most sensitive to geomagnetic fluctuations, albeit in different directions. The alkaline solution dominates for the sunspot correlation. The correlation results also show that for the two influences (Ap, moon), there is an almost linear relationship between the pH (acidic, neutral, alkaline) of the solution and both the magnitude and direction of the correlation (Figure 2).

3.3. Cosmic Influences on pH Measurements

Similar to conductivity, in general, correlations of cosmic factors with pH measurements exhibit an inverse effect between acidic and alkaline receiver solutions, though the effect is less pronounced (Figure 3).

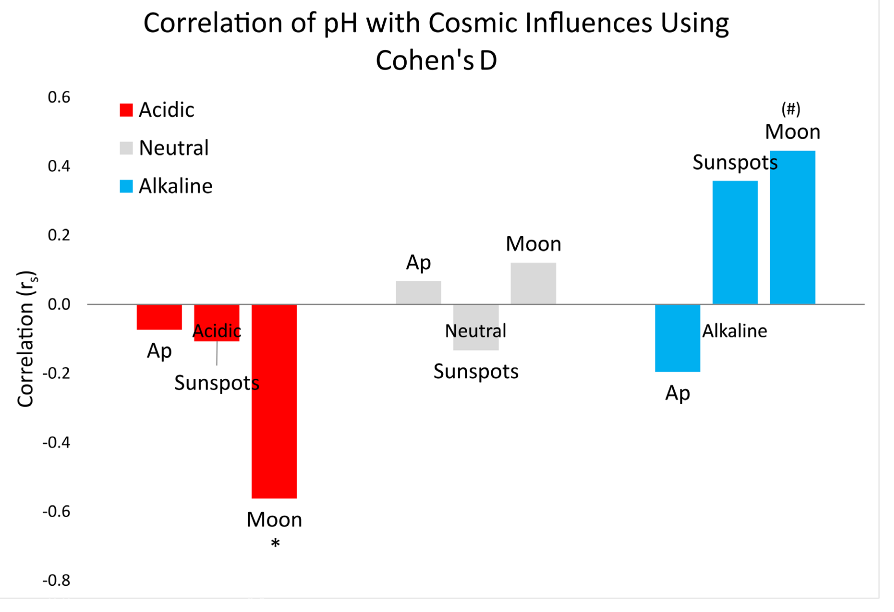

Figure 3. Correlation of pH with cosmic influences (Ap index, sunspots, and moon illumination) in three pH-types of receiver solutions. Bars represent acidic (red), neutral (grey), and alkaline (blue) solutions. The y-axis shows Spearman's correlation coefficient (r_s). Statistical significance is indicated as follows: *: $p < 0.05$; #: $p < 0.09$ (a trend-level significance prior to FDR correction). N = 19 for all correlations. Cosmic parameters varied simultaneously under natural conditions; effects shown represent covariation rather than the isolated causal influence of a single factor.

Here again, two of three cosmic influences (sunspots and, most notably, moon) show that their correlation results match the pH of the receiver solution. At least with the moon correlations, with their negative values at acidic pH ($r_s = -0.563$, $p = 0.012$, $p_{FDR} = 0.036$), and highly positive at alkaline pH ($r_s = 0.445$, $p = 0.056$, $p_{FDR} = 0.168$), we can speak about a polarizing effect (*i.e.*, the effect that draws a solution away from pH 7).

3.4. Cosmic Influences on UV Relative Absorption

Although UV spectroscopy represents a different class of measurements compared to the previous methods, it also reveals an overall tendency toward a reversal between acidic and alkaline solutions (see **Figure 4**). However, when examining individual influences, this trend is more difficult to observe, as the Ap index results remain at the same level in acidic and neutral solutions ($r_s = 0.424$, $p = 0.070$, $p_{FDR} = 0.070$) and fall to a very low positive value in basic solutions. The correlations of sunspots decrease from low positive (acidic) to more pronounced negative in neutral ($r_s = -0.440$, $p = 0.059$, $p_{FDR} = 0.070$) and alkaline solutions ($r_s = -0.474$, $p = 0.041$, $p_{FDR} = 0.123$), while moon illumination shows a reversal between acidic and neutral solutions ($r_s = -0.750$, $p = 0.000$, $p_{FDR} = 0.001$).

