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Highlights

- The Scope of Science
- Vegetable Fields by Spectroscopic
- Moscow Residence Permit
- Characteristics in Aluminum Alloys

Discovering Thoughts, Inventing Future

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Photosynthetic Study of the Effects of Some Weeds in Rice and Vegetable Fields by Spectroscopic and Multimodal Technique in Yamoussoukro (Ivory Coast)

By Mama SANGARE, K. BERTHE, I. TRAORE & O. K. BAGUI
Institut des Sciences Appliquées

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Furthermore, the phytopathological approach by multimodal spectroscopy is an actuality method allowing particular to detect pathogenic diseases in real-time to monitor their development early and consider preventing their spread.

The aim of this research is the study of effects caused by weeds according to the phenomenon of photosynthesis influencing the yield of fields of rice and vegetable crops. The multispectral transmission, reflection, and scattering microscope has been used for image acquisition in the ultra-violet to the near-infrared band.

Keywords: photosynthesis, weeds, spectroscopic and multimodal analysis, yamoussoukroivory coast.

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Photosynthetic Study of the Effects of Some Weeds in Rice and Vegetable Fields by Spectroscopic and Multimodal Technique in Yamoussoukro (Ivory Coast)

Mama SANGARE [α], K. BERTHE [σ], I. TRAORE [ρ] & O. K. BAGUI [ω]

Abstract- Optical spectroscopy has been in full expansion for several years for sustainable development, which is a challenge impacting the agricultural sectors.

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Through the microscopic images obtained, the average intensities of the pixels of an area of the image have been evaluated to reconstruct their corresponding spectrum to proceed with a study of their wavelength-by-wavelength optical property. The results obtained by the adopted multimodal technique highlighted the influence of weeds on rice and vegetable plants in the ultraviolet, visible, and near-infrared range in Yamoussoukro in Côte d'Ivoire; also estimating their chlorophyll level at specifique wavelengths.

The development of spectroscopic and multimodal analysis methods has mainly contributed to the diagnosis of certain weeds, which are; among others, *Boerhaviadiffusa*, *Echinochloastagnina*, *Mimosa pigra L.*, *Euphorbia heterophylla*, *Perotisindica*, *Lepto-chloacarulescens*, *Imperata cylindrical*, and *Cassia Mimosoideae*.

Keywords: photosynthesis, weeds, spectroscopic and multimodal analysis, yamoussoukroivory coast.

I. Introduction

In the Ivorian food security policy, agriculture is a challenge in sight to respond to the needs of interior consumption [1]. In recent years, studies of pest and agronomic control methods against weeds have focused on the Ivory Coast between 1968 and 1980 [2].

As a result, weeds have been poorly controlled due to their abundance and resistance in crop fields despite the efforts of other researchers [3, 4, 5]. These constitute a threat on the most rice and vegetable crops. The preventive measures adopted by microbiologists and agronomists require other complementary studies based on optical spectroscopy to eradicate these devastators.

Thereby, the establishment of research to improve weed detection tools are needed to develop new control methods. Moreover, to achieve the objectives of sustainable development to improve the yield of the crop production in Africa, particularly in developing countries, optical spectroscopy is considered one of the most promising recent techniques; to effectively prevent and control weeds and other various pathogenic diseases that may slow down the harvest of farmers' fields. Optical spectroscopy, already in use in some African countries for several years, has been the object of medical diagnosis through agriculture [6].

However, the application of optical spectroscopy on weeds rests a multidisciplinary study undeveloped by scientific researchers in Ivory Coast and elsewhere. Thus, to limit the impact of weeds on agricultural production, effective collaboration between local and external researchers has been necessary to carry out this scientific work. It is within this framework; the present research project has been carried out by the Institute of Applied Sciences (ISA) of Bamako-Mali, the Faculty of Sciences and Techniques (FST) under cover of the University of Technical Sciences and Bamako Technologies (USTTB) and the National Polytechnic Institute Félix Houphouët Boigny (INP-HB) Yamous-soukro/Ivory Coast; to achieve the desired objective.

The technique developed has been used to carry out a photosynthetic study of the optical properties of certain weeds in transmission, reflection, and diffusion mode and their micro-spectroscopic spectra from measurements by multispectral microscopy in any culture medium tropical all over Africa. The goal is to show the innovation of our technique to characterize the different weeds in the fields of rice crops and those of

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vegetable crops and making a study of their effect from the spectral data of the microscopic components in terms of concentration in chlorophylls.

II. Methodology and Materials used

a) Sampling

In a field of crops in Yamoussoukro, the sampling took place to the north and in lowland to the south of the Institut National Polytechnique Phélix Houphouët Boigny (INP-HB) by selecting certain weeds likely to cause effects on market garden plants and rice crops. The field trip has been supervised by the Plant Pathology and Biology Laboratory of the INP-HB. During this prospecting, eight (8) samples have been collected, including six samples of selected weeds attacking market garden plants (*Boerhaviadiffusa*, *Mimosa pigra L.*, *Perotisindica*, *Leptochloacarulescens*, *Imperata cylindrical*, and *Cassia Mimosoideae*) and two samples of weeds attacking rice crop fields (*Echinochloastagnina* and *Euphorbia heterophylla*).

b) Methodology and strategy for data analysis by multimodal spectroscopy

The data acquisition system is described in [7, 8]. The classique light sources have been removed and replaced for all modes by a set of 13 LEDs with wavelengths ranging from 375nm to 940nm. The initial mechanical eyepieces are substituted by a 12-bit CMOS monochrome camera (2592x1944, Guppy - 503B, Vision Allied Technology, with an MT9P031 micron / Aptina sensor), with a pixel size of 2.2 μm x 2.2 μm, which has been used to acquire images.The system automatically obtain a total of 39 spectral images (13 images per mode) for the same scene, using a data acquisition card (NI-DAQ) coupled to a computer, which controls the current intensities for fine adjustments.

In addition, the transmission, reflection, and scattering modes are used to acquire microscopic images of each of the weeds collected according to the location targeted for sampling. The thirteen light sources are sufficient to study the optical properties of biological cells [7]. Depending on the study method, the spectra correspond to the microscopic images of the samples obtained from the Yamoussoukro / Ivory Coast.

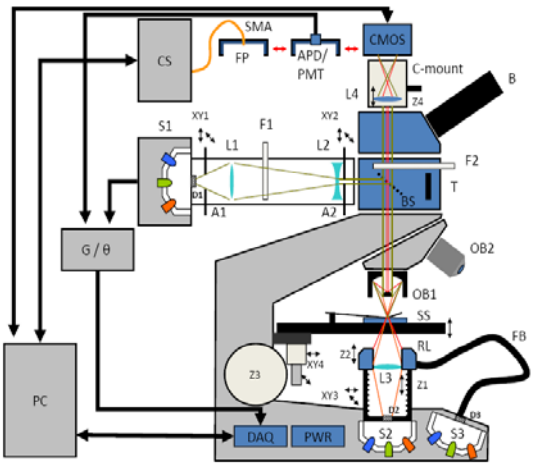

Figure 1: Photo image of the multispectral microscope

Through the images acquired of each of the sorted weeds by the multispectral microscope, the most rudimentary technique used to extract of multiple mean spectral signatures as a function of wavelengths in transmission mode, reflection mode, and scattering mode is the technique of multimodal spectroscopy analysis.

Microscopic and multimodal measurements have made between ultraviolet and near-infrared.

The transmission, reflection, and scattering spectra representative of the weed leaves areextracted after appropriate treatment of the images with the "Matlab" software.The spectra obtained represent the average distributions of the intensities transmitted, reflected, and diffused by the leaf samples of each weed (Figure 3, 4, and 5). The flow chart of the methodology is summarized as follows (Figure 2).

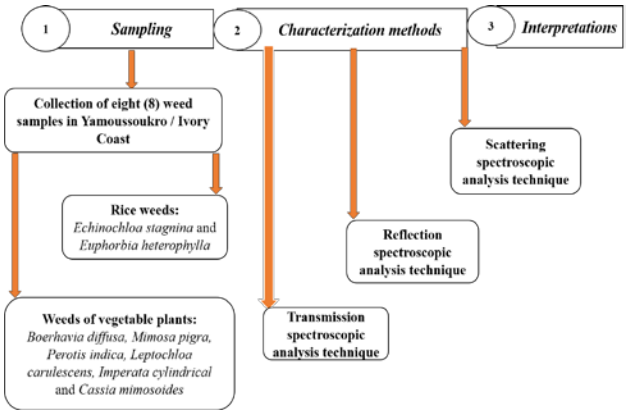

Figure 2: Methodological flowchart

III. Results And Discussion

After the data analysis, figures 3, 4, and 5 are the results obtained for each study mode according to the thirteen wavelengths ranging from ultraviolet to near-infrared.

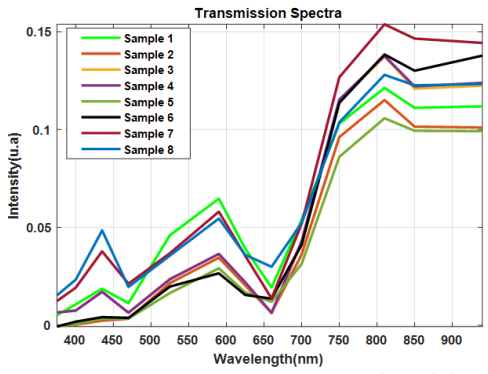

Figure 3: Average spectra of samples collected in transmission (1: *Boerhaviadiffusa*; 2: *Echinochloa Stagnina*; 3: *Mimosapigra L.*; 4: *Euphorbia heterophylla*; 5: *Perotisindica,* 6: *Leptochloacarulescens,* 7: *Imperata cylindrical and* 8: *Cassia Mimosoideae*).

The spectral distribution of the different transmission weed species (Figure 3 above) constitutes those that are likely to generally attack rice crop fields, and market garden plants in Yamoussoukro.They transmit quantitatively less UV and visible light (between 375 nm and 660 nm) in terms of intensities. It is in the visible radiation stage that photosynthesis unfold, carrying away some nutrients necessary for the plant leaves. However, the spectroscopic study in the same bands certifies that the sorted weeds behave similarly to a healthy leaf [9]. Hence, it is often difficult to visually differentiate weeds from certain crop plants (rice fields, for example).

In addition, a leaf that transmits less visible light absorbs a sufficient amount of chlorophyll,playing the process of photosynthesis to provide more nutrients to crops. Thus, the effect of these weeds has not to influence on rice crops and vegetable crops; hence they resist better by strengthening these cultures.

On the other hand, these same species transmit the maximum infrared wavelength with an insufficient concentration of chlorophyll to not effectively play the phenomenon of photosynthesis. That often causes yellowing and wilting of these weed species by attacking rice leaves and vegetable plants in fields.It is also to consider that their rate of chlorophyll concentration varies from one electromagnetic radiation (UV-Visible) to another (Near-Infrared) to play probably appropriately the phenomenon of photosynthesis using light energy. Among the weeds studied by our transmission multispectral imaging method, *Leptochloacarulescence* and *Perotisindica* have practically no influence on vegetable plants because of their high amount of chlorophyll for photosynthesis because they absorb more electromagnetic light ranging from ultraviolet to visible (375 nm to 700 nm) than they transmit in terms of intensities.But, *Imperatacylinchical* (sample 7) is considered one of the most dangerous weeds among those studied in Yamoussoukro because it transmits the maximum infrared light ranging from 660 nm to 940 nm.

Compared to the weeds *EchinochloaStagnina* and *Euphorbia heterophylla*, which influence rice crops, the spectroscopic study suggests that only *Euphorbia heterophylla* transmits less visible light during photosynthesis in a field of rice cultivation;thus, its presence will not affect on the evolution of rice.

Nevertheless, spectroscopic analysis shows that the weeds selected in our study have peaks characteristic of a healthyleaf at 660 nm with variable behavior playing the role of photosynthesis in rice and vegetable fields.Thus, despite the degree of influence of these weeds on the sampled fields, it is likely to have a good harvest depending on the growing environment.

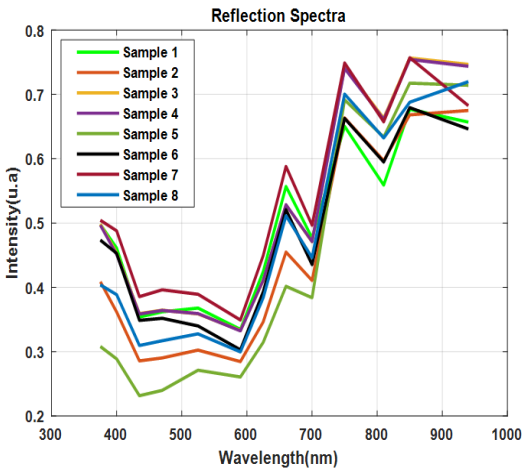

Figure 4: Average spectra of samples collected inreflection (1: *Boerhaviadiffusa*; 2: *EchinochloaStagnina; 3: Mimosapigra L.; 4: Euphorbia heterophylla*; 5: *Perotisindica,* 6: *Leptochloacarulescens,* 7: *Imperata cylindrical and* 8: *Cassia Mimosoideae*)

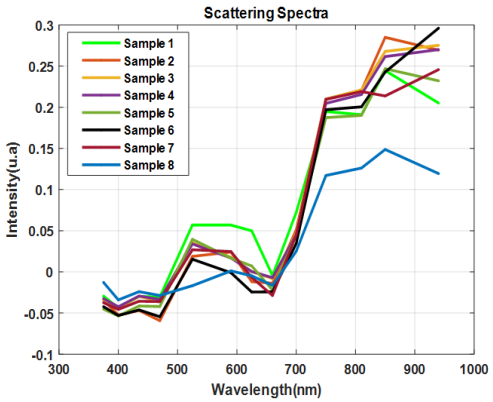

Figure 5: Average spectra of samples collected in scattering (1: *Boerhaviadiffusa*; 2: *EchinochloaStagnina*; 3: *Mimosapigra L.*; 4: *Euphorbia heterophylla*; 5: *Perotisindica,* 6:*Leptochloacarulescens,* 7: *Imperata cylindrical and* 8: *Cassia Mimosoideae*).

In reflection and diffusion, it is also to notice that these same weed species selected in Yamoussoukro reflect and scatter more ultraviolet (375 nm), visible (400 nm-700 nm) radiation than infrared (Figure 4 and 5).On the other hand, the amount of reflected light depends on what has been absorbed by the weeds.The green coloration of the leaf is a function of the degree of absorption of red light to provide the reaction of photosynthesis, at the same time, near-infrared radiation (700nm-940nm) have fully reflected or transmitted [10, 11, 12]. In this case, the spectral study of these weeds shows that they absorb the maximum of chlorophylls (a and b) to capture ultraviolet and visible light.Generally, photosynthesis does not realize in the absence of light radiation. Thus, their chlorophyll level is sufficient to receive and convert the sun's energy into certain nutrients for healthy rice growth; because some of these defense mechanisms can help save water. That is why some species of weeds stay alive to a new culture.Thus, for anwell harvest, spectroscopic information from the multimodal analysis of these weeds isimportant for growers and essential to properly monitor their behavior in crop fields.

IV. Conclusion

This research project has been realized in collaboration with other researchers, members of the Plant Pathology, and Biology Laboratory at INP-HB and the Image and Spectroscopy Instrumentation Laboratory at INP-HB.

It has been proved in this study that the reaction of weeds depends on their optical properties and the growing environment.Optical spectral analysis provides powerful insight into the biochemical content of weed samples in a wide variety of applications.

Thanks to spectroscopic techniques; the effects caused by weeds influencing the yield of rice and other vegetable crops have been studied, thus estimating their chlorophyll levels through their spectral variation in terms of transmitted, reflected and scattered light intensities.The results obtained show the potential of the proposed technique; to further facilitating the struggles of agronomists, and the biochemical analyzes in laboratories for the diagnosis of weeds in crop fields to improve agricultural production.

An added value, the scientific contribution of this research project is a complementary study on weeds in Côte d'Ivoire and elsewhere using spectroscopic and multimodal techniques, this subject is not sufficiently developed in Africa.

Acknowledgments

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Laser without a Moscow Residence Permit

By Acad. Victor V. Apollonov

Abstract- Two great physicists of our time-academicians Nikolai Basov and Alexander Prokhorov in recent interviews said that they managed to significantly advance laser physics, which they also discovered and developed. But nevertheless, it has not yet become possible to create a strategic laser weapon (LW). They passed this baton to the students. Today, assessing what was done then in the conditions of acute competition with the United States, I want to confirm the validity of what Academician Andrey Kokoshin said: "Laser technology, like space and nuclear technologies, was a powerful catalyst for the scientific and technological progress of the country." And here it is more than appropriate to recall together with the Nobel laureates another outstanding creator. This progress was made by Dmitry Ustinov, who in 1969 insisted on making an important decision to establish the NPO Astrophysics – a leading scientific center of the country focused on the development of the element base of high-power and high-energy LW and related laser technologies /1/.

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Laser without a Moscow Residence Permit

Acad. Victor V. Apollonov

Abstract- Two great physicists of our time-academicians Nikolai Basov and Alexander Prokhorov in recent interviews said that they managed to significantly advance laser physics, which they also discovered and developed. But nevertheless, it has not yet become possible to create a strategic laser weapon (LW). They passed this baton to the students. Today, assessing what was done then in the conditions of acute competition with the United States, I want to confirm the validity of what Academician Andrey Kokoshin said: "Laser technology, like space and nuclear technologies, was a powerful catalyst for the scientific and technological progress of the country." And here it is more than appropriate to recall together with the Nobel laureates another outstanding creator. This progress was made by Dmitry Ustinov, who in 1969 insisted on making an important decision to establish the NPO Astrophysics – a leading scientific center of the country focused on the development of the element base of high-power and high-energy LW and related laser technologies /1/.

I. Pushing off from Solid-State

The world laser science began its ascent to the strategic LW with solid-state (SS) lasers on glass and, obviously, will end up with a solid body when searching for structures with a minimum weight factor (kg/kW), which is important for mobile applications of high-energy laser systems for civil and military purposes. The active body in the first laser device of the American physicist Theodore Meymann. A ruby rod served as the device, created in 1960, and the excitation was carried out by optical pumping from a flash lamp. Everything, it would seem, is everyday and simple, like many other great things in this world. Time has passed, and now a recent DARPA report already says, and this is quite true, about a global change in the rules of the game after the widespread spread of "directed energy weapons", which will turn traditional symbols of military power into obsolete trash like cannonballs and cavalry. To assess the timing of the formation of the serious LW from the idea and the first prototype product to the final product, it should be remembered, for example, that strategic aviation has reached a very decent level in 110 years. So do you have a strategic LW there is still time for development. But in reality, its creation today is much faster, this is already clear from the dynamics of events. Solid-state technologies in the world have reached a level of maturity that allows the creation of the required tactical LW with acceptable weights and dimensions. When evaluating laser technologies, the key criterion today is the weight factor, which allows us to soberly judge the applicability of the complex as a mobile weapon.

II. Weight as a Priority

Comparison of the weighting factor for the gas-dynamic (GDL), electro-discharge, chemical lasers: oxygen-iodine (COIL) and hydrogen/ deuterium-fluoride (HF/DF),diode pumped alkaline metals vapor lasers (DPAL) with the same attitude for a new generation of ss lasers in the optical fiber and ceramics in the disc geometry tells about the unconditional priority of the latter. Achievement the increase in the value of the weight factor of 5 kg per kW allows us to confidently talk about equipping almost all aircraft, all rolling stock of the battlefield forces and sea-based means with tactical, and in the future, strategic law. For all the laser systems listed above, leaving the distance leading to effective tactical and strategic LW, the weight factor is significantly greater. A similar fate at this distance, unfortunately, is prepared for solid-state laser systems on rods and on slabs. Experimental models of LW complexes based on well-known laser systems, which the United States has already abandoned or is abandoning, have become a thing of the past, it became clear that it is impossible to get a light and compact law based on them. The weight factor of these systems is in the range of 200-400 kg /kW, which means that a complex with an output power of 100 kilowatts will weigh at least 20 tons and it can hardly be placed even in a heavy ATA transport vehicle. To achieve air supremacy, it is necessary to create and equip serial combat aircraft with light and compact tactical complexes weighing several hundred kilos. What can we say about more energy-intensive strategic missile systems with a range of more than a thousand kilometers. With all the effort and huge amounts of money invested, up to now, the strategic LW has not been created anywhere in the world. Finding a solution to this problem combines several important requirements. Thus, to the maximum compactness and minimum weight of the complex, the variability of the time structure of the radiation and the scalability of the average power up to several tens of megawatts are added. The whole world is in search of this physico-technical idea based on solid-state technology and its structural basis.

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III. Adding Modules does not Lead to Progress

Here it is necessary to dwell in more detail on the already created ss disk laser technology. This idea of the academician Basov is already 55 years old, but it is his principle of building powerful LC that is dominating today and in the future. With the same very advantageous factor of less than 5 kg / kW as for fiber technology, this design principle allows the implementation of a high-energy high-frequency pulse-periodic (P-P) mode, so as the aperture of the disk laser that exists today with a diameter of about 1.5 centimeters, which is much larger than the diameter of the active body of the fiber laser. To increase the average power of the system, several disks are added in an optical sequence ZIG-ZAG, the average power of such a module today is already 50 kilowatts. Modules, as in the case of fiber systems, can be built in parallel and the power is added to the target. Based on the above figures, it can be seen that a one-hundred-kilowatt laser will weigh less than 500 kilograms! The spectral addition of the modules ' radiation leads to an increase in the pulse energy in a high-frequency periodic sequence, which qualitatively changes the interaction mechanism. However, it should be noted that to perform the tasks.

The Armed Forces of the Russian Federation need LW complexes of much greater average power. Fiber laser technology is limited to the tactical level of medium power, and created in the United States with the help of the complex with a power of 300 kilowatts of spectral addition has convincingly proved this. At the same time, the disk technology that exists today, even with a module of 75 kilowatts (Lockheed Martin plans to increase this due to the quality of reflective coatings), will reach the power level of the entire system of about 10 megawatts, whether he can. It is impossible to combine the power of more than a hundred modules into a single beam of a mobile complex. It is appropriate to recall the well-known in the history of solid-state laser creativity experimental models of complexes created in the USSR, "Omega" (96 modules) and "Tandem" (60 modules) from the point of view of the feasibility of their tactical and technical parameters and reliability. It is obvious that a different constructive construction of the ss LW complex is necessary, which would allow further effective scaling of its average power while maintaining the minimum weight factor characteristic of a modern solid-state LW.

IV. Arrow and Shield Dispute

In the article "Laser spears for the defense of Russia" /2/ the discussion of the proposed new approach to the creation of a ss monomodule disk laser with a large diameter of the working fluid has begun. The article aroused great interest among laser specialists in the country, a series of meetings has already been held with a detailed discussion of the new opportunities provided by the developed technology of advanced laser systems. Emerging technologies pose new questions to the developers of defeat systems, and this in turn calls to life the improvement of already created technologies. Which once again poses difficult challenges for the creators of weapons. Such a step in solving the problems of destruction is the creation of a scalable laser source with a monomodular disk geometry, which solves two problems inherited from Academician Basov: the effective cooling of the body of a large-diameter disk and the suppression of the amplification of spontaneous emission (ASE) along its diameter. So, it is clear that mobile LW can be obtained only on the basis of new technical and technological solutions. But strategic.

There is no law yet, and in the near future a way out of the ideological impasse can only be found based on ss technology. The entire scientific world is in search of this constructive basis. We have the idea of creating it, it is analyzed in detail, numerically modeled, tested on models and is waiting for its implementation. On this basis, the entire line of light and compact LW can be obtained from hundreds of watts to many tens of megawatts.

Let me remind you that in the US, by the end of 2022, the aircraft will be equipped with a tactical LW. At significant altitudes, where MANPADS do not reach the aircraft carrier, there is no large scattering and absorption, and the range of destruction for the LW with a capacity of 100-150 kilowatts, they increase to several tens of kilometers in power mode (violation of the integrity of the structure). In functional mode (in the US, this mode is called "smart interaction») the distance of the lesion increases significantly, but there is no complete certainty about the reality of the effect of the lesion.

Further. On the basis of fiber lasers with the spectral addition of radiation from single sources in the United States, LW complexes with an average power of 30, 60, 100 kilowatts have been consistently created. The weight of the complex based on a fiber laser is brought to the level of 5 kg / kW. It is shown that with further scaling, the TTK can be reduced to 2 kg / kW, in the US, the development of an already created prototype of a laser system of 300 kilowatts and a total weight of only 600 kilograms is underway. The illusory nature of further increasing the power of such a LW in the chosen design is convincingly shown. Obviously, we need a different scheme of the ss LW complex, which allows us to would further scale its average power while maintaining the achieved weight factor. This is particularly important when equipping spacecraft with lasers, a similar task is already on the agenda in the US. According to the strategic defense plans (the fight

against hypersonic missiles) and the accumulated experience of operating already created LW on an outdated physical and technical basis, the need for creating complexes is confirmed. A LW with an output power of several tens of megawatts. A partial return to the SDI program has already been announced by the US Joint Chiefs of Staff. High-energy fiber lasers, due to physical limitations, cannot be high-frequency P-P at a large average output power due to the destruction of the fiber. The spectral composition of the radiation of these compact and light LW complexes, even in the continuous generation mode, is limited by the tactical level of average power. This is the whole limitation of fiber technology, not only the strategic level of power, but also many new exposure modes and effective applications of high-frequency P-P radiation from high-energy lasers is impossible for them.

The existing world-wide ss laser technology based on disk geometry, developed by Academician Basov at the FIAN, as well as fiber laser technology, does not allow us to solve the problem of further scaling the average power of LW complexes to strategic characteristics. The only promising and effective at the moment constructive approach to the creation of the entire line of ss LW complexes from the tactical to the strategic levels is the monomodule technology proposed in Russia (GPI RAS). It is obvious that the new aviation complex LW SHiELD created by the Americans will not only be able to defend against a missile attack, but will also become a serious threat to the objects of military equipment (OME) and enemy aircraft. Laser radiation is significantly absorbed and scattered in the desert conditions in the Middle East, where they conducted tests of tactical LW systems to combat drones. It is known that under these conditions, the beam power drops three times at every mile of the distance. And this really complicates the use of LW in conditions of high dust and humidity. But none of this is true. It follows the conclusion of some experts that the law is ineffective in principle. It is necessary to increase the capacity of the complexes and create a higher level of average power, go to other time modes of generated radiation. There are other military tasks besides destroying drones. This is the use of LW in the upper atmosphere and in space. At altitudes of seven to nine kilometers, the environment is more transparent and the target ranges for destroying OME even for a power level of 100-150 kilowatts can be many tens of kilometers. And if we are talking about the megawatt level, then it is already historical works experts from the USA and the USSR experimentally proved the reality of the range of active operation of "laser monsters" in 100 kilometers. Another thing is that all this is again a tactical range and it is necessary to continue to increase the average power of the LW to achieve a strategic level of range 1000 or more kilometers with a significant reduction in their weight and size. It is already clear that the chemical, gas, and metal vapour-based LW, with their enormous size, have left this strategic road. Now among scientists and designers, understanding dominates the fact that only the solid-state basis of the active element of the LW complex, fiber and disk geometries determine the future of the LW for almost all branches of the armed forces. The question of the range of destruction of OME in space will rest only on the optical quality of the generated radiation. But apart from the quality of the beam, there is another problem – the multi-megawatt LW complex must be put into space. For this purpose, in the US, the emphasis is on creating a solid-state technology that allows you to provide a weight factor of 2 kg/kW and even lower. And there are still great difficulties here.

V. There is a Solution, But...

A few words about the problem of protection from laser radiation. Yes, on the football field, the goalkeeper can easily cover himself with a glove from an annoying fan with a laser pointer. But with a laser power 30 kilowatts this trick will not pass. Drones in the Middle Eastern sky were burning at a distance of 1.5-2 kilometers. But these were toys in comparison with modern multi-ton drones made of titanium and aluminum alloys. Here, even 100 kilowatts of continuous radiation at tactical distances in the power mode of destruction may not be enough. But in the functional high-frequency I-P mode, it will be more than enough. This is a mode in which the laser energy is released as a sequence of short pulses with a high repetition rate. At the same time, the peak power of individual pulses is hundreds or thousands of times higher than the average power of the same LW in the normal continuous generation mode. Leading experts in the field of creating high-power high-frequency P-P lasers and the authors of the patent they are employees of the GPI RAS, who worked under the leadership of Academician Prokhorov. The same team proposed and experimentally tested a laser engine based on the mechanism of a high-frequency optical pulsating discharge and obtained record-breaking characteristics of the engine thrust. Using a high-frequency IPP laser, an intense and frequency-varying sound in the far zone is obtained, containing up to 20 % of the laser energy, a conducting channel with a minimum resistivity is experimentally implemented, the possibility of its scaling to significant distances and the reality of such a highly conducting channel, including in a vacuum, are shown. These new-old technologies-P-P mode with a high pulse repetition rate (more than 10 kHz) and a monomodule disk-are perfectly combined in a single laser complex. In particular, we, in addition to the experimental demonstration of the mode at level 10 kilowatts and cutting of metals, glass and composites, theoretically shown to be highly effective for the destruction of space

debris, cutting the ice of the Arctic Ocean and much more. Thus, the increase in the level of laser output energy and the use of new time modes of radiation generation allow us to confidently look at the problem of overcoming protection from laser radiation. Once again, we note that the simple summation of radiation on the target (purely geometric from various sources) is inefficient for a number of reasons. The most, if not the only, promising approach for solid-state technology is to obtain a single laser beam of radiation in a single resonator with a single large-diameter disk element. It is with this approach developed by us that it is possible to solve the problem of scaling the average power of the LW complex to many tens of megawatts. And this is the goal to which LW creators all over the world have been striving and are striving. Only in this case can the most complex problems of the Russian Aerospace Forces be solved, which are now being brought to the fore due to the strategic plans of the US, which continue to strive for world domination.

