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# 2nd International Summit on Civil, Structural and Environmental Engineering

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# 2nd International Summit on Gravitation, Astrophysics and Cosmology

## ISCSEE2024 & ISGAC2024

March 18-19, 2024

Florence, Italy

# FOREWORD

## Dear Colleagues,

It is our pleasure to extend a warm invitation to all scientists, academicians, young researchers, business delegates, and students from around the globe to participate in the 2nd International Summit on Civil, Structural, and Environmental Engineering (ISCSEE2024) and the 2nd International Summit on Gravitation, Astrophysics, and Cosmology (ISGAC2024), scheduled to take place in Florence, Italy from March 18-19, 2024.

ISCSEE2024 & ISGAC2024 will provide a platform to explore recent research and cutting-edge technologies, attracting a diverse and enthusiastic audience of young and talented researchers, business delegates, and student communities.

The primary objective of ISCSEE2024 & ISGAC2024 is to bring together, a multidisciplinary gathering of scientists and engineers from across the globe to share and exchange groundbreaking ideas in the fields of Civil, Structural, and Environmental Engineering, as well as Gravitation, Astrophysics, and Cosmology. The summit aims to foster high-quality research and international collaboration, facilitating discussions and presentations that are globally competitive and highlighting recent notable achievements in these fields.

We're looking forward to an excellent meeting with scientists from different countries around the world and sharing new and exciting results in Civil, Structural and Environmental Engineering & Gravitation, Astrophysics and Cosmology.

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# Silica Fume and Crumb Rubber as Partial Replacement of Cement and Fine Aggregate Concrete

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## Abstract:

This study investigated nine mixes containing 0 or 15% silica fume as the cement replacement and 0 or 10% treated and untreated crumb rubber as the fine aggregate replacement. The fresh and mechanical properties of these concrete mixes were correlated with non-destructive test results including rebound hammer and Ultrasonic Pulse velocity (UPV). One curing scheme was adopted here in this study which was normal curing. Microstructure characterization was carried out using X-ray diffraction Analysis (XRD) and Scanning Electron Microscope (SEM). The XRD showed that the crumb rubber must be washed in clean water after pretreatment with sodium hydroxide (NaOH) to avoid ettringite formation in the concrete pores. The results showed that combining the silica fume and crumb rubber enhanced the compressive strength of the rubberized concrete. The rebound hammer numbers were closely correlated linearly with the compressive strength of the test mixes.

### Introduction:

Rubber extracted from waste tires, commonly called crumb rubber (CR), can be used in concrete as a partial replacement for aggregate, reducing its carbon footprint [1]. Several researchers [2 -7] investigated the properties of rubberized concrete containing various percentages of CR. Gholampour et al. [3] found that rubberized concrete has a high deformation capacity, making it an attractive choice for structural elements designed against dynamic and impact loads. Khaloo et al. [4] found that rubber concrete had a higher tensile strain at failure, indicating a more energy-absorbent mix. They also noted that rubber concrete had a low coefficient of thermal expansion, and the rubber mixes were more resistant to thermal changes. Gerges et al. [8] and Ling [9] concluded that including rubber can enhance concrete's flexibility, impact strength, and toughness and described a successful process to manufacture concrete paving blocks using CR as a partial replacement for sand. Schimizze et al. [10] recommended that rubber concrete be used in light-duty concrete pavements.

Some reports apply non-destructive testing (NDT) to rubber concrete [11, 12, 13] to assess the compressive strength and correlate their results with the destructive values. Relationships between mechanical properties and NDT results have been established for unheated concrete [14,15].

Limited reports are available on the behavior of concrete containing NaOH-treated crumb rubber and silica fume, subject to normal heating in service. In addition, no research addressed the assessment of the rubberized concrete with silica fume inclusion using NDT. Thus, filling these research knowledge gaps is crucial by assessing the rubberized concrete while pretreated and untreated crumb rubber with silica fume. This will address whether this type of concrete has potentially beneficial uses in the wider construction industry

**Experimental Program:**

Concrete Mix Design: The concrete mixes were designed following the ACI PRC-211.1 [16]. Five mixes containing CR and an additional control mix, without rubber, were designed for the test program. Table 1 shows the physical properties of cement, fine, and coarse aggregate used for mix design. Table 2 presents the concrete mix design for a one-meter cube. For each test variable, the following specimens were prepared: nine cubes of side dimensions of 150 mm, three cylinders of a diameter of 150 mm and height of 300 mm, and three prisms dimensioned 100 x 100 x 500 mm. The five mixtures include 10% fine aggregate replacement by treated or untreated CR. For the mixes with silica fume, 15% silica fume cement replaced the exact weight of cement. As shown in Table 2, mixes 1 and 3 represent the use of untreated CR at 10% of fine aggregate replacement, while mixes 2 and 4 contained similar content for treated CR replacement. It should be noted that mixes 3 and 4 contained 15% cement replacement by silica fume.

**Table 1. Concrete ingredients and data used for concrete mix design.**

| Type of concrete | Non-Air-Entrained Concrete |
|---|---|
| Maximum size of Aggregate (MSA) | 25 mm |
| Fineness Modulus for Fine Aggregates | 2.6 |
| Specific Gravity of Cement | 3.15 |
| Specific Gravity of Coarse Aggregate | 2.65 |
| Specific Gravity of Fine Aggregate | 2.60 |

Sample Preparation: The concrete mixes were mixed in a mechanical mixer and poured into the molds. The molds were placed onto the vibrating table, ensuring the compaction of the concrete thoroughly. The specimens were left in the molds in the laboratory for 24 hours. Then, the specimens were taken out of the molds and placed inside curing tanks for 7 and 28 days until testing. Forty cube specimens were tested for compressive strength at 7- and 28 days of age, along with Rebound Number testing at 28 days. Fifteen-cylinder specimens were prepared for the direct Ultrasonic Pulse Velocity (UPV) test after 28 days. Finally, fifteen prism specimens were prepared for the UPV indirect test for concrete homogeneity. All samples were prepared, and water cured as per BS EN 12390-3 [17].

**Table 2. Concrete quantities used for concrete mix design in 1 $m^3$.**

| I.D. | Water, Kg | Cement, Kg | Coarse Aggregate, Kg | Fine Aggregate, Kg | Crumb Rubber, Kg | Silica fume, Kg | Rubber treatment |
|---|---|---|---|---|---|---|---|
| Mix 0 | 200 | 500 | 1024 | 631 | 0 | 0 | N/A |
| Mix 1 | 200 | 500 | 1024 | 567.9 | 26.69 | 0 | Non treated |
| Mix 2 | 200 | 500 | 1024 | 567.9 | 26.69 | 0 | Treated* |
| Mix 3 | 200 | 425 | 1024 | 567.9 | 26.69 | 54.76 | Non treated |
| Mix 4 | 200 | 425 | 1024 | 567.9 | 26.69 | 54.76 | Treated* |

* Rubber treated in NaOH for 30 minutes

**Test Methods:**

A slump test for the fresh concrete mixes was conducted as per ASTM C143 / C143M [18]. The density of the hardened concrete was conducted according to ASTM C642 [19] at 28 days. NDT using Rebound hammer Number (RN) and Ultrasonic Pulse Velocity (UPV) measurements were conducted before testing specimens for mechanical properties according to the ASTM C805 / C805M [20] and ASTM C597 [21]. The RN apparatus and corundum stone were used to smooth the surface before the test. The RN test took place before testing the cubes in compression, during which the cubes were mounted in a universal machine. Each cube surface was divided into nine 5 cm x 5 cm equal cells using a permanent marker. The apparatus was repeatedly placed perpendicular to the cube specimen's surface at the center of each cell, and hence nine readings were taken to obtain the mean RN for each cube at 28 days of age to measure the RN. UPV was applied as an indicator of the voids/pores in the internal structure of the prism samples. This method was indirectly used to evaluate the concrete homogeneity in the prisms' samples indirectly. The wave propagation time between the transmitter and receiver and the distance was recorded in all UPV tests. Table 3 addresses the ultrasonic pulse velocity classification [22] as per the UPV values.

**Table 3. Ultrasonic pulse velocity classifications of concrete [23]**

| S/N | UPV range of values (m/s) | Concrete Classification / Quality Rating |
|---|---|---|
| 1 | UPV > 4500 | Excellent |
| 2 | 4500 > UPV > 3500 | Good |
| 3 | 3500 > UPV > 3000 | Medium |
| 4 | 3000 > UPV > 2000 | Doubtful |
| 5 | UPV < 2000 | Very weak |

**Experimental Results and Discussion:**

Slump: The test results for the slump of the mixes are reported in Table 4. In all mixes, the inclusion of CR, treated or untreated, leads to a slump reduction compared to the control mix (Mix 0). The results also show that the mixes with fine aggregate replaced by untreated CR (mix 1 and mix 3) had a lower slump reduction than those with treated rubber (mix 2 and mix 4). The reduction in slump relative to the control mix was 15%, 28%, 32%, and 36% for mix 1, mix 2, mix 3, and mix 4, respectively. It should be noted that in mix 3 and mix 4, the slump exhibited a higher reduction than in mix 1 and mix 2 as the cement was replaced by 15% silica fume. Therefore, rubber pretreatment and the inclusion of silica fumes caused a further reduction in mix workability, and the reduction was observed when untreated rubber was used in the mix.

**Table 4 Typical slump, density values, and compressive strength results**

| | | | Compressive strength - Age N/mm² (MPa) | | | Predicted compressive strength (y) (y=0.804 (x) + 12.581) ($R^2$=0.9929) |
|---|---|---|---|---|---|---|
| Mix, ID | Slump - mm | The density of hardened concrete at 28 days ρ (g/cm³) | 7 days | 28 days | Rebound number, (x) | |
| 0 | 24.0 | 2.50 | 30.0 | 40.50 | 45 | 45.14 |
| 1 | 20.0 | 2.40 | 20.0 | 26.90 | 34 | 34.21 |
| 2 | 17.0 | 2.40 | 21.0 | 28.0 | 35 | 35.09 |
| 3 | 16.0 | 2.44 | 23.0 | 29.40 | 36 | 36.22 |
| 4 | 15.0 | 2.44 | 24.0 | 30.80 | 38 | 37.34 |

ElNemr [24] reported that adding silica fume to mortar reduced the workability by 16%, on average, relative to the mixes without it. Youssf et al. [25] reported an 88.2% reduction in a slump when 15% silica fume partially replaced cement in the mix. However, the reduction in a slump was only 25% in the mixes containing 20% rubber and 15% silica fume.

Density: The results of the density of the test mixes are shown in Table 4. It can be observed from these results that the concrete density was slightly reduced due to the inclusion of CR; however, the silica fume inclusion decreased this reduction, as evident in mixes 3 and 4. Replacement of fine aggregate by 10% CR reduced density by 4 and 2% for the mixes without and with silica fume, respectively. It can be noted that the rubber treatment did not significantly affect the density of the rubberized concrete.

Pham et al. [26] prepared mixes with 15% rubber by volume and concluded that the effect of rubber on density was negligible. In contrast, Ramli and Dawood [27] noted that partially replacing cement with 10% silica fume in mixes with superplasticizers led to a 13% increase in concrete density. Both reports align with the current study's findings.

Siddique and Naik [28] suggested that the non-polar nature of rubber particles may result in the ability to repel water and entrap air on the rubber surface, which would subsequently increase the number of air voids and thus decrease the concrete density. In addition, Raffoul et al. [29] studied the physical properties of CR and reported that rubber has a specific gravity of 1.10 and a bulk density of (400 - 460 kg/m3). These values are significantly lower than those for sand, as reported in Table 2, which contributes to the reduction in the density of rubberized concrete, mainly when high rubber content values are utilized.

Compressive Strength of Rubberized Concrete : The average compressive strength results of the cube specimens at age 7 and 28 days are reported in Table 4. The influence of the treated and untreated CR inclusion and the addition of silica fume on the mechanical properties of concrete are discussed in the following sections.

Effect of crumb rubber inclusion: Table 4 shows the average compressive strength results of the cube specimens at age 7 days. It can be observed that mixes 1, 2, 3, and 4 showed a reduction in compressive strength by 33%, 30%, 23%, and 20% compared to the control mix (Mix 0), respectively. At 28 days. Table 4 shows that the reduction in compressive strength was 34%, 31%, 27%, and 24%, respectively.

Mavroulidou and Figueiredo [30] reported 32% and 40.9% loss of compressive strength at 7 and 28 days, respectively, with 10% rubber replacement. Their mixes did not contain silica fumes. The results of Jalal et al. [31] indicated a loss in compressive strength of 46.0% and 46.1 % for mixes with 10% CR and without silica fume and a loss of 43.6% and 48.1% for mixes with 10% silica fume at 7 and 28 days, respectively. Both above studies did not apply any rubber pretreatment. Roychand et al. [32] explained that the reduction in strength with the increase in rubber content could be attributed to three main reasons, these were: (a) the high deformability of the rubber particles compared to the surrounding paste matrix, resulting in crack initiation, (b) weak interfacial bond between the CR and hardened paste matrix, and (c) reduction in density leading to a detrimental effect on the strength.

Effect of Crumb Rubber Pre-treatment with NaOH: When comparing the results of (mix 2 with mix 1) and (mix 4 with mix 3) in Tables 4. The mixes with treated CR exhibited limited improvement in mechanical properties compared to their counterparts containing untreated CR, both when normal curing was applied. For instance, for the samples with and without silica fume, the improvement in compressive strength at 28 days was 4.2 % and 4.8%, respectively.

Copetti et al. [33] reported similar findings as they found that rubber pretreatment did not significantly affect the mechanical properties of their concrete. On the same note, Marques et al. [34] tested mortar samples with and without CR treatment and reported that rubber treatment slightly reduced the strength of the mortar in compression. Similarly, Balaha et al. [35] and Chiraz et al. [36] showed approximately 13% and 15% improvement in compressive strength in rubber concrete containing NaOH-pretreated CR, respectively. Saloni et al. [37] attributed the improvement in mechanical properties of their mixes with CR treatment to modifying the CR surface by the treatment. Hence, there are conflicting reports on the benefits of pretreatment. It is apparent from the findings of this investigation that the effect of CR pretreatment depends on how it is applied, that is, its duration and whether washing with water occurred after any pretreatment.

Effect of Silica Fume Inclusion in Mixes with Crumb Rubber: When comparing the results of mix 3 and 1, mix 4 and 2 as in Table 4, the mixes containing silica fume exhibited some improvement in mechanical properties compared to their counterparts without silica fume under the application of normal curing. For compressive strength at 28 days, silica fume inclusion enhanced the strength by 9.3% in untreated rubber mixes. In contrast, the improvement was 9.9 % for the mixes with treated rubber.

Gu¨neyisi et al. [38] reported a 9.6% increase in compressive strength with 15% silica fume in a mix with 10% rubber. The CR replaced fine aggregate in their mixes, and crumb rubber replaced coarse aggregate. When no rubber was utilized in the mixes, the compressive strength increased due to silica fume inclusion of 10.8%. It appears that silica fumes offered a lower contribution to mechanical properties for the rubber mixes. A similar effect was noted by Li et al. [39], who found that adding 10% silica fume to a mix without rubber increased the compressive strength by 41.6%, whereas when the mix contained 20% CR, the increase in compressive strength, due to silica fume addition at 28 days, was only 35.7%. It is worth mentioning that Sun and Young [40] found that for a mix with 18% silica fume, only 44.1% of the silica fume had reacted at 28 days. Therefore, its effect on strength at this age is not profound. Indeed, Gesoğlu and Güneyisi [41] found that silica fume continued to contribute to the strength of rubberized concrete with extended curing of up to 90 days. All these reports support the findings of the current investigation on the effect.

**Non-Destructive Test (NDT):**

Rebound Hammer Number Results: The results of the Rebound Hammer Number (RN) test are reported in Table 4, whereas Fig. 1 shows the relationship between the RN and compressive strength results for the test samples. It can be noted from Table 4 that the RN values recorded at 28 days for the mixes with 10% CR varied between 31 and 38, depending on rubber treatment, and silica fume inclusion.

Mohammed et al. [14] reported an RN value at 28 days of 33, for a comparable mix to those in the current investigation. Akshay and Sofi [42] reported an RN value of 39 for the 10% CR rubber mix. These values are of a similar order of magnitude to the results in the current study. However, Kumar and Dev [23] reported an RN of 48 for a mix with 10% CR, but their mix had a higher strength; hence, a higher RN was recorded. It can be seen from Fig. 1 that the RN is reasonably correlated with compressive strength values for all mixes in the current investigation, regardless of whether or not the samples included silica fume, or the CR was treated.