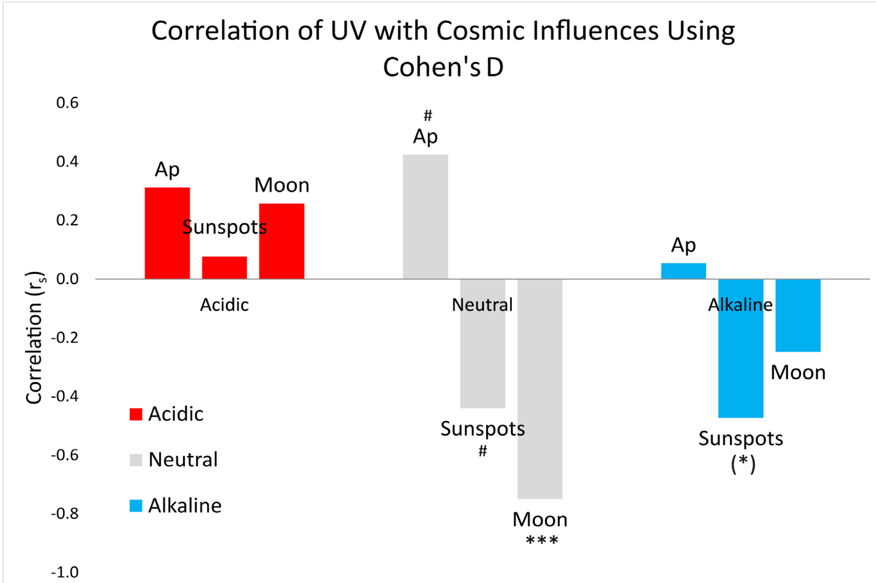

Figure 4. Correlation of UV absorption with cosmic influences (Ap index, sunspots, moon illumination) in three pH-types of receiver solutions. Bars represent acidic (red), neutral (grey), and alkaline (blue) solutions. The y-axis shows Spearman's correlation coefficient (r_s). Statistical significance is indicated as follows: ***: $p < 0.001$; *: $p < 0.05$ (nominal significance prior to FDR correction); #: $p < 0.09$. N = 19 for all correlations. Cosmic parameters varied simultaneously under natural conditions; effects shown represent covariation rather than the isolated causal influence of a single factor.

4. Discussion

4.1. General Considerations

The results of this pilot study are consistent with both previous research and our expectations outlined in the Introduction; however, they should be interpreted according to the strength of the statistical evidence. The most robust findings are those that remained significant after FDR correction. These results provide preliminary evidence that the differential physicochemical response of receiver solutions may covary with selected cosmic sources under the tested conditions. Associations that reached only nominal significance or trend level before FDR correction are considered exploratory and are used here mainly to guide mechanistic interpretation and future hypothesis testing. These observations align with Presman's hypothesis that many biological processes show correlations with variations in solar activity and natural electromagnetic fields, suggesting that living systems may be sensitive to subtle cosmophysical fluctuations [76].

Systematic analyses by Chizhevsky further supported this view, based on long-term historical patterns of human activity with peaks coinciding with the solar sunspot cycle, suggesting a non-random solar influence on large-scale biological and societal processes [77]. In addition, Piccardi and Capel-Boute reported measurable rate changes in various chemical reactions as a function of solar activity, suggesting that solar cycles can modulate physicochemical processes even in non-living aqueous systems [50] [78].

These findings are consistent with Piccardi's long-term chemical flocculation experiments, conducted over more than a decade and later independently replicated across multiple international laboratories. His standardized bismuth-precipitation reactions (the so-called F, D, P tests) showed reproducible temporal correlations with solar flares, sunspot numbers, geomagnetic storms, and even lunar tidal components, suggesting that aqueous systems can act as sensitive detectors of cosmophysical fluctuations [48] [50]. In the present pilot study, the FDR-corrected results provide the strongest basis for interpretation, while the broader pattern of nominal and trend-level associations suggests two additional, hypothesis-generating features:

1) In all three measurement methods, the influence predominantly reverses when comparing measurements in acidic versus alkaline solutions, which indicates different effects on the two opposite water ions.