VI. Conclusion

I will repeat once again what I already said in the article " Laser spear for Russia" /2/ unfortunately, the country has created a monopoly on the development of high-energy tactical LW, there are no serious advances in the development of solid-state technology yet. In the US, more than a dozen enterprises have already been created to solve the problem of tactical and strategic LW and its element base for all branches of the armed forces, including space. Therefore, the policy of concentrating material resources in one laser center located at a distance from the qualified personnel of the capital seems erroneous. In a similar situation scientists in Moscow and St. Petersburg are deprived of the opportunity to effectively participate in the creation of new samples of high-energy LW. And the creation of a new galaxy of engineering and technical craftsmen is a long process, and there is no time for their training. The placement of laser centers and their branches on this topic is advisable in these cities or in their suburbs. Despite the prohibitions established by the international community, LW by the efforts of the US, it will be launched into space after equipping the aircraft with tactical LW. In accordance with the doctrine of the National Space Policy of the US, the right of Americans to extend their sovereignty to outer space is proclaimed. An important place among the possible types of effective means of fighting in space and in the air is given by American strategists to space-based air defense systems, with special attention being paid to the destruction of hypersonic missiles. The strategic level of power will be provided only by the monomodule disk geometry of the active element of the LW complex. Exactly this way the project, initiated jointly with academicians N. Basov and A. Prokhorov, has been promoted by us for many years. To ensure it, it is necessary to urgently create a target organization and urgently, even ahead of the creation of the element base of such solid-state monomodule disk drives.

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Relationship between Temperature and the Holding Force of an Electromagnet in a Changing Magnetic Field

By Ana Lorena

Abstract- This quantitative research study was conducted to illustrate the relationship between temperature and the holding force of an electromagnet in a changing magnetic field. To answer this question, an electromagnet was connected to the direct current while being heated to different temperatures, so as to observe at what temperature a nut attached to the electromagnet would fall off. The results showed that with an increase in the electromagnet's temperature a lower attractive force is noted. The results also revealed that this relation is linear. The implications of this study could be used to design more energy efficient electromagnets.

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Abstract- This quantitative research study was conducted to illustrate the relationship between temperature and the holding force of an electromagnet in a changing magnetic field. To answer this question, an electromagnet was connected to the direct current while being heated to different temperatures, so as to observe at what temperature a nut attached to the electromagnet would fall off. The results showed that with an increase in the electromagnet's temperature a lower attractive force is noted. The results also revealed that this relation is linear. The implications of this study could be used to design more energy efficient electromagnets.

To what extent does the increase in temperature of an electromagnet, specifically a coil of wire wound on a ferromagnetic core, affect its holding force?

I. Introduction

The explanation of the phenomena of the universe can be reduced to four fundamental forces: the weak nuclear force together with the strong one, the gravitational and the electromagnetic ones. From these, all others are derived. In particular, research in the field of electromagnetics has given way to a large number of technological advances. His study took a radical turn in the mid-nineteenth century thanks to the work of the Scottish physicist, James Clerk Maxwell, who unified the two laws of Gauss, Ampère's law, and Faraday's law with four equations. Thus, Maxwell demonstrated that electricity and magnetism are part of the same phenomenon (Schombert, 2021).

The study of electricity is concerned with the phenomena related to the presence of electric charge in matter and its movement. Electric charges have fundamental characteristics: they are conserved, they are quantifiable and they correspond to an antiparticle, whose properties are opposite except for those where there are no opposites, such as mass. It is important to emphasize that the charges are scalar quantities because they do not point in one direction and the term conservation refers to the fact that in a closed system there is no change in the total electric charge (García, 2020).

On the other hand, magnetism arises from magnetic fields, generated by electric currents or by the magnetic dipole moment. This, in turn, is the property of magnetized matter, either induced or because it is a permanent magnet, which gives it its orientation when subjected to a magnetic field (Schombert, 2021). It is extremely important to emphasize that the existence of magnetic monopoles has been hypothetically proposed, however, this theory has not been verified (Brilliant, 2021).

The question that will guide the focus of this research is:

To what extent does the increase in temperature of an electromagnet, specifically a coil of wire wound on a ferromagnetic core, affect its holding force?

In this way, throughout this writing, the effects that the rise in temperature of an electromagnet has on its retaining force will be explored and the hypothesis that has been formulated in this regard is indicated in the next section.

a) Hypothesis

When a direct current passes through a conductor it produces a surrounding magnetic field. If a coil of wire is wound on this conductor or the current through it is increased, the magnetic field intensifies and along with it, its stored energy. Since the existence of a net magnetic force on objects in the vicinity of the electromagnet depends on the magnetic field being non-uniform, the force can be calculated from the change in energy associated with the magnetic field with respect to displacement. But, if the temperature of the coil is increased, the resistance of the wire will increase due to its positive temperature coefficient. Given the inversely proportional relationship between current and resistance, the holding force of the electromagnet will also decline, as it is directly proportional to the current. In addition to this, the fact that the alignment of the magnetic domains is disturbed by an increase in temperature implies that the magnetic effects of the coil can be affected.

In the following section, different concepts and theoretical elements, that allow a greater understanding of the phenomena associated with the research question and that could support the validity of the hypothesis, will be explained in depth.

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II. Theoretical Framework

a) Faraday's Law

If a coil of wire is in a changing magnetic field, an electric current will be induced in the wire. This happens because any change in a magnetic field, either in its magnitude, the magnitude of the surface vector, in the position of a conductor with respect to it, or its direction, originates an electric field and an electromagnetic force. However, this term has been reduced to *emf* (ε) because it is not a force but a voltage. This phenomenon is described by Faraday's law, which succinctly summarizes how the *emf* can vary by establishing that it is proportional to the rate of change in the magnetic flux. In turn, the magnetic flux is a measurement of the total magnetic field that passes through a certain area and can also be defined as the number of magnetic field lines per unit area (Haus et al., 2008). Although the concept of *emf* and voltage are similar, no charge separation is required for the former to be generated. The direction of the induced current can be determined from Lenz's Law, which indicates that the polarity of the *emf* is such that it induces a current whose magnetic field opposes the change in the magnetic field that generated it in the first instance.

In the specific case of a current-carrying coil of wire, if the geometry of the coil is kept fixed, the change in magnetic flux will depend on variations in current. The tendency of the coil or any type of electrical conductor to oppose a certain change in current is quantified with the property known as inductance, defined by the symbol L. Thus, inductance is also defined as the ratio between the voltage and the ratio change of current, and its unit is the henry (H):

$$L = -\frac{\varepsilon}{\frac{\Delta I}{\Delta t}} \tag{1}$$

Thus, if the winding has an area *A*, length *l*, a number of turns *N*, and is in a magnetic flux *B*, the *emf* $\boldsymbol{\varepsilon}$ is:

$$\varepsilon = -\frac{NA\Delta B}{\Delta t} \tag{2}$$

The magnetic field in any closed path is calculated from Ampère's circuit law, which states that the product of the elements of length and the intensity of the induced magnetic field in the surrounding space is proportional to the current flowing through the loop. In the idealized case of an infinitely long solenoid, the magnetic field is homogeneous along almost its entire length, only with the exception of its ends; thus, the bulging of the magnetic field lines at the ends can be ignored, a phenomenon also known as the marginal effect (Bae et al., 2009). This effect is observed because the magnetic field lines repel each other and, therefore, bulge when they pass through non-magnetic materials such as air, thus producing an inhomogeneous magnetic field. But if the diameter of the solenoid is much smaller than its length, it can be considered infinitely long so as to simplify calculations (Nave, 2021). Using Ampère's law and the previously mentioned approximation, the expression for the magnetic field of a solenoid is obtained:

$$B = \frac{\mu_0 IN}{l} \tag{3}$$

In (3), μ_0 denotes the permeability of free space, or the property of materials - in this case of a vacuum- to allow the formation of magnetic fields. Therefore (2) is rewritten as:

$$\varepsilon = -\frac{\Delta I}{\Delta t}\left(\frac{\mu_0 N^2 A}{l}\right) \tag{4}$$

When entering (4) in (2), the result is:

$$L = \frac{\mu_0 N^2 A}{l} \tag{5}$$

However, if a magnetic material is introduced into the solenoid, μ_0 will have to be replaced by μ, the permeability of the core and hence, its inductance increases. Since the relative permeability is the quotient between μ and μ_0, the following statements are equivalent:

$$L = \frac{\mu_0 \mu_r N^2 A}{l} \tag{6}$$

$$L = \frac{\mu N^2 A}{l} \tag{7}$$

To find the force produced by a coil's magnetic field, it is necessary to understand how the energy associated with it changes. For conservation of energy, the energy required to push current through a conductor must have an outlet. For an inductor, this output is the magnetic field. Now, in an electromagnet with varying current, such as the one that is being analyzed in the present work, it is important to consider the power required to push the current through the conductor against the voltage induced by the change in the magnetic flux. The calculations can be simplified under the assumption that all electrical energy is converted into the energy of the magnetic field and consequently, the effects of eddy currents, which dissipate energy in the form of heat, are ignored. In addition, if the air gap of the electromagnet is small compared to its cross-sectional area, it can be assumed that the field within

the air gap is uniform, so it is not necessary to take into account the marginal effects. The following equation is derived from Maxwell's equations and it is also based on the previous assumptions (Clarke, 2021):

$$F = \frac{(IN)^2 A\mu_0}{(2g)^2} \quad (8)$$

b) Magnetic domains

When materials that exhibit magnetic behaviour are in the presence of magnetic fields, structures called magnetic domains are formed within them, where different groups of magnetic moments align in such a way that they do not cancel each other out. When all or a large majority of the domains are directed in the same direction, the object becomes magnetized in that direction and it becomes a magnet. This is because the magnetic field exerts a torque that tends to align the magnetic moment (μ) with itself, which represents the smallest energy configuration such that the vector μ is parallel to the magnetic field lines and perpendicular to the current loop. Thus, the torque is given by the cross product of the magnetic field and μ, which in turn gives the characteristics of a current-carrying spiral such as its current and cross-sectional area. Importantly, the μ of an object is provided by the intrinsic magnetic moment of the electron spin and the magnetic dipole of the electron orbits.

The process in which an object is magnetized is called induction and once an object has been induced, it will produce its own magnetic field as long as its dipoles stay aligned. In contrast, an electromagnet remains magnetized only when a current passes through it. In particular, ferromagnetic materials such as iron, nickel and cobalt can become permanent magnets, that is, they will remain magnetized even after being removed from a magnetic field, but they can also present spontaneous magnetization below a temperature critical known as Curie temperature. In general, the Curie temperature for different materials is that at which a material loses its magnetic properties although in most cases it can be replaced by magnetic induction. This is because electrons have higher energies at higher temperatures, which is why the alignment of the magnetic domains is disturbed (Nave, 2021).

c) Effect of temperature on resistance

Increasing the temperature of a material alters its electrical resistance depending on whether it is a conductor or an insulator. In the case of most conductors, because of their significant number of free electrons, an increase in temperature generates a greater number of collisions between electrons, atoms, and impurities. This hinders the electrical flow, which is equivalent to an increase in resistance and, therefore, the material is said to have a positive temperature coefficient. On the other hand, insulators tend to experience a decay of resistance since having a low number of free electrons means that there are not as many collisions between them and the vibration, caused by the increase in kinetic energy, releases electrons.

First, the relationship between a certain physical property *M* and temperature is determined by:

$$\frac{\Delta M}{M} = \alpha \, \Delta T \quad (9)$$

Where delta *M* is the change in resistance, *delta T is* the temperature change, and α *is* the temperature coefficient of resistance. The expression indicates that the fractional change of the variable *M* is proportional to the product of the temperature and the coefficient already mentioned. The temperature coefficient indicates how much a physical property increases or decreases with the change in temperature (Nave, 1999). Rewriting (8) by decomposing ΔM into $M - M_o$, and ΔT into $T - T_o$, we obtain:

$$\frac{M - M_o}{M_o} = \alpha \, (T - T_o) \quad (9)$$

The terms are rearranged:

$$M = M_o(1 + \alpha \, (T - T_o)) \quad (11)$$

Thus, the temperature-dependent physical property is resistivity, which is constant under certain conditions and which determines the strength of material to material given the cross-section and length of the object. In certain cases, it is more convenient to use the inverse of resistivity, called conductivity. It is important to note that increasing the cross-section of an object decreases its resistance since there is more space for the electrons to flow with fewer collisions. On the other hand, increasing its length causes an increase in resistance since the electric potential is "diluted" over a greater distance, causing the speed of the electrons to be lower. Therefore, the resistance is directly proportional to the length and inversely proportional to the cross-section, as shown in the following expression:

$$R = \frac{\rho L}{A} \quad (12)$$

If one wants to find how the resistivity varies with temperature, one should substitute ρ in place of R and the following remains:

$$\rho = \rho_o(1 + \alpha \, (T - T_o)) \quad (13)$$

In a graphical representation of this phenomenon, resistivity is placed on the *y*-axis, as the dependent variable, and temperature on the *x*-axis with the coefficient α being the slope of the graph. At room temperature, the curve is linear and the increase in

resistivity is inversely proportional to the mean free path or the average distance that a particle travels between successive shocks that at a certain temperature is limited by the thermal vibrations of the atoms (Zední ček, Kühl & Primavesi, 2021). On the other hand, the relationship between resistivity and resistance is shown below:

$$\frac{R}{R_o} = \frac{\left(\frac{\rho L}{A}\right)}{\left(\frac{\rho_o L}{A}\right)} \quad (14)$$

If the length and cross-section remain constant, simplify the equation to:

$$\frac{R}{R_o} = \frac{\rho}{\rho_o} \quad (15)$$

Therefore, in (12) ρ and ρ_o can be replaced by R and R_o, respectively:

$$R = R_o(1+\alpha\,(T - T_o)) \quad (16)$$

III. Experiment

A brief summary of the experiment carried out will be made hereafter to enlighten the reader about how to try to find the relationship between the dependent and independent variables. To begin with, an electromagnet, which consists of a coil of wire wound in a ferromagnetic material, is connected to the direct current after being heated to temperatures higher than that of the ambient and lower than 333.15 K. Specifically, this limit was determined to avoid the risk of burns and thus guarantee the safety of the experiment. Subsequently, a steel nut is brought close to the electromagnet so that it attracts it. The current provided to the electromagnet is reduced by manually decreasing the potential difference between the terminals, in order to observe at what voltage the electromagnet no longer provides the retaining force that holds the nut and the screw together. In this way, it is intended to confirm the hypothesis that the decrease in current caused by the increase in resistance after heating of the electromagnet, generates a reduction in the magnetic flux and, therefore, also in its force.

a) Key variables

This section specifies the characteristics of the variables included in the experiment and the reasons that account for them being kept under control or being allowed to change.

i. *Constants*

Table 1: Identification and analysis of controlled variables

Controlled variable	Why is it constant?
Nut Features • material • mass • position relative to the winding	An object whose material was magnetized in the presence of a magnetic field was sought in order to measure how the magnetic effects of the electromagnet change at different temperatures, such as steel.
Winding characteristics ● geometry • core material • cable gauge	At first, it was considered to use nuts of different masses as a parameter to determine the strength of the magnet. But this idea was discarded, as there was a possibility that the nuts could be positioned differently. This would be a source of error because the intensity of the magnetic field changes in different parts of the electromagnet, as explained in the next point.
	The position of the nut was kept constant because the intensity of the magnetic field is greatest near the poles of the electromagnet and even greater within it. However, in this particular experiment, the internal part is not taken into account because a hollow electromagnet is not used.

The number of turns was not altered because a greater number of turns results in a greater force of the electromagnet. On the other hand, it was ensured that the cable was tightly wound around the core, to avoid the formation of air gaps and that this caused the dispersion of the magnetic flux, as explained in section 2.3.2. Iron electromagnets, having better magnetic properties, produce stronger magnetic fields, while steel electromagnets generate weaker fields. For this reason, if in the different attempts the type of material of the nuclei had been changed, the variation of the magnetic field could have altered the pattern of the results obtained.
Cables with different gauges will have different resistances, since resistance is indirectly proportional to cross-sectional area.

ii. *Types of variables*

Table 2: Identification and analysis of dependent and independent variables

Dependent variable	Independent variable
• Voltage value for which the electromagnet can no longer support the weight of the nut. This result depends on the temperature to which the winding is heated, since the higher the temperature, the lower the current through the wire. When the minimum current necessary to maintain a perceptible electromagnetic effect is reached, that is, before the nut is dropped, the minimum voltage will also be reached due to the direct proportionality between these two variables. The voltage was measured by first raising it to a fixed amount of 6V, chosen on the basis of the ease of joining the nut to the electromagnet. Then, the voltage was slowly reduced until the nut falled off. It is important to note that great care was taken to lower the voltage in constant intervals because an analogue power supply is used which, unlike digital circuits, is more sensitive to user movement. Consequently, if the source fails to supply the required value of voltage, the nut is no longer attracted by the electromagnet.	• Wire coil temperature Twenty-two measurements of different temperatures were made because of the considerable variability of each individual measurement. This is due, in turn, to the fact that the experimental procedure has to be done quickly to avoid cooling the coil. Likewise, it is difficult to pinpoint the exact moment when the nut falls. On the other hand, the intervals between the temperature increases cannot be accurately controlled for the reasons mentioned above. However, the experiment tried to obtain measurements for each interval of 10 K, starting with approximately 293.15 K and ending with temperatures close to 333.15 K. Having several measurements of the same phenomenon allows greater confidence in the calculation of an accurate mean measurement.
• Holding force of the electromagnet This variable is temperature-dependent for the reasons mentioned previously.	

b) Methods and tools

This section details the qualities of the instruments, tools and materials used in the experiment, in addition to indicating the steps carried out in each of the procedures.

i. *Materials*

Table 3: List and description of the materials used in the experiment

Materials	Properties
1 winding made with a	144 turn winding.
screw and copper wire	Wire with a diameter of (5.7 ± 5) × 10 -4 m.
	Stainless steel screw hex head with the weight of 12 g ± 0.0005 g length (4.9 ± 0.05) × 10 -2 m
4 alligator cables	
2 banana to alligator cables	
4 cables for multimeter	
1 vernier calliper	Absolute uncertainty of ± 5 × 10 -4 m.
1 universal bracket	
1 three-prong clamp with clip	
1 double nut belay	
1 *IRT-BTA Vernier* Infrared Thermometer	± 273 K absolute uncertainty
2 ceramic power resistors	Power of 5W and resistivity of 1 Ω
1 stainless steel hex nut	Internal diameter of (1 ± 0.05) × 10 -2 m and weight of 15 ± 0.0005 g
2 multimeters	± 0.01 V absolute uncertainty
1 heating plate	
1 HP 6236B Triple Output Power Supply	Constant voltage source with overload protection with nominal power, or maximum power, from 0 to + 6V and with a nominal capacity of 2.5A.
1 masking tape	
1 breadboard	
1 pair of scissors	
1 grain scale	Absolute uncertainty of ± 0.0005g

ii. *Experimental design*

a. *Making and assembling the winding*

1. The copper wire is wound around the screw, ensuring that the wire remains firm and leaving its two ends free on each side, with a certain length to spare.
2. The plastic covering is removed from the two ends with the scissors, taking care not to damage the copper part.
3. The winding is held firmly with the three-prong clamp.

4. The three-prong clamp is accommodated in the universal bracket and secured with the double nut.

b. *Circuit assembly*

5. The power supply is connected to the outlet.
6. A pair of alligator cables are attached to the ends of the copper wire.
7. Connect the banana tips of the red and black coloured banana to alligator cables to the positive and negative terminals, respectively, of the power supply.
8. For clarity, a distinction will be made between the two multimeters as 1 and 2. In both, the negative terminals are connected to the COM inputs and the positive terminals to the inputs with the V symbol.
9. Since direct current is used in the experiment, the range indicated by the letters DCV, the acronym for Direct Current Voltage, is selected. Also, since the nominal power goes from 0 to + 20V, the range from 0 to + 6V is chosen.
10. A connection is made in series with the resistors in some track of the breadboard.
11. The alligator tip of the red banana to alligator cable attaches to one end of the resistor configuration.
12. The alligator tip of the black banana to alligator cable attaches to the negative terminal of multimeter 1.
13. An alligator cable, in this case the yellow one, is attached to the other end of the resistor configuration.
14. The other alligator cable, the green one, is connected to the positive terminal of multimeter 1.
15. The remaining pair of alligator cables are connected to the pair of banana to alligator cables connected to the power supply terminals. Its other ends connect to multimeter leads, keeping in mind that the polarity must match. The circuit should look like Figure 1 and is illustrated in Figure 2.

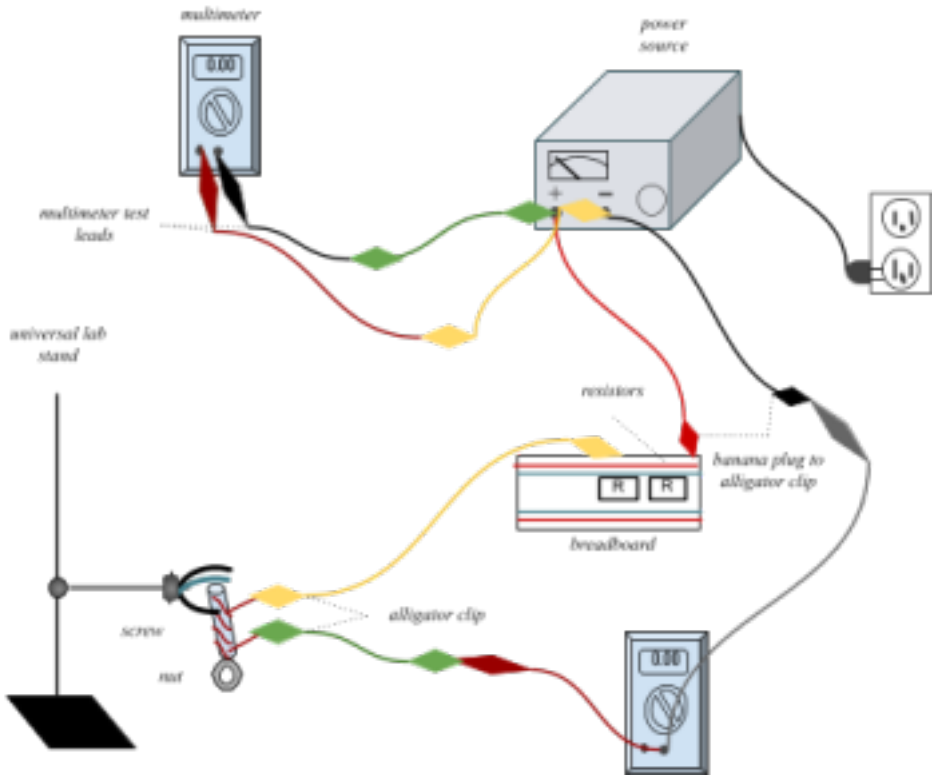

Figure 1: Device and part summary

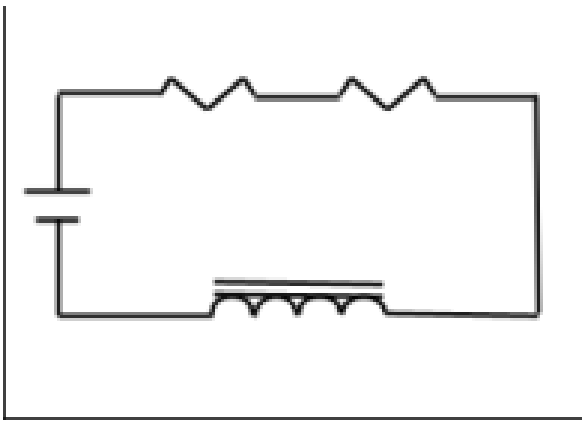

Figure 2: Schematic diagram of the circuit

c. *Carrying out the experiment*

16. The power supply is turned on.
17. The range of values for voltage and current is selected, which are 0 to + 6V and 2.5A respectively.
18. With the knobs, it is adjusted to the desired voltage, which is 6V.
19. The three-prong clamp is removed from the universal bracket and placed on the hot plate and heated at temperatures above room temperature up to 333.15 K.
20. The clamp is reattached to the universal bracket.
21. The nut is brought closer to the electromagnet and it is allowed to attach to the electromagnet.
22. The voltage is reduced until the nut falls off. The power supply is immediately turned off.
23. The temperature of the head of the screw that makes up the electromagnet is recorded with the infrared thermometer.
24. The same procedure is repeated up to 22 times. For the first attempt, keep the electromagnet at room temperature. For the following attempts, it is sought to obtain several measurements for each range of 10 K, so that different measurements are recorded for the range of 293.15 to 303.15 K, then up to 313.15 K, etc. The experimental setup is shown in Figures 3 and 4.

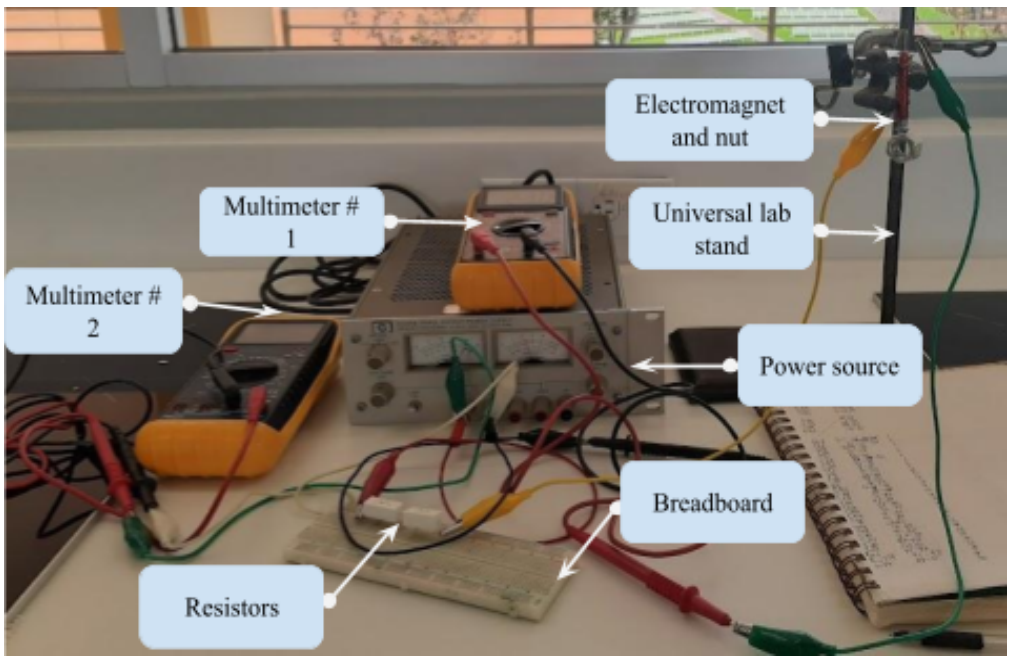

Figure 3: Experimental arrangement with the labelling of the dif erent materials

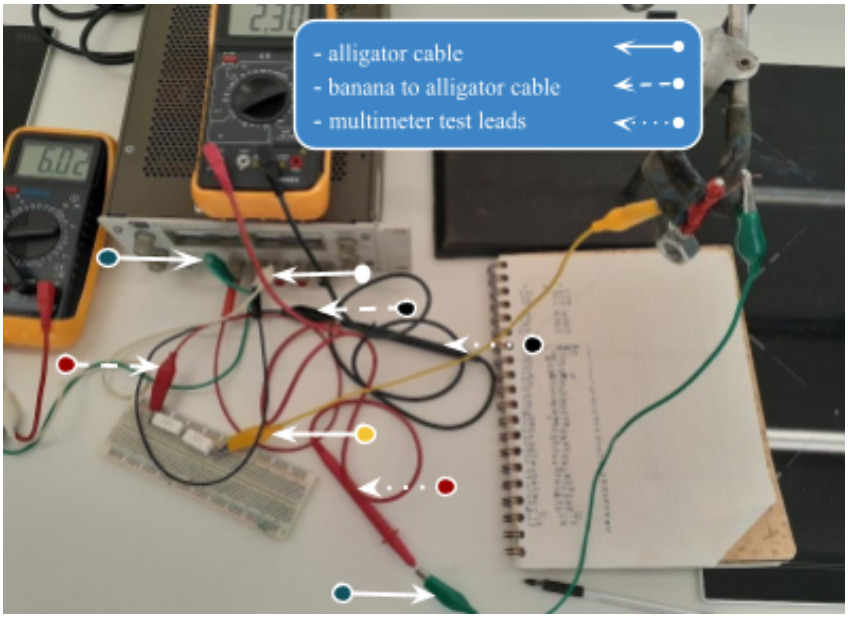

Figure 4: Experimental arrangement with the labelling of the types of cable used

IV. Data Collection and Processing

The raw data collected throughout the experiment are presented in Appendix A.

a) Results obtained

Table 4: Processed data from experimentation showing the voltages to which the nut is dropped at different temperatures

Voltage, V (V) ± 0.25 V	Winding temperature, T (K) ± 0.01K	Temperature mean, T (K)
	Maximum value Minimum value	
1.94	300 294	297 ± 3.0
1.89	303 299	301 ± 2.0
2.89	331 327	329 ± 2.0
1.95	306 299	302 ± 4.0
2.42	305 301	303 ± 2.0
2.06 2.18 2.55	306 301 305 301 323 319	303 ± 3.0 303 ± 2.0 321 ± 2.0
2.39 2.06 2.35 2.70	313 310 308 305 304 301 320 312	311 ± 2.0 306 ± 2.0 302 ± 2.0 316 ± 4.0
2.84 2.96	320 316 332 316	318 ± 2.0 324 ± 8.0
2.53	308 305	306 ± 2.0
2.31	320 314	317 ± 3.0
2.29	316 313	314 ± 2.0
2.44	317 309	313 ± 4.0

b) Data processing

Figure 5 presents the behaviour of the observed data with its respective trend line, or the line that best represents the data set. Thus, the graph shows an approximately linear increase in voltage to which the nut falls with increasing temperature. Also, the line of best fit indicates that when the temperature increases by 10 K, for example, the voltage value increases by 3.02 V; whereas the minimum voltage necessary so that the nut does not fall at a temperature of 0 K is - 6.99.