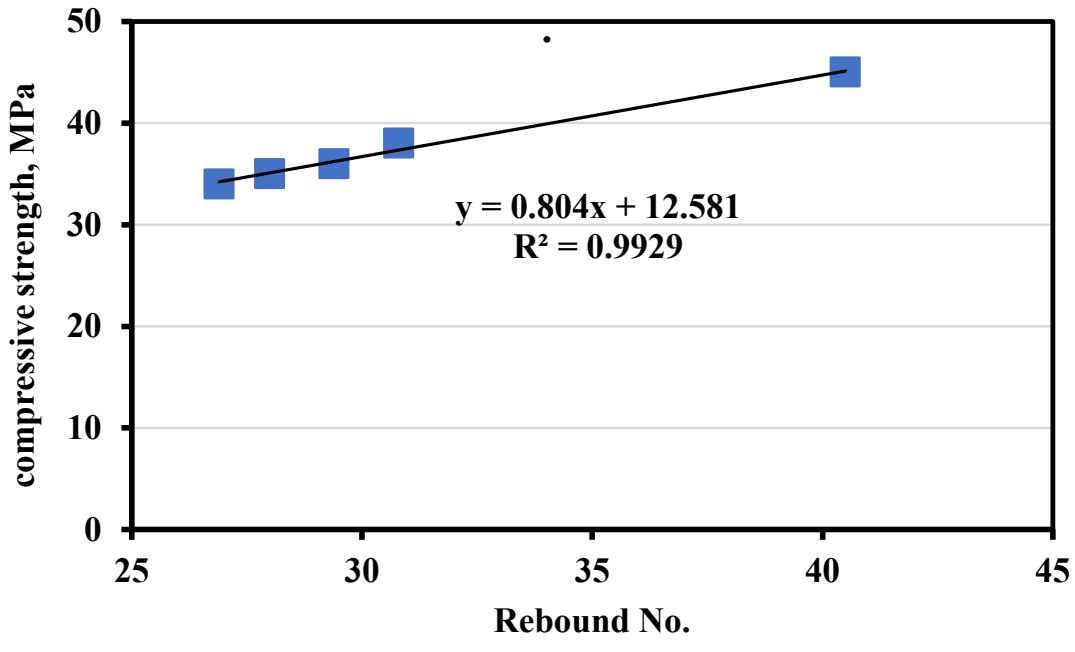


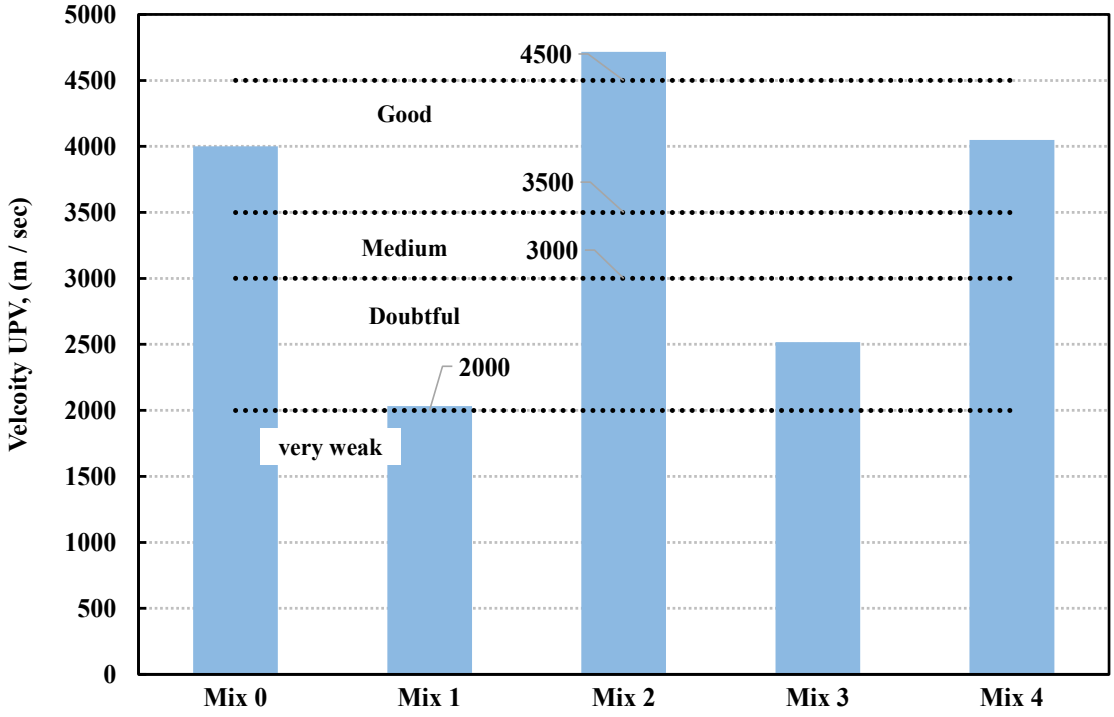

**Fig. 1 Correlation of Rebound Number of cube specimens with compressive strength at 28 days**

Ultrasonic Pulse Velocity (UPV): Fig. 2a shows the direct Ultrasonic Pulse Velocity (UPV) test results. BS 1881: Part 203 [22] gives guidelines to classify the concrete quality based on UPV values, as shown in Table 4. It can be seen from Fig.2a that the test mixes exhibited different classification qualities. The inclusion of CR reduced the UPV by 49.1%. Fig. 2b shows that, unlike the RN values, the UPV results for all the test mixes could not be correlated with the compressive strength on one trend line. For a comparable level of compressive strength, the mixes exhibited different UPV values, reflecting different classifications. A distinct difference is seen between mixes with untreated CR and those with treated CR.

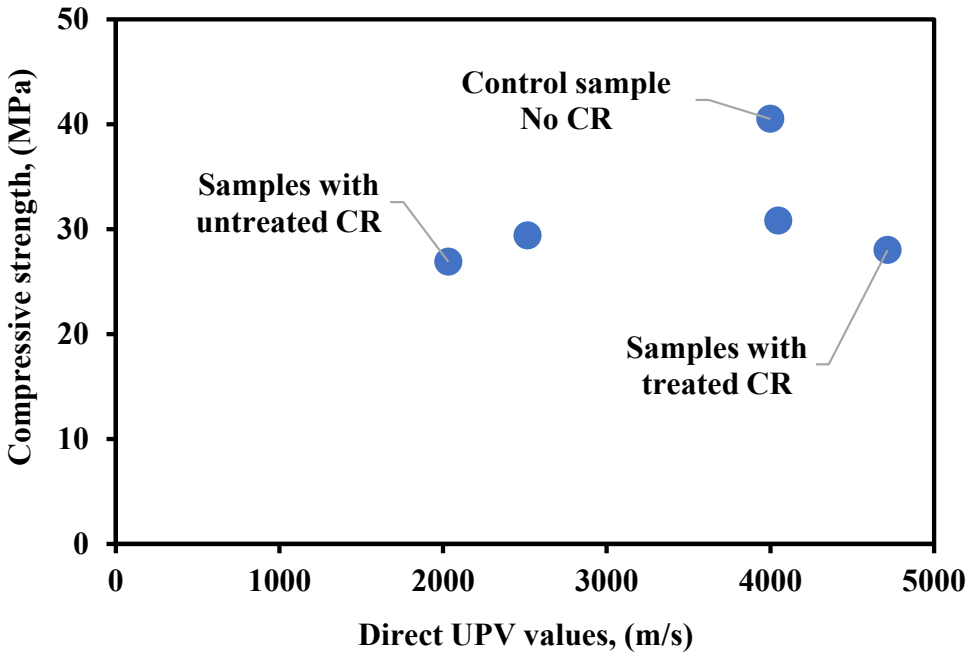
The indirect UPV test is applied to study the CR mixes' homogeneity. The results of the tests are shown in Fig. 3. The inverse of the slope of the lines is the indirect UPV for each mix. It can be seen that the results showed high sensitivity to the mixed variables.

Albano et al. [11] found a reduction in UPV of 56% with similar CR content. In general, rubber treatment and/or the inclusion of silica fumes had an evident impact on the classification. Rubber treatment affected the UPV values by 72.1% and 54.9% for the mixes without and with silica fume, respectively. These values contradict the findings of Najim and Hall [43], who reported no improvement in UPV with CR treatment. The reasons for the difference between the UPV result of the current study and those of Najim and Hall [43] shall be further explained when discussing the SEM results.

In the current study, the inclusion of 15% silica fume increased the UPV by 23.8% and 11.4% for mixes containing untreated and treated CR, respectively. In mixes with untreated rubber, Gesoğlu and Güneyisi [41] found that with 10% silica fume inclusion, the UPV was increased by 8% at 28 days. The low improvement in UPV can be attributed to the lower percentage of silica fume compared to the current study, which leads to more pores in the matrix, as rubber was utilized as a partial replacement for combined fine and coarse aggregates in their mixes. Mohammed et al. [14] also found that the UPV test was more realistic in evaluating the quality of the mixes with CR.




(a) UPV values for the different test mixes showing classification for concrete quality




(b) Scatter diagram for the compressive strength and UPV values

Fig. 2 Experimental results of direct ultra-sonic pulse velocity test (UPV)

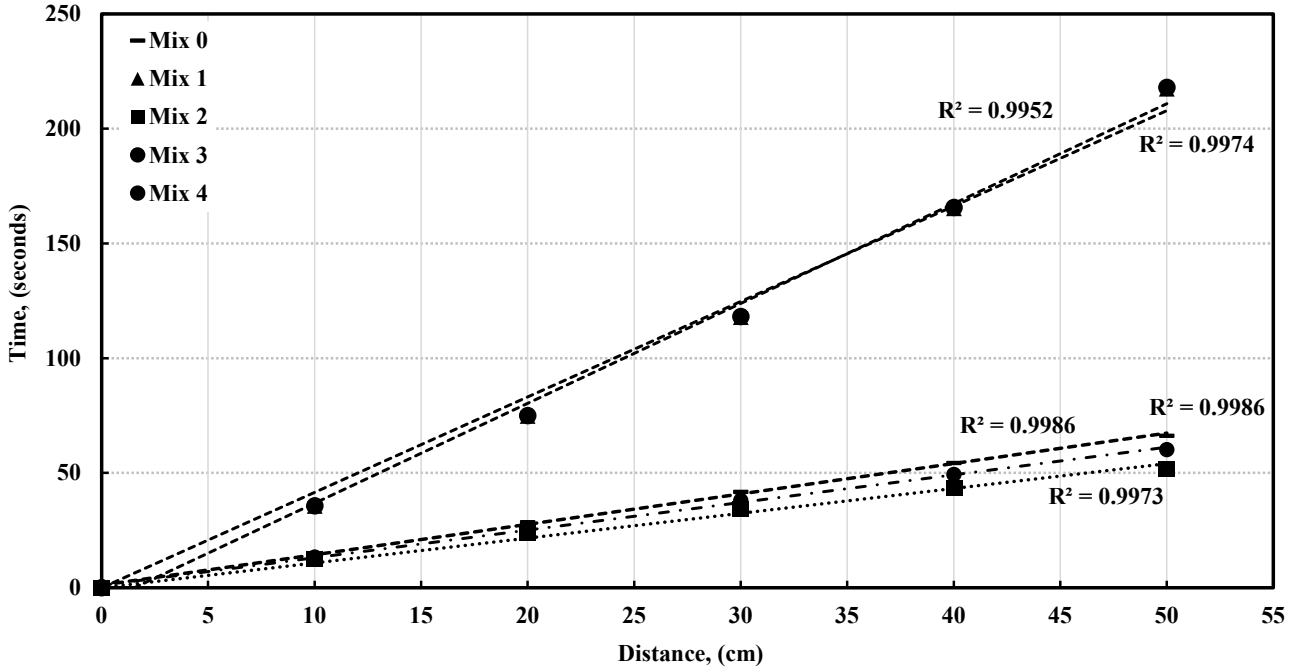



**Fig. 3 Indirect Ultrasonic pulse velocity (UPV) for homogeneity testing**

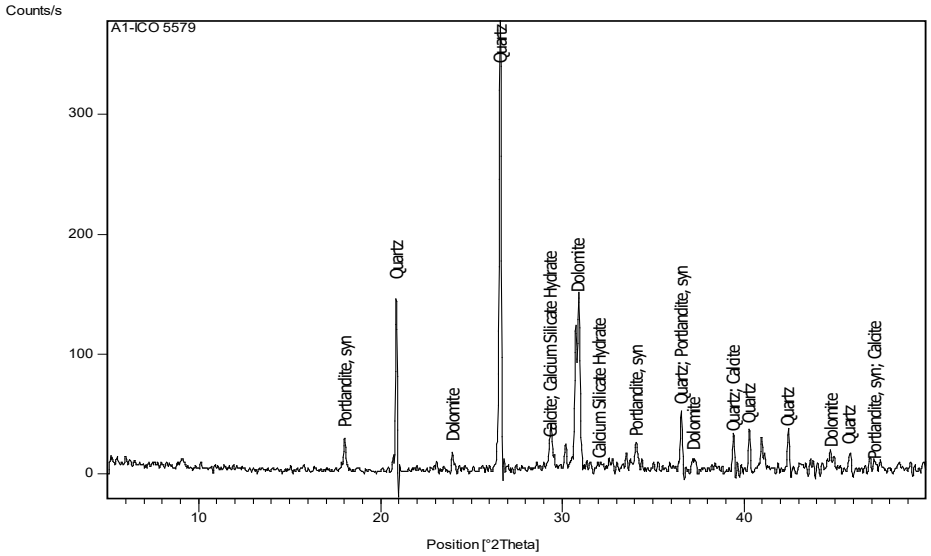
**Micro-Structural Studies Some of the Test Mixes:**

X-RAY Diffraction: Fig. 4a, and 4b show X-ray diffraction for Mix 0, and Mix 2, respectively. Fig. 4a, for the control mix without CR, shows the usual formation of Calcium Silicate Hydrate (C-S-H) and Portlandite (C-H). In addition, the usual peaks characteristic of quartz is present due to fine aggregates. In contrast, the Dolomite peaks are attributed to the coarse aggregate utilized, forming approximately 43% of the mix by weight. It can be seen that the peaks characteristic of C-H and C-S-H were weak, indicating the presence of un-hydrated cement particles. This behavior is reflected in the moderate strength of 40 MPa exhibited by Mix 0 at 28 days, although it was a 0.4 w/c mix containing 500 kg/m3 of cement.

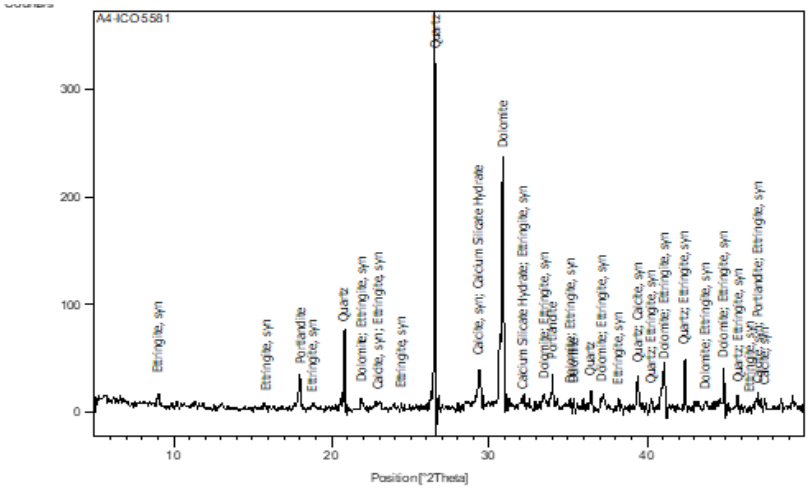
Fig.5b, for Mix 2 contained treated rubber shows that the characteristics of C-H were higher than the corresponding peaks for samples Mix 0. However, the peaks characteristic of C-S-H were found to be lower than the corresponding peaks in sample Mix 0. Furthermore, more significant amounts of ettringite (E) were observed. The increased C-H and the appearance of ettringite are probably due to the deposition of NaOH from treating the CR before adding it to the mix. It should be noted that in the current study, the CR was not washed after NaOH treatment. In contrast, the C-S-H phase's peak characteristics were higher than Mix 0; thus, it indicates that silica fume reacted with C-H, forming more C-S-H gel. In addition, lower quartz was exhibited because of the dilution effect of adding silica fume. However, the

presence of CR still adversely affected the mechanical properties, and the silica fume contribution to the mechanical properties was less than expected, as discussed earlier.

Mernerdac et al. [44] developed a mix with the same type of cement and identical proportions as the current study and achieved nearer to 70 MPa cylinder compressive strength at 28 days. This behavior indicates a lower volume of quartz because of the dilution effect of adding silica fume, as explained earlier.




a) Mix 0




b) Mix 2

**Fig. 4 X-ray Diffraction of rubberized concrete specimens**

Scanning Electron Microscope (SEM): Fig. 5a, and 5b present the SEM for Mix 0, and Mix 2, respectively. These mixes were the same as those tested for XRD above. Fig. 5a, for the control mix without CR, exhibits many voids resulting from un-hydrated particles, inadequate mixing, or interlayer and capillary pores in the matrix. In addition, Fig 5a shows the weak bond between the cement matrix and fine aggregate particles. This poor micro-structure was reflected in the mechanical properties of the control mix, as discussed above.

Fig 5b shows the SEM of Mix 2, in which the NaOH was deposited as the result of treating CR before using it in mixing. The deposits filled the voids created by the poor hydration around the CR particles. However, these deposits are not a substitute for hydration products. However, normally cured concrete containing CR, including rubber, was shown to have a detrimental effect on the matrix.

Wang et al. [45] extensively studied the interface between sand and cement paste (ITZ-S) and between CR and cement paste (ITZ-R) in rubberized concrete. They concluded that the addition of rubber inhibited the hydration of cement, thereby reducing the formation of C-S-H. They explained this formation by the hydrophobicity of the rubber surface, leading to a water reduction around the CR. Therefore, the hydration reactions become slow. They also noted that the micro-crack widths in ITZ-R were more significant than those for ITZ-S, indicating that the bond between cement paste and rubber is poor. Similar findings were reported by Albano et al. [11]. Marques et al. [34] reported that rubber treatment using NaOH did not affect the bond quality between the CR and the matrix. This conclusion contradicts the findings of Segre and Joekes [46], who reported that the bond between treated and washed CR and the cement paste is improved compared to that of a mix containing untreated CR.

Sugapriya and Ramkrishnan [47] support this finding and reported that raw rubber, possessing a smooth surface, exhibited a poor bond with the surrounding matrix. In contrast, treated rubber, where the zinc stearate layer has been removed, possessing a rougher surface, bonded well with the matrix. It seems that rubber washing after pretreatment with NaOH is essential to realizing better bonding with the matrix. However, the deposition of NaOH in the pores of the treated samples in the current investigation significantly improved the UPV results by reducing the internal spaces in the matrix. This improvement is probably the reason for the differences in the improvement of UPV in the current study compared to the observations of Najim and Hall [43]. Since they washed the rubber after pretreatment, probably no deposits of NaOH remained in the pores, and hence rubber pretreatment did not significantly improve their recorded UPV.

Similar to the current study's findings, Li et al. [39] found that the bonding surface between the rubber and cement paste was weak, but partially replacing the silica fume helped to improve this weakness. It seems that silica fume filled some of the gaps in the ITZ zone between the CR and cement paste leading to a more compact transition zone.