2) The influence of sunspots and moon illumination on the pH of receiver liquids shows a polarizing effect—the opposite of a neutralizing one.

4.2. Conductivity Measurements

Turning first to the conductivity measurements, the strongest result is the negative correlation between sunspot activity and conductivity effects in alkaline receiver solution, which remained significant after FDR correction (**Figure 2**). A broader acidic-to-alkaline reversal is also visible across the conductivity correlations: the Ap index showed a positive trend in acidic solution before FDR correction, whereas the alkaline correlations were generally negative. Because only the sunspot association in alkaline solution survived FDR correction, this broader polarity pattern should be treated as exploratory, although it is mechanistically relevant because it recurs in several forms across the dataset.

A plausible explanation for the observed differential acidic vs. alkaline solutions impact on conductivity measurements is that cosmic influences interfere with hydration shells of hydronium (H_3O^+) and hydroxide (OH^-) ions. As is well known, both of these essential water ions possess hydration shells; however, the shell of H_3O^+ is more compact than that of OH^- [79]. In acidic solutions, hydronium ions dominate conductivity, so if a cosmic influence interferes with LEIR in the direction of activating the mobility (loosening the cohesion of hydration shells or raising Grotthuss ordering of these ions) [80], one might see a positive correlation with cosmic influences. Conversely, in alkaline solutions, hydroxide ions govern conductivity [81]. It seems that the non-thermal influence from organisms impacted by cosmic factors exerts the opposite effect on these ions and their hydration shells. It could impact the shells, slowing down the propagation of proton holes (analogous to a real proton jumping in solutions with a preponderance of H_3O^+ ions) or some other propagation mechanism, resulting in a negative correlation [82]. These opposite correlations are reminiscent of hormetic behavior, in which ultra-weak environmental influences modulate coherent water-ion structures through non-thermal mechanisms [63]. This interpretation remains tentative and should be regarded as a mechanistic hypothesis generated primarily from the FDR-supported alkaline sunspot result together with the broader exploratory polarity pattern.

4.3. pH Measurements

Turning now to discussing pH measurements (**Figure 3**), the most robust pH finding is the negative correlation between lunar illumination and pH effects in acidic receiver solution, which remained significant after FDR correction. A positive association between lunar illumination and alkaline pH effects was also observed at the level of statistical trend before FDR correction. Together, these findings suggest a possible polarity away from neutral pH, but only the acidic lunar association should be treated as confirmatory within the limits of this pilot dataset. To understand this possible influence, it is useful to recall that, in acidic and alkaline solutions, the local activity of H_3O^+ or OH^- ions within their hydration shell governs acidity or alkalinity (Equation (1)).

$$\alpha\mathrm{OH}^- = \gamma\mathrm{OH}^- \times \left[\mathrm{OH}^-\right], \alpha\mathrm{H}^+ = \gamma\mathrm{H}^+ \times \left[\mathrm{H}^+\right] \tag{1}$$

here, alpha (α) stands for ion's activity and gamma (γ) for activity coefficient [83].

Therefore, focusing on lunar illumination (**Figure 3**), the FDR-corrected acidic result is consistent with a greater lunar illumination percentage corresponding to a lower pH effect value, *i.e.*, an enhancement of acidity in the exposed-versus-control difference. The alkaline trend points in the opposite direction, but because it did not survive FDR correction, it should be interpreted as exploratory support for the polarity hypothesis rather than as an independent finding. One possible interpretation is that lunar-related gravitational or geomagnetic modulations may alter the ambient vector potential $\boldsymbol{A}$ and thereby influence quantum-coherent dynamics in water. Specifically, $\boldsymbol{A}$-variations could affect ion mobility within coherent domains of receiver aqueous systems exposed to non-thermal influence, potentially through Aharonov-Bohm phase interactions or ion cyclotron resonance (ICR) mechanisms. Recent experimental work by D'Emilia *et al.* [64] [84] has shown that weak-field hydronium ICR results can markedly alter coherent-domain water properties, including refractive index, consistent with a specific H_3O^+ resonance frequency [64] [84].