On the other hand, the coefficient of determination, also known as R squared, is a statistical measurement that formalizes the evaluation of linear regression models; that is, R squared indicates how well the variation of the dependent variable can be predicted from the independent variable and its value ranges from 0% to 100%. According to the least-squares method, the line of best fit is the one that has the minimum sum of the squared residuals, which are the deviations between the observed data and the points on the line of best fit. For this reason, the regression curve with the smallest sum of squared residuals will have a larger R squared (Sundery, 2021). For this graph, the calculation of said coefficient was carried out with the regression functions available in the Excel program and the result obtained shows that the model can explain 69% of the voltage variation. It should be noted that the coefficient of determination may not be ideal due to the variability of the phenomenon and the sources of error, which affect the precision of the model, although it does show a significant trend in the data. Regarding the error bars, the uncertainties calculated in section 5.2 were used.

In order to find a model that better fits the data, logarithmic linearization was applied, which consists of applying logarithms to the two axes of the graphs 6 and 7.

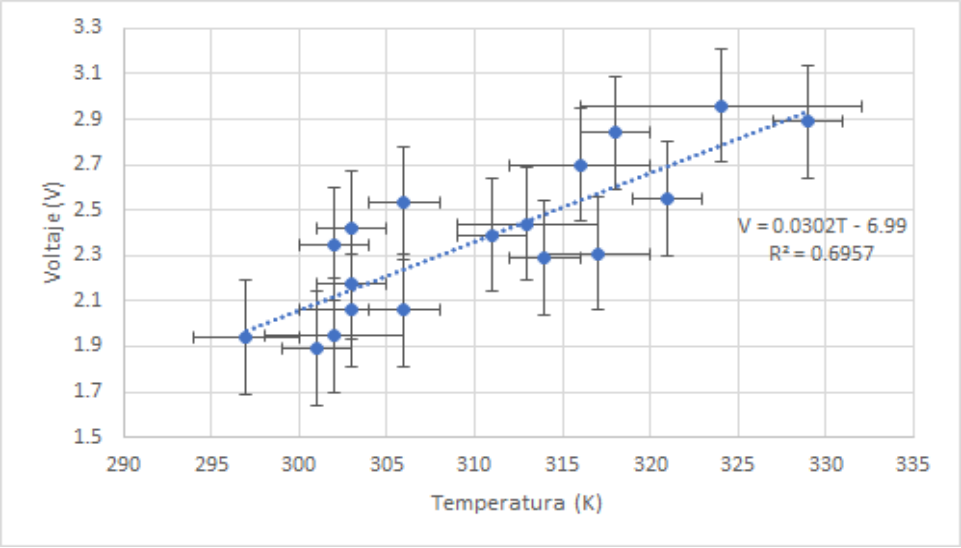

Figure 5: Scatter diagram for the relationship between voltage and temperature

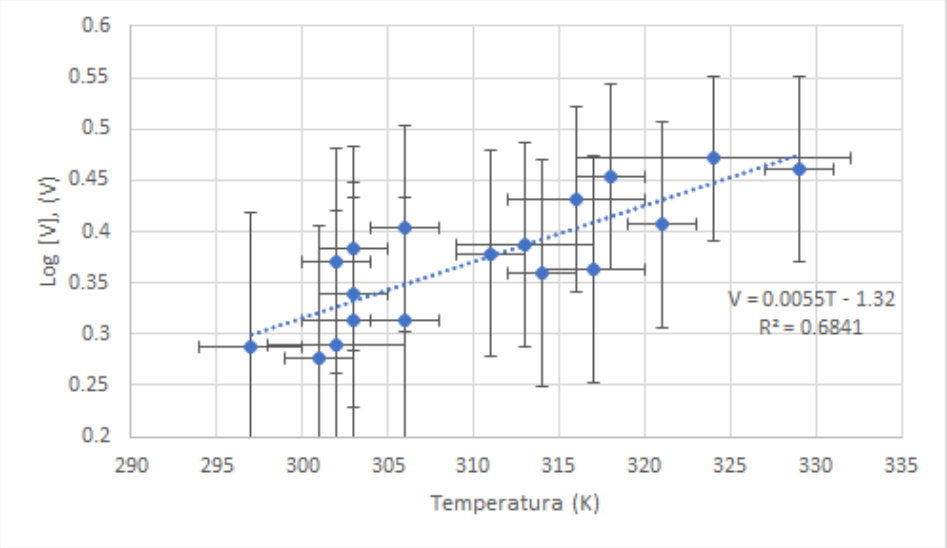

Figure 6: Scatter plot for the relationship between log [V] and temperature

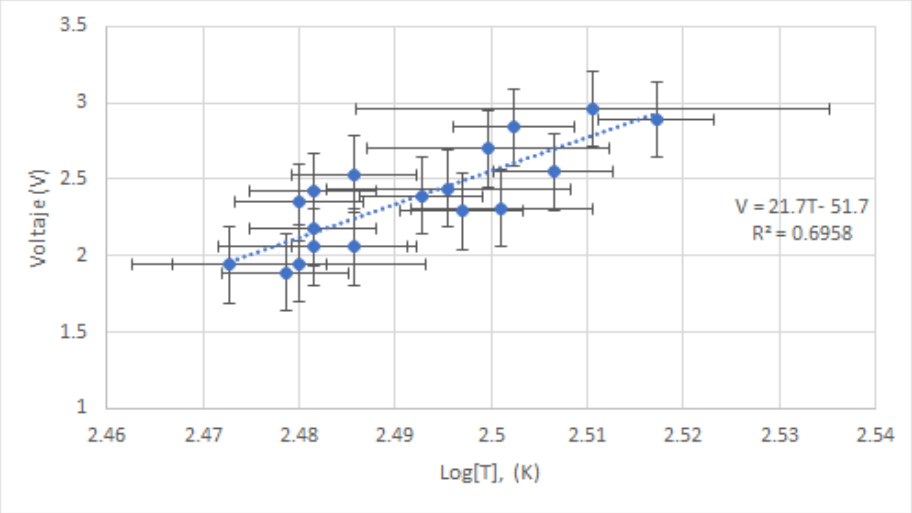

Figure 7: Scatter plot for the relationship between voltage and log [T]

V. Analysis of Results

This section delves into the possible reasons for the trends found in the collected data, as well as ways to identify the mathematical model that best adheres to the observations of the experimental results.

a) Statistical analysis of linear models

Population parameters are usually estimated from samples, and in order to know how much these differ from the real value, the confidence interval is used, which limits a range within which the population parameter can be located. According to the degree of confidence of a given confidence interval, the probability that the real one is present in a certain range of values can be known. Graphically, the degrees of confidence correspond to the area percentages of a normal curve, a continuous function that approximates the distribution of values of a variable. Likewise, it can be affirmed that a data set has a normal distribution if when graphing its histogram it can be plotted with a symmetric bell curve, such that the probability of approaching the real quantity is inversely proportional to the distance on the x-axis. In other words, the narrower the confidence interval, and thus the more precise the range, the smaller the discrepancy with the true value (Rio, 2021).

In the present work, since it is not possible to do repetitions of the experiment for every possible temperature, it is considered that the voltages registered in the experiment are only a sample of a complete population. For this reason, it was necessary to use the Python Statsmodels library, which provides functions for the estimation of numerous statistical models including confidence and prediction intervals. Through the use of this library, the confidence intervals of Figures 8, 9 and 10 were obtained; as well as the comparison of the ordinary least squares summaries presented in Table 5.

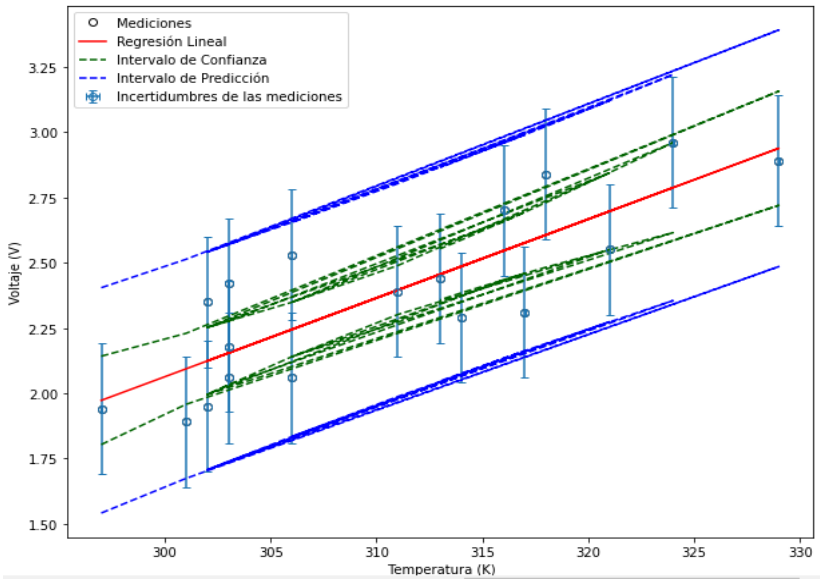

Figure 8: Confidence and Prediction Intervals in Linear Regression for the Voltage vs. Temperature Plot

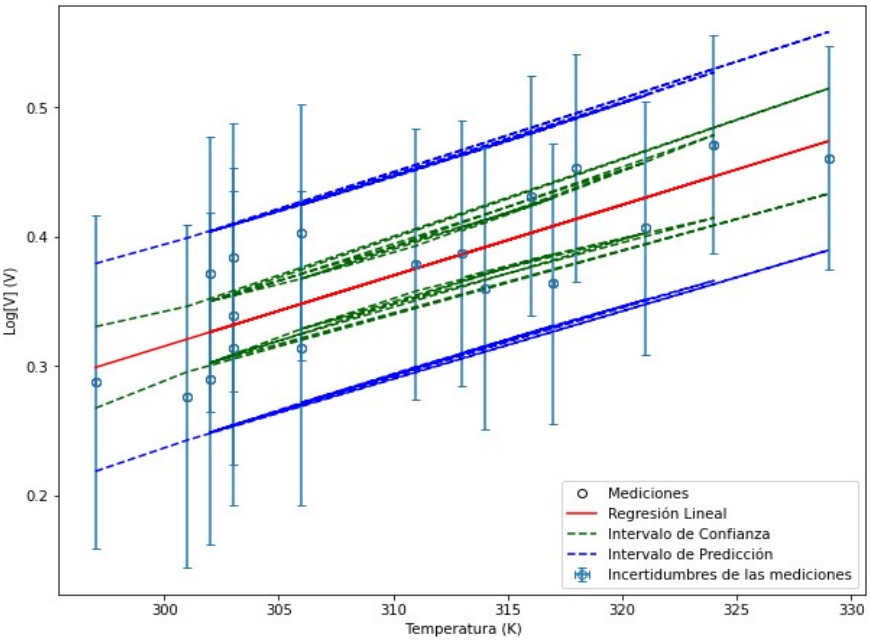

Figure 9: Confidence and Prediction Intervals in Linear Regression for the Log [V] vs. Temperature Plot

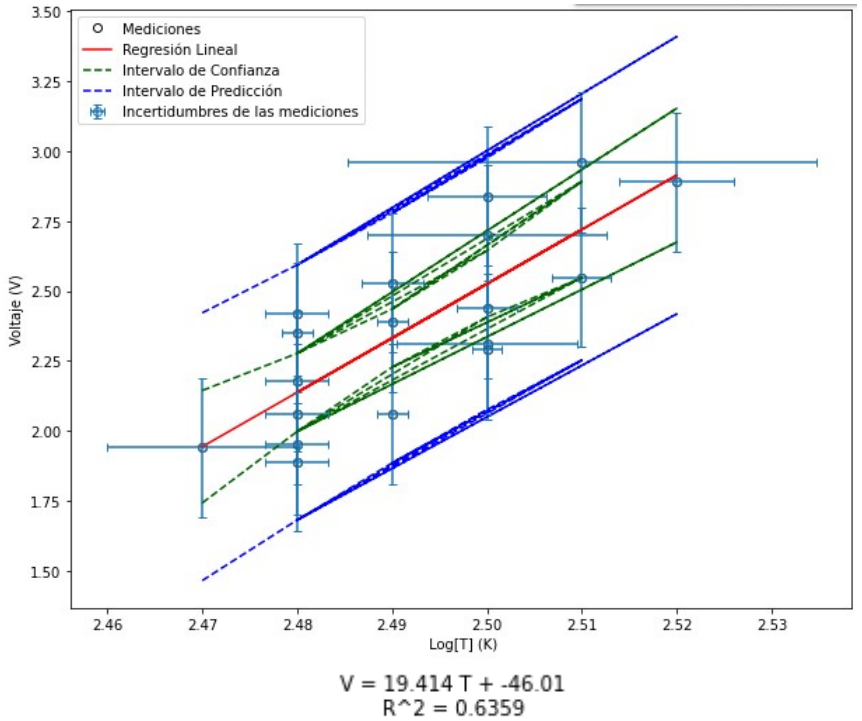

Figure 10: Confidence and Prediction Intervals in Linear Regression for the Voltage vs. Log [T] Plot

Table 5: Comparison of Ordinary Least Squares Summaries for Figures 8, 9, and 10

Graph	Adjusted R-squared	Probability of the F statistic	P-value	T value Constant Coefficient	
			Constant Coefficient		
Figure 8	0.677	1.69e-05	0.000 0.000	-4.513	6.048
Figure 9	0.664	2.30e-05	0.000 0.000	-4.594	5.886
Figure 10	0.613	7.38e-05	0.000 0.000	-5.027	5.286

Table 5 shows various tools for the analysis and examination of linear regression models. In particular, adjusted R-squared is a variant of R-squared that, unlike this other indicator, does not spuriously increase when more variables are added to a regression model. Therefore, the adjusted R squared of different models are comparable to each other even if they do not share the same number of independent variables.

On the other hand, the F-test is used mainly under the assumption that a set of data follows a normal distribution, as in the case of the present work. It is also based on the null hypothesis or the opposite statement to that found in an investigation, which states, more specifically, that the observed results occurred by pure chance and that therefore there is no correlation between the variables. Rejecting the null hypothesis and demonstrating the validity of the alternative hypothesis implies that the means of all the tests are not equal to each other. Hence the importance of the F-statistic, which is the ratio between the variation between tests and the variation within tests. Depending on how much the F-statistic differs from the critical value of F, the null hypothesis will be more or less likely to apply.

The P-value goes very hand in hand with the F-test because it is a measure to determine the possibility that the experimental results are a product of chance under the assumption that the null hypothesis is correct. Similarly, the T-value indicates how significant the difference is between experimental tests, that is, it expresses the possibility that the results happened by pure chance (Sundery, 2021).

b) Calculation of uncertainties

First, the uncertainty of the voltage is determined primarily by the reaction time to identify the voltage to which the nut falls and to a lesser extent by the uncertainty of the multimeter, since human error tends to be more relevant than instrumental ones. This can be validated by the fact that although the multimeter has an absolute uncertainty of ± 0.01 V, the readings for the same interval of 278.15 K have a range of up to 0.5 V. Knowing that the measurements cannot be reproducible within the Instrumental measurement, the uncertainty can be estimated from the range of values, dividing this by two, thus leaving an uncertainty of ± 0.25 V (College Physics Labs Mechanics, 2021). Instead, the absolute uncertainty of the minimum and maximum temperatures is given by the uncertainty of the infrared thermometer which is ± 273 K, while that of the average is obtained by dividing the range by two, as shown in Table 4.

The propagation of error due to the logarithmic transformation of the data is defined as: (17)

$$\Delta y = \frac{1}{\Delta x} \tag{17}$$

Whereas the complete result is declared as:

$$\log (x \pm \Delta x) = \log x \pm \frac{\Delta x}{x} \tag{18}$$

In Table 8, base ten logarithms are applied to each of the axes and the uncertainties of the logarithmic linearization are shown.

Table 6: Application of logarithms to the two axes with their respective uncertainties

Log[V], (V)	Log[T], (K)
0.29 ± 0.13	2.47 ± 0.01
0.28 ± 0.13	2.48 ± 0.01
0.46 ± 0.09	2.52 ± 0.01
0.29 ± 0.13	2.48 ± 0.01
0.38 ± 0.10	2.48 ± 0.01
0.31 ± 0.12	2.48 ± 0.01
0.34 ± 0.11	2.48 ± 0.01
0.41 ± 0.10	2.51 ± 0.01
0.38 ± 0.10	2.49 ± 0.01
0.31 ± 0.12	2.49 ± 0.01
0.37 ± 0.11	2.48 ± 0.01
0.43 ± 0.09	2.50 ± 0.01
0.45 ± 0.09	2.50 ± 0.01

0.47 ± 0.08	2.51 ± 0.02
0.4 ± 0.10	2.49 ± 0.01
0.36 ± 0.11	2.50 ± 0.01
0.36 ± 0.11	2.50 ± 0.01
0.39 ± 0.10	2.50 ± 0.01

c) Data cleaning

Outliers are those observations that appear to deviate markedly from the others in a sample, and consequently may be indicators of erroneous data. For example, they may be caused by errors in the experimentation process. If these do represent incorrect information, they should be eliminated, or if possible, corrected. On certain occasions, it may not be possible to identify whether the outliers are the result of errors since they could be caused by random variations of the analyzed event. Various formal tests have been established for the correct identification of possible anomalous values, among which it is assumed that the distribution is normal. However, in the present work, such methods cannot be used because they require a large sample that is considered representative of the complete data set. Therefore, another method was carried out and it consisted of graphing the recorded data and adding its trend line (Figure 5), in order to discard those values that were considerably away from it. In total, four measurements out of the twenty-two captured were discarded. The discrepancy of these was probably caused by various sources of error, mainly by measurement errors associated with the infrared thermometer, such as the inclusion of other heat sources within its field of view and the reflectivity of other bodies. It could also be caused by the sudden or rapid reduction of the voltage, as explained in Table 2, and that in some attempts the electromagnet was heated more evenly, among other factors.

VI. Conclusion and Evaluation

Through the experiment, various sources of error were found that could alter the experimental results, which are explained in detail in tables 7 and 8.

Table 7: Identification of possible random errors with their respective correction methods

Random error	Correction method
Instrumental uncertainties.	- Repetition of measurements under controlled conditions. - Comparison of the voltage readings produced by the power supply with those of the multimeters.
Variation in the heating uniformity of the electromagnet.	Selection of experimental procedures that guarantee homogeneous heating.
Sudden voltage drop. As mentioned in Table 2, the power supply, being analogue, may not supply the required voltage fast enough.	Slow voltage reduction.
Temperature recording without the power supply having been switched off immediately after the nut fell, which would lead to the electromagnet continuing to heat up during this period due to the passage of current.	The immediate shutdown of power supply after nut drop.
Reaction time to determine the moment of fall of the nut.	Increase the sample size.
Not capturing the temperature of the electromagnet in the same area. Since the heating of the electromagnet is not uniform, this would cast a shadow on the relationship between the variables.	Define a specific area where the temperature will be taken in all attempts.

Table 8: Identification of possible systematic errors with their respective correction methods

Systematic error	Correction method
Incorrect calibration	Regular calibration with an exact measurement standard.
The field of view of the infrared thermometer is larger than the screw head, where all temperatures were taken. Consequently, the readings may include other sources of heat.	Fix the thermometer in a position that is oriented exactly towards the screw head.
Delay error, which refers to the time it takes for certain instruments to reach their equilibrium state, as in the case of the thermometer.	Take measurements until instrument reading is stable
Positioning of the electromagnet.	Hold the electromagnet steady with a laboratory clamp

From the graphs obtained in section 4.2, it can be seen that the regression coefficients between them vary very slightly, with graph 7 being higher than graph 5 by just one-thousandth more, therefore, the comparison of this indicator alone does not allow us to definitively find the model that best suits the observed data. Therefore, it was necessary to review the tools for the examination of linear models presented in Table 5. First, contrasting the adjusted R-squared of each of the graphs is more correct than comparing R-squared because the latter increases automatically with the inclusion of more variables, even if they are insignificant. In addition to this, a larger adjusted R squared implies a smaller deviation between the model and the data. For this reason, figure 8, which corresponds to the graph of voltage versus temperature, has the best value of this coefficient. The probability of the F-statistic, on the other hand, is low enough in 8, 9 and 10 to reach the conclusion that the null hypothesis does not apply. Now, the figure with the lowest F-statistic is that of the graph of voltage against the logarithm of the temperature, although all the values of this probability are of the same order of magnitude. Furthermore, all three graphs exhibit a P-value of zero, which is a good indication that there is indeed a correlation between the dependent and independent variables. Likewise, the ideal T-value is as large as possible and in this case the T-values of the coefficient and the constant of the equation for graph 8 are greater than the others. Based on the previous analysis, it can be concluded that the equation that most closely matches the data collected is that of graph 8, whose equation is $V = 0.03T - 6.992$. According to equation (8) for the force produced by the magnetic field of an electromagnet, the retaining force of an electromagnet is proportional to the area of the magnetized surface and to the square of the product of the current and the number of turns, called magnetomotive force, and inversely proportional to the square of the gap between the core and the winding, *g*. In this sense, it can be confirmed that the experimental results fit with the theory. According to the data collected, with an increase in temperature a lower attractive force is noted due to the fact that the magnetic flux decreases with the drop in current through the electromagnet, caused in turn by an increase in resistance. Additionally, as the cross-sectional area of the electromagnets used in the pre-experiment was increased, a greater force of attraction could be perceived between them and the nut. Despite having consistent and robust results, further investigation is required to accurately and precisely quantify the rate of change in retaining force versus change in coil temperature.

Appendix

a) *Appendix A: Raw data*

Table 9: Raw data from experimentation showing the voltages to which the nut is dropped at different temperatures

Voltage, V (V) ± 0.25 V	Winding temperature, T (K) ± 0.01K		Temperature mean, T (K)
	Maximum value	Minimum value	
1.94	300	294	297 ± 3.0
1.89	303	299	301 ± 2.0
2.89	331	327	329 ± 2.0
1.95	306	299	302 ± 4.0
2.42	305	301	303 ± 2.0
2.06 2.18 2.55	306 305 323	301 301 319	303 ± 3.0 303 ± 2.0 321 ± 2.0
2.39 2.06 2.35 2.70	313 308 304 320	310 305 301 312	311 ± 2.0 306 ± 2.0 302 ± 2.0 316 ± 4.0
2.84 2.96	320 332	316 316	318 ± 2.0 324 ± 8.0
2.53	308	305	306 ± 2.0
2.31	320	314	317 ± 3.0
2.29	316	313	314 ± 2.0
1.71	299	297	298 ± 1.0
2.25	316	315	315 ± 0.5
2.04	311	308	309 ± 2.0
2.03	309	307	308 ± 1.0
2.44	317	309	313 ± 4.0

b) Appendix B: Sample Charts

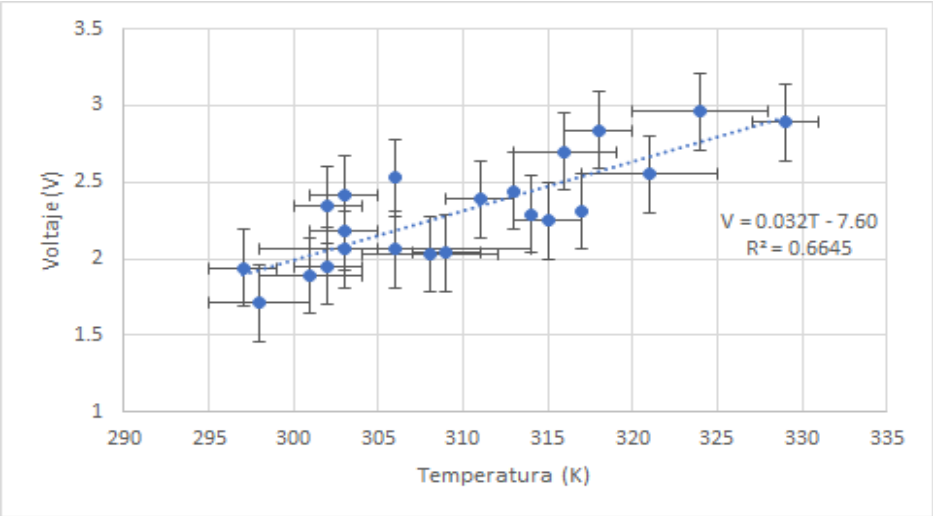

Figure 11: Scatter plot for the raw data of the variation of voltage versus temperature

c) Appendix C: Pre-experiment

i. *Research question*

The research question that guides the focus of this writing is:

To what extent does increasing the temperature of a coil of wire in a changing magnetic field affect the braking effect produced by eddy currents?

In the next section, the hypothesis regarding the phenomenon studied is formulated.

ii. *Hypothesis*

According to Faraday's law, if a current-carrying coil is in a magnetic field, a voltage or *emf* will be induced in it, which in turn produces currents whose magnetic fields oppose the change in the initial magnetic field. The system voltage will be the sum of the absolute values of the induced *emf* and the potential difference between the system terminals. Consequently, the induced and initial currents will also add up. But, if the temperature of the coil is also increased, the resistance of the wire will increase due to its positive temperature coefficient. Given the inversely proportional relationship between current and resistance, the sum of the absolute values of the currents will decrease. Since the electromagnetic damping force is proportional to the induced current, a decay in this force will be observed, in comparison with scenario in which the coil is not heated.

iii. *Variables*

a. *Constants*

- Length, weight and elastic constant of the spring.
- Position and holding force of the magnet.
- Length, diameter, material and number of turns of the coil, in addition to its position.
- The initial push that initiates the oscillating motion.
- The initial distance between coil and spring.

b. *Dependent variables*

- Braking force.
- Amplitude and frequency of the oscillation.

c. *Independent variable*

- Coil temperature.

iv. *Materials*

- Stainless soft spring
- Hollow Coil Of Copper Wire
- Ferrite magnet
- Grain scale (± 0.0005g)
- Ruler (± 5 × 10 -4 m)
- Laboratory stand
- Digital stopwatch (± 0.001 s)
- Heating plate
- Infrared thermometer (± 273 K)
- 2 three-pointed tweezers with clip
- Video Tracker Analysis Program
- Variable resistor

v. *Experimental design*

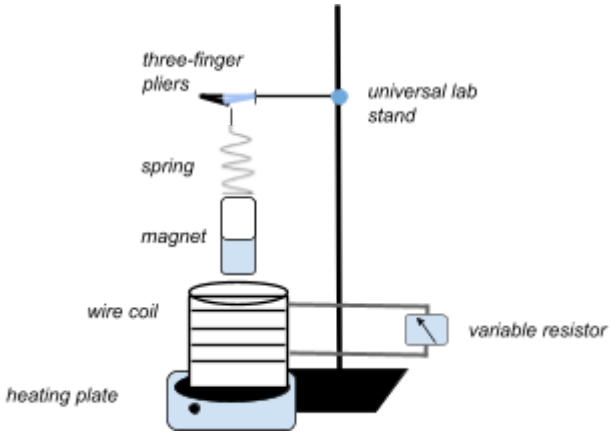

Figure 12: Apparatus and part summary for the pre-experiment

a. *Experimental setup*

1. The magnet is tied to the spring to later fasten it with one of the three-pointed pliers to the universal support already assembled.
2. The coil of wire is placed on the heating plate and directly below the hanging magnet so that when the spring is fully stretched the magnet is surrounded by the coil.
3. The rule is secured to the universal support with the second three-prong clamp, taking care that it does not obstruct the movement of the spring.
4. The coil is heated to the desired temperature.
5. Before starting the experiment as such, a slow-motion video recording is started, so as to have a more accurate record of the oscillation time.

b. *Carrying out the experiment*

6. The magnet is released with a minimal push force and as soon as it starts oscillating, the timer is activated.
7. Once the spring stops, the timer stops and the procedure is repeated four more times, so that a total of five repetitions are completed for the same temperature. Consequently, the electromagnet is heated to the same temperature as many times as necessary.
8. Steps 4 to 8 are repeated with an increase in temperature of approximately 5 degrees Kelvin, until having 10 measurements for each temperature with 5 repetitions.

c. *Using the Tracker program*

9. Open the video file.
10. In the playback control bar, the selection of frames is made.
11. A coordinate axis is defined, taking the equilibrium position of the spring as the coordinate origin.
12. The calibration rod tool is selected and its ends are moved until the rod covers a certain length of the ruler, in order to have a scale with which the observable distances in the video can be compared with the real ones.
13. The object to be analyzed is defined, this being the spring.
14. The path of the mobile is specified.

vi. *Complications in the experiment*

This experiment was not incorporated into the present work after the identification of numerous significant sources of error. Likewise, their minimization required instruments and materials with very specific characteristics that were not available in the laboratory, apart from a much more rigorous experimental procedure. For example, there was the complication of defining at what point the magnet stopped because it continued to oscillate around its final position for long periods of time; in addition to the fact that manual time recording can result in human error. On the other hand, the initial thrust to the spring clearly varied from test to test, which could obscure the relationship between the variables investigated. As for the instruments, a better grip clamp was needed to keep the spring-magnet system in a fixed position because with the clamp used the spring began to swing from side to side, instead of oscillating vertically. Additionally, although the circumference of the electromagnet was envisioned to be greater than the cross-sectional area of the magnet, it collided with the coil due to its movement in the horizontal axis. But, the main reason that led to the rethinking of the experiment was that little difference was observed between the times that it took the magnet to oscillate with and without the heated coil, which could complicate the analysis of a correlation between the temperature of the coil and the force of braking produced by the currents induced in it.