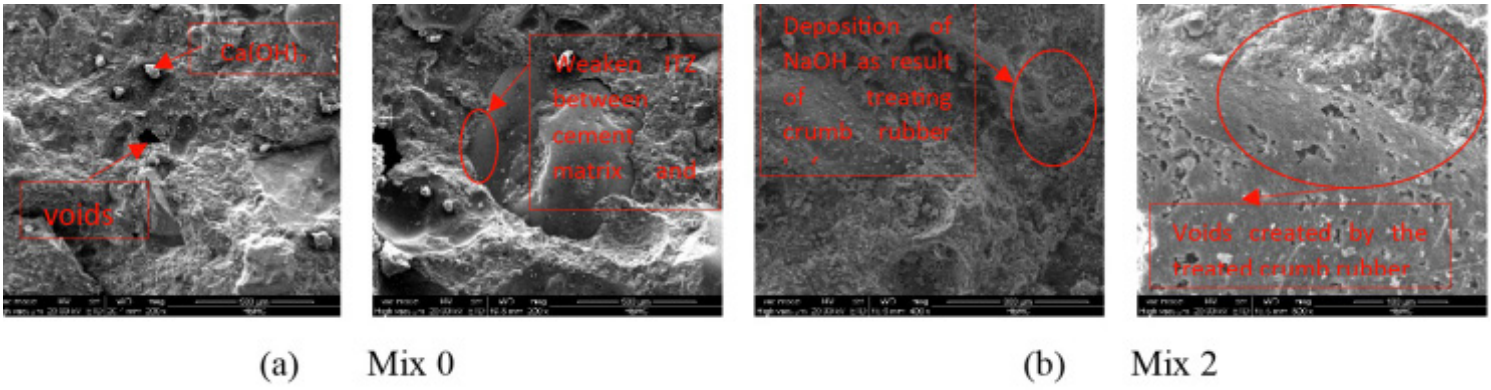



**Fig. 5 Scanning electron microscope (SEM) for specimens; (a) Mix 0, and (b) Mix 2**

Conclusions: Based on the results of the current investigation, the following conclusions can be drawn: Crumb rubber reduced the slump, whether it was pretreated or untreated. The reduction reached 16 and 42 % for untreated and pretreated rubber, respectively. The silica fume inclusion along with crumb rubber increased this reduction by 20 and 11.7 % for untreated and treated crumb rubber, respectively. The crumb rubber inclusion reduced the concrete density by 4%, which is considered a slight reduction considering the crumb rubber replacement was just 10%. On the contrary, the silica fume inclusion increased the density.

Treated crumb rubber reduced the compressive strength at 7 days by 25% on average, while untreated rubber reduced the compressive strength by approximately 28%. The silica fume inclusion enhanced the compressive strength better for those treated crumb rubber than untreated one.

The rebound hammer numbers of the studied mixes were closely correlated with the measured compressive strength of those mixes, exhibiting a linear trend. The RN results were not sensitive to the mixed ingredients, or rubber pretreatment.

The direct UPV results were not correlated with the compressive strength results on a single linear trend line since the mixes exhibited different UPV values. However, UPV was improved with rubber pretreatment and silica fume inclusion. The indirect UPV results highlighted the effects of mixed contents, and rubber pretreatment while showing good homogeneity.

The XRD results explained the mechanical properties in terms of compressive strength. Heat treatment and silica fume offered slight support to the compressive strength due to the formation of additional C-S-H. Still, the presence of rubber treated or untreated leads to reduced mechanical performance. The main concern with rubber pretreatment is the deposition of NaOH in the pores leading to Ettringite formation, adversely affecting the concrete matrix and the compressive strength. This behavior was evident in the current study as the rubber was not washed after treatment.

The SEM results explained UPV observations, as weak zones and deposits were observed. Rubber pretreatment and silica fume inclusion reduced the voids in the matrix; hence, a compact structure is detected in UPV.

## References:

[1] Rowhani A, Rainey TJ. (2016). Scrap Tyre Management Pathways and Their Use as a Fuel—A Review. Energies, Vol. 9, Issue 11, https://doi.org/10.3390/en9110888

[2] Fattuhi, N. I., &Clark, L. A. (1996). Cement-based materials containing shredded scraptruck tyre rubber. Construction and Building Materials, Vol. 10, Issue 4, pp.229–236, https://doi.org/10.1016/0950-0618(96)00004-9

[3] Gholampour, A., Ozbakkaloglu, T., and Hassanli, R., (2017) "Behaviour of rubberised concrete under active confinement," Construction and Building Materials, Volume 138, 2017, pp. 372-382, ISSN 0950-0618, https://doi.org/10.1016/j.conbuildmat.2017.01.105.

[4] Khaloo, A. R., Dehestani, M., &Rahmatabadi, P. (2008). Mechanical properties of concrete containing a high volume of tire–rubber particles. Waste Management, Vol. 28, Issue 12, pp. 2472–2482, https://doi.org/10.1016/j.wasman.2008.01.015

[5] Aiello, M. A., & Leuzzi, F. (2010). Waste tyre rubberised concrete: Properties at fresh and hardened state. Waste Management, Vol. 30, Issues 8–9, pp.1696–1704, https://doi.org/10.1016/j.wasman.2010.02.005

[6] Parveen, S., Rana, S., and Fangueiro, R., (2013). "A Review on Nanomaterial Dispersion, Microstructure, and Mechanical Properties of Carbon Nanotube and Nano fibre Reinforced Cementitious Composites", Journal of Nano Materials, Vol. 2013, Article ID 710175, https://doi.org/10.1155/2013/710175

[7] Shaaban, I. G., Rizzuto,J. P., El-Nemr, A., Bohan, L., Ahmed, H., Tindyebwa, H., (2021), "Mechanical Properties and Air Permeability of Concrete Containing Waste Tyres Extracts", Journal of Materials in Civil Engineering, ASCE, Vol. 33, No. 2, pp. 04020472-1-12. DOI: 10.1061/(ASCE)MT.1943-5533.0003588

[8] Gerges, N. N., Issa, C. A., and Fawaz, S.A. (2018). "Rubber concrete: mechanical and dynamical properties," Case Studies in Construction Materials, vol. 9, Article ID e00184. https://doi.org/10.1016/j.cscm.2018.e00184

[9] Ling, T. C. (2012). Effects of compaction method and rubber content on the properties of concrete paving blocks. Construction and Building Materials, Vol. 28, Issue 1, pp. 164–175. https://doi.org/10.1016/j.conbuildmat.2011.08.069

[10] Schimizze, R. R., Nelson, J. K., Amirkhanian, S. N. and Murden, J. A. (1994), Use of Waste Rubber in Light-Duty Concrete Pavements. Proc., Third Material Engineering Conference, Infrastructure: New Materials and Methods of Repair, San Diego, Calif., 1994, pp. 367–374.

[11] Albano, C., Camacho, N., Reyes, J., Feliu, J. L., & Hernández, M. (2005). Influence of scrap rubber addition to Portland I concrete composites: Destructive and non-destructive testing. Composite Structures, Vol. 71, Issues3–4, pp. 439–446, https://doi.org/10.1016/j.compstruct.2005.09.037

[12] Abusharar, S. W. (2015), Effect of Particle Sizes on Mechanical Properties of Concrete Containing Crumb Rubber, Innovative Systems Design and Engineering, Vol. 6, No.2, https://core.ac.uk/download/pdf/234643472.pdf

[13] Marie, I., (2016), Zones of weakness of rubberised concrete behaviour using the UPV, Journal of Cleaner Production, Vol. 116, pp. 217-222. http://dx.doi.org/10.1016/j.jclepro.2015.12.096

[14] Mohammed, B. S., Azmi, N. J., & Abdullahi, M. (2011). Evaluation of rubbercrete based on ultrasonic pulse velocity and rebound hammer tests. Construction and Building Materials, Vol. 25, Issue 3, pp. 1388–1397. https://doi:10.1016/j.conbuildmat.2010.09.004

[15] Shi, M., Jeong, D.H., Lee,S.W., Choi, Y. (2018). Relationship between UPV and Strength of Rubber -Concrete. DDF 382, 225–229.

[16] ACI PRC-211.1-91 (reapproved 2009), Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete.

[17] BS EN 12390-3 (2019) -TC, Testing hardened concrete – Compressive strength of test specimens

[18] ASTM C143 / C143M (2020), Standard Test Method for Slump of Hydraulic-Cement Concrete, ASTM International, West Conshohocken, PA,2020, www.astm.org

[19] ASTM C642 (2021) Test Method for Density, Absorption, and Voids in Hardened Concrete. ASTM International

[20] ASTM C805 / C805M (2018) Test Method for Rebound Number of Hardened Concrete. ASTM International. https://doi.org/10.1520/c0805-02

[21] ASTM C597 (2016), Standard Test Method for Pulse Velocity Through Concrete, ASTM International, West Conshohocken, PA, 2016, www.astm.org

[22] BS 1881-203 (1986): Testing Concrete Part 203: Recommendations for Measurement of Velocity of Ultrasonic Pulses in Concrete

[23] Kumar, R., Dev, N. (2022). Mechanical and Microstructural Properties of Rubberised Concrete After Surface Modification of Waste Tire Rubber Crumb. Arabian Journal for Science and Engineering. Vol. 47, pp. 4571–4587. https://doi.org/10.1007/s13369-021-06154-w

[24] ElNemr, A. (2020). Generating water/binder ratio-to- strength curves for cement mortar used in Masnory walls. Construction and Building Materials (Vol. 233, 117249).. https://doi.org/10.1016/j.conbuildmat.2019.117249

[25] Youssf, O., Mills, J. E. & Hassanli, R. (2016). Assessment of the mechanical performance of crumb rubber concrete. Construction &Building Materials. Vol.125, pp. 175- 183. https://doi.org/10.1016/j.conbuildmat.2016.08.040

[26] Pham, T. M., Renaud, N., Pang, V. L., Shi, F., Hao,H., & Chen, W. (2021). Effect of rubber aggregate size on static and dynamic compressive properties of rubberised concrete. Structural concrete, pp. 1-13. DOI:10.1002/suco.202100281

[27] Ramli, M. and Dawood, E.T., (2011). Comparative study between high strength flowable mortar and high strength flowing concrete, Concrete Research Letters, Vol. 2, No.2, pp. 249-61

[28] Siddique, R., Naik, T.R., (2004). Properties of concrete containing scrap-tire rubber – an overview. Waste Management, Vol. 24, No. 6, pp. 563-569.

[29] Raffoul, S. Garcia, R., Pilakoutas, K., Guadagnini, M., Flores Medina, N. (2016). "Optimisation of rubberised concrete with high rubber content: an experimental investigation", Construction and Building Materials,124. pp. 371-404. https://doi.org/10.1016/j.conbuildmat.2016.07.054

[30] Mavroulidou, M. & Figueiredo, J. (2010). Discarded tyre rubber as concrete aggregate: A possible outlet for used tyres. Global NEST Journal, Vol. 12, No. 4, pp 359-367

[31] Jalal, M.; Nassir, N.; and Jalal, H. (2019) Waste tire rubber and pozzolans in concrete: A trade-off between cleaner production and mechanical properties in a greener concrete, Journal of Cleaner Production. Journal of Cleaner Production, 238, 117882, https://doi.org/10.1016/j.jclepro.2019.117882

[32] Roychand, R., Gravina, R. J., Zhuge, Y., Ma, X. , Youssf, O. and Mills, J. E. (2020), "A comprehensive review on the mechanical properties of waste tire rubber concrete," Construction and Building Materials, vol. 237, 117651, https://doi.org/10.1016/j.conbuildmat.2019.117651.

[33] Copetti, C. M., Borges, P.M., Squiavon, J. Z., da Silva, S. R., & Andrade, J. J. (2020). Evaluation of tire rubber surface pre-treatment and silica fume on physical-mechanical behaviour and microstructural properties of concrete. Journal of Cleaner Production, Vol. 256, 120670. https://doi.org/10.1016/j.jclepro.2020.120670

[34] Marques A. C., Akasaki J. L., Trigo A. P.M. & Marques M. L. (2008). Influence of the surface treatment of tire rubber residues added in mortars. IBRACON Structures and Materials Journal. 1, 113-120. DOI: 10.1590/S1983-41952008000200001

[35] Balaha, M., Badawy, A., Hashish, M. (2007). Effect of using ground waste tire rubber as fine aggregate on the behaviour of concrete mixes, Indian Journal of Engineering and Materials Science. Vol. 14. http://hdl.handle.net/123456789/225

[36] Chiraz, K., F.Zohra, B., Ghania, N., Houria, H., Yacine, C., andBelachia, M. (2021). Influence of NaOH treatment of rubber aggregates on the durability properties of rubberised mortars, SSP - JOURNAL OF CIVIL ENGINEERING, Vol. 16, Issue 2, DOI: 10.2478/sspjce-2021-0026

[37] Saloni, A., Parveen, J., Pham T.M., Lim Y. Y., and Malekzadeh M.(2021). Effect of pre-treatment methods of crumb rubber on strength, permeability and acid attack resistance of rubberised geopolymer concrete. Journal of Building Engineering. Vol. 41:102448. http://dx.doi.org/10.1016/j.jobe.2021.102448

[38] Gu¨neyisi, E., Gesog? lu,, M., and O¨ zturan, T.(2004). Properties of rubberized concrete containing silica fume. Cement and Concrete Research, vol. 34, pp. 2309–2317, https://doi.org/10.4028/www.scientific.net/ddf.382.225

[39] Li, H., Xu, Y., Chen, P., Ge, J., and Wu,F. (2019). Impact Energy Consumption of High-Volume Rubber Concrete with Silica Fume. Advances in Civil Engineering, Volume: 2019, Publisher: Hindawi Publishing Corporation, https://doi.org/10.1155/2019/1728762

[40] Sun, G. and Young, J.F. (1993), Cement and Concrete Research, Vol.23, Issue 2, pp. 480-483

[41] Gesoglu, and M. Güneyisi, E. (2007). "Strength development and chloride penetration in rubberised concretes with and without silica fume", Materials and Structures, Vol. 40, No. 9, pp. 953 - 964, DOI:10.1617/s11527-007-9279-0

[42] Akshay; Sofi, A. (2021). The Effect of Crumb Rubber Powder as Partial Replacement of Fine Aggregate on the Mechanical and Durability Properties of Concrete. IUP Journal of Structural Engineering, Vol. 14m Issue 3, pp. 18-38.

[43] Najim, K. B., & Hall, M. R. (2013). Crumb rubber aggregate coatings/pre-treatments and their effects on interfacial bonding, air entrapment and fracture toughness in self-compacting rubberised concrete (SCRC).Materials and Structures (Vol. 46, Issue 12, pp. 2029–2043). Springer Science and Business Media LLC. https://doi.org/10.1617/s11527-013-0034-4

[44] Mernerdas, K., Ipek, S. and BozgeyIk, B. (2020). Experimental evaluation and genetic programming-based modeling of the compressive strength of concretes produced with various strength classes of cements, Cumhuriyet Science Journal, Vol. 41, No. 2, pp. 482-492, http://dx.doi.org/10.17776/csj.589207

[45] Wang, R., He, X. and Li, Y. (2019). Evaluation of microcracks in the interfacial transition zone of recycled rubber concrete, Structural Concrete, Vol. 20, pp. 1684–1694. DOI:10.1002/suco.201900044

[46] Segre, N., and Joekes, I., (2000) "Use of tyre rubber particles as addition to cement paste," Cement and Concrete Research, Volume 30, Issue 9, 2000, pp. 1421-1425, ISSN 0008-8846, https://doi.org/10.1016/S0008-8846(00)00373-2.

[47] Sugapriya, P.; and Ramkrishnan, R. (2018). Crumb rubber recycling in enhancing damping properties of concrete. IOP Conference Series: Materials Science and Engineering, 310(012013). doi:10.1088/1757-899X/310/1/012013

**Keywords:** Silica Fume; Rubberized Concrete; Untreated and Treated Crumb Rubber; Non-Destructive Testing (NDT)

## Biography:

Dr. Ibrahim G. Shaaban is a distinguished figure in the field of civil engineering, boasting a diverse career spanning several key areas. With expertise encompassing laboratory and in-situ testing of building materials, structural design, retrofitting of structures for change of use, construction site supervision, and providing expert testimony in legal proceedings and public hearings concerning structural integrity, Dr. Shaaban has made significant contributions to the field. In October 2015, Dr. Shaaban assumed the role of Visiting Professor at the University of Liverpool, further enhancing his academic prowess and sharing his wealth of knowledge with students and colleagues alike. Continuing his academic journey, in 2019, he transitioned to the University of West London, where he assumed a position focused on teaching and research. Dr. Shaaban's research interests are extensive, with a particular focus on innovative materials, structural design, and concrete durability. His dedication to advancing the field is evident through his prolific publication record, boasting 95 journal and conference papers that have contributed significantly to the body of knowledge in civil engineering. Dr. Shaaban's illustrious career serves as a testament to his unwavering commitment to excellence in civil engineering, and his contributions continue to shape the future of the discipline.

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# General Relativity, Dragging of Inertial Frames and the LARES and LARES 2 Space Missions

**Ignazio Ciufolini**

*Scuola di Ingegneria Aerospaziale, Sapienza Università di Roma, Italy*

## Abstract:

Einstein's general theory of relativity (GR) has had a number of experimental and theoretical triumphs, from the prediction and observation of the expansion of the universe to solar system and astrophysical tests and to the prediction and observation of gravitational waves and black holes. In spite of its experimental and theoretical successes, GR has some theoretical and observational issues and needs further experimental tests. The dragging of inertial frames or frame-dragging, as Einstein named it in 1913, is an intriguing and fascinating phenomenon of GR to be tested with high accuracy. It has relevant effects in a number of astrophysical phenomena from the emission of spectacular jets in active galactic nuclei and quasars to the emission of gravitational waves from colliding back holes.

The two missions of the Italian Space Agency (ASI), LARES 2 (2022) and LARES (2012) have the main objective to test GR and in particular to measure frame dragging with high accuracy. They also provide measurements in space geodesy and geodynamics. We describe these two space missions and their past, present and future test of GR.

## Biography:

Prof. Ignazio Ciufolini Research associate at Sapienza Università di Roma and GAUSS, Roma, former lecturer at the University of Texas at Austin and professor of physics at the University of Salento. Author of over 200 papers and academic books, he published with the leading experts of relativity, such as John A. Wheeler and Roger Penrose, and studied in the eighties under the supervision of J.A. Wheeler, Richard Matzner and Steven Weinberg. Among his international awards: USA PROSE 1996 (Association of American Publishers) for the best professional book in physics and astronomy (with J.A. Wheeler); Occhialini 2010 (UK Institute of Physics, IOP, and Italian Physical Society, SIF); Tomassoni-Chisesi 2001 (SapienzaUniversità di Roma). He is the Principal Investigator and the proposer of two space missions of the Italian Space Agency to test Einstein's general theory of relativity: LARES (Laser Relativity Satellite), launched in February 2012 and LARES 2, launched in July 2022.