4.4. UV Measurements

As described in the review by Yinnon, the use of UV spectrometry to analyze the state of water is a reliable indicator of the ordered state of coherent domains [84]-[86], and a UV absorption band around 300 nm was detected in a specially treated, presumably highly ordered MiliQ water [87]. In the present data (**Figure 4**), the strongest UV result is the correlation between lunar illumination and UV absorption effects in neutral receiver solution, which remained significant after FDR correction. Additional correlations involving Ap index and sunspots reached nominal significance or statistical trend (in alkaline) before FDR correction, but these should be interpreted as exploratory. The UV findings are therefore best viewed as preliminary evidence that UV absorption of the receiver solutions covaried with lunar illumination, while the broader acid-alkaline reversal suggested by some UV correlations requires confirmation in a larger, prospectively designed dataset.

4.5. Other Considerations

What, then, do the observed correlations suggest about the connection between cosmic indicators and LEIR in solutions exposed to non-thermal influence from organisms or related source systems? Within the assumptions outlined in the Introduction, the FDR-supported findings are compatible with the possibility that phase relationships among organismic or source-related fields, receiver-solution coherent domains, and external magnetic vector or scalar potential fields may modulate the detected physicochemical response. This remains a theoretical interpretation of covariation, not direct evidence of a causal pathway.

Historically, Piccardi's large-scale multi-year experiments demonstrated that even simple aqueous precipitation reactions exhibited synchronized fluctuations across globally distributed laboratories, tightly tracking solar flares, geomagnetic storms, ionospheric disturbances, and the sunspot cycle [48] [50]. His D-experiments—standardized aqueous precipitation experiments employing activated water and controlled exposure to cosmic conditions, performed repeatedly over long-term experimental series—showed a persistent annual minimum in March, which he attributed to the Earth's spiral motion through the heliospheric and galactic fields, suggesting that coherent water structures may be susceptible to variations in cosmophysical vector potentials [50]. These observations offer an early empirical precedent for the type of ultra-weak, field-sensitive water dynamics observed in the present study.

If we examine the cosmic factors, then the geomagnetic field originates primarily in the Earth's outer fluid core through dynamo processes. At the same time, short-term variations arise from electric current systems in the ionosphere and magnetosphere, and long-term secular variations result from changes in the core dynamics [47] [88]. Sunspots, for instance, influence not only the geomagnetic field but also electromagnetic and electric fields [89] [90]. Geomagnetic oscillations show multi-scale variations, from micro-pulsations and lunar tidal components to diurnal, seasonal, and decadal (solar-cycle) fluctuations, as outlined by

Bianchi and Meloni [91]. At the altitude of our experiments (300 m) and in the absence of strong solar flares, these effects are very subtle, and their physical strength is reminiscent of the solar-independent oscillations observed in the behavior of the geomagnetic field [92]. However, since the origin of life, organisms have not been exposed only to solar flares (stemming from sunspots) but also to more massive solar storms, which have already validated effects on organisms [45]. It is known that solar storms affect Schumann resonances [93]. Other authors reported a statistically significant reduction in HRV and alteration of HRV endpoints due to geomagnetic field (Ap index) oscillations [94]-[96], as well as increased risks of myocardial infarction, acute coronary syndrome, and stroke [97] [98], a raised frequency of suicides [99], and sudden infant death syndrome [100]. Therefore, we can expect a relatively high influence of solar activity on coherent water domains of organisms. This is corroborated by the far more conspicuous effects in alkaline receiver solutions than in acidic solutions, which may reflect the preponderance of mildly alkaline organismic fluids of the tested organisms (**Figures 2-4**).