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Influence about Zinc for Transient; Steady State Creep Properties, Microstructure and Characteristics in Aluminum Alloys

By M. Y. Salem
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Abstract- Regardless of enormous studies besides of attempts dedicated to studying the creep attitude about present samples, a complete characterization about creep on the foundation of precise structural coefficient and testing stipulations will remain wanting soon. A creep study will usually be performed by an expression called creep system. This study expresses more notification of transient and steady creep conductance in aluminum-zinc alloys. Our study was investigated around 15.25, 18.255, and 21.70 MPa. All tests about working degree 523 until 643 kelvin. The transient creep is expressed using $strain_{transient} = \beta eta\ time^{n}$; the constant n has values around 0.31 to 0.85 in the case of Al-8Zn, and it ranges from 0.44 to 1.21 in the case of Al-85Zn binary samples. The βeta has a rate of about -4.3 until -12.54 and -6.1 until -13.5 for the used present specimens consecutively. Amounts for activation energy are about 45.6 and 39.8 KJ/mole in low-temperature regions for tested alloys and 62.4 and 45.7 KJ/mole in high-temperature regions. Coefficient (m) is increased by increasing the working temperature.

Keywords: *aluminum; zinc; transient; steady-state creeps.*

GJSFR-A Classification: *FOR Code: 249999*

Strictly as per the compliance and regulations of:

Influence about Zinc for Transient; Steady State Creep Properties, Microstructure and Characteristics in Aluminum Alloys

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Abstract- Regardless of enormous studies besides of attempts dedicated to studying the creep attitude about present samples, a complete characterization about creep on the foundation of precise structural coefficient and testing stipulations will remain wanting soon. A creep study will usually be performed by an expression called creep system. This study expresses more notification of transient and steady creep conductance in aluminum-zinc alloys. Our study was investigated around 15.25, 18.255, and 21.70 MPa. All tests about working degree 523 until 643 kelvin. The transient creep is expressed using $strain_{transient} = \beta eta\ time^{n}$; the constant n has values around 0.31 to 0.85 in the case of Al-8Zn, and it ranges from 0.44 to 1.21 in the case of Al-85Zn binary samples. The βeta has a rate of about -4.3 until -12.54 and -6.1 until -13.5 for the used present specimens consecutively. Amounts for activation energy are about 45.6 and 39.8 KJ/mole in low-temperature regions for tested alloys and 62.4 and 45.7 KJ/mole in high-temperature regions. Coefficient (m) is increased by increasing the working temperature.

Keywords: aluminum; zinc; transient; steady-state creeps.

I. Introduction

Mineral creep considered as a major topic of various experiments like power, transportation, or chemicals. The creep conductance for present samples is studied; it is characterized using collecting mechanism ε(t) as a parameter of loads and interval. Typically 3 parts were presented, which are the initial creep region {where $strain^{\cdot\cdot}(time)=0$}; 2- system, which is named steady-state {where $strain^{\cdot\cdot}(time)=0$}; and 3- part {where $strain^{\cdot\cdot}(time)>0$}; where interrupt happens. Several authors, such as Evans, minimized steady-state study to one rotation case from region one to third stages of the curve manner; therefore, creep rate become minimum [1,2]. Therefore the purpose in straightforwardness, that, throughout this work, it becomes referring to stable regions. All studies aim to correlate the performance of the study by the exact constitutional coefficient for present samples, limiting its study creep system [3–5].

Relationship through stable creep rate $\varepsilon^{\cdot}_{ss}$ and applied stress is usually maintained by the law of authority, i.e.,

$$strain^{\cdot}_{steady\text{-}state} = \text{Constant } (stress/G)^{n} \quad (1)$$

where n is the stress exponent, G is the shear modulus, exponent n of the existing literature is explained by Sherry [6]; the n assessment determines predominant arrangement.

The cast aluminum alloy has depressed concentration, altitude abrasion impedance besides perfect elasticity. It is easy to molding, fabricate, shape, shape weld. Al and zinc offer enormous domains for characteristics that aid for the precise purpose of manufacturing combinations for confirmed usages. Therefore it stands out for various applications to outputs like airframes, boats, martial employment, and vehicles; their combinations. The main advantages for Al-Zn samples considered as lightweight, altitude individual intensity, idealistic, great concerning metal alloys [7-9].

The study was inescapable for shaping sections that undergo loads in high degrees, which leads to imperceptible loads recuperation; also, stress aggregation outputs in premature insufficiency for most combinations. A clear assertions for manufacture; papers establishments indicate a recent group for foundational equations about curve which wanted to progressing suitable study [10-12].

Precipitation-hardening aluminum alloy is the extremely joint sprightly heaviness industrial samples in case of constitutional implementation 303 kelvin [13-17], and considerably coveted in purposes around high degrees (573 Kelvin); also, recent developments in aerospace refractory aluminum alloys used as a pattern for airframe barriers also, pavilion lashings for altitude achievement warlike aircraft, automobile motives; besides of warmth dissenting jointer for intensity conveyance, when the composition for the specimen competence stay fixed beneath difficult situations of heat. However, the advice which coveted employ degree that much higher than consolidation point depending on the lifetime temperature, which is below 498 K for conventional aluminum alloys to obtain hardening deposits [18-21].

Through the particular thermal-mechanical domain of Al-Zn, the elastic deformation is progressively altered to constant distortion using strain-time curves, where meanwhile, present samples are enriched using

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longevity [22,23]. Paramount characteristic in Al-Zn in practice presents through contemporary approach for style construction; also specimens reinforcement, therefore conventional disconnect figuration; also warmth remediation operations is happened [24-26]. Nevertheless, because of congregation frame for complete tablets, like altitude side, unequal concentration, beside of unsteady bending, a different congregation loads classification becomes occurred for boards specialized Al-Zn. Especially, whereas polygonal schedule convenient for checkmate carefully, current intense loads density is just reproduction regional disproportionate ductile distortion for curvature side. For the present attitude, confirmed strain-time impediment has been generally happened when growing for distortion grade curves [27]. Most output for disadvantage is necessarily engender onerousness for monitoring for origination precision beside of manufacture accomplishment.

Considerable theory research besides on empirical on Al-Zn fundamentally concentrated on strengthening for hot-self-acting coefficient, present samples premier disposition, description of composition; features, besides of foretelling for spring back beside of rendering. Arabi Jeshvaghani et al. [28,29] investigated the influences for degree beside of interval for spring back and self-acting characteristics for Al-Zn specimens. They explained commanding techniques for period indeclinable and strain-time distortion.

In several papers mentioned that the addition of zinc to aluminum samples influences the installation and crystallization tendency, which enhances the deposition of stages through synthetic longevity [30-33]. The main reason has been spotted for the last automatic advantages for specimens. Through artificial longevity for samples, the ultimate impedance was supposed to use sedimentation for stages, which stable and have a similar structure phase [34]. We assumed such semblance for pure zinc molecules award much deepness that the reason for samples realized altitude impedance by perfect power characteristics for altitude degrees. Interval deposition was spotted for zinc alloys, forming GP regions [35] however, for minimum considerable influence. Though Aluminum sample has been examined for important conclusions, particularly for cases concerning with phase deposition also, the padlock relationship for refinement in spontaneous characteristics, small survey has been awarded for finding out influences for the supplement to other samples such as zinc on the behavior of the alloy [36].

In general, Al-Zn alloys have better castability than other alloys. Ji et al. [37-39]; sublime power for present sample has been developed specializes elevated stress as shaping. The short longevity handling consequence for considerable refinement for mechanical characteristics [40] besides, applied specimen was utilized to form combinations for the space industry. Likewise, et al. [41]; established most properties for Aluminum samples were strengthened using Zinc supplement, resulting in specimens using bending intensity and has moderate elongation. Ding et al. [42] were instituted an extension about zinc that can significantly enhance the life hardness of the aluminum alloy. Therefore, it is advantageou while checking the effect of adding zinc to the treated aluminum ingot by gravity casting of the mold, improving the characteristics and hardening mechanism.

One of the main advantages of Al alloys after adding the element Zn compared to other alloys is its altitude intensity along with elevation elasticity. Therefore, a perfect Al-Zn alloy has a resistance of about 400 MPa while the penetration elongation is about 12% of an inch. The altitude intensity for present samples produces large convenience in case of constitutional purposes that require altitude intensity for minimum heaviness. Therefore a car shock absorber beam has been formed from either hot extruded hollow or semi-hollow tubes. Therefore, an advantage for this alloy presented in great strength at about 300 kelvin was squirearchy by altitude impedance to deformation for warm working degrees, thus characteristic for zinc existence [43,44].

This paper describe a share in the recognition for an appropriate heat processing for applied specimens for improving the mechanical characteristics even come to terms installation deepness for used samples, the generation of aluminum alloys used in automobile bodies, and more purposes with the hope of producing more ductile stages with superior forming characteristics.

II. Testing

The dimensions for the specimen used are of diameter 0.8 $x10^{-3}$ m and $5x10^{-2}$ m. As mentioned earlier [45-49], The Aluminum-8Zinc and Aluminum-85Zinc samples are ready where prepared from Aluminum (purity 99.99%) and Zinc (purity 99.99%) specimens. Creep test has been achieved ranging about 15.25; 18.255; and 21.70 MPa at about degree of $4/10T_m$ until $7/10\ T_m$; T_m denotes fusion degree for used samples, ranging from 523 to 643 K to in steps.

The sample dissolved in the Cu melting-pot. The specimen has been measured beside completely jumbled using calcium $chloride_2$ wax for restraining corrosion using graphite style protected around 820 kelvin. In this study, the wires of Aluminum-8Zinc and Aluminum-85Zinc specimens are rigid around 180 celsius until 7200 seconds to cool remove cool effect coming through seesawing; at that time quietly refrigerated until 300 kelvin; to originate fine precise structure idealistic presented in a piece samples in

microelectronic bundle. Then the specimens were inconsiderate [50,51].

Strain-time experiments are temperature-dependent so that present size variations which occur to the level for used loads raise exponentially as degree increases [9,52]. The piece of experimentation has been demonstrated; the samples were mounted; also favored in the center of the heater beside of additional thermocouple was connected at center for specimens measurement elongation. The heater is turned off, and the heating turned on. The closed oven stands in about 1800 second for increment for arriving a constanty used degree. The suitable degree arrived, stress has been presented, and strains for samples know with preciseness.

The obtained outcome for Energy-dispersive X-ray spectroscopy dissection was symmetrical for used samples as pronounced in Table 1 and Fig.3.

Table (1): Immediate installations for used specimens weight %

Experimental alloys	Aluminum %	Zinc %
Aluminum-8Zinc	92	8
Aluminum-85Zinc	15	85

III. Results and Discussion

a) Characteristics for Strain-time

i. *Transient period*

Concerning the strain-time study, transient strains were particularly characterized by using the following formula [53]:

$$\text{Strain}_{transient} = Beta\ \text{time}^{n} \quad (2)$$

where Strain transient is the first interval deformation, beta and n are stable amounts.

Recent particular properties of creep for the binary samples Al-8Zn and Al-85Zn has been compared as shown in Fig.(1-3) a,b. The tendency in strain-time diagrams for all loads and different temperatures by seven degrees indicates a fast transmission for the concise initial strain-time period until another strain-time period.

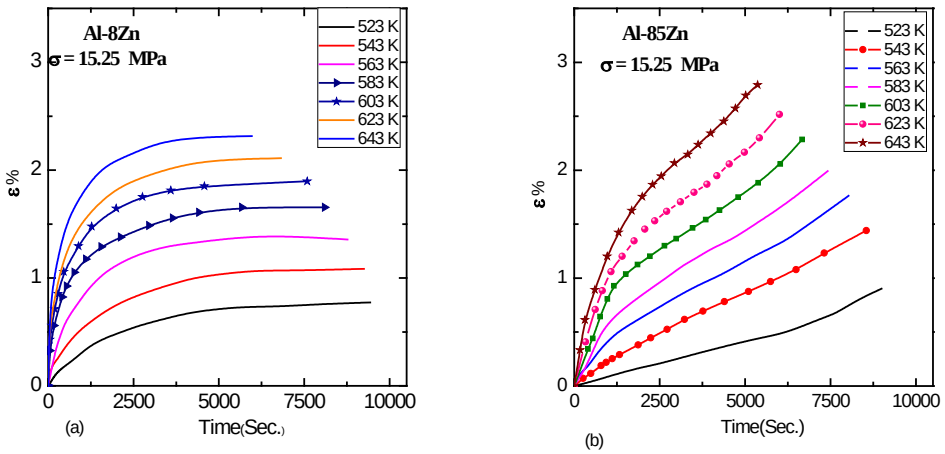


Figure (1): Isothermal Strain-Time diagrams for 15.25 MPa for different seven tested temperatures for a) Al-8Zn, and b) Al-85Zn

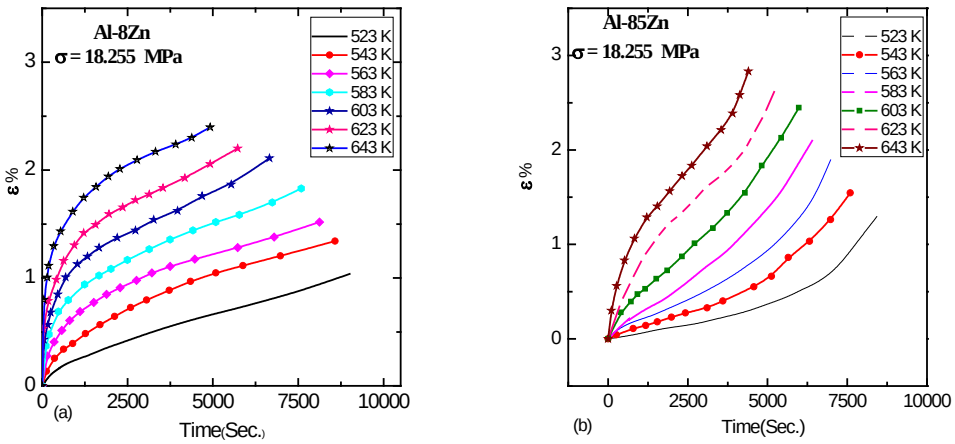


Figure (2): Isothermal Strain-Time diagrams for 18.255 MPa for different seven tested temperatures for a) Al-8Zn, and b) Al-85Zn

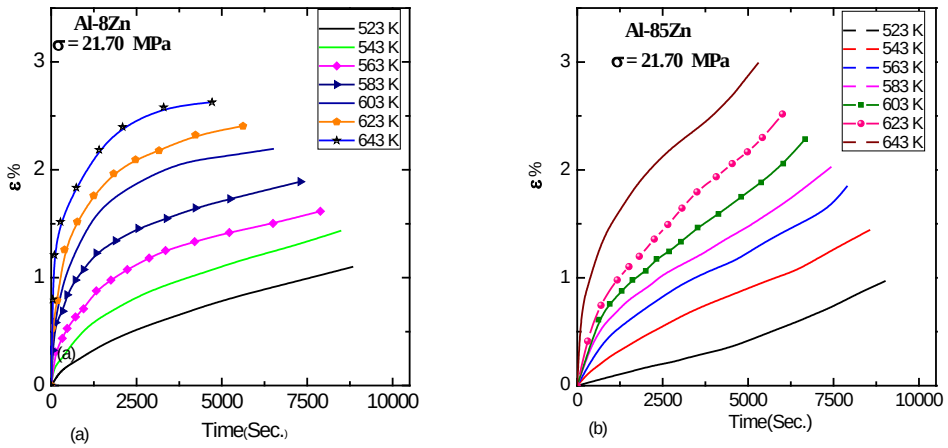


Figure (3): Isothermal Strain-Time diagrams for 1) Al-8Zn, and 2) Al-85Zn at 21.7 MPa for different seven tested temperatures

The relationship through in straintransient and in time donate upright ranges as represented at Figure (4-6) a, b. The values of strain / time denotes the amount for the exponent of the first strain-time diagrams; parameters n are point for possessing amounts about 0.31 until 0.85 in case of Al-8Zn samples; about 0.44 until 1.22 in case of Al-85Zn alloys see table 2. n parameters are heightened according to heighten distortion degree in case of two specimens accordingly represented in Figure(7); while their intercepts for ln time equal zero denotes; βeta the strain-time coefficient, βeta has been obtained using Equation(2) [54].

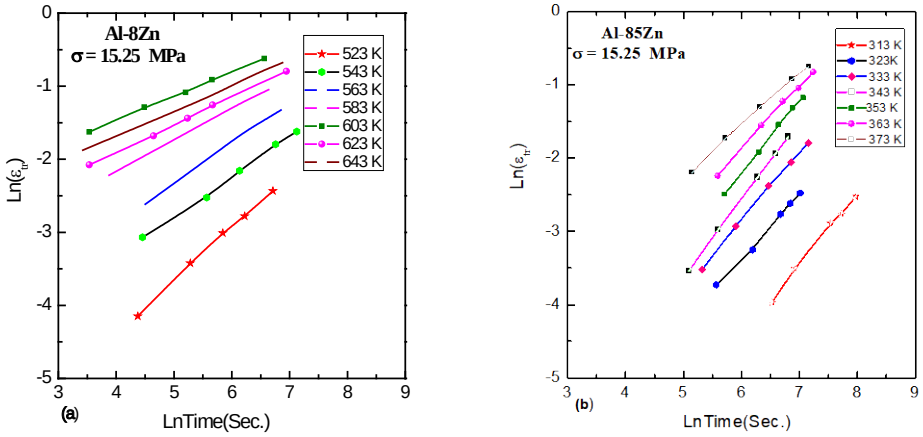


Figure (4): Relation through ln (ε_{tr}) and ln time at 15.25 MPa for a) Al-8Zn, and b) Al-85Zn.

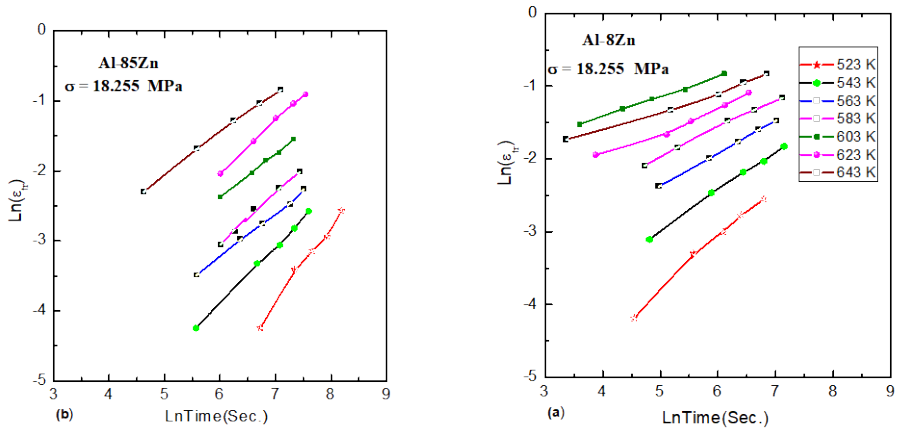


Figure (5): Relation through ln (ε_{tr}) and ln time at 18.255 MPa for a) Al-8Zn, and b) Al-85Zn for different seven tested temperatures

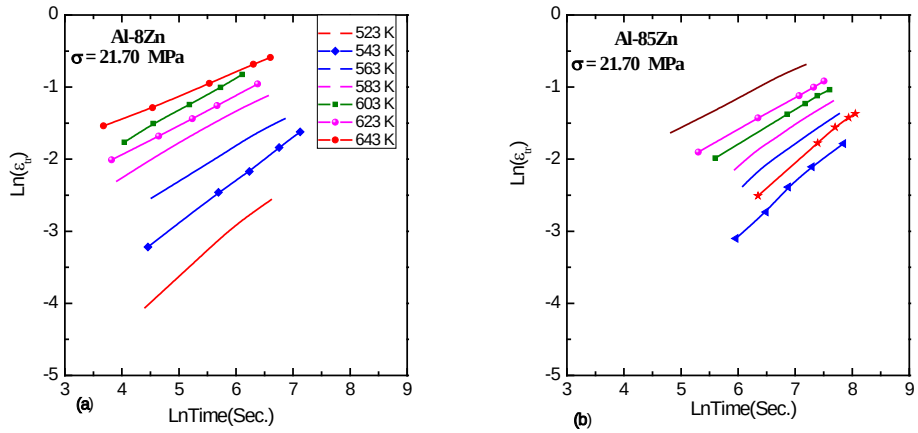


Figure (6): Dealing through ln ($strain_{transient}$) and ln time around 21.7 MPa for a) Al-8Zn, and b) Al-85Zn

$$\ln\beta = (\ln t_2\, \varepsilon_{tr1} - \ln t_1 \varepsilon_{tr2})/\ln t_2 - \ln t_1 \quad (3)$$

The βeta coefficient has been organized as increasing according to augment loads besides of degrees accordingly represented in Figure(8), βeta coefficient has the number between -4.3 until -12.54 in case of Al-8Zn samples; between -6.1 until -13.5 in case of Al-85Zn alloys as shown in Table 2.

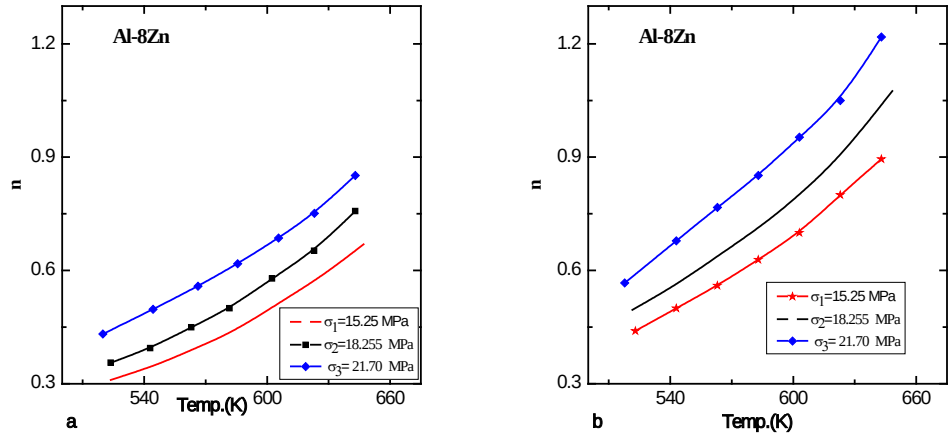


Figure (7): Subordination for parameters, *n*, in case of a) Al-8Zn, and b) Al-85Zn

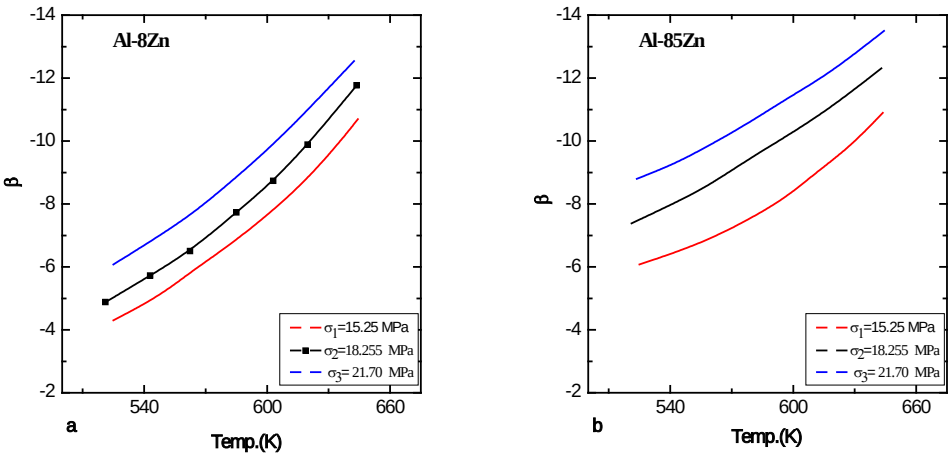


Figure (8): Relation for parameters,β in case of a) Al-8Zn, and b) Al-85Zn

Figure (9) investigates the relationship through ln straintransient and 1000/temperature (Kelvin) for a minimum degrees in case of Al-8Zn beside of Al-85Zn samples to seven different working degrees; values of A.E. are 45.6; 39.8 kilo joule mole-1 at a minimum degree for tested alloys and 62.4 and 45.7 kilo joule mole-1 at maximum degree see it represented in Figure (10); besides of table 2; it is clear that A.E. in case of Al-8Zn samples is higher that of Al-85Zn; thus Al-85Zn samples genesis higher precise for granule dimension beside of more elasticity compared with Al-8Zn specimens.

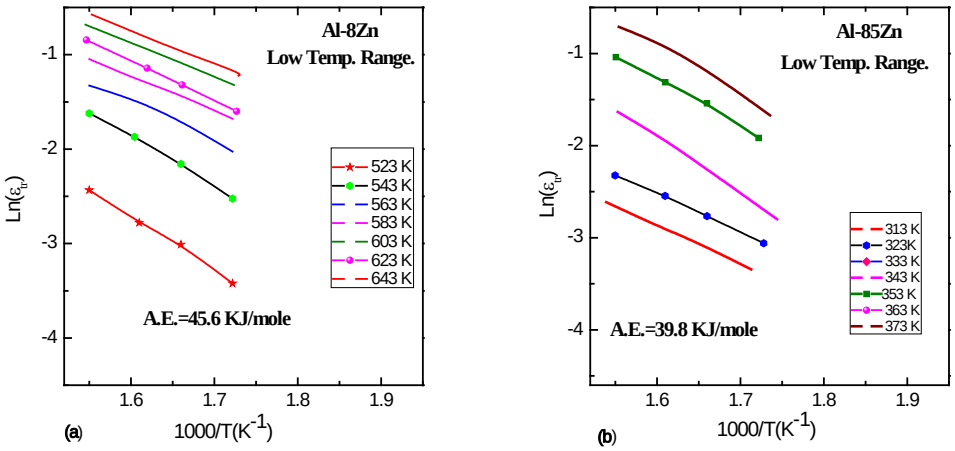


Figure (9): Relationship through in strain transient and 1000/temperature (Kelvin) for a) Al-8Zn, and b) Al-85Zn for low temperature range

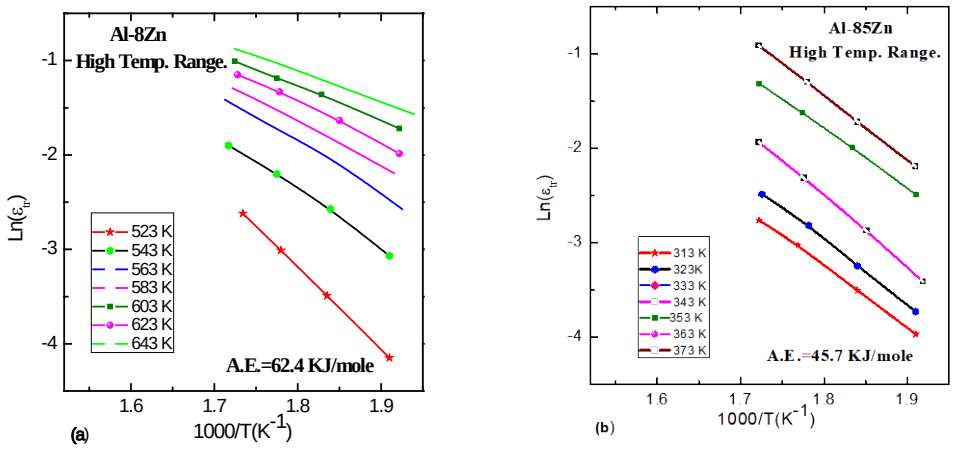


Figure (10): Relationship through in strain transient and 1000/temperature (Kelvin) for a) Al-8Zn, and b) Al-85Zn for high temperature range

Table (2): Competition for transient strain-time coefficient

Samples	Exp. n	βeta	A.E. ($kJmol^{-1}$)
Aluminum-8Zinc	0.31 : 0.85	20.2 : 28.8	45.6 : 62.4
Aluminum-85Zinc	0.44 : 1.22	18.1 : 26.0	39.8 : 45.7

For interfacing the relation through two strain-time intervals; the connections through in βeta and in strain $rate_{steady}$ is illustrated in Figure eleven; the value of in βeta/ln strain $rate_{steady}$ denotes amounts for γ ; it is clear that the value of γ is higher for Aluminum-85 Zinc than the second Samples; therefore Al-85Zn alloys are more superplastic than Al-8Zn alloys.

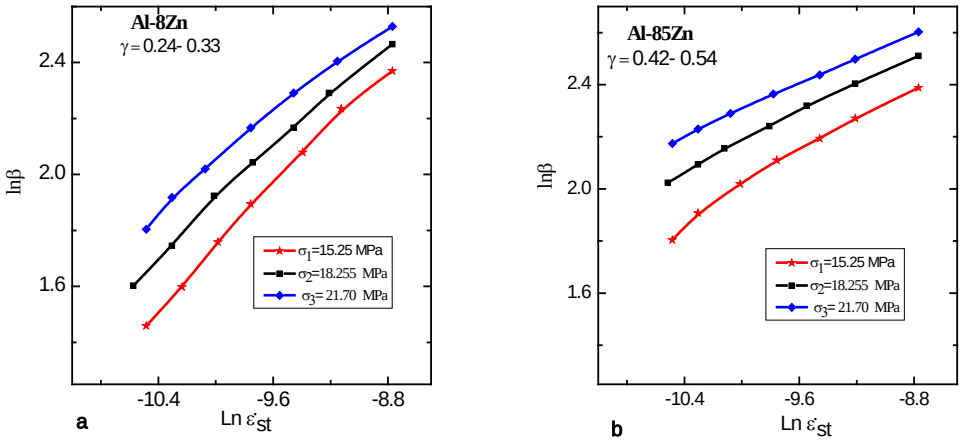


Figure (11): Relationship through in βeta and in strain in case of a) Al-8Zn, and b) Al-85Zn

ii. *Steady-state creep stage*

Functional steady-state strain-time is represent by Dorn equation [55,56].

$$\gamma^{\cdot} = A\mathbf{x}(1/d)^{p}\cdot\exp(-Q/RT)\ x\ \tau n \qquad (4)$$

Anywhere A is constant; p grain size; Q activation energy and n stress exponential; these amounts depend on microstructure beside of mechanism; therefore strain rate $\varepsilon^{\cdot}$.

$$\varepsilon^{\cdot} = A\ x\ (1/d)^{p}\ \exp.\ (-Q/RT)\ x\ \sigma^{n} \qquad (5)$$

We find, two or three parameter has been required for investigating steady-state strain-time, also the permanent creep mechanism is depends on microstructure and applied loads [57].