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# The Secret of Planets' Perihelion Between Newton and Einstein

**Christian Corda**

*Editor-in-Chief-Journal of High Energy Physics Gravitation and Cosmology, USA*

## Abstract:

It is shown that, contrary to a longstanding conviction older than 160 years, the advance of Mercury perihelion can be achieved in Newtonian gravity with a very high precision by correctly analysing the situation without neglecting Mercury's mass.General relativity remains more precise than Newtonian physics, but Newtonian framework is more powerful than researchers and astronomers were thinking till now, at least for the case of Mercury.

The Newtonian formula of the advance of planets' perihelion breaks down for the other planets. The predicted Newtonian result is indeed too large for Venus and Earth. Therefore, it is also shown that corrections due to gravitational and rotational time dilation, in an intermediate framework which analyzes gravity between Newton and Einstein, solve the problem. By adding such corrections, a result consistent with the one of general relativity is indeed obtained.

Thus, the most important results of this Lecture are two: i) It is not correct that Newtonian theory cannot predict the anomalous rate of precession of the perihelion of planets' orbit. The real problem is instead that a pure Newtonian prediction is too large. ii) Perihelion's precession can be achieved with the same precision of general relativity by extending Newtonian gravity through the inclusion of gravitational and rotational time dilation effects. This second result is in agreement with a couple of recent and interesting papers of Hansen, Hartong and Obers. Differently from such papers, in the present Lecture the importance of rotational time dilation is also highlighted.

Finally, it is important to stress that a better understanding of gravitational effects in an intermediate framework between Newtonian theory and general relativity, which is one of the goals of this Lecture, could, in principle, be crucial for a subsequent better understanding of the famous Dark Matter and Dark Energy problems.
This is an Invited Lecture which arises from the reseach paper Physics of the Dark Universe 32 (2021) 100834.

**Keywords:** Planet’s  Perihelion; Newtonian Gravity; General Relativity

## Biography:

Dr. Christian Corda was Born in Nuoro Italy on July 03, 1969, Resident in Prato Italy. Prof Corda is Global Energy Technology Plc, Scientific Director and Senior Scientist for Yellow Group of Companies. Christian Corda received his Ph.D from Pisa University Pisa, Italy during the period 2003 to 2007.Thesis title: â€œSignals andinterferometric response functions in the framework of gravitational waves arising from Extended Theories of Gravityâ€,During this time, he also did research ( between 2004 2005 ) at Pisa University, Department of Physics within the Virgo project on the Dark Matter gravitational, waves correlation, and the Instituto Nazionale Previdenza Della.

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# Spotlight on Mechanical Properties of Autogenic Self-Healing of Concrete

**Ibrahim G. Shaaban[1]*;** Amr ElNemr[2]; and Hanya Ahmed[2]

*1 School of Computing and Engineering, University of West London, St Mary's Road, W5 5RF, London, UK*

*2 Civil Engineering Department, German University in Cairo, Egypt*

## Abstract:

Self-healing concrete is defined as the concrete ability to recover its cracks. Cracks in concrete are a common phenomenon that reveals adverse effects on a structure's integrity, durability, and serviceability due to its relatively low tensile strength. Recently, self-healing techniques have been developed to ensure crack recovery and implemented in strategic structures to optimize maintenance costs. This study aims to highlight one self-healing technique type named the "autogenic self-healing technique". Four mixes including the control were designed and established to examine the self-healing mechanism when using mineral admixtures such as fly ash and polyvinyl alcohol fiber (PVA fiber) at various percentiles. All mixes encountered 20% cement volume replacement by fly ash with various PVA fiber percentile additions: 1, 2, and 3%. Compressive, flexural, and tensile strengths were examined after cracking and failure. The cube prism and cylinder specimens were cracked and then cured at 28 days for testing to failure. The results showed that the compressive strength recovered in mixes with 2 and 3% PVA. This work provides promising insight on cracks healing or recovery to a certain extent.

**Keywords:** Self-healing; Concrete; Crack Recovery; Mechanical Properties

## Biography:

Dr. Ibrahim G. Shaaban is a distinguished figure in the field of civil engineering, boasting a diverse career spanning several key areas. With expertise encompassing laboratory and in-situ testing of building materials, structural design, retrofitting of structures for change of use, construction site supervision, and providing expert testimony in legal proceedings and public hearings concerning structural integrity, Dr. Shaaban has made significant contributions to the field. In October 2015, Dr. Shaaban assumed the role of Visiting Professor at the University of Liverpool, further enhancing his academic prowess and sharing his wealth of knowledge with students and colleagues alike. Continuing his academic journey, in 2019, he transitioned to the University of West London, where he assumed a position focused on teaching and research. Dr. Shaaban's research interests are extensive, with a particular focus on innovative materials, structural design, and concrete durability. His dedication to advancing the field is evident through his prolific publication record, boasting 95 journal and conference papers that have contributed significantly to the body of knowledge in civil engineering. Dr. Shaaban's illustrious career serves as a testament to his unwavering commitment to excellence in civil engineering, and his contributions continue to shape the future of the discipline.

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# Design and Construction of Tall Buildings: A Sustainability Perspective

**Abbas Aminmansour**

*Fellow-Council on Tall Buildings and Urban Habitat, University of Illinois, USA*

## Abstract:

Tall buildings consume more structural material per unit floor area than buildings that are not tall. In addition, construction of tall buildings is very energy-intensive and leads to a higher Carbon footprint than other buildings. If measured with the same metrics used to assess sustainability of other buildings, tall buildings do not fare well. However, they have a substantial sustainability impact when viewed in the urban and suburban context. This presentation takes a examines the sustainability of tall buildings as well as their sustainability impact on their host communities. It is observed that while tall buildings do not do well in the area of sustainability when assessed using the same measuring criteria used for other buildings, they do indeed have a significant impact on their surroundings.

## Biography:

Dr. Abbas Aminmansour is a distinguished member of the Structures Concentration faculty and former Chair of the Building Performance Program within the School of Architecture at the University of Illinois at Urbana-Champaign. With a wealth of expertise in his field, Dr. Aminmansour's research and scholarship interests primarily revolve around the design of steel structures and tall buildings. An esteemed figure in the American Institute of Steel Construction (AISC), Dr. Aminmansour actively contributes to various technical committees, including the AISC's Committee on Manuals, Technical Committee 2, and Technical Committee 4 of the AISC Committee on Specification. Notably, he plays a pivotal role in shaping the contents of the AISC's Steel Construction Manual and the Seismic Design Manual, with his work being adopted and featured in the AISC Manual multiple times. His recent contribution, known as the "super table" in Part Six of the AISC Manual, underscores his significant impact in the field. In recognition of his outstanding contributions, Dr. Aminmansour was honored with the 2015 Special Achievement Award from AISC. He continues to push the boundaries of structural engineering, currently focusing on developing an integrated cloud-based book and software for the design of structural steel members. Beyond his academic pursuits, Dr. Aminmansour is actively involved in professional organizations such as the Chicago Committee on High-Rise Buildings (CCHRB) and the Council on Tall Buildings and Urban Habitat (CTBUH), where he serves on the Editorial Board of CTBUH's International Journal of High-Rise Buildings. His dedication to the field has been further recognized by CTBUH, which named him one of four 2022 Fellows selected globally for his exemplary

contributions. As a CTBUH Leader and member of the mentoring group, Dr. Aminmansour continues to inspire and mentor the next generation of engineers. Dr. Aminmansour's expertise has also been showcased on a global platform through his involvement in the television documentary "Skyscrapers: Engineering the Future", aired on the Science Channel in the United States and broadcasted in other countries as well. His illustrious career and numerous accolades stand as a testament to Dr. Aminmansour's invaluable contributions to the field of structural engineering and his enduring commitment to advancing the built environment.

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# MULTIVERSE: How Far is a Twin Universe with Identical Last 100 Years History?

**Andrew Radosz**

*Wroclaw University of Science and Technology, Poland*

## Abstract:

The density of luminous matter, dark matter and dark energy is apparently equal to its critical value, k=0. Hence the universe is infinite. It is isotropic and homogeneous, up to $10^{(-5)}$, at the (observable) scale, $10^{27}$ m. In the simplest version of Multiverse concept, such an Infinite and Flat Entity is filled with bubles, „Hubble spheres" of radius $R=10^{27}$ m, obeying the same physical laws and differing, due to different initial conditions („inflation") in their contents. Within this scheme, the Twin Universe to our own is located in a distance, at most, $10(10^{115})$ m. We argue that the Twin Universe should be filled with the same distribution of matter (and radiation), but also, should have the same history. Hence, it is discussed the problem of the distance between two Twin Hubble spheres with identical 100 years histories.

## Biography:

Dr. Andrew Radosz is a professor in theoretical physics, working at Wroclaw University of Science and Technology. He started his professional career (Ph.D., 1982) in Condensed Matter Physics (Structural Phase Transitions), being later involved in the research in Quantum Mechanics (path integral formalism), Statistical Mechanics (exactly solvable models), and other areas of Theoretical Physics. Recently he has been focused on the studies of classical and quantum phenomena undergoing in strong gravitational fields (exterior and interior of the Black Holes (BH)). His main achievements are associated with a path integral formalism in QM (formulation of a semi-classical approximation, Real Trajectories in Complex Time) and the results of the studies of the BHs interior (infinite volume of BHs, the anisotropic character of the BHâ€™s interior dynamics).

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# Extraction of Silicon from Construction Debris Using the Alkaline Fusion Technique

**Nevin Karamahmut Mermer**, Ece Ünlü Pınar
*Kalekim Construction Chemicals Co., Turkey*

## Abstract:

Cement is responsible for 5–8% of the existing carbon emissions in the building sector, mostly because of its high manufacturing temperature. The fact that cement is the second most utilized industrial raw material, behind water, and that a significant portion of the infrastructure surrounding us, such as buildings, tunnels, dams, and bridges, is constructed using reinforced concrete, makes the extent of the problem's impact apparent. The disposal of building waste, in addition to carbon emissions, is a significant issue. The quantity of debris generated by natural disasters like earthquakes presents a significant problem, as it is currently being used for filling purposes. The building debris resulting from the earthquake that took place in Turkey on February 6, 2023, was reported to be as large as Mount Erciyes. There are scholarly investigations on the extraction of silicon solution from different industrial wastes, such as fly ash, gold mine tailing slurry, etc., utilizing the alkaline fusion technique. The hydrated cement phases exhibit high concentrations of calcium and silicon. The goal of the study was to get the silicon out of the hydrated cement phases of the building debris with the alkaline fusion method, which is based on alkaline treatment of debris mechanically and heat treatment.

## Biography:

Dr. Nevin Karamahmut Mermer is an accomplished professional in the field of Chemical Engineering, with a diverse academic background and extensive industry experience. She embarked on her academic journey by completing her graduation project at Brno University of Technology, Czech Republic, in 2010. Following this, she pursued her higher education at Yildiz Technical University, Turkey, where she obtained her B.Sc., M.Sc., and Ph.D. degrees in Chemical Engineering. During her Ph.D. studies, Dr. Mermer demonstrated her commitment to practical application by working as a Research Engineer in a construction company for 1.5 years, gaining valuable industry insights and experience. Since 2019, she has held the position of R&D Assistant Manager at Kalekim Construction Chemicals Co., where she continues to contribute her expertise to research and develop-

ment initiatives. Dr. Mermer's academic and professional achievements are reflected in her impressive publication record. She has presented her research findings in 28 presentations at national and international congresses and has published 15 articles in national and international refereed journals. Additionally, she has authored a book chapter, further solidifying her contributions to the field of Chemical Engineering. Currently, Dr. Mermer shares her knowledge and expertise with students as she teaches Chemistry and Manufacture of Cement lecture at the university. Her dedication to both academia and industry underscores her commitment to advancing the field of Chemical Engineering and fostering the next generation of professionals in the field.

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# Thermodynamic Properties of Hot Q Equilibrium Hadronic and Quark Matter in the Neutrino-Trapped Regime

**Grigor Alaverdyan**
*Yerevan State University, Armenia*

## Abstract:

We investigate the thermodynamic properties of the hot?-equilibrated hadronic matter which consists of neutrons, protons, electrons, electron neutrinos, muons, and muon neutrinos(ve).To describe such matter, we use an improved version of there lativistic mean field theory (RMF) at a finite temperature, where, in addition to the effective fields of, amesons, the scalar-isovector ð-meson effective field is also taken into account.

For different values of temperature in the range of 0-100MeV, the dependences of pressure energy density, entropy density and baryon chemical potential on the bary on number density are determined. We studied the effect of temperature on the splitting of the effective masses of the proton and neutron due to the presence of the ð-meson field.

The temperature dependencies of the parameters of the first-order phase transition from hadronic matter to strange quark matter are also studied. In this case, the Nambu - Jona-Lasinio (NJL) local SU (3) model was used to describe the quark phase.

A phase diagram is obtained corresponding to the equilibrium coexistence of hadron and quark phases in the B plane. The thermodynamic parameters of the critical end point in the phase coexistence curve are found. Four different areas were identified in the B plane: the area of existence of matter with a purely hadronic structure the area of existence of matter with a purely quark structure; the region corresponding to the crossover transition between the hadron and quark phases, and the range of values which do not correspond to any structure.

## Biography:

Dr. Grigor Alaverdyan Educational biography is 1966 - 1971 Graduated from Yerevan State University, Faculty of Physics & Specialization: Theoretical Physics, Qualification: Physicist 1974 - 1977. PhD student, Yerevan State University, Department of Theoretical Physics; Seconded post-graduate student, Joint Institute of Nuclear Research (JINR), Dubna, Russia in 1980 Candidate of Physical and Mathematical Sciences, "Multiple scattering phenomena of guiding particles in inelastic hadron-nuclear interactions", Yerevan State University.

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# About Some Generalised Reissner-Nordstrom Spacetimes

**Orchidea Maria Lecian**
*Sapienza University, Italy*

## Abstract:

Some generalization of the Reissner-Nordstrom space times are proposed. The needs for generalisations of the Reissner-Nordstrom spacetimes are introduced. In particular, the generlaised Reissner-Nordstrom spacetimes with a comsological-constant term, the generalized Reissner-Nordstrom spacetimes with a lienar term, and the generlaised Reissner-Nordstrom spacetimes with a linear term and a cosmological constant are examined. For the considered spacetimes, the analytical expression of the radii are newly calculated, from which the conditions to obtain the analytical expressions of the physical horizons are newly found for the three instances. The coordinates-singularity-avoiding coordinate's extensions are newly written for the three cases, after which the tortoise coordinates are allowed to be implemented. The constraints on the paramaeter spaces of the models are newly set forth examples, form which new aspects of the generalized spacetimes are learnt. Particular new families of generalized Reissner-Nordstrom spacetimes are newly analytically described. The comparison with the Stokes portraits is analytically obtained. The new quantum prospective implementations are envisaged.

## Biography:

Prof. Orchidea Maria Lecian graduated in Physics- Theoretical Physics in 2005 at Sapienza University of Rome, Italy, Physics Department and ICRA- International Center for Relativistic Astrophysics Relativistic Astrophysics, and completed her PhD in Physics- Relativistic Astrophysics (IRAP_-International Relativistic Astrophysics PhD) at Sapienza University of Rome, Physics Department and ICRA in 2008, Sapienza Unviersity of Rome, with an INFN (National Institute for Nuclear Physics) Postdoctoral Fellowship. Accomplished postdoctoral studies at IHES- Institute des Hautes E'tudes Scientifiques, Bures-sur-Yvette, France, and APC- Astroparticules et Cosmologies, Paris, France (2009-2010) with a Sapienza University Postdoctoral CUN2 Research Fellowship , an Angelo Della Riccia Postdoctoral Fellowship and an IHES Postdoctoral Fellowship. AEI-MPI (2009-2011), Max Planck Institute for Gravitational Physics- Albert Einstein Institute, Potsdam-Golm, Germany (2011 and 2013) with a Grant awarded to Foreign Postdocs and a Postdoctoral Research Grant; and Sapienza University of Rome (2011-

2013 and 2013-2014) with a Sapienza University Postdoctoral Fellowship. Has been Assistant Professor at Sapienza University of Rome, Architecture Department, SBAI (Department of Fundamental Sciences and Engineering), DI-AEE (Department of Astronautics Engineering, Electric and Energetic) (2007-2017). Has been Researcher at Comenius University in Bratislava, Faculty of Mathematics, Physics and Informatics, Department of Theoretical Physics and Physics Education- KTFDF and appointed Erasmus Lecturer with a SAIA- NS'P (Slovak Academic Information Agency National Stipendium Program me of the Slovak Republic) grant for International University Researchers (2017-2018).

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# The First_Ever Biological Experiment on Moon

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## Abstract:

### Introduction

On Jan 3, 2019, Chang'E-4 successfully landed on the pre-selected landing zone on the far side of the moon, which is located in the Theodore von Kármán Crater in the Aitken Basin of the South Pole. This is the first lunar landing on the far side of the moon. Chang'E-4 also conducted a biology science experiment in addition to the first lunar landing mission. In the biological experiment payload (BEP), six organisms were carried: potatoes, rapeseed, Arabidopsis, cotton, yeast and fruit flies. The objective was to be able to verify the growth of plants, animals and microbes on the moon.

### Structures and Modules of BEP

The purpose of the biological experiment payload is to secure the relevant science experiment on the surface of the far side of the moon, which needs to be sealed under one atmospheric pressure. Considering the lunar high vacuum environment, the payload was designed as a pressure vessel with a cylindrical structure (Figure 1). The payload is designed to divide into two parts: the upper tank and the lower tank, and the insulating ring processed by the polyimide material is connected in the middle. The biological module, the camera, the water storage device were installed in the upper tank body and designed as a pressure vessel; the control module is installed in the lower tank body and is not designed as a pressure vessel.