The moon also affects known physical fields. We are all familiar with gravitational influence, which is manifested in the tides of the sea. But the moon's gravitational interaction with the Earth can have an indirect effect on the Earth's ionosphere and the geomagnetic field [101] [102]. It can cause tidal effects in the ionosphere, which affect the propagation of radio waves, especially during certain phases of the lunar cycle. Therefore, all three studied cosmic sources have some subtle, but still conventionally measurable effects on magnetic and electromagnetic fields, as a study conducted on conductivity of water if exposed to a weak magnetic field has already shown [103].

Focusing on magnetic field oscillations (common to all three factors), variations related to the lunar cycle may differ by up to ±2 nT [104], though they can be as small as 0.01 nT. The other two factors exert a somewhat larger influence, ranging from 10 to 100 nT [74]. From the perspective of conventional physics, such weak fields are typically considered insufficient to cause any noticeable changes in measurable properties of water, such as conductivity, ORP, pH, or UV absorption, as these parameters are generally much more dominated by chemistry and temperature. However, as early as the late 19^{th} century, Svante Arrhenius reported correlations between lunar phases and several phenomena—including births, deaths, epilepsy, menstruation, and atmospheric electricity [105]. Eighty years later, Lieber confirmed many of these observations [106]. Moreover, research has shown that some blind individuals synchronize their biological rhythms to the lunar cycle rather than to daylight [107].

Further mechanistic support for the sensitivity of aqueous systems to weak magnetic fields comes from a special study of Belousov-Zhabotinsky reaction involving oxidation of trivalent cerium by bromate. Agulova *et al.* showed that a very weak, low-frequency magnetic field accelerates the fast stage of this reaction and shortens its duration, whereas the addition of hydroquinone, a radical scavenger, has the opposite effect [108]. Notably, when both the magnetic field and hydroquinone are applied simultaneously, no significant result is observed, indicating that the mechanism of the magnetic field's action is radical-mediated [108]. Although the experiments were conducted in an acidic medium and did not explore pH-dependent variations, the results clearly demonstrate that weak magnetic fields can modulate water-based reaction dynamics through radical-sensitive pathways.

To summarize the common thread of the discussions, the observed FDR-supported and exploratory patterns are compatible with an influence related to magnetic or electromagnetic oscillatory context, since the Ap index directly reflects geomagnetic activity, while sunspot activity and lunar illumination can be associated with changes in the ionosphere, magnetosphere, or related field conditions. Small oscillations in the Earth's geomagnetic field, whether endogenous or driven by solar-wind fluctuations or lunar tidal cycle, may perturb the coherent oscillations of water domains by modulating the electromagnetic vector potential, $\boldsymbol{A}$, within which these domains exist. According to the Preparata-Del Giudice model [17], coherence domains in liquid water arise when a critical density of molecules collectively occupies a single quantum state, oscillating in phase at a characteristic frequency. Minute variations in $\boldsymbol{A}$ alter the boundary conditions of the electromagnetic field experienced by the water, thereby inducing phase shifts in the domain oscillations.

Even when the magnetic field intensity change is on the order of nanoteslas (nT), the associated variation in the vector potential extends over macroscopic distances. In the Preparata-Del Giudice coherent-domain (CD) framework, the relevant coupling is phase-mediated rather than energy-mediated. The phase of each coherent domain depends on the electromagnetic gauge potential, and even small variations can introduce relative phase shifts.

Importantly, the aqueous system is not considered as an isolated single CD, but as a matrix of mutually coupled coherent domains forming a mesoscopic network [25]. In such a network, coherence is maintained through phase locking between neighboring domains. A spatially extended perturbation of the vector potential does not act locally on a single domain; rather, it perturbs the global phase relationships across the coupled ensemble.

Because synchronization in coupled oscillatory systems can be sensitive to small phase perturbations—especially near dynamical thresholds—even weak, spatially extended changes in vector potential may slightly shift collective phase alignment. The effect is therefore not determined solely by the flux enclosed by an individual ~100 nm domain, but by how a distributed phase perturbation influences the stability and synchronization of the entire CD network.