The steady-state strain rate (strain$^{\cdot}_{steady}$) ($\boldsymbol{\varepsilon}^{\cdot}_{st}$) of the present alloys has been obtained by using values for strain/time for strain-time study as represented in Figures (1-3). It grows according to reproducible temperature besides loads as shown in Figure (12). Therefore using himself experimental circumstances for Aluminum-85Zinc samples demonstrated elevated strain rate $\boldsymbol{\varepsilon}^{\cdot}_{st}$; contrasted by $\dot{\boldsymbol{\varepsilon}}_{st}$ for Aluminum-8Zinc; we observed closely to all curves was described through all the three characteristic parts: (one) primary, (two) secondary state, and (three) tertiary. Because of stress besides temperature seem a constant, distinction for behavior suggests a necessary change for microstructure. Strain ε and strain rate $\dot{\varepsilon}$ are, in predominant, minimum in case of Aluminum-8Zinc specimens but for Aluminum-85Zinc specimens whereas even used loads, will smoothing microstructure for second samples. Like variations within strain-time behavior is regarding with variations in morphology and microstructure for specimens.

We find reality there is independent of the elongation at a lower strain-time average, indicates such strain-time attitude was mightily affected using zinc addition. Moreover, a present gained lower strain-time moderate is separate with strain-time sapping operator for continuous crystallizes again [58].

The relationship between loads ln σ, against average ln ε_{st} for different applied stresses for Aluminum-8Zinc and Aluminum-85Zinc alloys has been represented by Figure (13, a, b). The magnitude for strain average sensitivity parameter m calculated using ln σ/ lnε_{st}, it has values about 1.41 until 1.361 in case of Aluminum-85Zinc, ranging from about 1.11 until 1.41 in case of Aluminum-8Zinc see Figure (13, c). We find such m magnitude in case of Aluminum-85Zinc was altitude in amount with Aluminum-8Zinc specimens, illustrating m coefficient installation becomes degree dependent therefore Al-85Zn alloys are more superplastic than Al-8Zn alloys.

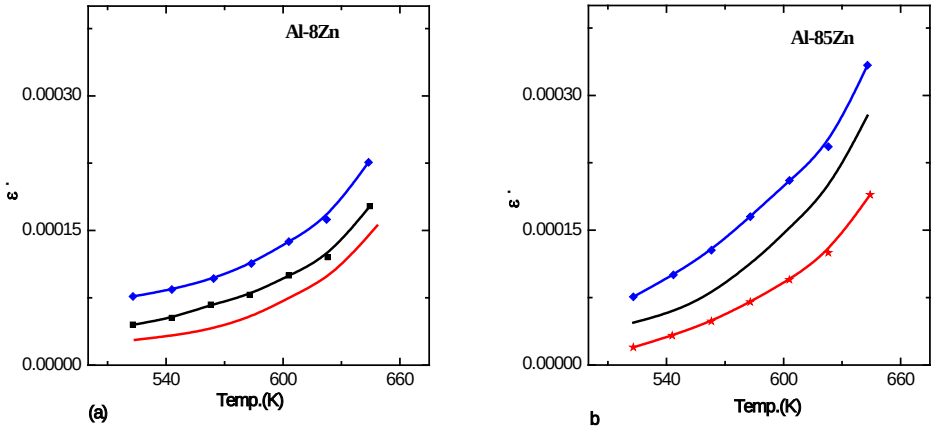


Figure (12): The relation through Strain Rate ($\varepsilon \cdot_{st}$) in case of a) Al-8Zn, and b) Al-85Zn

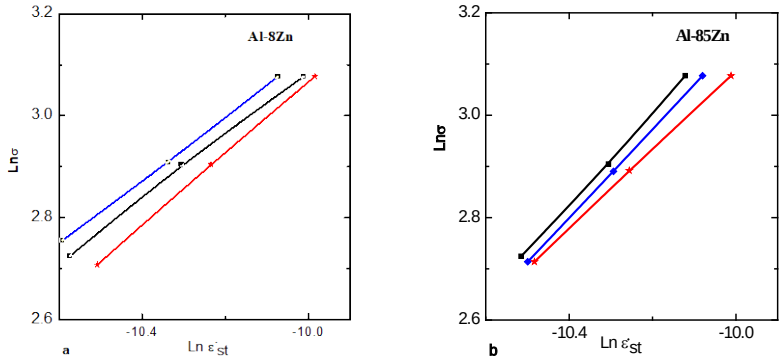


Figure (13) a, b: The relation through in stress and in strain rate $_{st}$ in case of a)Al-8Zn, and b) Al-85Zn; c) the relation through m and stress (MPa) for a)Al-8Zn, and b) Al-85Zn; c)

The A.E. for strain-time when we use fixed loads has been represented by equation [59].

$$A.E. = R\left(\partial \ln strain_{st} / \partial\left(1/T\right)\right) \quad (6)$$

where R is the gas constant.

Furthermore, our obtained consequences confirm the formula of steady-state strain-time [48]

$$\varepsilon \cdot_{st} = c\left(\frac{\sigma}{d}\right)^{1/m} \exp\left(\frac{Q}{kT}\right) \quad (7)$$

where m = 0.5 for dislocation climb among grain boundaries [46]. Thus, we find that more strain is due to dislocation activity leads to grain boundary sliding beside of contained it through distortion.

A.E. of steady-state strain-time is determined by plotting ln strain rate$_{st}$ and 1000/T (kelvin) for Aluminum-85Zinc beside Aluminum-8Zinc samples.

A.E. in case of first beside of second specimens are ranged from 77.6 and 69.1 and in case of the low temperature regions and 97.9 and 83.6 kilo joule mole^{1} at elevation degree regions and second alloys be 77.6 and 69.1 and at the low-temperature regions and 97.9 and 83.6 kJ mol−1 in the high-temperature regions, consecutively as represented in Figures (14, 15). We induce that A.E. in the case of Aluminum-8Zinc specimens lower that of Aluminum-8Zinc alloys, i.e., first alloys is more in superplasticity than the other by about 13 to 17 % in all regions as represented in Table (three).

Table (three): Competition strain-time characteristics

Specimens	(*m*)	γ	Q (kJmol^{-1})
Aluminum-8Zinc	1.11 : 1.41	0.24 : 0.33	77.6 : 97.9
Aluminum-85Zinc	1.41 : 1.361	0.42 : 0.54	69.1 : 83.6

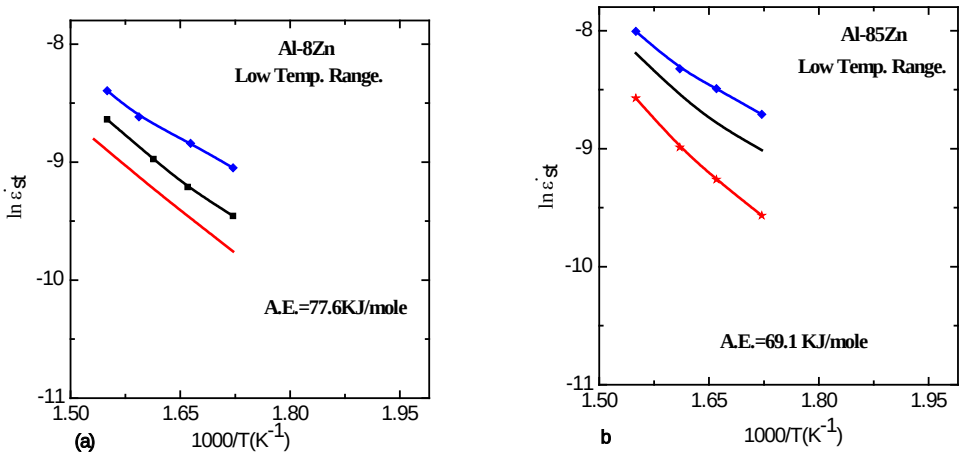


Figure (14): Relationship through ln strain rate $_{st}$ and 1000/Temp.(K) for a) Al-8Zn and b) Al-85Zn for low-temperature range

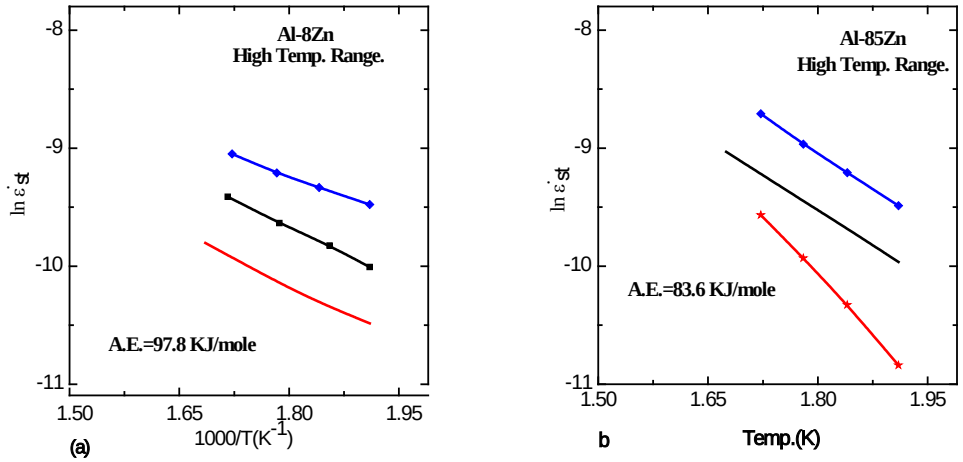


Figure (15): Relationship through ln strain rate $_{st}$ and 1000/Temp.(K) for a) Al-8Zn, and b) Al-85Zn for high-temperature range

Figure (16) represented XRD consequences for Aluminum-85Zinc and Aluminum-8Zinc analysis. Predominant analysis specimen has been fundamentally superimposed from Aluminum beside of Zinc structure. EDX pattern of present uses specimens; where white Al phase and dark Zn phase has been represented in Figure (17). The Scanning Electron Microscope morphology for two specimens is illustrated in Figure (18); within Figure (18) a); is Al-8Zn, where Al with white phase in prevalent phase while Zn is minority dark phase; while in b) is Al-85Zn binary alloy where Al with white phase in minority phase while Zn is gray.

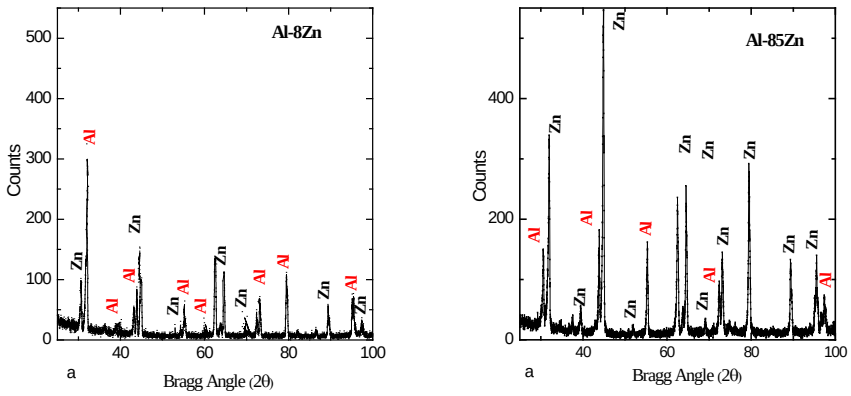
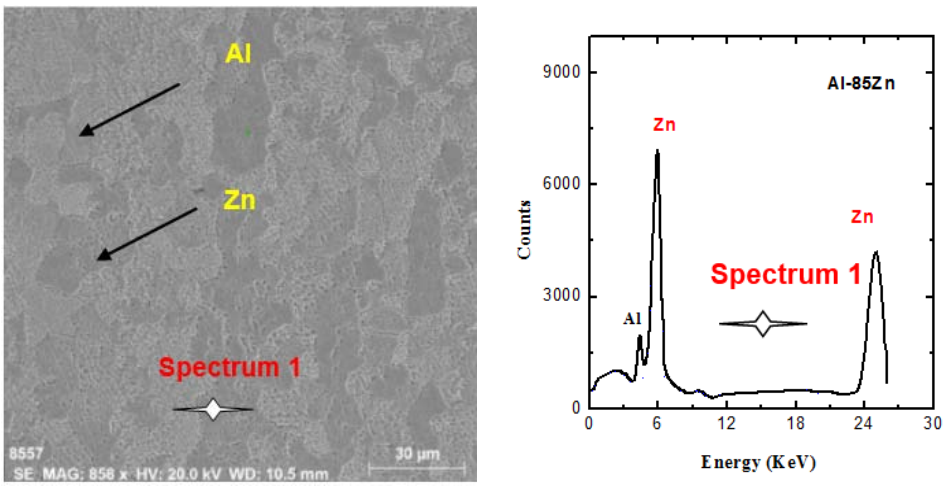


Figure (16): XRD pattern for a) Al-8Zn, and b) Al-85Zn binary alloys are mainly composed of Al and Zn phases



Specimen's structure

2.9	85.06	85.6	Zn 50 L-series 84.22
0.3	15	14.9	Al 30 L-series 15.2
		Total:100	

Figure (17): EDX pattern for the tested specimens; white Al phase and dark Zn phase

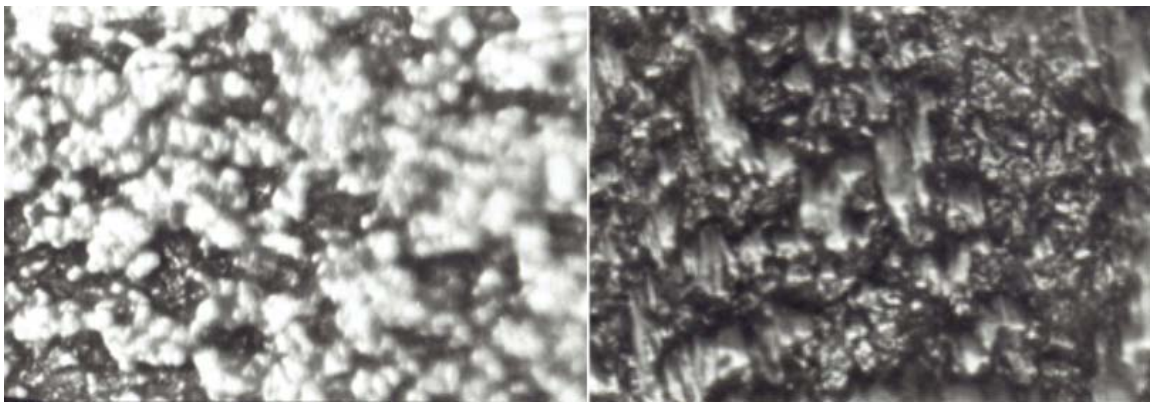


Figure (18): The Scanning Electron Microscope photograph has been illustrated in Figure (18) a); is Al-8Zn, where Al with white phase in prevalent phase while Zn is minority dark phase; while in b) is Al-85Zn binary alloy where Al with white phase in minority phase while Zn is a prevalent phase

IV. Conclusion

We derived some results, which are:

1. Time exponent n and were own magnitudes about 0.31 until 0.85 in case of Al-8Zn; between 0.44 until 1.22 in case of Al-85Zn alloys.
2. A. E. for first part strain-time were 45.6 while 39.8 kilo joule mole-1 in low- temperature regions for tested alloys and 62.4 and 45.7 KJ/mole in high-temperature regions.
3. (m) coefficient is increase with increasing the working degree.
4. A.E. for second part strain-time were 77.6 while 69.1 kilo joule mole-1 in low- temperature regions for tested alloys and 97.9 and 83.6 KJ/mole in high-temperature regions consecutively, characterizing grain boundary diffusion; therefore, we find at oneself experiments circumstances Aluminum-85Zinc specimens indicated elevation strain rate $\acute{\varepsilon}_{st}$ concurrence to that of Aluminum -8Zinc.

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Segmentation of Cancerous Mammography using MATLAB

By Samuel Yemoh Tetteh-Abaku, Calvin Kwesi Gafrey & Moses Jojo Eghan

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Segmentation of Cancerous Mammography using MATLAB

Samuel Yemoh Tetteh-Abaku [α], Calvin Kwesi Gafrey [σ] & Moses Jojo Eghan [ρ]

Abstract- Breast cancer is one of the main causes of cancer death in women. Detection is efficiently performed by using digital mammograms. Small clusters of micro calcifications appearing as a collection of white spots on mammograms show an early warning of breast cancer. Early detection performed on X-ray mammography is the key to improving breast cancer diagnosis. To increase radiologists' diagnostic performance, several computer-aided diagnosis (CAD) schemes have been developed to improve the detection of primary identification of this disease. In this research, an attempt is made to develop an adaptive K-means clustering algorithm for breast image segmentation to detect microcalcifications. The method was tested over several images of image databases taken from Mammocare, Ghana for cancer research and diagnosis. The algorithm works faster so that any radiologist can take a clear decision about the appearance of microcalcifications by visual inspection of digital mammograms and detection accuracy has also improved as compared to some existing works.

I. Introduction

Breast cancer is a type of cancer with the highest incident rates in women. It has been one of the major causes of death among women since the last decades and it has become an emergency for the healthcare systems of countries. It is commonly classified into four stages according to the size of tumors and degree of cancer spread from the breast to other body parts and takes years to develop[5].

Mammography is an imaging study that uses X-rays to image the breast to look for cancer. There are two main types of mammography: film-screen mammography and digital mammography also called full-field digital mammography or FFDM. The technique for performing them is the same. What differs is whether the images take the form of photographic films or digital files recorded directly onto a computer. Mammography also has its limitations. It is less reliable on the dense breast of young women or women who underwent surgical intervention in the breast because glandular and scar tissues are as radiopaque as abnormalities[9]. Furthermore, there is low-dose X-Ray radiation. The estimated sensitivity of radiologists in breast cancer screening is only about 75%. Double reading has been suggested to be an effective approach to improve sensitivity. To improve the accuracy of interpretation, a variety of Computer Assisted Detection (CAD) techniques have been proposed. Interpretation of mammograms mainly involves two major processes: Computer-Aided Detection (CADe) and Computer-Aided Diagnosis (CADi)[20]. It would be valuable to develop a CAD algorithm using extracted features from the breast profile region; region of interest (ROI). This would reduce the number of biopsies in patients with benign disease and thus avoid patients' physical and mental suffering, with a bonus of reducing healthcare costs.

Initial detection of the cancerous mammogram helps in the early diagnosis of a disease a diseased person which can reduce death possibilities. Methods developed for the detection of the malignant region of the mammograms may not be able to provide results successfully[1,15]. Finding an accurate, robust and efficient breast profile segmentation remains a challenging problem in digital mammography. Hence mammography misses about 17% and up to 50% of breast cancers due to the subtle and unstable appearances of breast cancer in their early stages[8]. To overcome this limitation. It is necessary to develop an approach that can segment malignant regions properly.

A significant method that first detects the cancerous region and then segment the area covered by malignant tissues was proposed. In this paper, the focus was placed on detecting malignant tissues which represent higher intensity values compared to background information and other regions of the breast. However, in the case of some normal dense tissues having similar intensities to the tumor region, it is necessary to detect tumor region excluding those regions successfully. In this research work, an attempt was made to study the effect of L*a*b color space K-means clustering on colour image segmentation. Several general-purpose algorithms have been developed for image segmentation including detection followed by segmentation of mammogram images based on simple image processing techniques using the L*a*b colour space K-means clustering algorithm which provides good results in real-time[10].

II. Materials and Method

a) Sample of images used

Mammogram images were retrieved from the website of Mammocare Ghana. The mammogram images were acquired from Ghanaian patients. The images consist of left and right breast images of fatty, fatty-glandular and dense-glandular breasts, true positive and true negative breast images, false positive

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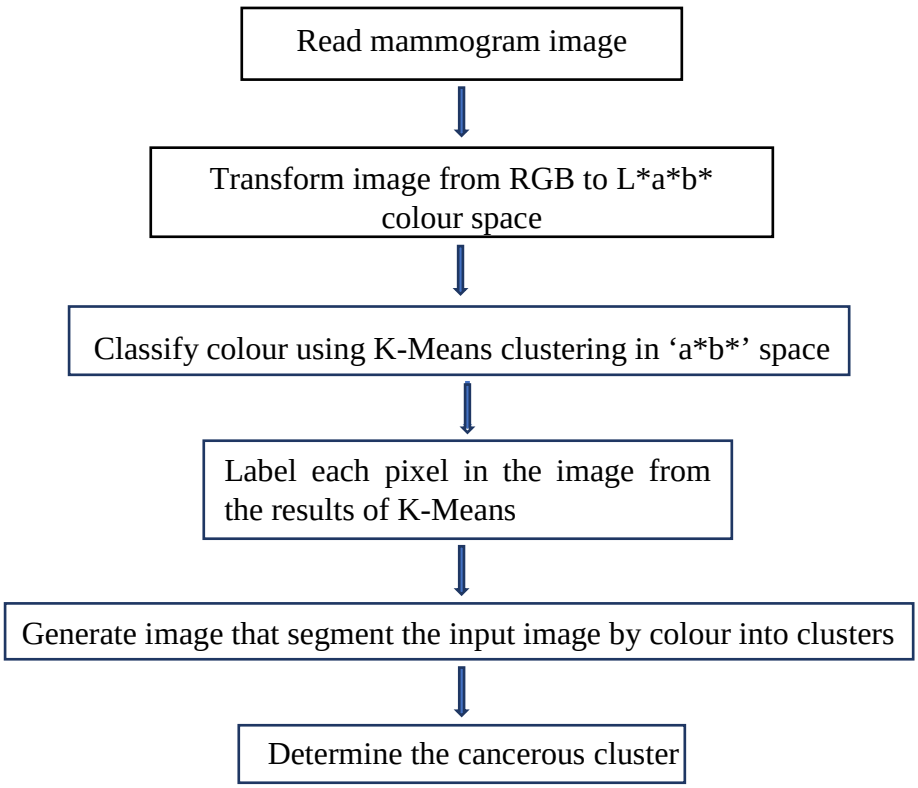
and false negative breast images. The retrieved mammogram images are classified into left breast lesion, right breast lesion, and non-palpable left breast lesion.

The images were retrieved in *Joint Photographic Experts Group*(JPEG)format. The pixels in the images were represented as an 8-bit word. The images were retrieved in Red, Green, Blue (RGB) format each with a pixel size of 500 × 500. The mammogram images were from diagnoses conducted by radiologists and clinicians using the Breast-i device. In taking the images, a patient undresses and in a darkened room, sitting slightly forward places the Breast-i light source on the inferior surface of (underneath) the breast. The patient views the superior aspect (top surface) of each breast, which should be uniformly bright except for typically a few darker lines corresponding to superficial blood vessels. The mammogram images are classified into three major cases: malignant, benign and normal.

b) Developed Matlab algorithm for image analysis

A flowchart of the method which is implemented in MATrix LABoratory (Matlab) application software (R2013a Matlab, Math Works Inc) is described in figure 3. The basic aim of the proposed approach is to segment colors automatically using the K-means clustering technique and L*a*b* colour space.



The mammogram images were read into MATrix LABoratory (Matlab) application software (R2013a Matlab, MathWorks Inc) from a folder in which they were saved. The images were transformed from RGB to L*a*b* colour space. The L*a*b* colour space was used because it consisted of a luminosity layer 'L*' and two chromaticity layers in 'a*' and 'b*'. Using the L*a*b* colour space is computationally efficient because all of the colour informationis present in the 'a*' and 'b*' layers only[12]. The colors were then classified using K-Means clustering in the 'a*b*' space. To measure the difference between the two colors, the Euclidean distance metric was used.Each Pixel was labelled in the image from the Results of K-Means. For every pixel in the input, K-means computed an index corresponding to a cluster. Every pixel of the image was labelled with its cluster index,also the mean 'a' and 'b' value for each area was extracted. These values served as colour markers in the 'a*b' space. The index image was further processed to generate 3clusters based on colour information[12]. The pixels in the image was separated by colour using pixel labels, which resulted in different images based on the number ofclusters. The results of the nearest neighbor classification were displayed. The labelled matrix contained a colour label for each pixel in the mammogram image. The labelled matrix was then used to separate objects in the original image by colour. The index of each cluster containing the cancerous part of the mammogramwas determined because K-means doesnot return the same cluster index value every time but this was done using the center value of clusters, which contained the mean value of 'a*' and 'b*' for each cluster[12].

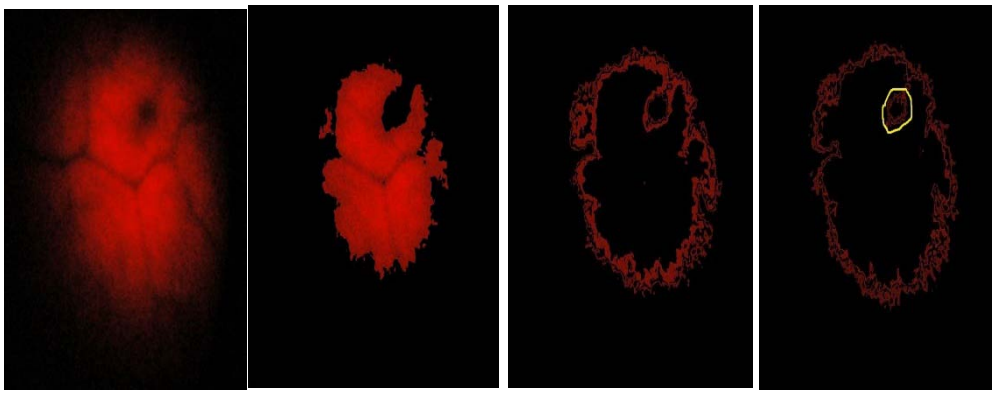
III. Results and Discussions

The proposed methodology has been evaluated on images collected from the database that belongs to Mammocare Ghana, emphasizing the importance of K-Means clustering algorithms in cancerous mammography segmentation. In the proposed methodology, specifically, the effectiveness of the segmentation methods was evaluated on the RGB image, based on the intensity levels of the segmented output.

The result of clustering intensities of the colour bands into different groups using the K-means clustering algorithm were a set of three distinct RGB level regions. These regions, referring to the colors existing in the original image are presented in figure 4, samples 1 to 8. Each region is relatively homogeneous in terms of pixel intensity. These regions were breast intensities (cluster 1), background intensities (cluster 2) and tumor intensity (cluster3) referring to the colors existing in the original image[18]. Therefore, it was assumed that there were three classes of objects to be separated with the K-means clustering algorithm.

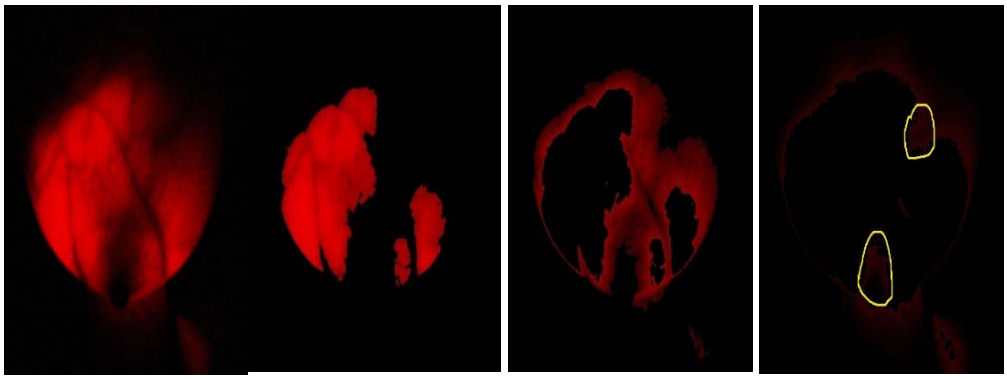
The figures show an original image from the image database and results for clusters using the K-means clustering method with only 4 clusters, and varying the values of classes are shown. Four clusters were used because using three clusters was not sufficient in that case due to the natural variability of sharpness in the input mammogram image. It can be seen that mass and lesion elements in the breast image became clearer by increasing the number of classes keeping the constant value of bins, visual appearance and classification of microcalcification get improved[6].

The following figures show the original images and their processed images using K-means clustering in L*a*b* colour spaces.