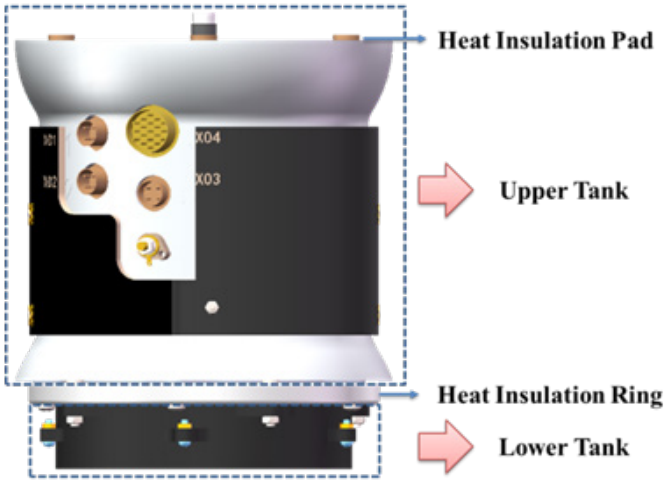


**Figure 1: The engineering structure of the payload**

The lower tank control module includes a power management circuit and a load control circuit. The lower tank lead wire is connected with the upper tank 37-chip connector for the data transmission between the upper and lower tanks. The outer surface of the tank and the outer surface of the heat sink are all blackened.

The payload is an independent whole unit without any accessory components, in which the line interface cooperates through the aerospace special socket form, including a control module, a thermal control module, a structural module, a light guiding module, and a biological module.

**How It Works on Moon**

The payload is a cylindrical structure with a weight of 2.608 kg, which meets the requirements of the Change 4 probe. It is fixed on the top plate of the lender by bolt connection. The biological space is about 0.82 L, which contains plant seeds, insects and yeast, and constitutes a micro-ecosystem. The payload has a very tiny light-transmitting hole with diameter at 10. The natural sunlight of the moon surface is collected by the mirror to verify the photosynthesis of the plants under the lunar environment. The semiconductor cooling/ heating sheet is combined with the polyester film material and the aluminum foil to form a temperature control system and the temperature in the payload is maintained within a range of 25 to 35 $^{0}$C to ensure the survival of the living organism. The photo collection is to facilitate observation of the activity of plants and animals in the micro-ecosystem. Independent control mode is adopted to realize thermal control, photo collection, data storage, data transmission and power management in the payload, while the energy supply is supported by the lander.

**Experimental Results**

An experimental photo sent back earlier this year showed a green leaf growing from the cotton seed inside the payload. It is the first green on the moon. Recently, the team has used 3D reconstruction and data analysis to further process the image. It turns out that the green is actually made up of two leaves. The image also shows the roots of plants growing on the moon.

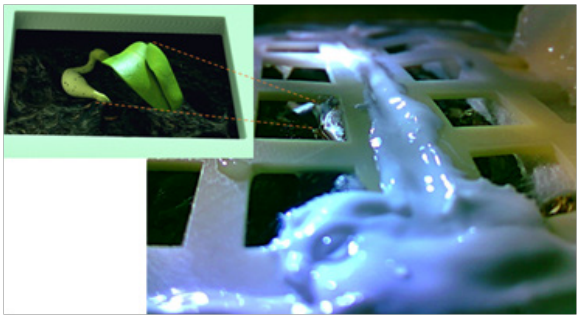

**Figure 2: Cotton seeds sprout on the moon, the top left corner is data repair**

The accumulated working time of the payload was 1300 hours, a total of 125 shots with 622 photos were received in 5 months, the experiment verified that photosynthesis and the respiratory action of plants work under low gravity and strong radiation conditions. Our biological experiment payload explored the growth and development of photosynthesis and photosynthesis effects on the lunar surface under low gravity, strong radiation and natural.

## Biography:

Prof. Gengxin Xie is a Doctor of Engineeringï¼Œand work as a post-doctoral fellow in the University of California, Berkeley. He currently serves as the Executive Deputy Director of the Deep Space Exploration Joint Research Centeunder the Ministry of Education r (COSE), Dean of Institute of Advanced Technology at Chongqing University, Ph.D supervisor at College of Environment and Ecology, Chongqing University, Member of the Science and Technology Committee under the Ministry of Education, Member of the Deep Space Exploration Professional Group, Member of the International Astronautical Federation, leader of the innovation team of the Ministry of Education. He is the winner of the second prize of National Science and Technology Progress Award, first prize of Science and Technology Progress Award and first prize of Natural Progress Award by Ministry of Education. He is the chief designer of the biological experiment playload on Chinaâ€™s Changâ€™e-4, a lunar exploration project, which has cultivated the first green leaf on the moon surface for the first time in human history, and was awarded as one of the Outstanding Contributors to the lunar exploration of Chang'e-4 by six state-level ministries such as the Ministry of Human Resources and Social Security.

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# Vulcan and Anomalous Displacement of Mercury's Perihelion

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## Abstract:

In this paper, I re-examine the question of a possible explanation of the anomalous advance of Mercury's perihelion by the existence of the hypothetical planet Vulcan proposed by Le Verrier, whose orbit would be located inside the orbit of Mercury. My calculations are focused on the optimization of the orbital parameters of Vulcan in order to explain precisely the anomalous advance of Mercury's perihelion.

Taking into account recent advances in experimental and theoretical exploration of the intra-Mercury zone, supported by my calculations, it has been concluded that the hypothetical Vulcan with a mass of 1/17 of Mercury and with realistic orbital parameters cannot explain the anomalous advance of Mercury's perihelion.

I optimized the orbital parameters of the hypothetical Vulcan in order to explain the anomalous advance of Mercury's perihelion. To account for this, Vulcan should have a mass of 1.6 times that of Mercury and would therefore be visible at almost the same solid angle as Mercury and could have been detected since antiquity.

Modern observations also rule out the possibility of an intra-mercurian asteroid belt of fairly large total mass in the stability belt located in Mercury's orbit between 0.08 and 0.18 AU. The question of whether the planet Vulcan existed with a lower longevity than the bodies currently observed around the Sun remains open.

**Keywords:** Gravitation; Celestial Mechanics; Asteroid Belt; Ephemerides; Planets and Satellites; Individual (Mercury); (Stars) Planetary Systems

## Biography:

Dr. Souren Pogossian earned his Ph.D. from the University of Brest, conducting a significant portion of his research at CNRS in Meudon. During this time, his studies focused on the guided propagation of light and neutron waves. He subsequently delved into silicon-germanium optoelectronics and explored exchange coupling in magnetism. Currently, Dr. Pogossian's interests lie in the field of astrodynamics. He serves as a lecturer at the University of Brest, affiliated with the "Laboratoire d'Océanographie Physique et Spatiale.

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# Is The Universal Gravitation From the Attractive Force of the Magnetic Field?

**Mei Yin**
*China*

## Abstract:

Newton's theory of universal gravitation has been extensively applied in many fields for more than 300 years. However, it is not clear where Newton's gravitation comes from. At present some phenomena cannot be reasonably explained under the frame of the universal gravitation's theory and hence there is a controversy. For example, when magnetic iron and stone have the same mass, magnetic iron has a stronger magnetic or attractive force than stone, which conflicts with the theory of gravitation. Besides, a great number of researches related to the universal gravitation all over the world are being and will be carried out. For example, humans expect to explore far-off stars in the universe at a more rapid speed and more safely. It is vital to make sure where the universal gravitation comes from. Furthermore, since the Newton's era, there have been many new discoveries, e.g., atomic magnetic field and magnetic force, atom, electron, nucleus, properties of solar system and planets. It is encouraging and attractive to make new scientific research on the source of universal gravitation based on related new discoveries. The paper aimed to clarify where the Newton's gravitation comes from by a comparison analysis of properties of atom and solar system, of electron and planets, and of nucleus and Sun based on related physical and chemical theories including magnetic and electric fields theories, electric and atomic nucleus motion theories, cosmic formation theory and Sun and planet motions theories. Besides, the paper also analyzed the interaction between the earth and human beings, animals and objects on the earth by analyzing the main compositions of the earth and atomic properties of human beings, animals and objects on the earth. It concludes that the universal gravitation of any object is in essence from the attractive force of the magnetic field of the object.

Newton's theory of gravitation was published in the late 17th century (Wang, 2008) and is extensively applied in many fields and people's everyday lives up to now. However, it is not clear where the gravitation comes from. Electron was discovered by English physicist Joseph John Thomson in 1897 and atomic nucleus by New-Zealand-born British physicist Ernest Rutherford in 1911 (Califano, 2012). That is to say that in the Newton's era, atomic magnetic field and magnetic force had not been discovered until around the turn of 20th century. Does the universal gravitation come from the attractive force of the magnetic field? The paper aimed to clarify where the Newton's gravitation comes from by a comparison analysis of properties of atom and solar system, of electron and planets, and of nucleus

and Sun based on related physical and chemical theories including magnetic and electric fields theories, electric and atomic nucleus motion theories, cosmic formation theory and Sun and planet motions theories. Besides, the paper also analyzed the interaction between the earth and human beings, animals and objects on the earth by analyzing the main compositions of the earth and atomic properties of human beings, animals and objects on the earth.

Research has revealed that all matter consists of atoms and atom is dividable and composed of smaller particles including a nucleus and one or more electrons, protons, neutrons, etc. (Jerabek et al., 2018). The monumental discovery in recent and modern physics have brought numerous electronic products (e.g., washing machine, air conditioner, television, calculator, computer, satellite, spacecraft) through innovative electronic technologies, which have brought people significant convenience in their daily lives, work, pastimes and entertainments, etc. Another significant research discovered that the electron in an atom has the property of rotation and revolution around nucleus (Jerabek et al., 2018, Califano, 2012). However, in the solar system, planets also have the property of rotation and orbiting the Sun. Is it a coincidence? Do they have other same or similar properties? An analysis was made through a comparison between properties of atom and solar system and of their important elements.

First, an atom has multiple electron motion orbits around nucleus, which are ring-shaped while the solar system also has multiple planet motion orbits around Sun, which are nearly circular or elliptic, also ring-shaped.

Second, an electron in an orbit can enter another orbit by absorbing or emitting enough energy (see Lieberoth et al., 2014). Can a planet move between orbits? We are familiar with our earth and know that on the earth there are sea, river and lake waters and ices which have melted and are melting and will melt into water due to the persistent shining of Sun over Earth. If the Sun lives much longer than the earth, sea, river and lake waters and ice-melted waters will gradually be steamed until the floors of sea, river and lake become dry or these waters will be steamed sufficiently, but the floors have not become dry. In either case, the earth will be becoming drier and lighter. The weight of the earth will have been significantly reduced and the gravitational force will also have subsequently significantly dropped. Thus, the earth will gradually divorce from the original third orbit and move to the next orbit in the solar system. Its movement between orbits is because the earth absorbs and releases energy from the Sun, which is similar to the cause of an electron jumping between orbits because of the absorption or emission of energy. Besides, research has shown that the moon is leaving the earth 3.8cms per year (NASA, 2005). Obviously, it is becoming drier and lighter and its gravitation is persistently reduced based on the role of the Sun in drying things. Sometime in the future it is inferred that the moon will leave the earth and move to another orbit. The movement to another orbit also has a cause similar to that of electron jumping between orbits. Similar cases will also happen to other planets more probably at different times.

Third, nucleus occupies around 99.9%, almost all the mass of an atom, but has a very tiny volume occupying around $10^{-10}$ time volume of an atom (Agarwal, 2015) though it is much bigger than an electron. Research has shown that the mass of an electron is only around 1/1836 of that of a proton in a nucleus (Patra1 et al., 2018), indicating that the electron is very light, too much lighter than the nucleus. Other studies noted that the radius of a proton is 0.84184(67) femtometers, deviating by 5.0 standard from the official value of 0.8768(69) femtometers (Pohl et al., 2010) while an electron is regarded as a point charge (Dorfmann and Ogden, 2014), indicating the electron is extremely tiny and looks like a point. Thus, electrons have not enabled their physical properties to be distinguished from each other using present technology. Research also noted that around 99% of an atom space is empty (cf. Califano, 2012). These studies demonstrate that an electron is much smaller and lighter than a nucleus. The Sun occupies 99.86%, almost all the mass of the solar system and also has a very small volume, occupying about $10^{-10}$ time volume of the solar system (Agarwal, 2015) though it is much bigger than any planet in the system, indicating the Sun is very small in contrast to the solar system. Other studies showed that the radius of the largest planet Jupiter in the solar system is around 67000 km though more detailed Jupiter radii are reported in Mallarna et al., 2000, indicating that any of all planets in the system is much smaller than the Sun with a radius of around 700,000 km though Trotter (1938) displayed more detailed Sun radius research. Ratios of nucleus to atom in mass and size are almost the same as those of Sun to the solar system in mass and size. And ratios between the masses and sizes of a nucleus and an electron are also similar to those between the masses and sizes of Sun and a planet.

Fourth, an electron spins and revolves around nucleus. It has an orbital angular momentum (Grillo et al., 2017), and also possesses an intrinsic angular momentum due to its spin 1/2 or -1/2 (Hodge, Migirditch and Kerr, 2014). Watt's (1972) study indicated that odd numbers of protons and neutrons have only intrinsic angular momentum, also due to their spin 1/2 or -1/2. Besides, Grillo et al. (2017) noted that the electron spin is helical. In contrast to these properties of the electron, any of eight planets in the solar system also spins and revolves around Sun and also has an orbital angular momentum, and an intrinsic angular momentum due to the planet spin and the Sun also has only intrinsic angular momentum, due to the Sun spin (Cang et al., 2016). Cang et al. (2016) showed that the Sun has a spin angular momentum of 1.8838 x 10^41 kg m^2 s^-1" and the solar system has angular momentum of 3.3212 x 10^45 kg m^2 s^-1. In addition, Sondkar, and Kahraman's (2013, P. 157) study suggested "a linear, time-invariant model of a double-helical planetary gear set" whereas literatures have recorded numerous analytic models of helical planetary gear set, indicating that the planet spin is helical. These studies show that electron and planet motions are similar, in a spiral and both electrons and planets rotations and revolutions in orbit are also almost the same, and nucleus and Sun rotations are also similar.

Fifth, an atom consists of one or more negatively charged electrons and one positively charged nucleus with one or more positively charged protons and one or more neutral neutrons (Caruso and Oguri, 2008, Blank, Giovinazzo and Pfützner, 2003). When containing equal numbers of positive and negative electric charges or of electrons and protons, an atom is a neutral atom. If protons are more than electrons in an atom, the atom is a positively charged atom. If electrons are more than protons in an atom, the atom is a negatively charged atom. In any case, an atom has positive and negative electric charges, which form an electric field and subsequently generate a magnetic field on the basis of electromagnetic theory (Dorfmann and Ogden, 2014). That is to say that any atom is a dipole with positive and negative electric charges and with opposite magnetic poles. Besides, in an atom, a nucleus with a positive electric charge is also always in motion, rotating, which generates magnetic fields and corresponding magnetic forces. Based on Hansen (1925), a rotating atomic nucleus can cause its magnetic field to spin. Blehl (2006) noted that opposite magnetic poles or electric charges attract and like magnetic poles or electric charges repel each other. At this time, the positively charged nucleus attracts the negatively charged electron. When the negatively charged electron moves towards the nucleus, it generates a magnetic field, which is perpendicular to the rotating magnetic field from the nucleus. Dorfmann and Ogden (2014) noted that charged particle produces magnetic force perpendicular to the direction of its motion. Thus, the two mutually perpendicular magnetic fields start to attract and repel each other, which lead to the much lighter electron rotation and revolution around the nucleus. Instantly, electron rotation and revolution generate new mutually perpendicular magnetic fields. These different magnetic fields interact and parts of these magnetic fields overlap. With the change of the intensity of the magnetic field, the time-varying magnetic field leads to a new electric field based on electromagnetic fields theory (Dorfmann and Ogden, 2014). The new electric field will continue producing a new magnetic field. That electric field generates a magnetic field and magnetic field generates a new electric field is constantly repeated. As such, any atom has mutually perpendicular and non-perpendicular and partially overlapped magnetic fields, which results in a stronger or weaker atomic magnetic field. That further highlights that any atom is a magnetic atom whether it is a neutral or charged atom. The difference between atoms is in the magnitude of magnetic force. Xing et al., (2007) noted that any atom has magnetic property. If an atom has two or more electrons, the two or more negatively charged electrons are similarly attracted by the nucleus and move towards the nucleus, which subsequently generate two or more magnetic fields, which are perpendicular to the rotating nucleus magnetic fields. These two or more electrons similarly start to spin and revolve around the nucleus, which subsequently generated two or more new mutually perpendicular magnetic fields. Simultaneously, the two or more electrons with like charges repel one another to keep them in respective orbits and the two of them in the same orbit are also possible, but go in an opposite spiral. Hajalilou et al. (2016) and Eckhardt and Sacha (2001) noted that two electrons in the same orbit go in an opposite spiral. Zhang and Zhao's (1995) study showed that two anti-parallel electrons do not occupy the same orbital state, but have strong correlation. It is clear that electromagnetic fields in an atom keep the atom in a stable structure, not collapse and keep the high speed motion of the electron.

Dorfmann and Ogden (2014) noted that attractive and repulsive forces of the magnetic field between opposite charges are inversely proportional to the square of distance between them. With the change of temperature or pressure, an atom easily gains or loses an electron which lies in the orbit farthest from the nucleus, which generates a new electric field, and causes subsequent change of strength of the atomic magnetic field. With the change of the magnitude of the atomic magnetic field, adjacent atoms also easily gain or lose an electron. Eckhardt and Sachas (2001) showed that the external field can lead to the sequential or simultaneous loss of two electrons, indicating the role of external magnetic force in loss of the electron. When there is one or two electrons lost from an atom, other atoms have an opportunity to gain one or two electrons. As a result, the magnitudes of these adjacent atomic magnetic fields also change based on the status of gain or loss of the electron. That is to say that the intensity of atomic magnetic force changes with temperature or pressure change. In this case, the balance of particle magnetic fields in an atom is destroyed and a new balance will necessarily be almost simultaneously built to maintain the atom in a new stable structure.

When a black hole exploded into the universe with incredibly high temperatures (Hawking, 1974) and pressures, liquid and solid substances spewing out of the black hole had been in gaseous state besides original gas also from the black hole (Yin, 2020). Atoms which make up these different types of gases lost or gained an electron most frequently than any time later, which led to an extremely strong electric and magnetic fields. That is to say that at the beginning of black hole explosion or cosmic formation, the magnitude of electric and magnetic fields are the largest, stronger than any time later in the universe. How the universe formed is described as follows on the basis of Yin's (2020) study:

With a drop in temperature and pressure, adjacent atoms which gases consisted of started to mass and form a gaseous lump. As such, all kinds of gaseous lumps formed with their respective sizes and weights and compositions. When temperatures became lower sufficiently, these gaseous lumps became star- or planet-shaped objects. The compositions of each star- or planet-shaped object relied on the compositions of each gaseous lump. If the gaseous lump had the same compositions as the Sun, the Sun was born. If the gaseous lump had the same compositions as the earth, the Jupiter, or the Mars, etc, the earth, the Jupiter or the Mars, etc. was born.