Thus, while the magnetic energy associated with nT fields is extremely small, their extended vector potential may, in principle, modulate collective phase relations within a coherently coupled domain matrix, potentially nudging the system away from perfect synchrony without requiring large local flux values.

Such phase modulations could transiently modify the domain's energy gap and, consequently, their physical properties, such as dielectric constant, refractive index, or redox potential, potentially accounting for the subtle physicochemical differences observed in bottled receiver solutions. Related work within ICR research suggests that weak-field interactions at the hydronium ion resonance frequency can alter coherent-domains-bound properties of water, resulting in changes in conductivity, pH and refractive index [64] [86]. Similar investigations have reported ICR-based effects involving resonant frequencies of essential cations and amino acids in organisms [84]. This theoretical background offers a plausible, but still unconfirmed, mechanism by which weak cosmic or terrestrial magnetic oscillations could couple to the quantum-coherent structure of water and produce measurable physicochemical changes.

Given its pilot-scale scope, our study raises questions that only more systematic, targeted research can address. In organisms, the hydration matrix is embedded within a hierarchy of highly ordered biomolecular structures. Fröhlich first proposed that polar macromolecules can sustain long-range coherent dipole oscillations [109] [110]; later QED extensions by Del Giudice, Vitiello, and collaborators showed that these collective electromagnetic modes can phase-lock to coherent water domains [111]. Such coupling offers a possible pathway by which weak external perturbations, including geomagnetic and solar-lunar variations, could influence intracellular chemistry in living beings and thereby contribute to changes detected in locally exposed receiver solutions.

5. Conclusions

In the presented pilot study, we referred to relatively little-known research on cosmic factors affecting organisms and water. In our study, we combined all three, examining how cosmic factors work on the interaction between organisms and water. The research corroborated the findings of other authors, namely, that cosmic factors, which predominantly impact geomagnetic oscillations, can have noticeable effects despite their extremely low intensities. We found:

- Some conspicuous correlations between water physicochemical properties exposed to organisms (or their transmitted molecular information) and cosmic factors, though different organisms.
- Differential influence on alkaline and acidic water solutions that indicate direct or indirect interaction between organisms' potential field, cosmic factors (that may be regarded as a subtle change in the environmental magnetic field or potentials), and water ions.
- From the standpoint of conventional physics, the magnitudes of these cosmic influences appear too small to directly account for the measured effects, suggesting that cosmic factors, while mostly perturbing the geomagnetic field, likely act via magnetic field oscillations or associated changes in the vector potential $\boldsymbol{A}$ and electric scalar potential V, as we stated in our assumptions.

Whether the LEIR is just a complex interaction of the already known potential fields like $\boldsymbol{A}$ or V, or it is about some other physical mechanism, remains an open question. Addressing these possibilities will require systematic and targeted follow-up studies. They can shed new light on both the nature of the LEIR and the importance of cosmic influences for healthy human life and various complementary healing practices.

As a guide for further research, especially when it comes to differences between the effects on acidic and alkaline solutions, a model of basic CDs can be used, where the surface in a neutral solution is electronegative, with an excess of electrons (actually, their donor). A basic solution is electron-neutral but has a relatively high concentration of negative hydroxide ions in its bulk phase, while an acidic solution has an excess of positive hydronium ions. Future studies should utilize time-resolved spectroscopy and targeted frequency sweeps to test whether external vector potential modulations act as an initial, transient phase trigger that shifts the kinetic thresholds of these hydronium and hydroxide networks, leaving behind the stable, macroscopic chemical remnants observed in this pilot study.

Declaration

The Emerald Gate Charitable Trust did not take part in writing the article and analyzing the results.

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Author Contributions

Conceptualization, I.J.; methodology, I.J; formal analysis, I.J., L.O., and J.P.; data curation, J.P.; writing—original draft preparation, I.J., L.O., and J.P.; writing—review and editing, I.J., L.O., and J.P.; visualization, L.O.; supervision, I.J.; project administration, M.S. All authors have read and agreed to the published version of the manuscript.

Conflicts of Interest

The authors declare no conflicts of interest.

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