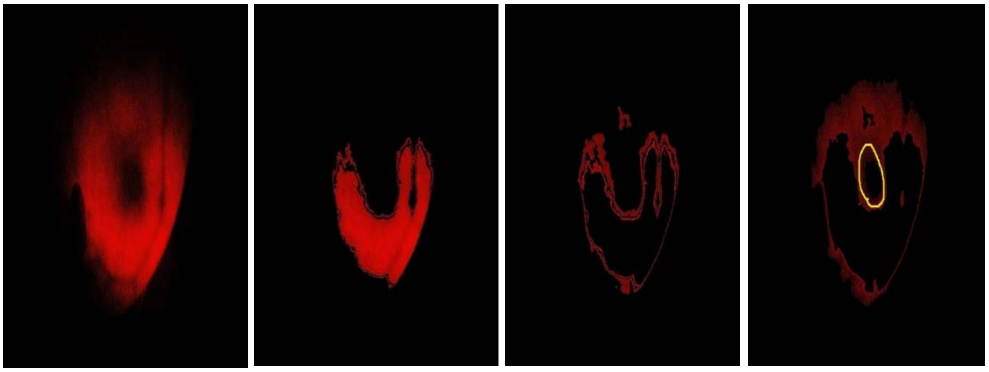
(A) (B) (C) (D)

Figure 4: Sample 1 shows, (A) the original image, (B) cluster 1, (C) cluster 2 and (D) cluster 3 after separating objects by colour using K-means clustering technique in L*a*b* colour space with the tumor region circled in yellow



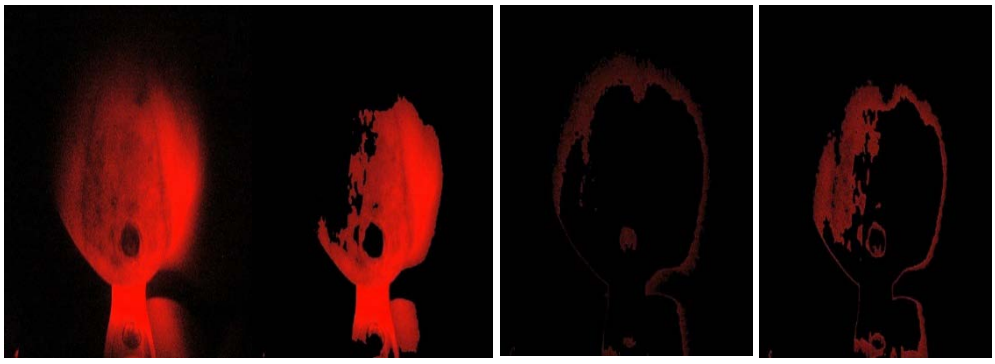
(A) (B) (C) (D)

Figure 5: Sample 2 shows, (A) the original image, (B) cluster 1, (C) cluster 2 and (D) cluster 3 after separating objects by colour using K-means clustering technique in L*a*b* colour space with the tumor region circled in yellow



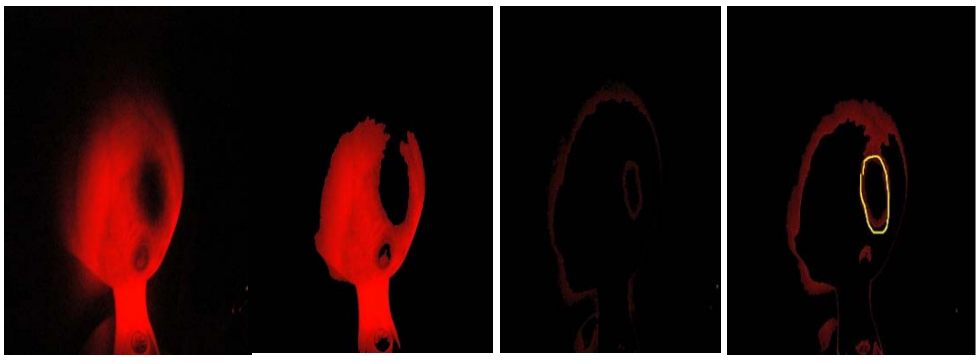
(A) (B) (C) (D)

Figure 6: Sample 3 shows, (A) the original image, (B) cluster 1, (C) cluster 2 and (D) cluster 3 after separating objects by colour using K-means clustering technique in L*a*b* colour space with the tumor region circled in yellow



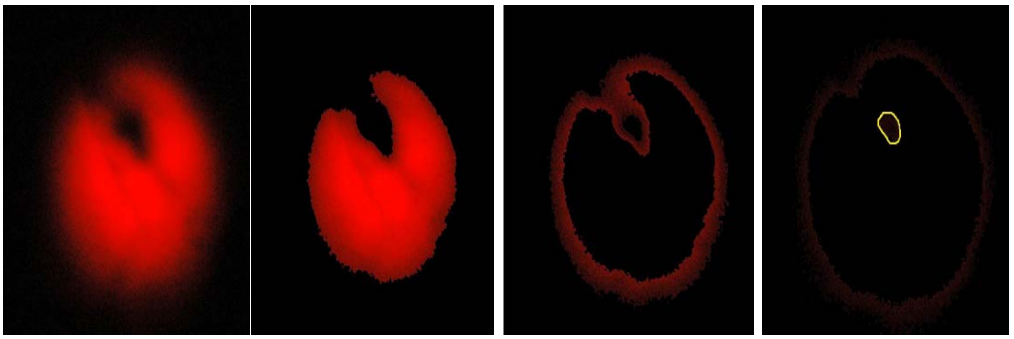
(A) (B) (C) (D)

Figure 7: Sample 4 shows, (A) the original image, (B) cluster 1, (C) cluster 2 and (D) cluster 3 after separating objects by colour using K-means clustering technique in L*a*b* colour space with no tumor found



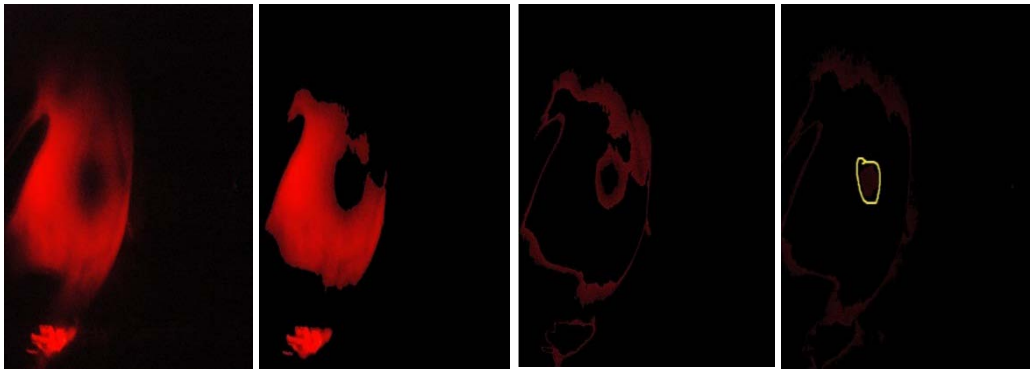
(A) (B) (C) (D)

Figure 8: Sample 5 shows, (A) the original image, (B) cluster 1, (C) cluster 2 and (D) cluster 3 after separating objects by colour using K-means clustering technique in L*a*b* colour space with the tumor region circled in yellow



(A) (B) (C) (D)

Figure 9: Sample 6 shows, (A) the original image, (B) cluster 1, (C) cluster 2 and (D) cluster 3 after separating objects by colour using K-means clustering technique in L*a*b* colour space with the tumor region circled in yellow



(A) (B) (C) (D)

Figure 10: Sample 7 shows, (A) the original image, (B) cluster 1, (C) cluster 2 and (D) cluster 3 after separating objects by colour using K-means clustering technique in L*a*b* colour space with the tumor region circled in yellow

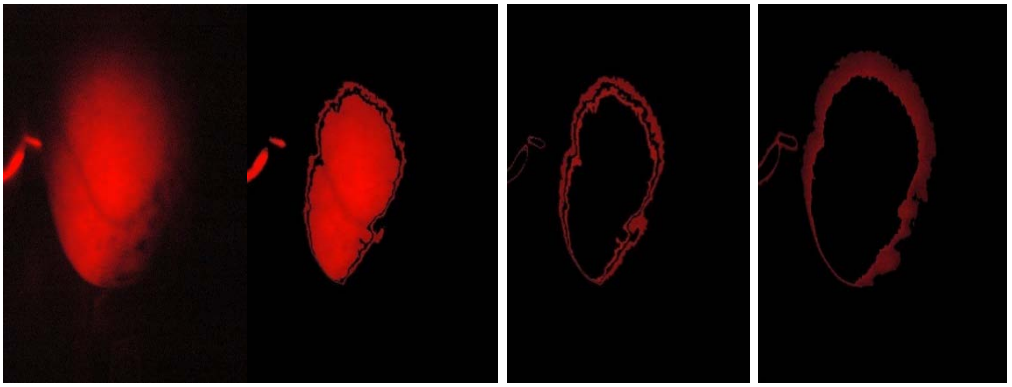


Figure 11: Sample 8 shows, (A) the original image, (B) cluster 1, (C) cluster 2 and (D) cluster 3 after separating objects by colour using K-means clustering technique in L*a*b* colour space with no tumor region

Figures 4 to 11 show the defect segmentation result of the breast with masses and lesions using the K-means clustering technique. After segmenting the input image into four clusters in figures 4 to 11, it was affirmative that the fourth cluster correctly segmented the tumor portion of the image[1]. From the empirical observations, it was observed that using 3 or 4 clusters yielded good segmentation results. Thus, in this experiment, the input images were partitioned into four segments as it also shows the detection result on an image mass while considering a different number of clusters for K-Mean clustering[4]. When the number of clusters is set to 2, one cluster contains the breast part while another one contains mass and background.

If the number of clusters is increased to 3, the defective part is separated with a background. Hence, we further increased the number of clusters to 4. In Figures 4 to 11, samples 1 to 8, the segmentation result was better for 4 clusters than 3 clusters because the area of masses and lesions in the breast is less and the

colour of the mass part is quite similar to the colour of the rest of the mammogram. So, if the mass area is larger, fewer clusters will be required while in the mass area is smaller more clusters will be needed. It means the number of clusters required for the mass detection from the mammogram image is inversely proportional to the mass area[3,7,11].

The following shows the results for the fourth clusters of all the images and their respective histograms also obtained using the MATLAB R2013a *imhist* tool. This can be observed that the affected regions are more accurately located i.e. the identification of affected areas with malignant effects gets more prominent.

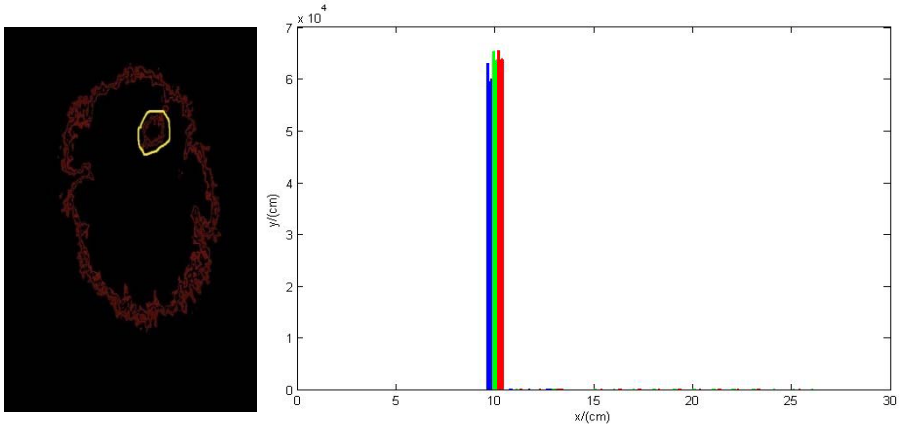


Figure 12: The processed image of sample 1 and its histogram

From figure 12, The tumor was seen when the fourth cluster was applied as compared to the 3rd cluster.

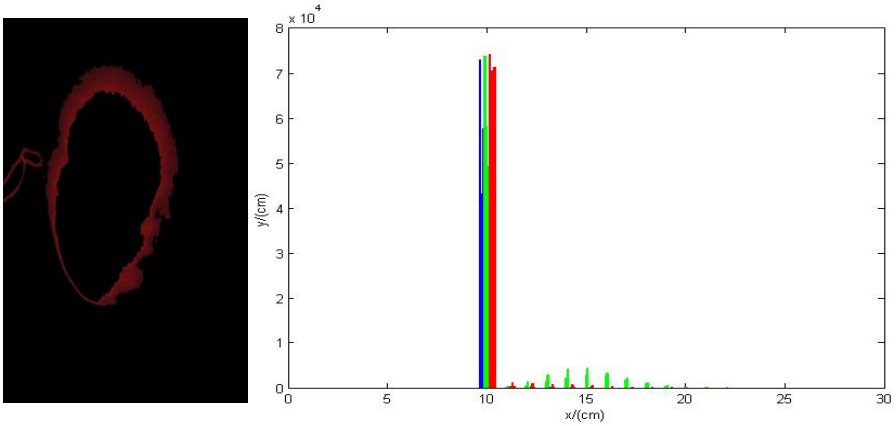


Figure 13: The processed image of sample 2 and its histogram

From figure 13, no tumor was seen in the breast as compared to the original image.

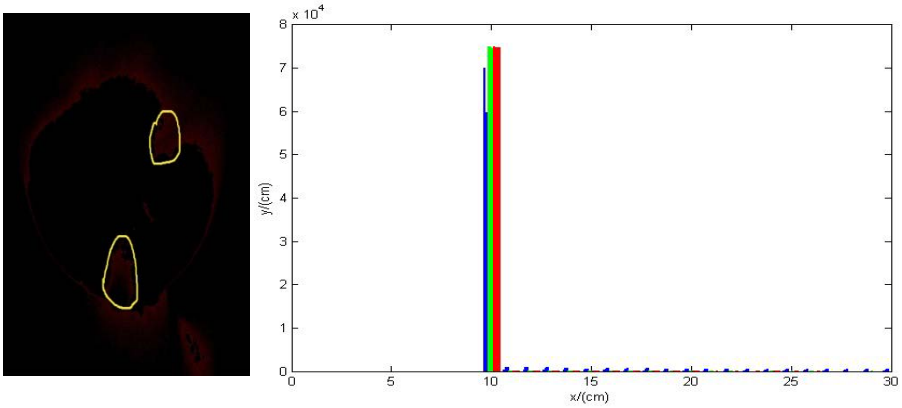


Figure 14: The processed image of sample 3 and its histogram

From figure 14, two masses were identified in the breast as compared to the original images acquired from Mammocare Ghana, and the histogram was indicated.

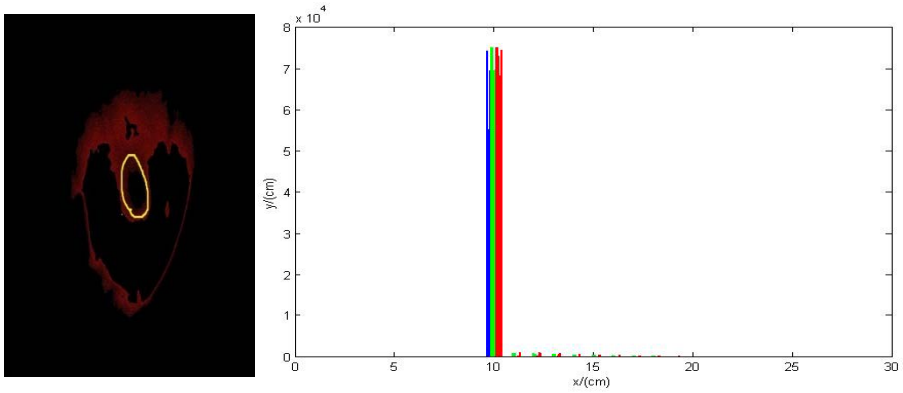


Figure 15: The processed image of sample 4 and its histogram

In figure 15, the tumor was identified in the center of the breast with the red boundary around it and it can be seen in the histogram. Although the tumor was well extracted, the red boundary was a result of the unclear nature of the image acquired.

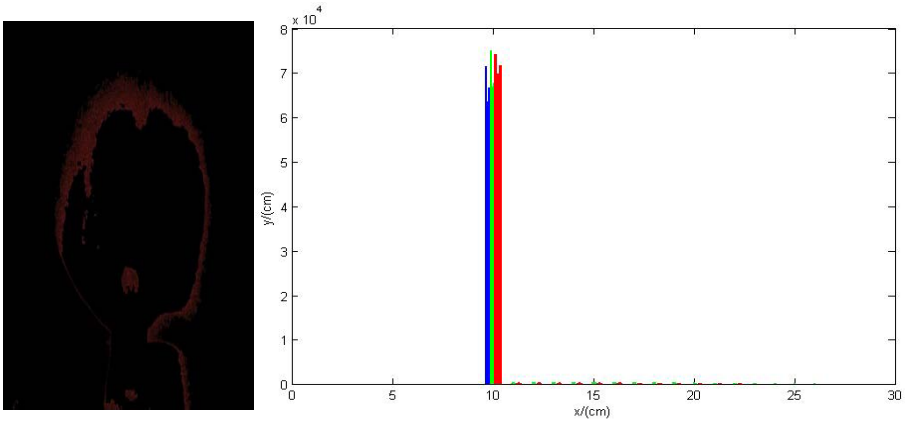


Figure 16: The processed image of sample 5 and its histogram

From figure 16, no tumor was identified as compared to the original image acquired from Mammocare Ghana. The histogram indicates the red boundary seen in the image.

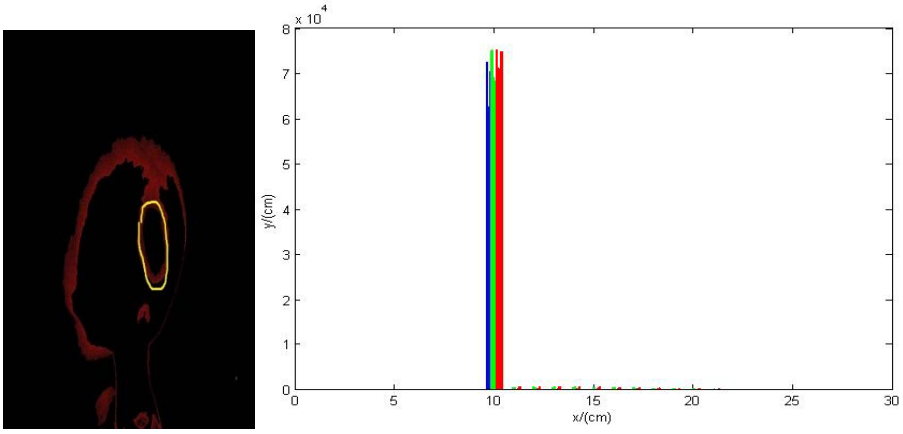


Figure17: The processed image of sample 6 and its histogram

From figure 17, although the area was large, the histogram was not clear enough this is due to the red circle around the tumor. This is because of the blurred nature of the original image and the direction in which the image was taken and hence the mass could be identified within the red circle, further increase of the

cluster to be able to well identify the tumor only resulted in the whole image becoming black.

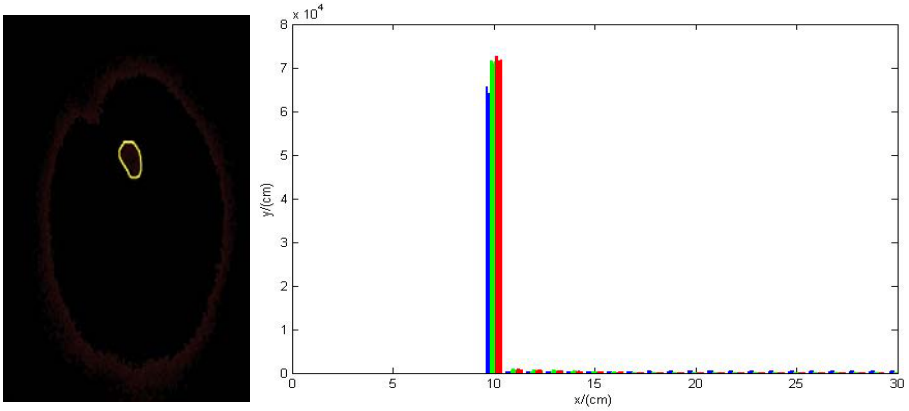


Figure 18: The processed image of sample 7 and its histogram

From figure 18, it can be seen that the mass was seen when the fourth cluster was applied, the histogram also indicated that the tumor has gotten to the mass stage but smaller as compared to the one in figure 19.

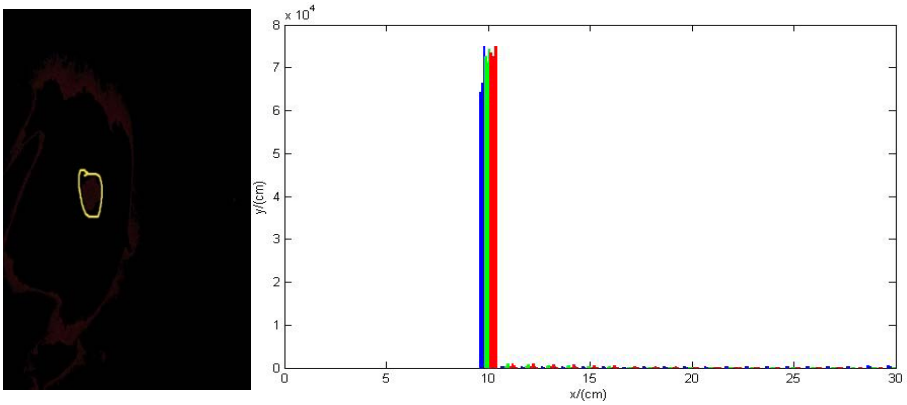


Figure 19: The processed image of sample 8 and its histogram

From figure 19, the tumor was identified when the cluster was increased to 4 the when the histogram for the image indicate that the vibrant colors showed that the tumor was large as compared to the other tumors in the other images.

The experimental results suggest that the introduced method for defect segmentation in this research is robust because it can accurately segment the cancerous part with the breast region, background and the blurred region of interest (ROI) boundary[19].

Finally, the detection accuracy was estimated and compared the performance with previous similar research works emphasizing the detection accuracy. The results obtained are also in support of anticipation with the findings and diagnosis by the radiologist of Mammocare Ghana of cancer research. The accuracy of detection has increased.

IV. Conclusion

In this work, the cancerous mammography segmentation of mammograms using K-means cluttering based on L*a*b* colour space was proposed and evaluated. The proposed approach used the K-means clustering technique for segmenting mammogram image four clusters. Mammograms images were used for the experimental observations and the introduced method was evaluated considering a cancerous mammogram as a case study. Experimental results suggest that the proposed approach is capable of accurately segmenting the tumor(mass) area of mammograms present in images. K-means based tumor segmentation approach is to also segment the cancerous area of the mammogram.

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The Earth: An Alien Planet in Another Universe

By Joseph Simeon Oyepata & Joseph Oyepata Simeon

Federal University

Abstract- The true future perspective of the Earth can be understood and appreciated only if there is a true reconciliation with its past. There are several competing theories about the ultimate fate of the universe and possibility of anything preceding the Big Bang, while other physicists and philosophers refuse to speculate, doubting that information about prior states will ever be accessible. Some scientist have suggested various multiverse hypotheses, in which our universe might be one among many universes that likewise exist. There has been so many possibilities that are yet to be explored and investigated about our earth. The Earth is strangely different from other member of the universe. This study and observation intended to interpret the likelihood of our Earth been a stranger in a foreign universe.

Keywords: *universe, earth, planets, stars, galaxy.*

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The Earth: An Alien Planet in Another Universe

Joseph Simeon Oyepata [α] & Joseph Oyepata Simeon [σ]

Abstract- The true future perspective of the Earth can be understood and appreciated only if there is a true reconciliation with its past. There are several competing theories about the ultimate fate of the universe and possibility of anything preceding the Big Bang, while other physicists and philosophers refuse to speculate, doubting that information about prior states will ever be accessible. Some scientist have suggested various multiverse hypotheses, in which our universe might be one among many universes that likewise exist. There has been so many possibilities that are yet to be explored and investigated about our earth. The Earth is strangely different from other member of the universe. This study and observation intended to interpret the likelihood of our Earth been a stranger in a foreign universe.

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I. Introduction

It is known that the universe is all of space and time and their contents, including planets, stars, galaxies, and all other forms of matter and energy (*Zeilik and Stephen, 1998).* . 'Our Universe' is believed to be about 13 billion years old [1] with a minimum diameter of 23 trillion light years, and approximately 93 billion light-years in diameter at the present day [2]. There are hundreds of billion galaxies in the universe with hundreds of billions of stars in our Milky Way. Many of the stars in a galaxy have planets. At the largest scale, galaxies are distributed uniformly and the same in all directions, meaning that the universe has neither an edge nor a center. Our planet, the earth, is no more than a small point in a universe full of worlds [3,4].

The Earth is part of a unique planetary system, under the milky way galaxy align with different matter and energy [5,6]. Earth is the third planet from the Sun and the only astronomical object known to harbour and support life. According to radiometric dating estimation and other evidence, Earth is formed over 4.5 billion years ago. Within the first billion years of Earth's history, life appeared in the oceans and began to affect Earth's atmosphere and surface, leading to the proliferation of anaerobic and, later, aerobic organisms [7,8,9]. Some geological evidence has indicated that life may have arisen as early as 4.1 billion years ago. Since then, the combination of Earth's distance from the Sun, physical properties, and geological history have allowed life to evolve and thrive. In some other study, it is believed that in the history of life on Earth, biodiversity has gone through long periods of expansion, occasionally punctuated by mass extinctions. More than 99% of all species that ever lived on Earth are extinct [10,11,12,13]. But what if these believe and estimation are not entirely true.

II. Possible Truth

A more holistic, philosophical and analytic look at the Earth shows that it may be a stranger among the universal bodies it found itself. A direct example is the fact that the makeup and composition of the Earth is destitutely different from other planetary features. Earth is unique among the known planets: it has an abundance of water. Other worlds — including a few moons — have atmospheres, ice, and even oceans, but only Earth has the right combination to sustain life. The Earth seems to be the only planet among other uncountable 'floating particles' that is habitable to all forms of life; animal, plants and microorganisms. It is unique among planets even in our solar system for having water in its liquid form at the surface, in an amount conducive to life sustaining and evolving. Earth's crust is made up of several elements: oxygen, 46.6 percent by weight; silicon, 27.7 percent; aluminum, 8.1 percent; iron, 5 percent; calcium, 3.6 percent; sodium, 2.8 percent, potassium, 2.6 percent, and magnesium, 2.1 percent [14,15,16]

No other planet has close to this geologically and biologically unique blend. The Earth plate tectonics allows for the carbon-silicate cycle to operate over geological timescales. With the carbon-silicate cycle, the levels of carbon in the atmosphere get regulated to keep the surface temperature around that of liquid water. Oxygen is another vital element for life. Free in the air and dissolved in water, oxygen is second only to nitrogen in abundance among uncombined elements in the atmosphere. Plants and animals use oxygen to respire and return it to the air and water as carbon dioxide (CO_2) [17,18,19]. Also, Earth's atmosphere is composed of about 78 percent nitrogen, 21 percent oxygen, 0.9 percent argon, and 0.1 percent other gases. Trace amounts of carbon dioxide, methane, water vapor, and neon are some of the other gases that make up the remaining 0.1 percent [20,21,22]. Such special atmospheric mix needed for a biological energy generation, growth and nucleation for all form of life cannot be found in any other planet or body existing in our present universe. Another aspect of Earth is its proportionate size: If it was much smaller, it wouldn't be able to hold on to our precious atmosphere, but much larger and it might be a gas giant too hot for life.

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It is possible that the Earth was part of another universe, with similar or closely related condition, system, matter and energy to that of ours. Earth may be originally located peripherally from its parent and may lack enough pull-in force (Oyepata Force) resulting in been pulled in by our currently strange universe that may possess a much stronger force (Antioyepata force). If this theory is true our planet may not be at the center of our current universe, rather it may have been comfortable trapped, sustained or stabilized by the combination of force it posses and by the force around it.

Another plausible theory is the reinterpretation of big bang theory. Every universe is sustained by a balance of two forces centripetal (Oyepata force) and centrifugal (Antioyepata) force. It is possible that at a particular point or time our parent Universe (Opeyemi Universe), for some yet to be known reasons had a chronic or acute drop in Oyepata force, compared to an incredibly strong Antioyepata force. This failed balance may have resulted in total or peripheral explosion of Opeyemi's Universe causing different fragments and matter to be snatched away by multitudes of available universe. This may explain why it is very difficult to find another Earth-like planet in our current universe (called Dare's Universe). The big bang theory (in this case Simeon Oyepata's theory) may not be the beginning of a (the) Universe, rather the end of our previous Universe. It is also possible that our parent or Opeyemi's Universe to be well over 13 billion years. This may be the reason for chronic decay, disintegration and/or explosion.

These theories may explain why many unnatural cycles that we assumed to be natural continuously occur. These include

1. Adaptation and survival of the fittest. It is worthy of note that from the period of our planet leaving Opeyemi's Universe to its current fate in Dare's Universe, most organisms and microorganism have undergone adaptive change or regrettably gone extinct.
2. Death and Reproduction; it is possible that our Opeyemi's Universe (parent Universe) contains fundamental elements that provides close to eternal existence, that is, the ability for humans to live at least a thousand years. But because of absence or loss of this life sustainable element due to unfavourable universe condition, living organism, humans in particular, may have underwent rapid evolutionary changes that favours rapid reproduction to compensate for short life and death.
3. Sickness and diseases: the origin of sickness and diseases maybe due to inconveniences the change caused living organisms of different forms resulting in different form of disease manifestation. It is also possible that struggle for survival and inadvertent mutation and evolutionary changes may have resulted in some microorganisms relying on other organism for survival, in the process, causing infection and diseases on the host.

III. Conclusion

The fact that Earth hosts not just different forms of life, but also intelligent life. This makes it doubly unique. It is possible that some other ostracized or snatched away planets by our current or other universes may have lost many of their parental trace due to harsher environment, hence becoming unhabitable. It is important we find and explore all possible explanation on the origin of the Earth. It is also vital we locate our original planetary, solar and galaxy neighbors or even Universe. In that way, the Earth can be at peace with itself and we the inhabitant will understand and appreciate that we are the true alien.

IV. Recommendation

More robust hypothesis, advanced facilities and scientific analysis are needed to be conducted to provide real or alternative view about the origin and destiny of the Earth. Understanding the true origin of our Earth may provide a more plausible explanation to implication and significance of its physical chemical makeup.