Due to a remarkable drop in temperature, the gain or loss of an electron in an atom started to be obviously decreased. The strength of electric and magnetic field also started to subsequently obviously drop. That indicated that the universe was born in an extremely high electric and magnetic fields environment. The electromagnetic fields of the universe where we live nowadays should be much weaker than at the beginning of the universe. When we go back to gaseous lump formation, high frequency of gain or loss of electrons in atoms which make up each

gaseous lump generated strong electric and magnetic fields. That also indicated that each gaseous lump has more opposite electric charges and stronger opposite magnetic poles. It is inferred that gaseous lumps of the earth and other planets in the solar system formed in different locations, which were not far away from the Sun gaseous lump. Due to the extremely strong role of electromagnetic fields of the Sun gaseous lump in the electromagnetic fields of gaseous lumps of 8 planets in the solar system, based on electromagnetic fields theory that opposite magnetic poles and charges attract and like magnetic poles and charges, gaseous lumps of the earth and other planets in the solar system moved towards the Sun gaseous lump. The movement of each of the 8 planet gaseous lumps with positive and negative electric charges each generated a new magnetic field, which is perpendicular to the magnetic field produced by the rotation of the Sun with positive and negative electric charges. The two mutually perpendicular magnetic fields from the Sun gaseous lump and each of 8 planet gaseous lumps interact by attracting and repelling one another, which led to these much lighter planets rotation and revolution around the Sun. The rotations and revolutions of these planets generated new mutually perpendicular magnetic fields respectively. With the change of intensities of the magnetic fields, these magnetic fields generated new electric fields, which subsequently resulted in new magnetic fields. The case is constantly repeated, indicating that the universe where we live is in essence an electromagnetic universe. Moreover, the electromagnetic fields between planets also attract and repel one another. That indicates that any of the 8 planets in the solar system is affected and constrained by multiple magnetic forces to keep their present locations. These multiple magnetic forces include the extremely strong magnetic field from the Sun, strong or weaker magnetic fields from other planets, asteroids and small and tiny objects on the basis of locations near or farther from one another, sizes, compositions, temperatures, etc,. And the magnetic fields of other galaxies also have more or less roles in any object in the solar system.

Above comparison analyses indicate that the very tiny atom and the very large solar system unexpectedly have strong resemblances or are the same in many important aspects: orbit shape, transfer between orbits, causes of rotation and revolution, ratios between the masses and sizes of the electron and nucleus and of the planet and Sun, and ratios between the masses and sizes of the atom and nucleus and of the solar system and the Sun, causes of change of magnitude of the magnetic field, generation and role of electromagnetic fields and constraints of multiple magnetic forces. It is magnetic forces which interact with the electron and nucleus in an atom and keep the atom in a relatively stable state. Similarly, it is also magnetic forces that interact with planets and the Sun in the solar system and keep the solar system in a relatively stable state. Same cases also happened to other stars and planets and all asteroids, smaller and tiny objects in the Galaxy and other parts of the universe. It is inferred that the universal gravitation of any object is in essence from the attractive force of the magnetic field of the object.

As far as electron motion is concerned, other research indicated that "motion orbits of electrons in phase space can become chaotic as the current increases, and the chaotic orbits are affected by the detuning." (Hao and Ding, 2004, p. 1136). The research displayed the phenomenon about electron motion they observed and recorded and did not conflict with above mentioned other studies "an electron spins and revolves around nucleus". As the foregoing discussions, an electron itself and electron magnetic fields and all those magnetic fields associated with the electron are always in motion, and an electron is extremely light and moves extremely fast. As such, an electron would very frequently change to another orbit or/and another direction due to absorption or release of even a little bit energy or/and even a little bit change of related magnetic forces. Therefore, it is not strange that electron motion looks chaotic. However, it does not hamper that an electron spins and revolves around nucleus if an electron was not impacted by even a little bit change of related magnetic forces.

Since each object consists of magnetic atoms, each object has magnetic fields with the property that opposite magnetic pole attracts and like magnetic pole repels each other. The property of objects with strong magnetic fields (e.g., a piece of magnetic iron or nickel) can be seen with people's eyes by putting two objects with strong magnetic fields together. The property of objects with weak magnetic fields (e.g., the human body, the animal body) can be detected only by intensive instruments (e.g., nuclear magnetic resonance). The property of objects with extremely weak magnetic fields possibly has not been able to be observed or measured using current technologies. Zhu et al. (2006) noted that magnetic iron grains had been found in bacteria, insects, mollusks, birds, fish and human beings. Snowball, Zillén and Sandgren (2002) noted that the bulk magnetic properties of organic rich lake-sediments in Northern Sweden and of sediments in other fresh water and marine environments were caused mainly by bacteria, indicating the dominant role of bacteria in magnetic sediments in the water. These magnetic sediments make up an important part of geomagnetic fields because the majority of the earth consists of lakes, rivers and seas and hence there are a large number of magnetic lake, river and sea sediments. Besides, living and dead bacteria are also common on land, especially on and in the ground of hospitals, parks, buildings, roads, bridges, restaurants, etc. Sjogren and Gibson (1981) noted that bacteria exist in an aquatic environment, even in a dilute, nutrient-deficient freshwater environment. Natural rainfalls in the majority of countries and snows in many countries and water used in daily life or work (e.g., cleaning floors, washing clothes, or/and cooking) provide favorable conditions for the existence and development of bacteria in more public or private places on land. Since there are living things on the earth, several billions of years have passed. There have been countless dead animals and other living things besides bacteria on the land and in the water. Thus, countless dead living things besides bacteria in water bottoms also contribute a lot to the magnetic property of the earth, especially earth crust. Shikazono (2012) noted that liquid magma in the crust, mantle and outer core is composed of liquid iron (Fe) and nickel (Ni) and other less than 10% elements including oxygen, hydrogen, sulfur, silicon and potassium by weight. He also noted that the outer core of the earth is in liquid phase

and the inner core is solid, consisting primarily of iron and nickel; about 37% MgO and about 45% SiO2 make up the primary part of the mantle mixed with other substance including FeO, CaO and Al2O3. Besides, he also showed that continental crust is composed of about 50% granite and about 50% basalt on average, consisting primarily of about 66% SiO2 mixed with Al2O3, K2O, Na2O, CaO, Fe2O3, MgO, TiO2, etc. Based on above mentioned compositions of the earth in Shikazono (2012), liquid iron and nickel with strong magnetic forces exists in the crust, mantle and core of the earth, or goes through the earth. Because they are liquid, the transfer of their magnetic poles is flexible. And solid iron and other metals also exist in the curst, mantle and core of the earth. Because they are mixed with other primary substance SiO2 in the crust and mantle, they take on small pieces or particles or other shapes in most cases. As such, they are also flexible in the transfer of magnetic poles. Similarly, magnetic fields which a large number of dead living things above mentioned including bacteria formed are also flexible in the transfer of magnetic poles because of their small or tiny sizes. The easy transfer of magnetic poles is closely collated with the main compositions of the earth and atomic magnetic properties. Actually 90% of the earth consists of iron, oxygen, silicon and magnesium by weight (Shikazono, 2012). Bakker et al.'s (2015) study also showed electric and magnetic fields of an isolated silicon nanodimer. Silicon is a high proportional atomic composition of the earth. In fact, each atom is a magnetic as above mentioned. The earth is a magnetic earth. The earth as a gigantic object has extremely strong magnetic fields in North and South magnetic poles as well-known. Each patch or inch of land making up the earth is in essence also magnetic, having a compound of numerous magnetic fields, which is composed of countless atomic magnetic fields. Thus, each patch or inch of land has north and south magnetic poles just as each small or tiny piece of magnetic iron also has north and south poles when one piece of magnetic iron is cut into two small or many tiny pieces of magnetic irons. Each animal, plant and human body also has their respective weak magnetic fields with the property that the opposite magnetic pole attracts and like magnetic pole repels each other. When each of whatever types of animals, plants, human bodies, or each of objects with different sizes, masses or shapes interact with a patch or foot or inch of land on the earth, the magnetic pole of that animal, plant, human body or object and the magnetic pole of that patch or foot or inch of land automatically adjusts to the state that opposite poles attract just as two pieces of magnetic irons can automatically adjust to mutually attractive state when they are put together. That indicates that any thing on the earth has north and south poles, which are always in a state that opposite pole attracts when interacting with its adjacent piece of land on the earth. As such, the universal gravitation of any object on the earth is just from the attractive force of the magnetic field of the object.

For more examples, when people were born, they actually automatically adjust to that state of mutual attraction with the earth. When they stand inversely, the magnetic poles of human bodies and the magnetic poles of the adjacent piece of land on the earth will automatically readjust to a state of mutual attraction. At this time people generally feel not completely same as when they stand normally. The swift transfer of magnetic poles of human bodies should be the cause.

Under the same temperature and pressure, the bigger the mass of any object of the same material is, the bigger its magnetic force including attractive and repulsive forces is; the farther from another object any object of the same material lies, the smaller its magnetic forces to attract and repulsive another object are. Dworzanowsk (2012) showed that magnetic force of particles is proportional to particle mass. Yung, Landecker and Villani (1998) and Pesteanu and Schwerdtfeger (2001) showed that magnetic force is inversely proportional to the distance between two objects. The above three studies should be under a specific temperature and pressure. For example, under the same temperature and pressure, one kilo of magnetic iron ball has smaller attractive and repulsive forces than 10 kilos of magnetic iron ball. That shows that the earth with a gigantic mass has much bigger magnetic force to attract too much or much smaller objects (plants, animals, human beings, buildings and sea, river and lake waters) than it to fall on it. If temperatures or pressures change, the magnitude of magnetic force of the same object will change. For example, one kilo of iron ball at 100 degree centigrade has bigger magnetic forces than one kilo of iron ball at 10 degree centigrade. Zhou, He and Nan's (2007, p. 7459) study indicated that "the saturation magnetization of the $CoFe_2O_4$ films increases with the deposition temperature until 600 ºC and then decreases" and "the in-plane and out-of-plane coercivities increase with the substrate temperature". If two balls have the same mass and one is electrified and the other is not electrified, obviously, the electrified ball has bigger attractive force than the other, which conflict the theory of the universal force that objects of the same mass have the same gravitational force. Besides, when the same planet or star has more water in it, more electrolyte chemical compounds which dissolve in water will become conductive. Electrolytes produce ions and thus conduct electricity in the water (Kawai et al., 1997), which leads to stronger magnetic fields. On the contrary, if it loses more water, less electrolyte chemical compounds can dissolve in the water and less of them will become conductive, which results in weaker magnetic fields and magnetic force. Because of loss of water, the mass of the planet or star will be decreased and its gravitation will drop, which is consistent with the reduction of attractive force of magnetic fields of the planet or star. Furthermore, when a planet or star is in enough high temperatures, more electrolyte chemical compounds will be molted and become conductive. For example, some molten salts have high ionic conductivities at the room temperature 30 ºC as shown in Noda and Watanabe's (1999) study, which indicates some electrolytes become more conductive at a higher temperature rather than below 30 ºC (e.g., 5 ºC, -10 ºC). The higher temperature subsequently leads to stronger magnetic fields and bigger magnetic forces and attractive force. In the opposite case, the planet or star will have weaker magnetic field and smaller attractive force. That also indicates that if two electrolyte chemical compounds have the same mass with one in enough high temperature and the other in enough low temperature, attractive forces of their magnetic fields are bound to be different though they have the same universal force according to the definition of the universal force. The above discussion further suggests that the universal gravitation is from the attractive force of the magnetic field because only magnetic force can accurately solve all related problems including those which cannot be solved by the universal gravitation.

The universe is mainly composed of planets, stars, asteroids, small and tiny objects and other substances, which consist of magnetic atoms. Each of them has magnetic fields with different magnitudes. The universe is actually one with magnetic fields. The universe without full of magnetic fields does not seems to exist. Since the theory of the universal gravitation was born, more than 300 years have passed. With the progress of scientific research, many fields have improved a lot and had new discoveries since then. It is necessary, challenging, but significant to make new scientific research on past subjects including theories according to related new discoveries. Physics field is no exception.

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## References:

- Agarwal, N. S. (2015). Experimental Proof of Mass in Photo. Journal of Modern Physics, 6, 627-633
- Bakker, Reuben M., Dmitry Permyakov, Ye Feng Yu, Dmitry Markovich, Ramón Paniagua-Domínguez, Leonard Gonzaga, Anton Samusev, Yuri Kivshar, Boris Luk'yanchuk, Arseniy I. Kuznetsov (2015). Magnetic and Electric Hotspots with Silicon Nanodimers, Nano Letters , 15, 3, 2137–2142.
- Blank, B., Giovinazzo, J. and Pfützner, M. (2003). First Observation of Two-Proton Radioactivity from an Atomic Nucleus. C. R. Physique, 4, 521-527.
- Blehl, M. F. (2006). Electric and Magnetic Power Paperback. USA: Pearson Scott Foresman.
- Califano, S. (2012). Pathways to Modern Chemical Physics. Berlin: Springer-Verlag Berlin Heidelberg.
- Cang, Rongquin, Guo, Jianpo, Hu. Juanxiu and He, Chaoquiong (2016). The Angular Momentum of the Solar System. Astronomy and Astrophysics (Hans Publishers), vol. 4, no. 2, p. 33-40.
- Caruso, F. and Oguri, V. (2008). Bohr's Atomic Model Revisited. Physics.hist-ph. arXiv: 0806.0652v1
- Dorfmann, L. and Ogden, R. W. (2014). Nonlinear Theory of Electroelastic and Magnetoelastic Interactions. Springer Science + Business Media New York.
- Dworzanowsk, M. (2012). Maximizing the recovery of fine iron ore using magnetic separation. The Journal of the South Africa Institute of Mining and Metallury, Vol. 112, 197-202.
- Eckhardt, B. and Sacha, K. (2001). Wannier Threshold Law for Two Electron Escape in the Presence of an External Electric Field. Europhysics Letters, 56, 5, 651. DOI: 10.1209/epl/i2001-00570-7
- Grillo, Vincenzo, Amir H. Tavabi, Federico Venturi, Hugo Larocque, Roberto Balboni, Gian Carlo Gazzadi, Stefano Frabboni, Peng-Han Lu, Erfan Mafakheri, Fred´ eric Bouchard, Rafal E. Dunin-Borkowski, Robert W. Boyd, Martin P. J. Lavery, Miles J. Padgett,8 and Ebrahim Karimi (2016). Measuring an electron beam's orbital angular momentum spectrum. Quant-ph. arXiv: 1609.09129v1
- Hajalilou, A., Amri Mazlan, S., Lawafi, H. and Shameli, K. (2016). Field Responsive Fluids as Smart Materials. Springer Nature Singapore Pte Ltd.

- Hansen, K. L. (1925). The Rotating Magnetic Field Theory of A-C. Motors. Transactions A. I. E. E., 340-348.
- Hao, J. H. and Ding, W. (2004) Chaotic Electron Motion in a Travelling-wave Tube Amplifier. Acta Phys Sin. 53(4), 1136-1144. Doi: 10.7498/aps.53.1136
- Hawking, S. W. (1974). Black hole explosions? Nature Volume 248, pages 30-31.
- Hodge, W. B., Migirditch, S. V. and Kerr, W. C. (2014). Electron spin and probability current density in quantum mechanics. Am. J. Phys., Vol. 82, No. 7, 681-690.
- Jerabek, P., Schuetrumpf, B., Schwerdtfeger, P. and Nazarewicz, W. (2018). Electron and Nucleon Localization Functions of Oganesson: Approaching the Thomas-Fermi Limit. Physics Review Letters, 120, 053001.
- Kawai, T., Lee, Y. M., Nakajima, K. and Ehara, K. (1997). Hydration of Ions in Aqueous Electrolyte Solutions Studied by Differential Thermal Analysis at Low Temperatures. Journal of Electroanalytical Chemistry, 422. 133-138.
- Lieberoth, A., Pedersen, M. K., Marin, A. C., Planke, T. And Sherson, J. F. (2014). Getting Humans to do Quantum Optimization - User Acquisition, Engagement and Early Results from the Citizen Cyberscience Game Quantum Moves. Human Computation Vol. 1, No. 2, 219-244.
- Mallarna, A., Krobusek, B. A., Collins, D. F., Nelson, P. and Park, J. (2000). The Radius of Jupiter and its Polar Haze. Icarus, 144, 99-103.
- NASA (2005). Measuring the Moon's Distance: Apollo Laser Ranging Experiments Yield Results from LPI Bulletin, No. 72, August, 1994. NASA.
- https://eclipse.gsfc.nasa.gov/SEhelp/ApolloLaser.html
- Noda, A. and Watanabe, M. (1999). Highly Conductive Polymer Electrolytes Prepared by in Situ Polymerization of Vinyl Monomers in Room Temperature Molten Salts. Electrochimica Acta, 45, 1265-1270.
- Patra1, S., Karr, J.-P., Hilico, L., Germann, M., Korobov, V. I. and Koelemeij, J. C. J. (2018). Proton-electron mass ratio from HD+ revisited. Journal of Physics B: Atomic, Molecular and Optical Physics, Vol. 51, No. 2.
- Pesteanu, O. and Schwerdtfeger, K. (2001). Electromagnetic Stirring with Adjustable Force Density. ISIJ International, Vol. 41, No. 1, 98-99.
- Pohl, Randolf , Aldo Antognini, François Nez, Fernando D. Amaro, François Biraben, João M. R. Cardoso, Daniel S. Covita, Andreas Dax, Satish Dhawan, Luis M. P. Fernandes, Adolf Giesen, Thomas Graf, Theodor W. Hänsch, Paul Indelicato, Lucile Julien, Cheng-Yang Kao, Paul Knowles, Eric-Olivier Le Bigot, Yi-Wei Liu, José A. M. Lopes, Livia Ludhova, Cristina M. B. Monteiro, Françoise Mulhauser, Tobias Nebel, Paul Rabinowitz, Joaquim M. F. dos Santos, Lukas A. Schaller, Karsten Schuhmann, Catherine Schwob, David Taqqu, João F. C. A. Veloso & Franz Kottmann (2010). The Size of the Proton. Nature, 466, 213-216.
- Shikazono, N. (2012). Introduction to Earth and Planetary System Science. Springer.
- Sjogren, R. E. and Gibson, M. J. (1981). Bacteria Survival in a Dilute Enviroment. Applied and Environmental Microbiology, 1331-1336.