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Competing interests
The author declares no competing interests.

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Twelve Ideas that Might Expand the Scope of Science

By Ashok Kumar Mukhopadhyay

Abstract- Science progresses slowly by Apollonian, who extends its boundary by bringing perfection on the established lines. Science often takes an intuitive leap by Dionysian, who opens an unexpected new line of research. The present paper presents twelve mixes of such ideas which together are capable of extending the scope of science. An analyst could find several ideas within one main idea; assumption, imagination, intuition or obvious reality, not one, however, on any beaten track. Each of the main idea is supported by a figure, the mind's artwork, captioned with several new ideas. Most of the ideas have a bias towards operational consciousness. The erected framework has the potential of ushering in a new Multiversal Worldview accommodating science, humanities, and spirit together.

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Ashok Kumar Mukhopadhyay

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I. Introduction

"Science, derived from the Latin "*scientia*," originally meant general knowledge of physical and spiritual world. Through the ages, however, the meaning of science narrowed to the description and understanding (knowledge) of nature (i.e., the physical world)" – George A Olah, Nobel Prize winner in Chemistry in 1994. Thus, science deals with nature. The present science has been working under the umbrella of Einstein's constant, the velocity of light, Planck's constant of space (10^{-32} cm) and time (10^{-44} sec), and the constancy of the entropy barrier. Einstein's constant excludes the simultaneity of events. Planck's constant, which indicates objective cognitive limit, excludes continuity of events. The entropy barrier excludes the identity of events. Nature does not end under the shadow of these constants. There are events that are simultaneous, continuous, and identical! The scientists are looking for the ideas that stimulate science-sensitized minds to extend the scope of present science [1]. There might be bottom-up ideas that push the envelope of science further. It is possible to investigate in science across the pores in its mind-made envelope. It is also possible to start with some ideas which transcend its present boundary. Or, the idea begins from seemingly the imaginary 'top' and across the 'down' embrace the whole. We choose to discuss twelve such ideas spirally intertwined with each other.

II. The Twelve Ideas

a) *Axiology of Reality*

Nature does not end with the material reality ($e=mc^2$), space-time reality (warping of space-time as gravity, and hyper-dimension), and abstract mathematical reality (multiverse)! There is biological reality as well. Within the biological reality, there is a cognitive reality! Cognitive reality could extend into any kind of reality including cosmological reality. Mathematical reality could construct multiple universe(s) but cannot account for biological reality which is integral (in contrast to integration) of several asymmetries. To look into the axiology of the reality within systems science could be our first idea (Figure 1). When someone says he is a "voice" without a form, it seems in*form*ation exists prior to 'form' (space and time). Informational reality is before space-time reality! The source of such a voice, i.e., 'information' is "life". The reality of life is prior to the reality of information. The idea provokes us to ask, what is the source of matter, and what is the source of space and time? Which of the two statements is correct; matter generates life as prevalent in present science, or the life generates matter?

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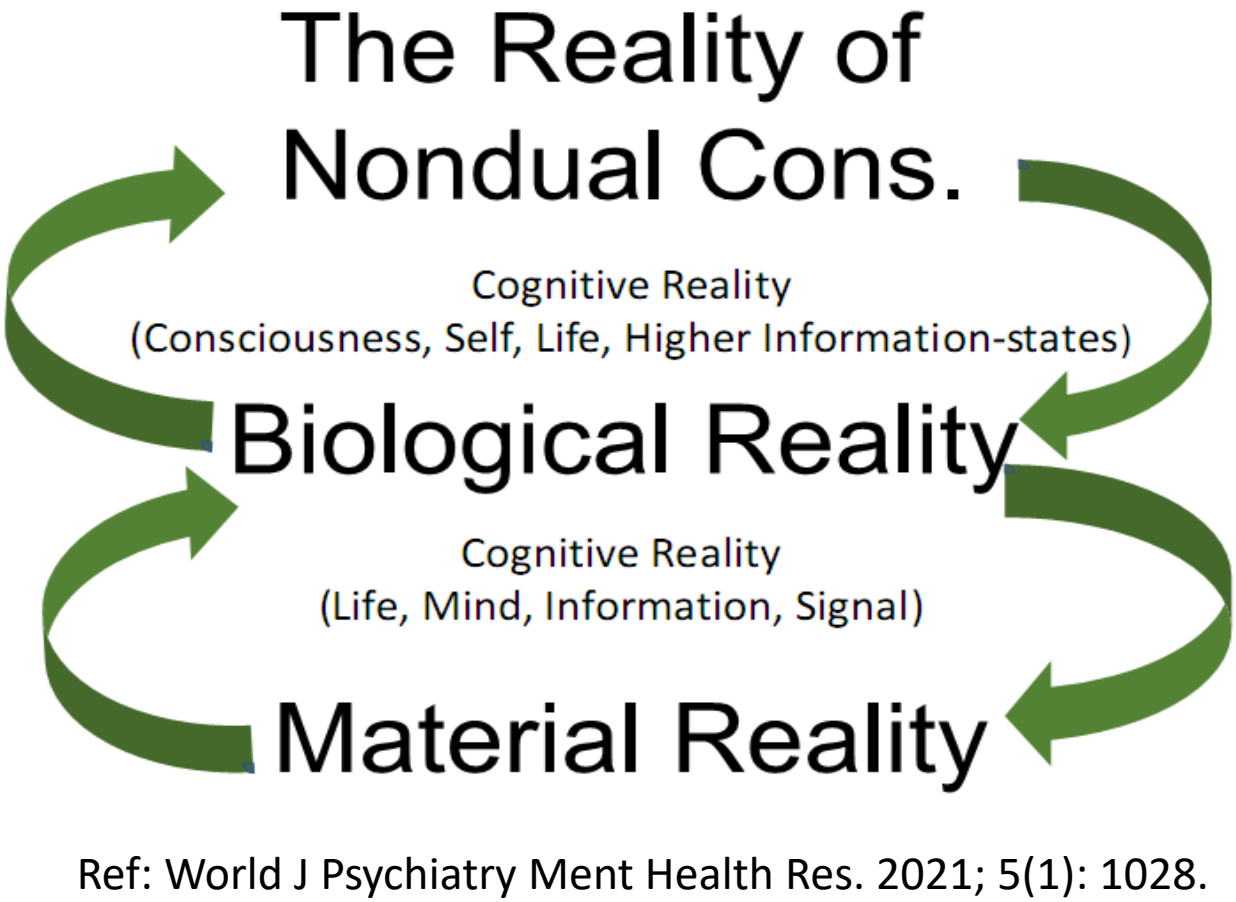

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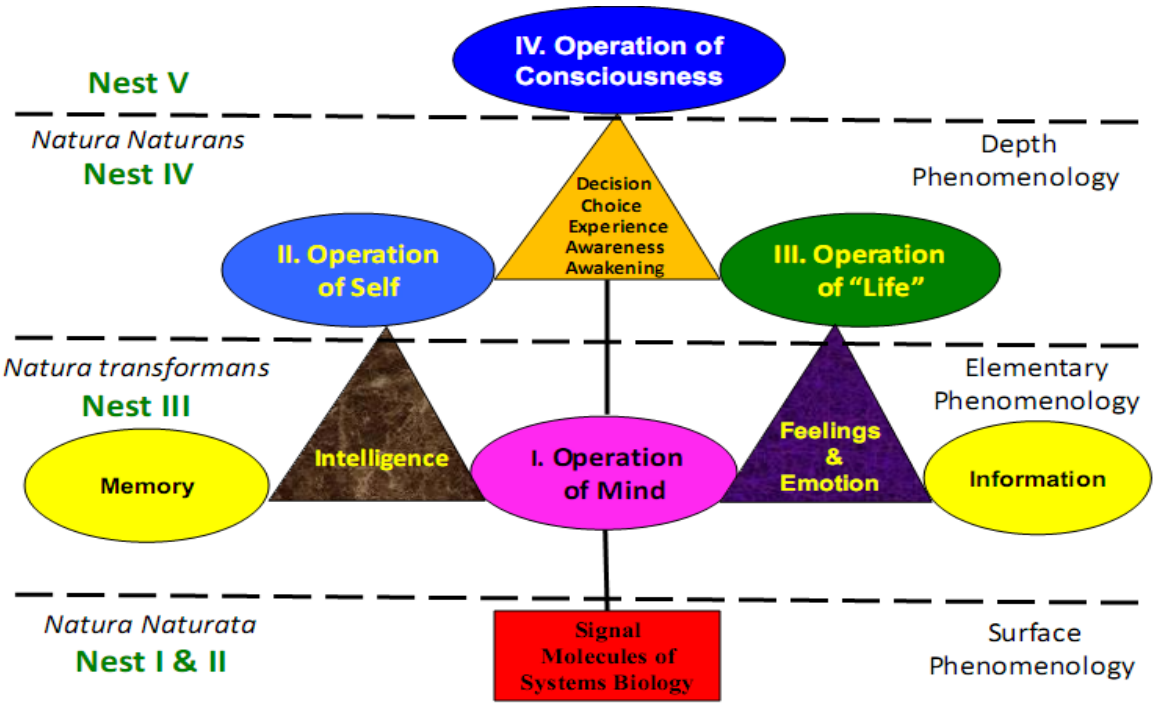
Figure 1: The Reality could be described in three strata. Biological reality is at the center. Nondual Consciousness Reality is at the Top, and Material Reality is at the Bottom. Biological Reality does the homeostasis between Consciousness reality and Material Reality. Three Realities influence each other, both Top-Down and Bottom-Up. Biological Reality has a Cognitive Reality within. Biological Reality connects with the Material Reality with the help of Faculty of Life and Mind, Information and Signal. Biological Reality connects with nondual reality by System's consciousness, Faculty of Self & Life, and initially with the Higher Information States

b) Cognitive Systems

Within the cognitive reality, there are several operators, for example, mind, self, life, and consciousness, several operations, and specific currency with which the operations are conducted. Exploration of this system of cognitive faculty as a cognitive organ (Figure 2) is the proposed second idea for extending the boundary of science. Consciousness is the will-making entity and operates as the event manager. The event-generating entity is the mind. The logic and ethics for events are laid down by 'self'. The aesthetics of the event is taken care by 'Life', which also works as a homeostatic manager to handle uncertainty, asymmetry, and imbalance of visible and invisible dark energy (funding of events). Asymmetry-symmetry homeostasis is a function of "life". Science does not begin and end in symmetry. The creation begins in asymmetry and ends in asymmetry. Life-operation transforms non-qualifiable consciousness into quality state. The self and the mind together transform quality state into a quantifiable state. When mind-operation breaks down integrated state into a state of disintegration, life-operation produces an integral state out of disintegrated components.

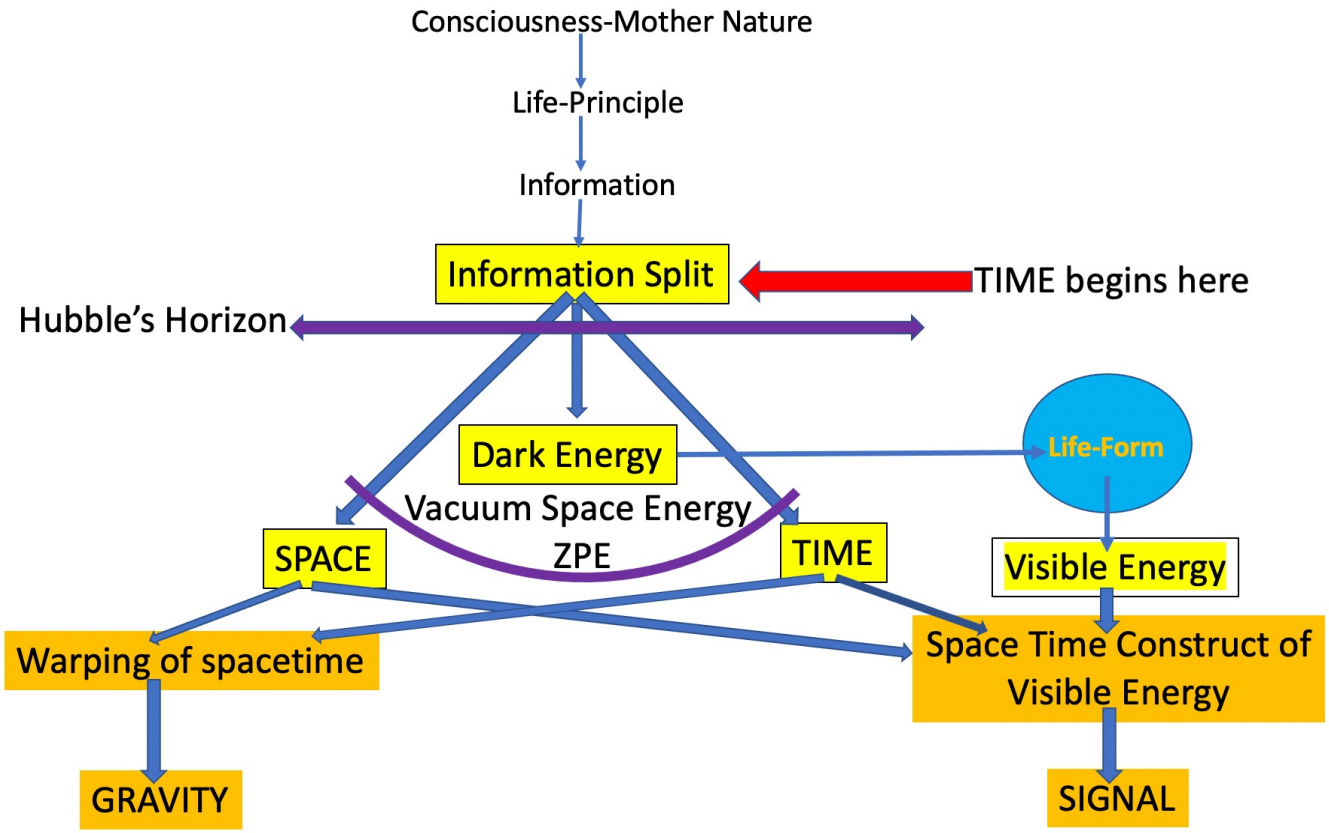


Stratified and hierarchically nested Faculty and the Operations of the Cognitive Organ

Figure 2: The Cognitive Organ consists of Cognitive Faculty and their Operations. Cognitive Faculty, although nonlocal, are hierarchically positioned when they perform as a system. The Mind, from the Nest III of Nature (*Natura Transformans*), operates (Operation I) as the Final Common Pathway to connect with the material nests (*Natura Naturata*, Nest I & II). Operational positions of the Faculty of Self (Operation II) and of Life (Operation III) are Nest IV (*Natura Naturans*). Consciousness operates (Operation IV) from Nest V. Within nest III, Mind, Self, and Memory jointly operate to produce Intelligence while Mind, Life, and Information jointly generate Emotion. Once the Mind is stabilized, Consciousness, Self, and Life are responsible for Awakening, Awareness, Experience, Choice, and Decision. Phenomenology observed in the Material Nest is Surface Phenomenology. Phenomenology of Self & Life is Depth Phenomenology. Phenomenology of Nest III is Elementary Phenomenology.

c) Information. Its nature and science

The currency with which this cognitive organ operates is information in its various states such as signal (a space-time construct of energy), information-as-such (non-digitized but factorizable), information with a definite architecture (non-digitized and non-factorizable) that could be used without further deliberation (which in common language is called knowledge), information manifold (in common language called experience), and the crystallized information as the wisdom. We do not know the mechanism of interconversion of different states of information! What is the currency of this interconversion? Surely not visible energy! Is it some kind of invisible energy, dark energy operating within the non-observable semantic domain? Exploring the nature and science of information is, therefore, the third idea (Figure 3) to ponder. For science, this is the time to embrace information holograph, shifting focus from classical and quantum holography.

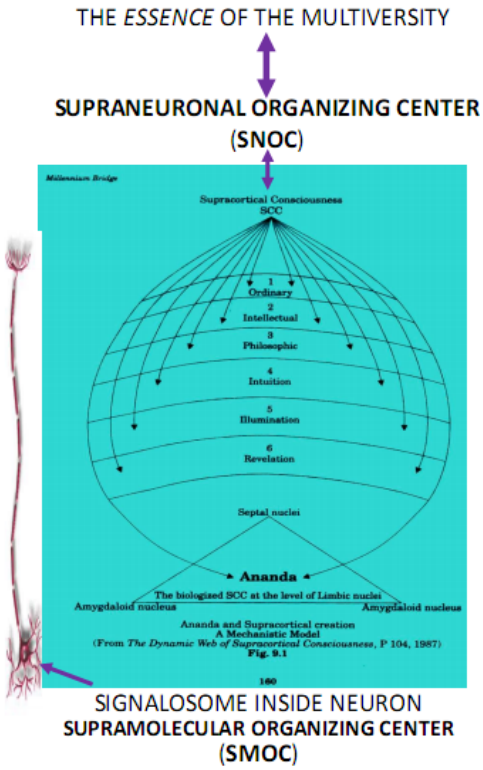


Ref: J Neurosurg Imaging Techniques (2020); 6(3):347-366.

Figure 3: The subtle part of Life has been called Life-Principle that is sourced from Consciousness-Mother Nature. Information originates out of uncertainty in the relationship between Consciousness and Life Principle. Information Split, an operation of Mind, is the cause of the genesis of Form (Space & Time) and Energy at the level of ZPE (Zero-Point-Energy). Mind originates with Duality at the border of the system. The Mind works as the organ of communication between two conscious systems, and Information is the unit of communication between two conscious systems. Time begins with Information split. Space and Time, so produced, are warped as Gravity in a 4-D World. Dark energy is converted into Visible Energy by Life-Form. The space-time construct of visible energy is a signal

d) SMOC and SNOC

The living cell is a holographic minuscule of the whole universe. This idea supports the view that David Bohm tried to explain to Einstein that the universe is living, infinite and holographic! Within such larger overarches, genes are merely carriers of information. Information drives the genes. Neurons are too carriers of signals. Information processing is a prerogative of the mind in the semantic domain. The idea of signalosome (Supra Molecular Organizing Center, SMOC) [2] within the smart cellular laboratory is the latest in cell biology. The SMOC is where from cell signalling is coordinated and is probably regulated. However, the signal is not the information. Information is in the semantic domain deeply connected with cognitive faculty such as mind and self. Therefore, SMOC is also the center where molecular automation and cell autonomy, a property of the living entity, merge. This idea could be extended in neuroscience as Supra Neural Organizing Center (SNOC) (Figure 4) for connecting the nervous system of the biological body with the cognitive reality. Within this SNOC there is a supposed merger of neural automation, neural autonomy, and consciousness with a greater degree of freedom of cognitive "will" that operates with a large number of options. This is our fourth proposal for extending the scope of science. The idea of SMOC and SNOC push the present envelop of science further. However, this is the number one idea that makes the whole of neuroscience upside-down, accepting supracortical consciousness as an existing reality.



The Cerebral cortex – as a Supracortical Machinery

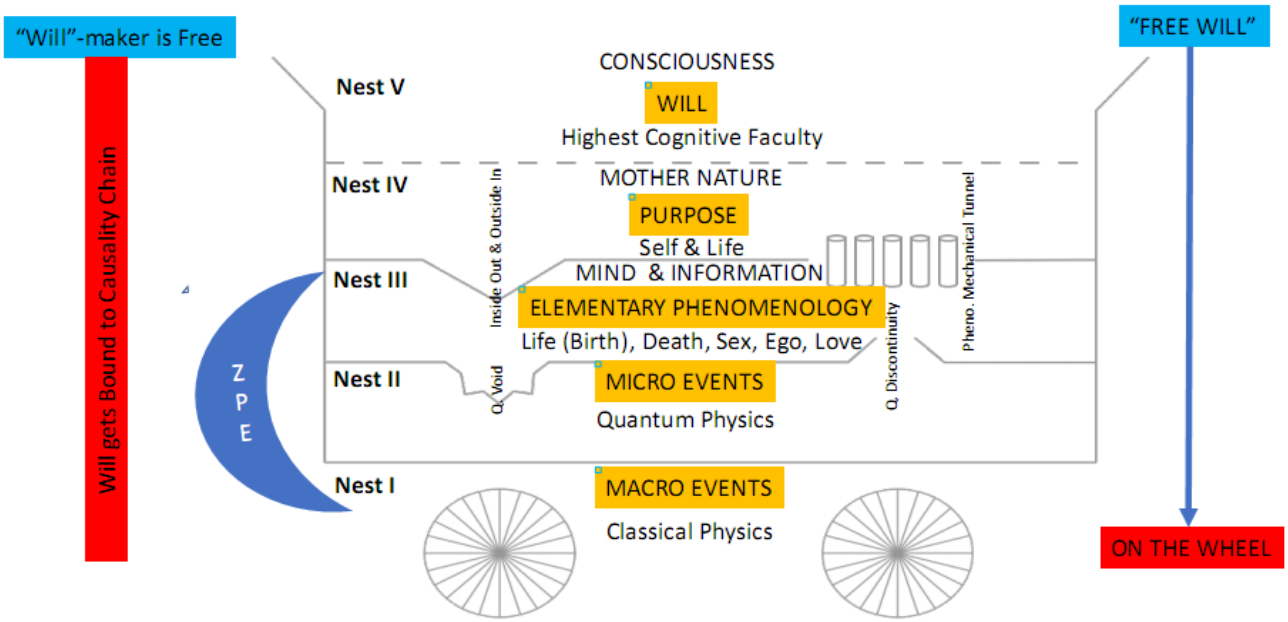
Incorporation of Operations of		Results in
Third layer cortical neurons	In the executive machinery of downstair modules of cerebral cortex	Intuition
Third, Second layer of cortical neurons		Illumination
Third, Second and First layer of Cortical neurons		Revelation

Ref:Mukhopadhyay AK. *The Millennium Bridge* (2000)

Figure 4: The blue-colored picture is from Author's book, *The Millennium Bridge* (2000). The cellular laboratory is not merely automated but is also smart. The Supra Molecular Organizing Center (SMOC), also called Signalosome, is the junction of Automation and Autonomy in the function of a cell (neuron). One hundred billion neurons make the human brain. On the upper surface of the cerebral cortex, there is proposed to be a Supra Neural Organizing Center (SNOC) for communication between brain-bound consciousness and brain independent universal/multiversal consciousness. Supracortical consciousness (SCC) is then an existing reality. SCC and SNOC maintain a tangled hierarchy. At this phase, the cerebral cortex becomes a supracortical machinery. Cerebral cortical neurons are arranged in six layers, the top layer is the first, and the bottom layer is the sixth. The Neurons of the lower three cortical layers work in a modular fashion. In the absence of operation of SCC, mostly lower three-layers (4^{th}, 5^{th}, and 6^{th}) are active. With the action of SCC, incorporation of 3^{rd} cortical layer neuron activity in modular cortex results in Intuition. Incorporation of 2^{nd} and, 3^{rd} cortical neuron activities in modular function results in Illumination. Incorporation of 1^{st}, 2^{nd}, and 3^{rd} cortical layer neuronal activity in modular cortex results in revelation.

e) Pentaune Model of Nature-consciousness

The fifth idea is to look at the total spectrum of nature in a stratified nested way. Nature does not end with the end of gravity or is not limited within Planck's scale. Nature could be visualized as nested, the one nest within a deeper nest and so on…., all together might be categorized as nest I, nest II, nest III, nest IV and, nest V (Figure 5). Chronologically, the nests represent respectively the nests for macro events, micro-events, elementary phenomena for the events to happen, a nest for planning the purpose and the intents of the events, and the nest from which the "will" for the events generates.



Pentaune Model of Nature-Consciousness

Figure 5: The nature-consciousness spectrum is delineated into five nests. Nest I accommodates the macro events governed by principles of classical physics. Nest II accommodates the micro-events governed by principles of quantum physics. Nest III is the domain of Mind, Information, Memory, Intelligence, and Emotion. This is also the site for Elementary Phenomenologies such as Life (Birth), Death, Ego, Sex, and Love. Nest II could be bypassed, and one could enter Nest III from Nest I through ZPE. Nest III ends at the boundary of the systems, our brain/Universe, with the happenstance of the phenomena of inside-out and the outside-in. Nature transits to Mother Nature in Nest IV, where the purpose is chalked out for the required phenomenology in Nest III, and the events planned for Nest II and I. Self and Life, which maintain a tangled hierarchy amongst themselves operate from the border of Nest IV. Consciousness, the highest Cognitive faculty, asserts its supremacy through its strongest political "will"! The will-maker is Free but the will, once made, gets bound to the causality chain.

On the side view, this arrangement looks like the layers of nature while in fact, this might be considered as a spiral beginning at the level of will and extending down to the event. This is an infinite spiral on the cosmic scale, finite-infinite on the human scale, minuscule on the cellular scale, connecting the will-making entity/operator/operation/center at the deepest domain with the broad-based most superficial domain of macro events. Every nest has a boundary, doors of communication with the adjacent nests, and specific currency with which the specific operators work for the operations.

Now, we will describe two Ideas (Idea no 6 & 7), which see science across the "pore" in the existing envelope. Albert Einstein had led science to the level of ZPE. Quantum physics has led science to the point of quantum discontinuity and quantum void. There are enough scopes for extending science across these pores existing on the envelope of today's framework of science.

f) ZPE

Space and matter are closely connected in the 4-D world. The matter is that which has mass and always occupies space. Could there be any space not related to matter or rather totally independent of matter! Einstein found a space with no matter but is occupied with near-zero energy, which is not constant but fluctuating. This energy does not follow the law, $e=mc^2$. It is reported that after working with it for several years, Einstein abandoned this from his doing science. This is widely known as Einstein's cosmological constant. Zero-point energy (ZPE), is said to be the most serious fine-tuning problem in theoretical physics because of its inexplicable smallness as found by experiments (non-zero but not greater than 10^{-120}Ap. One Ap is equal to one Planck's mass per cubic Planck's length). This energy has a role in preventing the collapse of the universe or preventing inflation being eternal. From this fact comes suggestion of its relation with dark matter and dark energy of the universe. The value is not stable and there could be several values between zero and 10^{-120}Ap. Only a small fraction of the stable vacuum is hospitable to "life"[3]. Several post-COVID-19 sufferers' experiences of space empty of matter, which includes many scientists, have brought ZPE on focus for germination of a new science across ZPE. The new idea (Fig.6) is that this pore leads us to the domain of mind, therefore connecting psychology with physics!

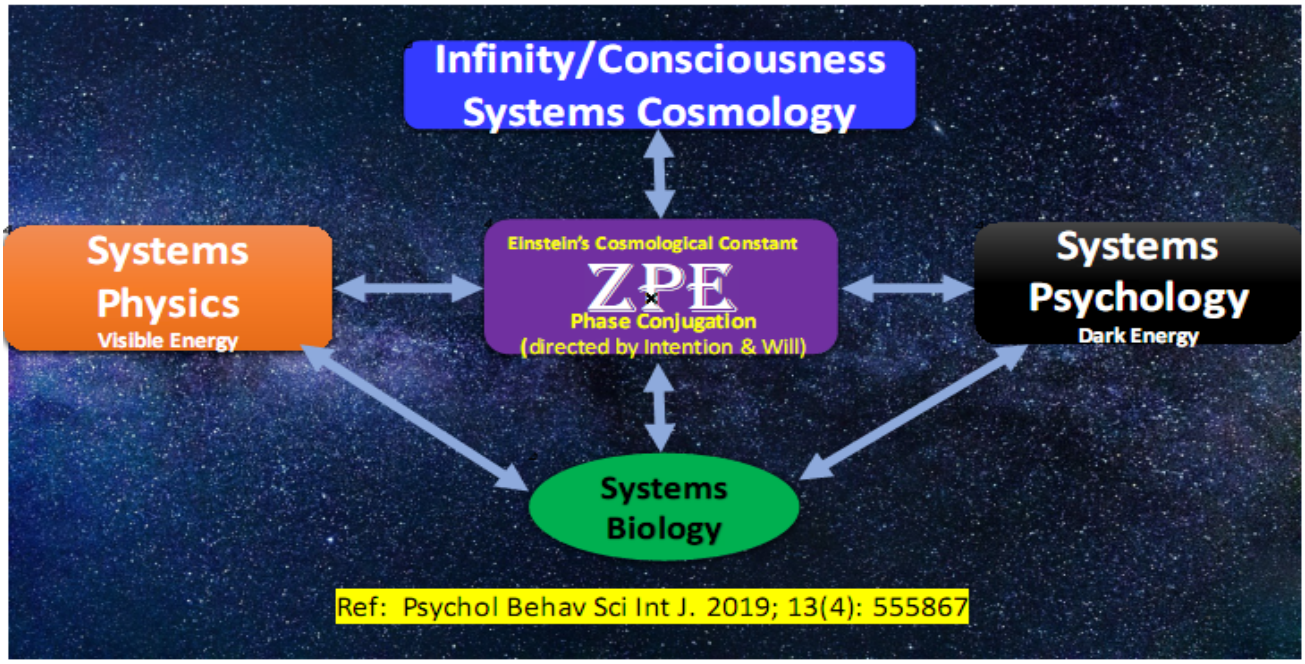


Figure 6: Zero-Point Energy is the transit gate between observable and non-observable nature. This is the exchange ground for Systems Physics and Systems Psychology. Through ZPE, Systems Cosmology communicates with Systems Biology. Phenomena and Events happen by phase conjugation. This is the site of dark energy-visible energy inter-conversion, also the site of information-signal and signal-information conversion

When a cell or any biological organism accesses the domain of semantics, accession happens through ZPE. Conversion of signal into information and vice versa happens through ZPE. Also therefore, cell biology accesses cosmology through ZPE! The entrainment and enactment of the heart and the brain are supposed to happen involving ZPE. The idea merits further investigation.

g) Quantum Discontinuity and Quantum Void

The photon is here, the photon is there, but where was the photon in between? Oh! Do not bring the existential issues here! We are interested in the mechanics executed by photons and are not concerned with existential issues! Others say photon disappears to hold an instantaneous transaction with the Infinity! But, what about the quantum void, which is supposed to be the source of quantum physics? What is the relation between quantum void and intergalactic void of cosmology? Quantum void leads us to nature beyond Planck's scale! When we ask, "*quo Vadis* quantum mechanics", we move towards discontinuity. When we ask, "*unde venis* quantum mechanics", we focus on the quantum void (Figure 7).

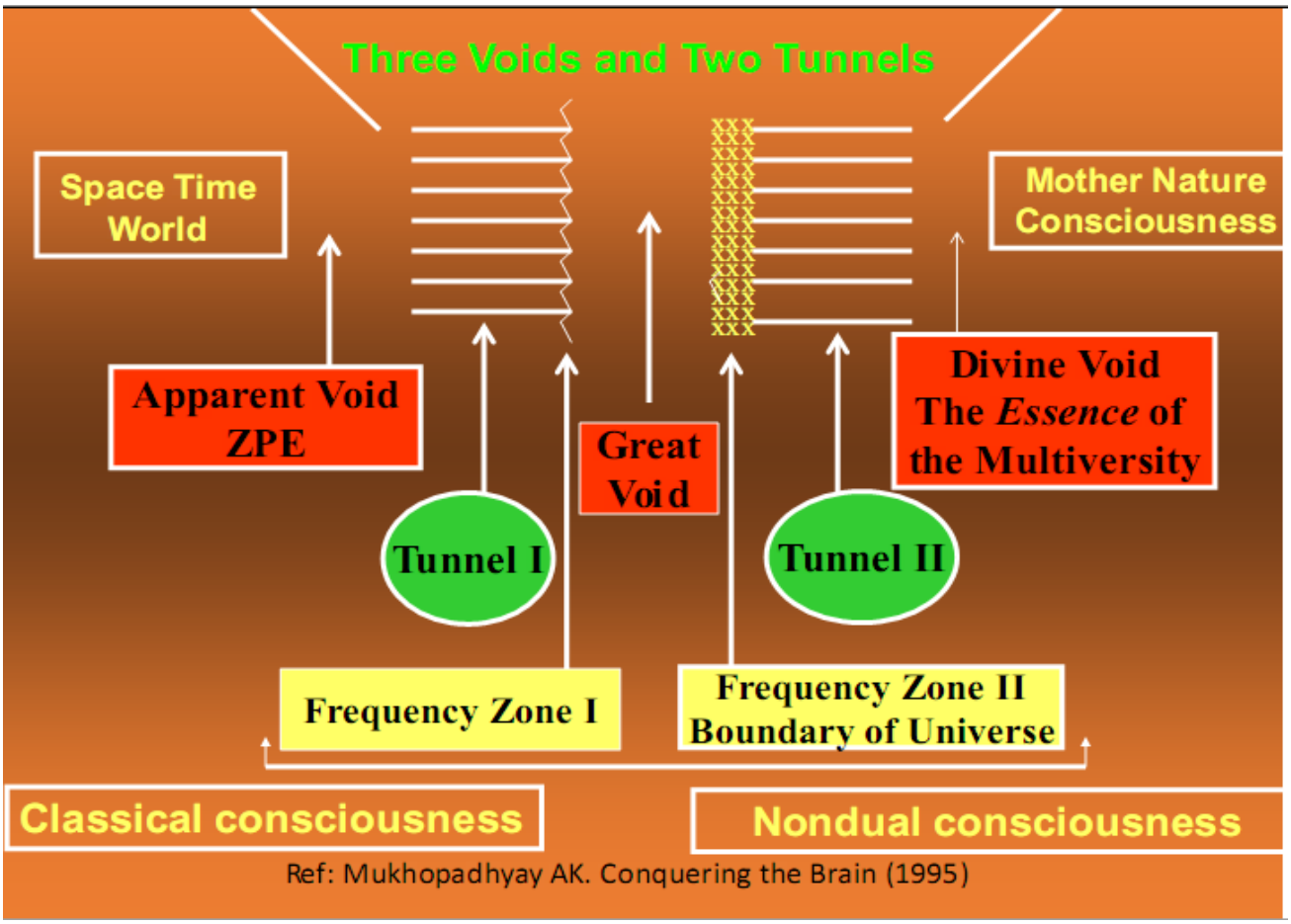


Figure 7: The passage of communication across the total reality consists of three Voids, two Tunnels, and two Frequency zones separating the space-time World from the *Essence* of the systems Multiverse(s). Apparent Void begins at ZPE. The Great Void is the dark cold domain of the Intergalactic region. The Divine Void is the domain of Nondual Consciousness and Mother Nature. The Voids are linked by Tunnels I & II having frequency-like zones on either side of the Great Void. Interestingly, our Mind is a structure and process consisting of these seven layers acting as a communicating organ between system-bound human consciousness and system-independent non-dual consciousness!

From Idea no seven and figure seven, we get seven layers of the mind that is interposed for communication between two conscious systems. This also leads us towards the design of the cosmic womb.

h) *Mother's womb has been designed in the image of Cosmic womb!*

The relationship of ZPE with quantum discontinuity and quantum void is not known. When we follow the classical physics, we are pushed to the porous space at ZPE. When we follow quantum physics, we reach discontinuity and void! Their relationship with the black hole and the white whole is completely unknown! What is amazing, however, is that Mother's womb and the cosmic womb have a similar design (Figure 8).

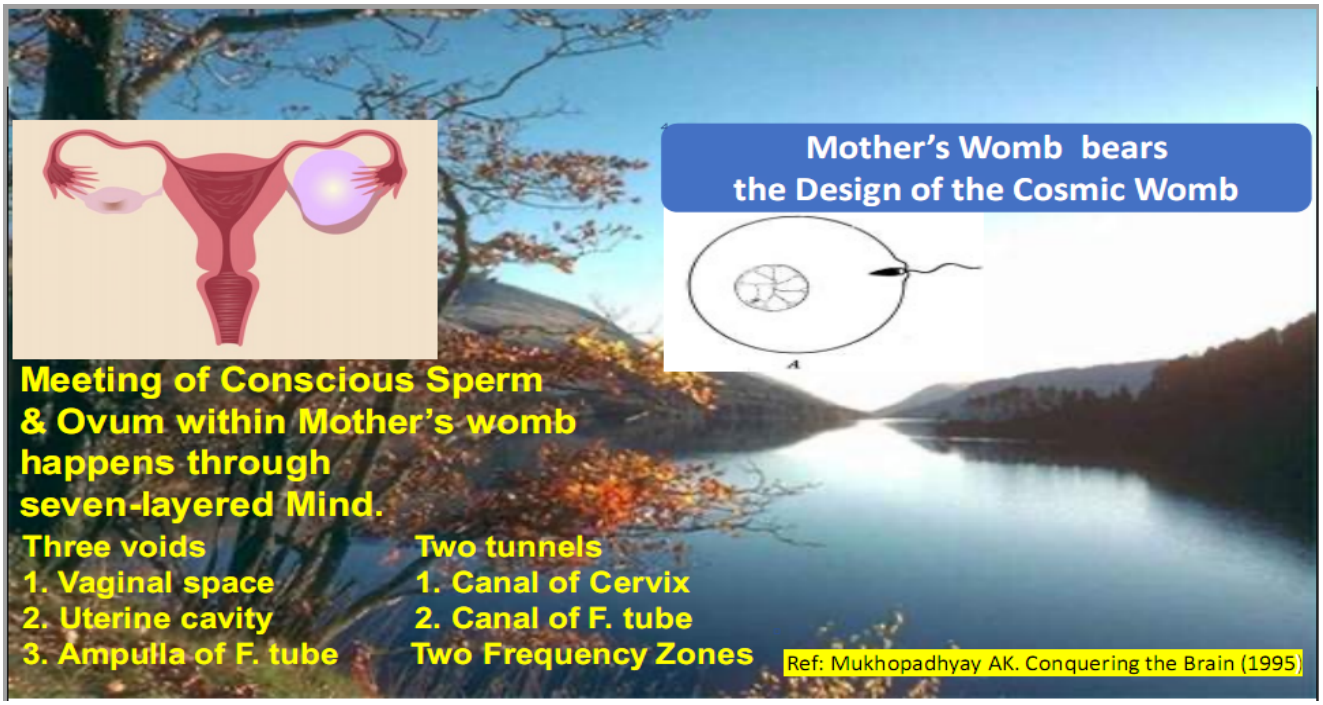


Figure 8: Amazingly, Mother's womb has a design similar to Cosmic womb. Vaginal space corresponds to void at ZPE. The uterine cavity represents the Great Void. Ampulla of the Fallopian tube represents the safe Divine void within the system, for fertilization! The narrow cervical canal is the first tunnel. The narrow Fallopian tube from the isthmus represents the second tunnel. Two conscious systems, sperm and ovum, meet at the fertilization site of the birth canal after crossing over the design of the cosmic womb, racing across seven layers of the mind

In biological creation, all masculinity ends in vaginal space, equivalently at ZPE. The next all are femineity. Out of millions of seed creatures, one and only one becomes successful for a new creation. The Divine void is the sacred place for fertilization. We learn the ethics that while exploring cosmology, we better respect nature as Mother Nature. Better we also respect every female, girl, and woman as Mother, since she possesses the womb made in the image of cosmic Mother! On the top of our brain, the divine void operates on SNOC.

Next,, we are led to two ideas, Idea no 9 and 10, that take us across the present framework of science; the idea of the multiverse and the existence of an operational consciousness.

i) The idea of the Multiverse

Our science, so far, has been working with the concept of only one universe! Is there nothing beyond our own universe? The emerging idea is that there is multiple universe(s). Mathematics supports the idea of a multiverse [4]. The Multiverse is an extension of our Hubble's horizon beyond 42-44 billion light-years radius when it is Type I. This kind of multiverse is often described as Megaverse! The multiverse might be interconnected bubbles of different sizes (Type II), often described as Metaverse! The Multiverse might be multiple superposed versions of our existing universe (Type III), or as existing completely disconnected and independent of each other (Type IV multiverse). We are not satisfied to accept the extension of the boundary of the existing universe as Megaverse in the stillness and emptiness, silence and nothingness. We are equally dissatisfied with hyper dimensional/multidimensional interconnected bubbles of Metaverse where life cannot flourish! We are not concerned with the superposed universe where the cat will be simultaneously dead in one and alive inside the other because different universe follows different laws. We are interested in the multiverse Type IV, which has room for an infinite number of nested Hubble spheres, sourced from the One, and governed by the identical systems of laws, maybe with contingent modification. Therefore, this idea cannot be considered as a neologism to escape from several constancies in science and phenomenology, ethics and aesthetics! In social science, a close example of the existence of such a multiverse is when thousands of members of the entire community simultaneously get the dream of one person as their leader-elect. Such apparently disconnected and independent multiple universe(s) form a system, which might be called, The Multiversity. There exists an *Essence* from which these multiple universes are sourced. This might be called the *Essence* of the Multiversity. The Multiversity is the largest intellectually comprehensible system, supposedly the primal source

of systems science. We are interested in final transcendence into this *Essence*! That multiple universe(s) dance on the SNOC of some of our brain means little. We feel blessed when the SNOC is immersed in this *Essence* to usher in the beginning of Multiversal Neuroscience and Immersive Neuroscience! Along with oxygen we breathe in, and along with carbon dioxide we breathe out the *Essence* of the Multiversity. As First-Person-Universal we swim in the *Essence* of the systems Multiverse. Figure 9 shows how the idea of the *Essence* of the multiverse Type IV could be connected with several disciplines of science.

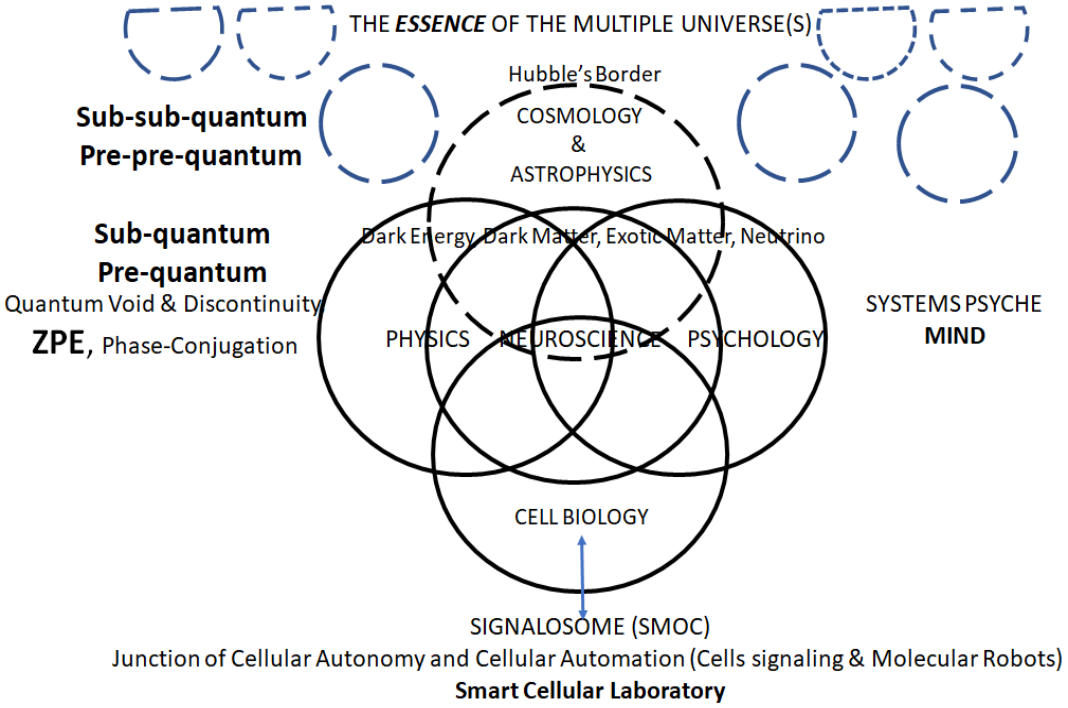


Figure 9: Figure shows how the *Essence* of the systems Multiverse might connect with several disciplines of science. The *Essence* is the source of multiple universe(s). This *Essence* could be connected with the disciplines of Physics and Astrophysics, Cosmology and Psychology, Neuroscience and dark energy, smart cellular laboratory with the laboratory of the Multiverse. The link is through the subtle part of Life, the Life-Principle. The concept of pre-quantum (sub-quantum) and pre-pre-quantum (sub-sub-quantum) are important. The Mind operates across the level of ZPE.

Is it all a Mind-Game by Self and Life across sub-quantum (pre-quantum) and sub-sub-quantum (pre-pre-quantum) space! The Mind operates across the level of ZPE! However, the mind becomes imperceptible towards the border of the universe!

j) The idea of Operational consciousness

The idea that consciousness is not merely an ontological and inert substance but also operational, merits to be taken up by science. Consciousness, although is the ground without any background, is a "will"-generating ground. To begin with, consciousness is a strong supportive ground that supports elementary phenomenology of observable events, an intervening active substance to change the trajectory of events, a creative field along the infinite spiral line of conversion of "will" into an event (Figure 10).

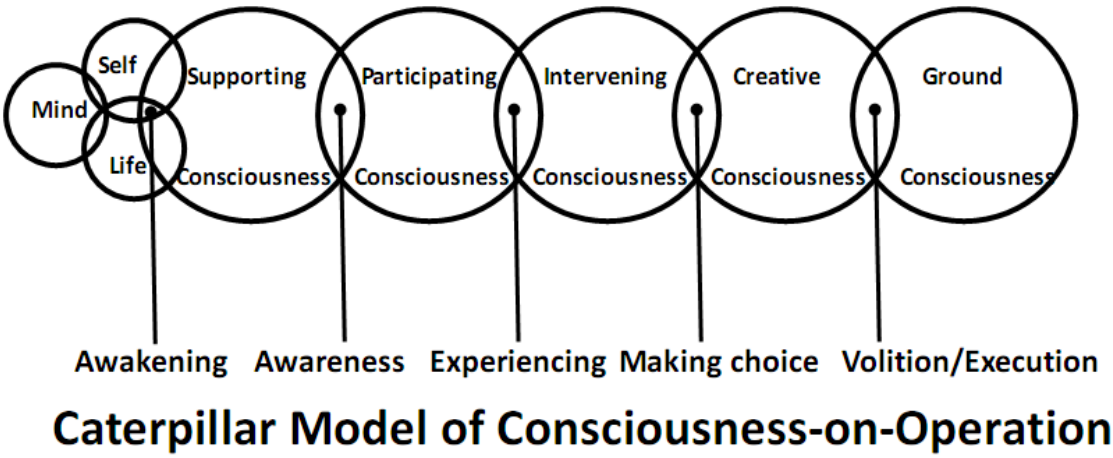
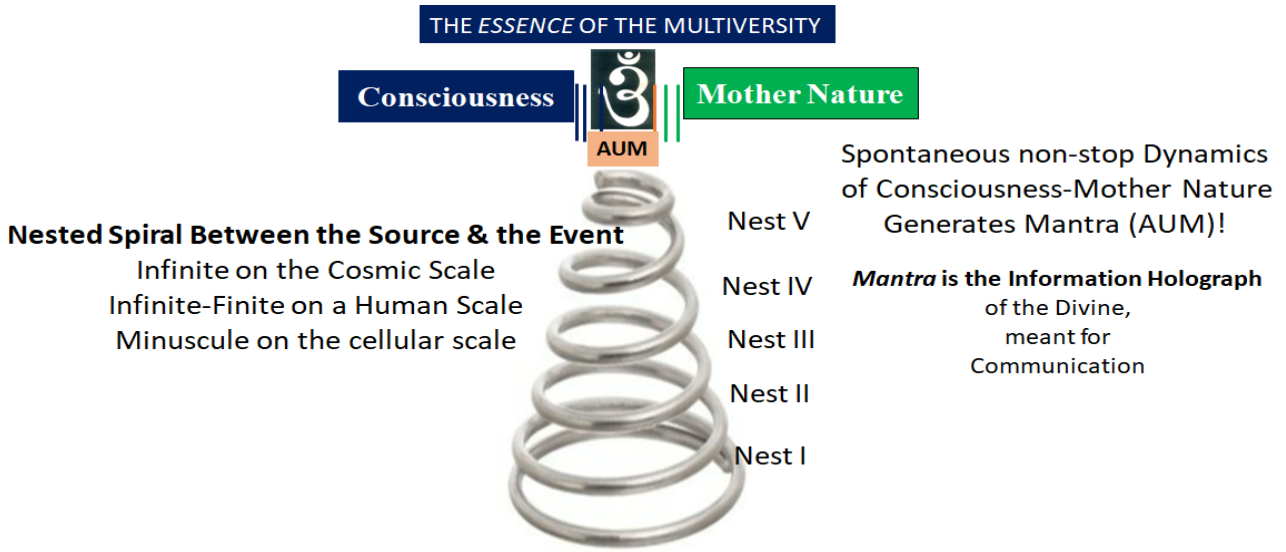


Figure 10: The Mind is the Event-making agent. Self provides ethics, logic, and a part of logistic. Life participates as a homeostatic manager to take care of asymmetries, uncertainties and, dark energy. All these happen with consciousness's support (supportive consciousness). The person becomes awake. When consciousness starts actively participating (attention, concentration), the person becomes aware of what all is happening. Following looping of the operation with intervening consciousness, the being starts experiencing. Looping with creative consciousness brings the ability to choose. "Will" generates from inter-looping with ground properties of consciousness; volition/execution of the desired choice is the result. In this way, consciousness gets involved stepwise like the movement of a caterpillar, thereby producing a caterpillar Model of Operational Consciousness.

Consciousness operates not with any currency of force, energy or field! Consciousness operates with will and intention, disarming all kinds of energy, fields, and force! Science *for* consciousness is occupied with operational consciousness, where holding consciousness as the inviolable constant, the ongoing science coevolves with humanity and the spirit helping the emergence of a new intergenerational and Multiversal Worldview, that accommodates humanity, science, and spirit along with the attitude, the knowledge, and the skill, thus integrating the affective brain, the cognitive brain, and the psychomotor brain in the behavior.

k) The Ultimate Source

With the transit of nature to Mother Nature, born is the Science *of* consciousness that deals with Nondual Consciousness and Mother Nature at the level of the *Essence* of the systems multiverse, the Source-field for all, everything and everyone. The apparent epistemological pluralism in science, humanities, and spirit is sourced from one and only One, the operating consciousness within the *Essence* of the Multiversity. Mother Nature operates as the mobile facet, the kinetic pole, the executive front of nondual consciousness. This *Essence* evokes the primordial vibration AUM, AUM, AUM …….. from the union of Consciousness Mother Nature. Their dynamism spirals down as manifestations, becoming of nature-consciousness in a nested fashion (Figure 11).



THE NESTED SPIRAL BETWEEN THE SOURCE & THE OBSERVED NATURE

Figure 11: With the transit of nature to Mother Nature, the Source of Multiverse(s) is reached. The source is Consciousness-Mother Nature, also called the *Essence* of the systems Multiversity. The most primordial vibration emanates from spontaneous non-stop dynamics of Consciousness-Mother Nature, like Om, Om. Om……., the *Mantra*, the Information on the Divine, which is carried down in the spiral (which appears as nests on side view). This is the nested spiral pathway between the Source and the observed nature and between the "will" and the Event. The spiral appears Infinite on a cosmic scale, Infinite-Finite on a human scale, and minuscule on a cellular scale

l) The Algorithm from Consciousness to Energy and from the "Will" to the Event

Finally, we are in a position to describe the pathway from the "Will" to a Signal, and expand Albert Einstein's World to the level of the systems of apparently disconnected and independent multiple universe(s), sourced from the One and only One, the *Essence* of the Multiversity. Einstein although stopped investigation in science at the level of ZPE continued to say from his imaginative and intuitive mind on various occasions that he does not know God's Will! We are also reminded of George Wald, Nobel Prize winner in Physics, who said, "Consciousness gives us no physical signals. ... We have no way of identifying either the presence or absence of consciousness, let alone its content." What could be the narrative for the science of this other World, describing the emergence of the empirical science of matter, energy, and space-time from such a will!

To make a "Will" is a prerogative of consciousness. The signal is what is already articulated, and is observed. It has got into a form. In fact, a signal is a space-time construct of energy. The signal is converted into information and information is converted into a signal by operation of the mind! When there is no mind, there is no entry into the domain of information, and there is no conversion of information into signal! The pathway from Consciousness to Energy, and from the Will to the Event is shown in Figure 12.

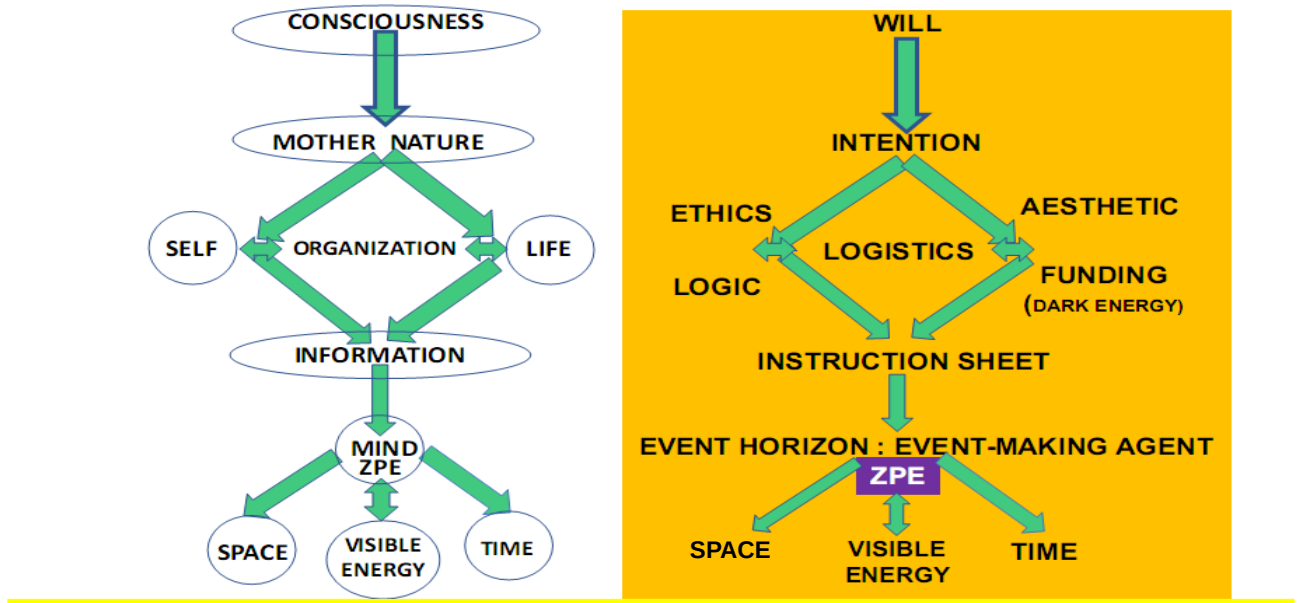


Figure 12: Consciousness is the Event-Manager. The "will" of consciousness is the letter of intent at the nest of Mother Nature. The Intention is passed on to both Self and Life, which maintain a tangled hierarchy between themselves. The Self decides on the Ethics and the Logic of the operation. The Life decides on the Aesthetics and Funding of the mission from dark energy. The Logistic of the operation is taken care of by both Self and Life, manifested respectively as Self-organization and Life-organization. With the ethics and aesthetics, logic and logistics, and proper funding from the inexhaustible resources of dark energy the instruction sheet is prepared and is handed over as Information to the Mind. The Mind conceives Information and delivers Space, Time, and Energy at the level of ZPE.

In the context of "Free Will", the will-maker is Free but the will, once expressed, is bound to the causality chain, an Artwork of the spiraling and nested nature!

III. Perspectives

We are reminded of Albert Szent-Gyorgyi, Nobel laureate in Medicine, who said, "A discovery must be, by definition at variance with existing knowledge" (2 June 1972, Letter to *Science*). While narrating twelve new ideas, which are at variance with existing knowledge, we have come across two landmarks as two event horizons in the context of extending the scope of science; (i) ZPE and (ii) the Boundary of the universe. The terrain beyond the boundary of the universe is least known. The terrain between the two event horizons is a lesser-known universe. The universe nested within the ZPE (Einstein's limited universe) is a better-known part of the entire terrain. With this narrative, we could recognize that we are at the threshold of several discoveries, at the gateway of multiple new doors of science. We might get into the technology of harnessing dark energy.

When we analyze several unexplained issues in the context of these twelve ideas and two event-horizons, we lean towards a New Worldview, the Multiversal Worldview, which evolves and develops (Evo-Devo) accommodating science, humanity, and spirit!

Still, the question that remains unanswered is how consciousness asserts the supremacy of its will over self, life, mind, information, and matter, and is capable of stripping off their conditioned properties and dressing them up as and when necessary! The great wonder and the greatest hidden secret of how consciousness makes such a strong political statement by its will, make all of us humble and a student of consciousness!

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Fellows may join as a member of the Editorial Board of Global Journals Incorporation (USA) after successful completion of three years as Fellow and as Peer Reviewer. Additionally, Fellows get a chance to nominate other members for Editorial Board.

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ASSOCIATE OF SCIENCE FRONTIER RESEARCH COUNCIL is the membership of Global Journals awarded to individuals that the Open Association of Research Society judges to have made a 'substantial contribution to the improvement of computer science, technology, and electronics engineering.

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To the institution

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Global Journals sends a letter of appreciation of author to the Dean or CEO of the University or Company of which author is a part, signed by editor in chief or chief author.

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Financial

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Associates are authorized to organize symposium/seminar/conference on behalf of Global Journal Incorporation (USA). They can also participate in the same organized by another institution as representative of Global Journal. In both the cases, it is mandatory for him to discuss with us and obtain our consent. Additionally, they get free research conferences (and others) alerts.

Career | Credibility | Financial

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Associate	Fellow	Research Group	Basic
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Certificate, LoR and Momento **2** discounted publishing/year **Gradation** of Research **10** research contacts/day **1 GB** Cloud Storage **GJ** Community Access	**Certificate,** LoR and Momento **Unlimited** discounted publishing/year **Gradation** of Research **Unlimited** research contacts/day **5 GB** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**Certificates,** LoRs and Momentos **Unlimited** free publishing/year **Gradation** of Research **Unlimited** research contacts/day **Unlimited** Cloud Storage **Online Presense** Assistance **GJ** Community Access	**GJ** Community Access

Preferred Author Guidelines

We accept the manuscript submissions in any standard (generic) format.

We typeset manuscripts using advanced typesetting tools like Adobe In Design, CorelDraw, TeXnicCenter, and TeXStudio. We usually recommend authors submit their research using any standard format they are comfortable with, and let Global Journals do the rest.

Alternatively, you can download our basic template from https://globaljournals.org/Template.zip

Authors should submit their complete paper/article, including text illustrations, graphics, conclusions, artwork, and tables. Authors who are not able to submit manuscript using the form above can email the manuscript department at submit@globaljournals.org or get in touch with chiefeditor@globaljournals.org if they wish to send the abstract before submission.

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Authors must ensure the information provided during the submission of a paper is authentic. Please go through the following checklist before submitting:

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2. Authors must accept the privacy policy, terms, and conditions of Global Journals.
3. Ensure corresponding author's email address and postal address are accurate and reachable.
4. Manuscript to be submitted must include keywords, an abstract, a paper title, co-author(s') names and details (email address, name, phone number, and institution), figures and illustrations in vector format including appropriate captions, tables, including titles and footnotes, a conclusion, results, acknowledgments and references.
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Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

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Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

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Tips for Writing a Good Quality Science Frontier Research Paper

Techniques for writing a good quality Science Frontier Research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of science frontier then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10. Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

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	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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