- Snowball, I., Zillén, L. and Sandgren, P. (2002). Bacteria Magnetite in Swedish Varved Lake-Sediments: A Potential Bio-Maker of Environmental Change. Quaternary International, 88, 13-19.
- Sondkar, P. and Kahraman, A. (2013). A Dynamic Model of A Double-Helical Planetary Gear Set. Mechanism and Machine Theory, 70, 157-174.
- Trotter, A. P. (1938). The Apparent Size of the Sun. Nature, 141, page123.
- Wang, X. S. (2008). Derivation of the Newton's Law of Gravitation Based on a Fluid Mechanical Singularity Model of Particles. Progress in Physics, Vol. 4, 25-30.
- Watt, A. (1972). Angular Momentum Projection from Nonaxial Intrinsic States. J. Phys A: Gen. Phys. Vol. 5, 584-595.
- Xing, Y. T., Barb, I., Gerritsma, R., Spreeuw, R. J. C., Luigjes, H., Xiao, Q. F., Rétif, C. and Goedkoop, J. B. (2007). Fabrication of Magnetic Atom Chips Based on FePt. Journal of Magnetism and Magnetic Materials, 313, 192-197.
- Yin, Mei (2020) How Do the Black Hole and the Universe Form? International Journal of Psychosocial Rehabilitation, Vol. 24, No. 7, 243-247, ISSN: 1475-7192 Accepted for publication by International Conference on Physics (ICOP-20), 14th January, 2020, Shanghai, China.
- Yung, K. W., Landecker, P. B. and Villani, D. D. (1998). An Analytic Solution for the Force between Two Magnetic Dipoles. Magnetic and Electric Separation, Vol. 9, 39-52.
- Zhang, M. L. and Zhao, Z. X. (1995). Correlation of Two Anti-parallel Spin Electrons in the Same Orbital State. Physics Letters, 207, 362-366.
- Zhou, J. P., He, H. C. and Nan, C. W. (2007). Effects of Substrate Temperature and Oxygen Pressure on the Magnetic Properties and Structure $CoFe_2O_4$ Thin Films Prepared by Pulsed-Laser Deposition. Applied Surface Science, 253, 7456-7460.
- Zhu, R. X., Pan, Y. X. and Deng, C. L. (2006). Geomagnetism and Biomagnetism, Science and Biology Review, Vol. 24, No. 8, 5-7.


**Keywords:** Universal Gravitation; Magnetic Force; Electron, Proton, Nucleus and Atom; Planet, Sun and the Solar System; Electromagnetic Fields; Compositions of the Earth

## Biography:

Ms. Mei Yin like studying new things. I once received education in multiple field such as Business Information Systems, European Business and Linguistics. Particularly love theoretically-based research also in multiple fields including the universal gravitation, black holes and cosmic formation, origins of life, medicine and linguistics.

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# Lean and BIM Synergy in the Design Phase: Auto-Generation and Evaluation of Thermal Alternatives

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## Abstract:

The integration of Lean principles and Building Information Modeling (BIM) techniques in the design phase of construction projects has proven to be a promising combination for enhancing decision-making process efficiency. This approach, offers significant opportunities for improving construction project management, especially in the design phase. In this article, we will thoroughly examine this convergence of methodologies and present a decision support tool aimed at assisting construction stakeholders in improving their design processes.

In the context of our research, we began by conducting in-depth literature reviews. These reviews allowed us to observe that Lean techniques, such as Set-Based Design (SBD), Choosing by Advantages (CBA), and the concept of the Big Room, have the potential to bring significant improvements to the design phase when implemented with BIM. Our research then focused on the thermal aspect of buildings, which plays a crucial role in the current environmental context. Despite the critical importance of energy efficiency in building design, we found, based on our comprehensive literature review, a lack of studies applying these Lean principles in conjunction with BIM during the thermal design phase. It is in this context that we developed a decision support tool aimed at optimizing this phase from its inception. Our approach differs from traditional thermal simulation, which focuses on heating and cooling solutions once the project has been designed by the architect. Our goal is to assist thermic engineers in this crucial project stage in generating all possible variants, carefully evaluating them, and selecting the optimal solution before proceeding with the actual thermal simulation. This approach is essential because once the envelope is finalized, thermal simulation can be time-consuming, and costly errors may occur, complicating any subsequent corrections.

Our decision support tool was developed following various surveys we conducted among professionals and scientists. The results of these surveys allowed us to design and validate a new synergy between Lean and BIM, enabling the automated optimization of data flow management, reducing unnecessary costs, minimizing data management risks, and increasing the project's added value. This approach facilitates a systematic and comprehensive evalua-

tion of each alternative, taking into account various factors such as energy efficiency, profitability, sustainability, and compliance with design criteria. By systematically comparing these alternatives, thermal engineers can identify the most advantageous solutions, in line with Lean principles aimed at maximizing value and reducing waste. Furthermore, the integration of programming into this process offers substantial benefits. Programming not only accelerates the generation of alternatives but also ensures consistency and precision throughout the design process. It enables design teams to quickly explore various parameters and configurations, thereby promoting the emergence of innovative and optimized solutions.

**Keywords:** Lean Construction; Set-based Design; Choosing by Advantages; Automation

## Biography:

Mr. Karim EL Mounla earned his bachelor's degree in Civil Engineering from Beirut Arab University, Lebanon, in 2019. Subsequently, he completed his master's degree in Innovative Construction and Rehabilitation Techniques at the University of La Rochelle, France, in 2020. While at the University of La Rochelle in 2021, he also worked as a research engineer, focusing on assessing indoor air quality. Currently, he is pursuing a Ph.D. at the Research Laboratory CESI LINEACT, located in Brest, France. His doctoral research focuses on enhancing the design phase of construction projects through the integration of Lean and Building Information Modeling (BIM) methodologies, with the aim of improving project efficiency and outcomes.

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# Accelerometers Complete Feynman's Gravity Lecture

**David Levitt**
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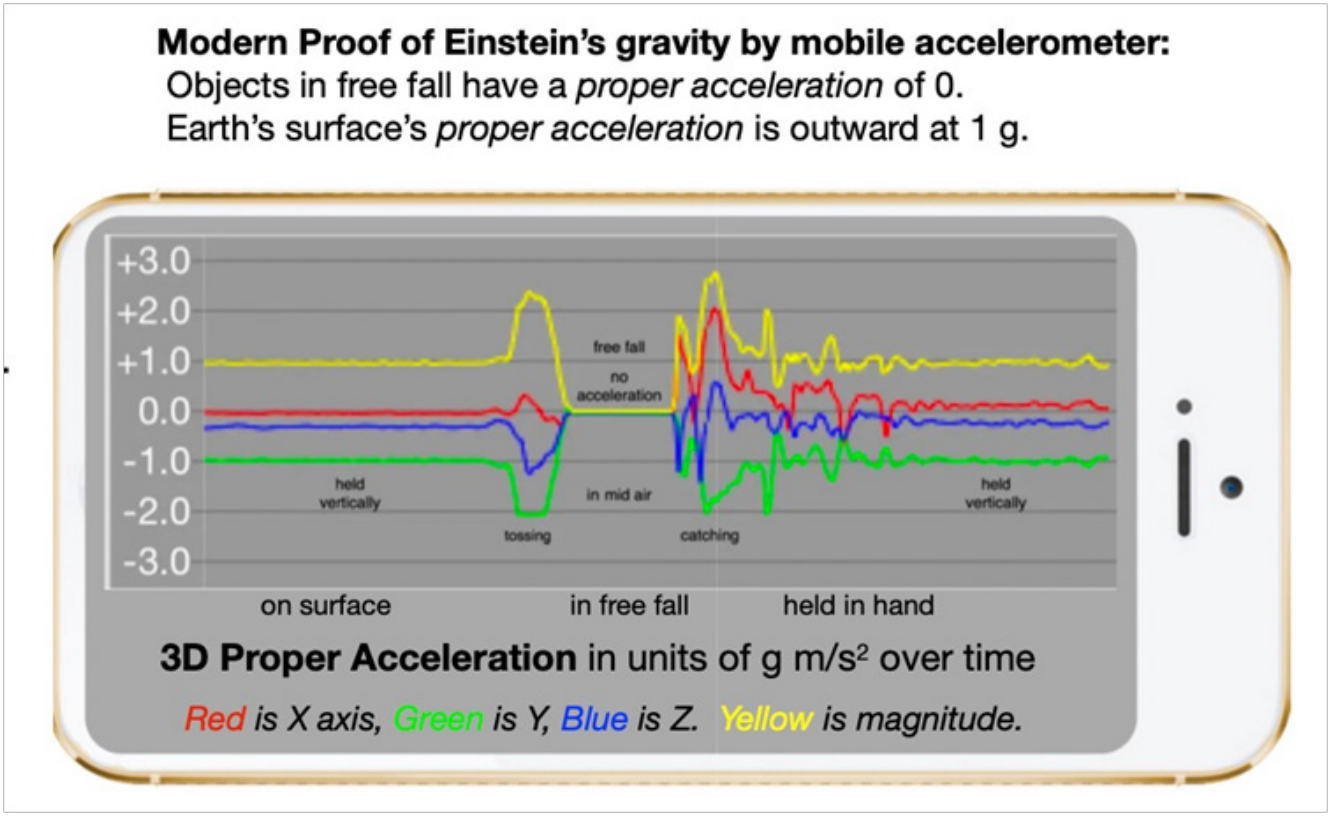
## Abstract:

We present a new, simpler way to describe and prove Einstein's gravity theory, using modern mobile accelerometers. These days we can easily do key experiments that prove Einstein was correct whereas Newton had some things backwards — using a smartphone.

Professor and Nobel laureate Richard Feynman touched on these issues in his lectures and writing, but his discussion was abbreviated and incomplete. Here we briefly recap his comments on the "possibility" that gravity is a fictitious (or pseudo) force — that the real "proper force" behind a massive object's gravity is its surface accelerating outward at a rate proportional to its mass.



We can easily confirm this today, using the now-ubiquitous mobile accelerometers — in smartphones that didn't exist in Feynman's or Einstein's day. The clear proper acceleration data compels us to ask: How can earth's surface constantly accelerate outward everywhere at

1 g, without the planet's radius in meters getting any bigger? The answer captures the geometric and physical meaning behind Einstein's spacetime curvature field equation. Thus we clarify the simple non-Euclidean geometry responsible for everyday gravity — specifically, just how meters and seconds themselves grow in length in the vicinity of matter.

This in turn provides a simple geometric model how the accelerated stretching of volumes of space — emerging from matter M at a volume acceleration of 4πGM m^3/s^2 — result directly in classical phenomena like Newton's inverse square law and Kepler's law of orbits
— providing a comfortable new bridge between classical and relativistic curvature ideas.

Amid clear and repeatable evidence from accelerometers, this approach lets us fill in the details surrounding Feynman's comments, so the "possibilities" he discussed can be persuasively understood as experimentally proven facts. Mobile accelerometer experiments thus provide a deeper understanding, a startling new intuitive description, and proof of Einstein's theory of gravity and spacetime curvature.

**Keywords:** Gravity; General Relativity; Spacetime Curvature; Accelerometer.

## References:


- Schilpp, Paul Arthur, Editor. Albert Einstein, Philosopher-Scientist: The Library of Living Philosophers Volume VII.
- Open Court, 1998.
- Einstein, Albert. Relativity — The Special & the General Theory.
- Crown Publishers, 1961.
- Feynman, Richard P. and Leighton, Ralph. Surely You're Joking Mr. Feynman
- W. W. Norton & Company, 2010.
- Feynman, Richard P. Six Not-So-Easy Pieces: Einstein's Relativity, Symmetry and Space- Time.
- Basic Books, 1996.
- Thorne, Kip S. Black Holes & Time Warps: Einstein's Outrageous Legacy.
- W. W. Norton & Company, 1994.
- Cohen, I. Bernard and Westfall, Richard S., Editors. Newton.
- W. W. Norton & Company, 1995.

## Biography:

Dr. David Levitt is a physicist, AI researcher, software engineer, virtual and augmented reality innovator, entrepreneur, musician and writer.He is co-founder, president and CEO of Pantomime Corporation, and a Research Fellow at Stochastic Labs. He earned his B.S. in Engineering and Applied Science at Yale, and his masters in Electrical Engineering and Computer Science and doctorate in Artificial Intelligence at MIT. At MIT, on a Bell Labs fellowship with Prof Marvin Minsky, Levitt pioneered the field of algorithmic music generation for traditional classical and jazz styles. Dr. Levitt was on the founding team of the MIT Media Lab, where he led MIT's first Mac lab, focused on real-time media, graphical programming kits and music. When he joined the team that invented virtual reality at VPL Research, Levitt created the first VR worlds with physics including gravity, object collisions and 3D sound. Dr. Levitt, who has worked in physics since his time at Bell Labs, is passionate about physics education and misconceptions about relativity. In the fall of 2023 he presented Accelerometer Experiments Clarify Einstein's Gravity Theory at the ACP 2023 Conference on Fundamental and Applied Physics. His approach provides easy ways to use smart phones to show gravity is a fictitious force arising from spacetime curvature, simplifying explanations of general relativity. In 2023 Dr. Levitt joined Stochastic Labs in Berkeley as a Research Fellow, renewing his focus on algorithmic music and physics. Levitt plays and improvises music on keyboards and vocals. He lives with his family in Sebastopol, California.

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# From Ruins to Reconstruction: Harnessing Text-to-Image AI for Restoring Historical Architectures

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## Abstract:

The preservation of cultural heritage has gained increasing importance in the face of conflicts and natural disasters threatening historical sites worldwide. This research explores the application of artificial intelligence (AI), specifically text-to-image generation technologies, in reconstructing heritage sites damaged by these adversities. Utilizing detailed textual descriptions and historical records, the study employs AI to generate visual representations of ruined heritage sites, aiming to bridge the gap between historical documentation and contemporary digital reconstruction techniques. The methodology integrates data collection, iterative AI-generated image production, expert review, and comparative analysis against historical data to evaluate the reconstructions' accuracy and authenticity. Preliminary findings suggest that AI-generated imagery holds significant promise for enhancing digital heritage preservation, offering novel approaches for visualizing and understanding historical sites. This study contributes to digital humanities and archaeological conservation, demonstrating AI's potential in supporting and complementing traditional heritage preservation methods.

**Keywords:** Text-to-Image Synthesis; Architectural Heritage; AI-Assisted Reconstruction; Prompt Engineering; Digital Archaeology; Cultural Heritage Preservation

### Introduction:

The architectural design process is crucial across various disciplines, from engineering and software development to the arts and humanities, significantly shaped by the fusion of traditional methods and contemporary technological advancements. Recent innovations in AI, particularly text-to-image systems such as Midjourney, DALL-E, and Stable Diffusion, mark a substantial evolution in the design and heritage conservation arenas, signifying a paradigm shift towards more dynamic, intuitive, and efficient conceptualization practices [1], [2]. This evolution reflects a broader movement to integrate cutting-edge AI tools within the architectural design process, underscoring a transition from conventional methods to more advanced, future-oriented approaches. The advent of 3D and 2D modelling tools, including Building Information Modelling (BIM) software like ArchiCAD, AutoCAD, and SketchUp, has revolutionized architects' ability to visualize conceptual designs, while the application of AI techniques—ranging from conditional Generative Adversarial Networks (cGANs) to deep learning and machine learning algorithms—has initiated a new era in the digital preservation and reconstruction of historical landscapes and artifacts [3]. These technological advancements are reshaping methodologies in archaeological research and conservation efforts, particularly as the architectural and cultural heritage sectors confront the profound losses inflicted by conflicts and wars. Considering such destruction, AI emerges as a pivotal tool, not only in attempting to preserve and reconstruct cultural heritage but

also in facilitating a deeper understanding of historical contexts [4], [5]. This research aims to delve into the efficacy and broader implications of leveraging AI-generated imagery for the digital reconstruction of heritage sites significantly damaged by conflicts. By interweaving historical narratives with AI capabilities, the study seeks to uncover new methodologies in cultural heritage preservation, contributing to the academic discourse within digital humanities [6], [7]. This exploration is not merely a testament to technological innovation but also a commitment to bridging past and present, ensuring the enduring legacy of our collective cultural memory.

## Methodology

In the exploration of digital reconstruction methodologies for heritage sites decimated by conflict, this study adopts a comprehensive, multi-faceted approach grounded in the latest advancements in artificial intelligence (AI) technology. The core objective centers on harnessing the potential of AI, particularly text-to-image generation models such as Midjourney and DALL-E, to reimagine and digitally resurrect heritage sites from textual descriptions informed by historical, architectural, and archaeological evidence. This methodology intersects technological innovation with historical scholarship, aiming to reconcile the physical remnants of the past with digital reconstructions, thereby offering new avenues for understanding and preserving our cultural heritage. Architects can utilize natural language inputs to convey their design intentions more naturally, which promotes quicker revisions and reduces the obstacles usually associated with traditional design tools [8], [9]. The process involves a synergistic blend of data collection, AI image generation, expert validation, and comparative historical analysis, outlined as follows:


**Figure 1. Overview of the five-step research methodology**

1. **Data Collection and Preparation:** The initial phase involves meticulous collection and analysis of textual descriptions, architectural details, historical accounts, and existing visual records of selected heritage sites [10]. This comprehensive dataset forms the foundation for generating descriptive prompts tailored for AI applications, ensuring a rich historical context is provided to guide the image generation process. In this phase, we enhanced our dataset with official photographs from the UNESCO site, which provide authentic references for the heritage sites studied. These images are instrumental in validating the accuracy of our AI-Generated reconstructions and ensure our work aligns with established architectural and cultural standards.

2. **AI Image Generation Process**: Employing AI platforms such as Midjourney and DALL-E, this study implements a systematic approach to convert textual prompts into visual reconstructions [11], [12]. The textual prompts, derived from the compiled data, aim to accurately reflect the architectural and cultural essence of the targeted heritage sites. Multiple iterations and a variety of prompts are utilized to address the multifaceted nature of each site, facilitating a broad spectrum of visual outputs [4]. Despite our exhaustive research efforts aimed at uncovering photographic records to inform and validate our reconstructions, for certain heritage sites, such definitive visual records remained elusive. This lack of photographic evidence presents a significant challenge in our pursuit of accurately reconstructing the prime versions of these heritage sites. In light of these constraints, we adapted our methodology to rely more heavily on prompt engineering, employing detailed textual descriptions derived from available historical documentation and expert insights. However, it is important to acknowledge that the AI-generated images produced under these conditions serve as initial approximations rather than exact replicas of the original structures.

The iterative nature of this reconstruction process is highlighted as we engage in continuous refinement of the AI-generated outputs. This involves a collaborative effort with historians, archaeologists, and cultural experts who provide critical feedback and additional details, enabling us to enhance the prompts and, by extension, the accuracy of the generated images. Therefore, within the confines of our methodology, we delineate the strategies employed to tackle the challenges presented by the absence of photographic records. This encompasses the reliance on expert collaboration and iterative prompt refinement to inch closer to a more accurate representation of historical realities, underpinning our commitment to authenticity in digital heritage preservation.

3. **Image Selection and Iterative Refinement:** In this phase our methodology emphasized a systematic approach to evaluating AI-generated images against historical and archaeological benchmarks. This iterative refinement process is crucial, as it involves re- adjusting textual prompts and regenerating images to enhance representational accuracy and architectural fidelity. Prompt engineering emerges as a pivotal strategy in this context, enhancing the AI's capability to produce images that accurately reflect complex architectural designs and cultural nuances [13]. According to [14], the strategic crafting of textual prompts significantly influences the AI's performance, ensuring that the generated images align closely with the architectural intent and historical context. This phase adheres to established digital heritage reconstruction practices, where the synthesis of textual prompts and AI capabilities fosters a collaborative environment for generating historically authentic and culturally resonant visual representations.

4. **Comparative Analysis and Validation:** The research incorporates a rigorous comparative analysis between the AI-generated images and available historical records, photographs, and scholarly interpretations. This validation phase assesses the AI's capacity to accurately encapsulate the architectural styles, cultural significance, and ambient settings of the ruins [15].

5. **Scholarly Discussion and Practical Implications:** The final phase of this research will engage in a scholarly discussion on the implications of utilizing AI for heritage reconstruction, focusing on future perspectives. This analysis will delve into ethical considerations, ensuring historical accuracy while balancing technological advancement, and examining the interplay between digital innovation and traditional restoration practices. Key themes will include the role of AI-generated imagery in enhancing educational and commemorative initiatives and its contribution to broader heritage conservation efforts. This forthcoming discourse aims to navigate the complexities of AI application in cultural preservation, addressing both the potential benefits and challenges. It will propose a framework for integrating AI responsibly into heritage preservation, considering the insights from diverse fields such as archaeology, ethics, and digital technology. The goal is to outline a path forward those respects historical integrity while embracing the opportunities AI offers for the future of heritage conservation. Furthermore, the study evaluates how these reconstructions could serve educational, commemorative, and advocacy purposes within the broader framework of heritage preservation [6], [7].

This detailed methodology articulates an academically rigorous approach, integrating AI technologies within heritage conservation practices. By systematically employing AI- generated imagery based on historical and textual data, the research seeks to contribute to the emerging discourse on digital approaches to cultural heritage preservation and reconstruction. Prompt engineering is a critical factor in improving the generation of realistic images in text-to-image synthesis. This process involves carefully selecting and composing textual prompts to guide AI models in producing images that match the intended visual style or content described in the text, a notion supported by [13]. Through strategic prompt engineering, the objective is to ensure that the generated images accurately reflect the input prompts, resulting in visually coherent and contextually relevant outputs. The effectiveness of prompt engineering is rooted in its capacity to optimize the interaction between textual descriptions and image generation models. Methodically designing prompts allows researchers and practitioners to influence generative AI systems to produce images with desired characteristics such as realism, diversity, and adherence to specific visual styles, as noted by [14], [16]. Prompt engineering enhances the interpretability and controllability of text-to-image synthesis systems. By refining prompts used to condition image generation, researchers can adjust output images to meet specific criteria or constraints like photorealism, colour accuracy, or object composition, which is an aspect highlighted by [17]. This approach empowers users to shape the creative process of AI- generated image synthesis, allowing them to steer the output towards their desired visual outcomes, as [18] explained.

The strategic design and optimization of prompts significantly influence the capabilities and performance of text-to-image generation systems. By employing prompt engineering techniques, researchers can enhance the realism, fidelity, and relevance of generated images, thereby expanding the potential applications in design, art, and visual content creation. This methodology articulates an academically rigorous approach integrating AI technologies within heritage conservation practices.

**Results and Discussion**

This study examines the integration of three-dimensional modelling techniques and artificial intelligence (AI) in the reconstruction efforts of various heritage sites. Table 1. provides a concise yet comprehensive overview of the characteristics and current conditions of various historical heritage sites, such as Palmyra, the Buddhas of Bamiyan, and Pompeii. It highlights their significance and the extent of damage over time. This foundational comparison underscores the urgent need for innovative reconstruction efforts, showcasing the potential impact of AI in preserving and reviving our global cultural heritage. Table 2. highlights the employment of technologies such as photogrammetry, 3D GIS, and diverse 3D modelling tools in documenting and revitalizing landmarks such as Palmyra and the Buddhas of Bamiyan. The analysis indicates a progressive shift towards digital methodologies in heritage preservation, acknowledging the ongoing nature of these reconstructions due to challenges in data fidelity and interpretation of fragmented relics.

The introduction of AI into this domain is identified as a significant development, offering new possibilities to expedite the restoration process through predictive modelling and conceptual design ideation. This fusion of historical data with predictive AI capabilities promises to refine and accelerate the restoration workflow, facilitating a more efficient path to conserving cultural heritage (Rahim et al., 2021). Traditional architectural design, grounded in the rich tapestry of cultural and historical significance, emphasizes sustainability and artistic excellence cultivated over centuries (Liu et al., 2019). Such methods are pivotal in the context of modern architectural innovation, providing a sustainable framework for incorporating heritage values into contemporary design (Hosseini et al., 2016; Mohammed & Haruna, 2021). Conversely, AI-based architectural design represents a departure from conventional methods, leveraging the power of AI to foster a more adaptable and superior architectural planning process (Li et al., 2023). Despite its transformative potential, this approach prompts critical ethical debates, particularly concerning its influence on human creativity and the preservation of traditional design ethics (Hegazy & Saleh, 2023). Furthermore, the role of AI in architectural education is emerging as a field of study, offering insights into how contemporary pedagogical theories can integrate with cutting-edge technological advancements (Sadek, 2023).

The AI-generated images, derived from meticulous textual descriptions, offer new perspectives on the original appearance of damaged or destroyed heritage sites. For example, the images associated with Palmyra (Figures 2 & 3) illustrate the potential of AI to bridge the gap between past and present, offering a tangible glimpse into ancient

grandeur while maintaining historical accuracy. The prompts used were aimed at capturing the essence of Palmyra's ancient glory, focusing on significant elements such as the Temple of Bel. Similarly, the images related to Maya Sites (Figures 4, 5 & 6) highlight AI's role in understanding the architectural layout and individual features of ancient cities. The prompts for these images were designed to showcase the architectural and astronomical precision of sites like Chichen Itza, thereby enhancing our knowledge and appreciation of Mayan civilization. Furthermore, the Pompeii reconstruction images (Figures 7 & 8) show how AI can assist in the meticulous restoration of specific historical sections. The focus on hyper-realistic reconstructions of specific Roman buildings emphasizes the restoration of architectural elements, contributing significantly to the overall preservation and understanding of the site.

In conclusion, the AI-generated images, stemming from detailed prompts and historical analyses, provide innovative views on the original states of damaged heritage sites. The integration of AI methodologies marks a new era in architectural conceptualization and heritage conservation. Future research should focus on refining AI algorithms and expanding methodological frameworks to enhance the precision and applicability of AI in these fields. This study advocates for the development of ethical standards and interdisciplinary frameworks, guiding the responsible application of AI in architectural endeavours and heritage conservation. The results suggest an evolving paradigm where traditional architectural principles are blended with AI's technological advancements, ensuring a balanced preservation of cultural legacies alongside the advancement of architectural practices.

**Table 1. Overview of Historical Heritage Sites: Characteristics and Conditions**

| Site | Country | Period Founded | Significant Historical Period | Main Features | Destruction Year | Area | Causes of Damage | Current Condition | Damaged Parts | Key References |
|---|---|---|---|---|---|---|---|---|---|---|
| Palmyra | Syria | 3rd millennium BC | Roman Empire, Islamic Caliphate | Temple of Bel, Great Colonnade | 2015 | Varies | Extremist group activities | Partially ruined | Temple of Bel, other structures | UNESCO, Britannica, [19], [20] |
| Buddhas of Bamiyan | Afghanistan | 6th century AD | Gandhara period | Two monumental statues | 2001 | 105 hectares | Extremist group activities | Destroyed, niches remain | Two monumental statues | UNESCO, [21], [22], [23] |
| Ancient City of Nimrud | Iraq | 13th century BC | Assyrian Empire | Palaces, temples, colossal statues | 2015 | Over 360 hectares | Extremist group activities | Ruined | Palaces, temples, statues | UNESCO, [24], [25] |

| Site | Country | Period Founded | Significant Historical Period | Main Features | Destruction Year | Area | Causes of Damage | Current Condition | Damaged Parts | Key References |
|---|---|---|---|---|---|---|---|---|---|---|
| Pompeii | Italy | 6th-7th century BC | Roman Empire | Urban infrastructure, frescoes | 79 AD | 66 hectares | Natural disaster (Volcanic Eruption) | Ruins preserved | Entire city | UNESCO, Britannica, [26], [27], [28], [29] |
| Hampi | India | 14th century AD | Vijayanagara Empire | Temples, royal complexes | 1565 | 4187, 24 hectares | Historical Conflict | Ruins | Temples, marketplaces | UNESCO, [30], [31], [32], [33], [34 |
| Parthenon (Acropolis of Athens) | Greece | 447-432 BC | Classical Greece | Doric temple dedicated to Athena | 1687 | 69.5 by 30.9 m (228 by 101 ft) | Military Bombardment | Partially ruined | Structure, sculptures | UNESCO, Britannica, [35], [36], [37] |
| Temples of Thebes | Greece | 1500 - 30 BC | New Kingdom of Egypt | Karnak and Luxor temples | Various periods | 7,390 ha with a buffer zone of 444 ha | Natural and Human Impact | Partially ruined | Karnak, Luxor temples | UNESCO, Britannica, [38], [39], [40] |
| The Great Wall | China | 7th century BC and onwards | Various Chinese dynasties | Fortification system | Ongoing | 21,196 km (total length) | Erosion and Human Impact | Partially ruined | Sections over time | UNESCO, Britannica, [41], [42],[43 |
| Maya Sites | Mexico | 2000 BC to 16th century AD | Pre-Columbian Maya civilization | Temples, pyramids | Post 9th century AD | 331,397 ha,surrounded by a buffer zone of 391,788 ha | Socio-political Decline | Ruins | Several city structures | UNESCO, Britannica, [44], [45] |
| Angkor Wat | Cambodia | Early 12th century | Khmer Empire | Temple complex | Not specified | Over 162 hectares | Neglect and Decay | Partially restored | Temples, infrastructure | UNESCO, Britannica, [46], [47], [48], [49] |

**Table 2. Technological Approaches in Heritage Site Reconstruction**

| Site | Author and Year | Photogrammetry | 3D GIS | CityGML | Parametric | 3D Reconstructio | EMF | 3DMM | 2D-ERT | TOF Cameras | Point Cloud | Deep Learning | MayaArch3D | Reality-based 3D | Information System | 3D WebGIS | Crowdsourcing | Panoramic | Remote Sensing | 3D lase- scanning/recor | Historical Photograp | VR Technologies |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Palmyra | [50], [51], [52], [53] | ☐ | | | | ☐ | | | | | | | | | | | | ☐ | | | | |
| Buddhas of Bamiyan | [54], [55], [56], [57] | ☐ | | | | ☐ | | | | | | | | | | | | | | ☐ | ☐ | ☐ |
| Ancient City of Nimrud | [10], [58], [59] | ☐ | ☐ | ☐ | | | | | | | | | | | | | | | | | | |
| Pompeii | [60], [61] | | | | ☐ | | | | | | | | | | ☐ | | | | | | | |
| Hampi | [62], [63] | ☐ | | | | ☐ | | | | | | | | | | | | | | | | |
| Parthenon | [64], [65] | | | | | | | | | | | | | | | | | | | ☐ | | |
| Temples of Thebes | [64], [66], [67], [68] | ☐ | | | | | ☐ | ☐ | ☐ | | | | | | | | | | | | | |
| The Great Wall | [69], [70], [71] | | | | | | | | | ☐ | ☐ | ☐ | | | | | | | | | | |
| Maya Sites | [72], [73] | ☐ | | | | | | | | | | | ☐ | | | ☐ | | | | | | |
| Angkor Wat | [74], [75] | | ☐ | | | ☐ | | | | | | | | | | | ☐ | | ☐ | | | |

### 1. Palmyra (Syria)

Prompt: a newly reconstructed Palmyra, where the essence of its ancient glory is captured in a structure that stands proud and unblemished under the clear sky. At its heart, a grand edifice, inspired by the Temple of Bel, showcases a symmetrical front view with a grand entrance. The architecture boasts complete and pristine columns rising to support a perfectly restored entablature, capped with a pediment that marries timeless artistry with contemporary innovation. This masterpiece gleams in the sunlight, reflecting a blend of historical reverence with the pinnacle of modern reconstruction. The surrounding environment is meticulously maintained, featuring a well-kept street leading to the temple's imposing steps, inviting visitors into a space where history and the present are seamlessly intertwined. Capture the essence of both ancient grandeur and modern architectural achievements, highlighting the harmony between past and future.

Figure 2. Photographs of the existing ruins of Palmyra, showcasing the Temple of Bel, the Baalshamin temple, and the ancient theatre, taken by Ko Hon Chiu Vincent and provided by UNESCO.

Figure 3. Midjourney and DALL-E, AI-generated reconstructions of different sections of the ancient city of Palmyra

**2. Maya Sites**

(Mexico) Prompts:

a. Chichen Itza in its heyday, focusing on the Pyramid of Kukulcan and the Great Ball Court. Show the precise architectural and astronomical alignment of the pyramid, the ornate carvings, and the surrounding temples and sacred cenotes. The lush Yucatan jungle should frame the site, highlighting the Maya's connection with their environment. realistic, architectural design

b. A detailed 3D model description of the complete architectural layout of Chichen Itza, focusing on the overall arrangement of the ancient Maya city's buildings and structures.

Describe the spatial relationships between the step-pyramids, temples, ball courts, observatory, and other key architectural features, providing information on their relative sizes, orientations, and distances from one another. Emphasize the architectural aesthetics and the visual impact of Chichen Itza's layout as a whole, allowing for a comprehensive representation of this ancient Maya city's architectural grandeur.

Figure 4. Photographs of ancient Maya archaeological sites in Mexico, captured by Community Tours Sian Ka'an and Ko Hon Chiu Vincent, under UNESCO's recognition of these historical treasures.

Figure 5. Midjourney AI-generated complete architectural layout of Chichen Itza of the ancient Maya city

c. The intricate architectural features of Chichen Itza, emphasizing the design and construction of the ancient Maya city's iconic buildings and structures. Highlight the specific elements of architecture, such as the step-pyramids, temples, ball courts, and observatory, and provide insights into their unique architectural styles, ornamentation, and any notable construction techniques or materials used. Capture the essence of Chichen Itza's architectural marvels in their prime, showcasing the cultural and artistic achievements of the ancient Maya civilization.

Figure 6. Midjourney AI-generated representations of distinctive features of Chichen Itza

**3. Pompeii (Italy)**

Prompt: Create a hyper-realistic image reconstructing the specific section of the ancient Roman building in Pompeii, Italy. The reconstruction should focus only on the visible section in the original image, maintaining the same perspective and architectural elements. The mosaic patterns, column details, and architectural style should match the original as closely as possible, restored to how they might have appeared before any damage. The setting remains the same with the surrounding ruins still visible, but the specific section should appear fully restored with accurate colours and details.

Figure 7. Photographs showcasing the ruins of Pompeii, including detailed architectural remnants and structures. Images captured by J. Frias Velatti and Limes.Media/Tim Schnarr, as featured on the UNESCO website.

Figure 8. Midjourney and DALL-E, AI-generated reconstructions of ancient Pompeii, showcasing its historic architecture and interiors.

**Conclusion**

This research highlights the significant potential of artificial intelligence (AI) in the preservation of cultural heritage, particularly through the digital reconstruction of sites impacted by conflicts. Utilizing AI-generated imagery, derived from detailed textual descriptions and historical analyses, has provided new insights into the original state of heritage sites. The study introduces innovative methodologies for architectural conceptualization and heritage conservation by integrating AI with traditional practices, advocating for a balanced approach to preserving cultural legacies. Future research should focus on refining AI algorithms and expanding methodological frameworks to improve the accuracy and applicability of AI in cultural heritage. This entails tackling ethical, technical, and collaborative challenges while enhancing the interpretability and sustainability of digital reconstructions. The findings advocate for a multidisciplinary approach, combining AI's capabilities with the expertise of historians, archaeologists, and conservationists to ensure the respectful and authentic preservation of our historical heritage.

## References:

[1] N. Kenig, J. Monton Echeverria, and A. Muntaner Vives, “Human Beauty according to Artificial Intelligence,” Plast Reconstr Surg Glob Open, vol. 11, no. 7, p. e5153, Jul. 2023, doi: 10.1097/GOX.0000000000005153.

[2] R. Brisco, L. Hay, and S. Dhami, “EXPLORING THE ROLE OF TEXT-TO-IMAGE AI IN CONCEPT GENERATION,” Proceedings of the Design Society, vol. 3, pp. 1835–1844, Jul. 2023, doi: 10.1017/pds.2023.184.

[3] D. Navarro-Mateu, O. Carrasco, and P. Cortes Nieves, “Color-Patterns to Architecture Conversion through Conditional Generative Adversarial Networks,” Biomimetics, vol. 6, no. 1, p. 16, Feb. 2021, doi: 10.3390/biomimetics6010016.

[4] I. Kadhim and F. M. Abed, “A Critical Review of Remote Sensing Approaches and Deep Learning Techniques in Archaeology,” Sensors, vol. 23, no. 6, p. 2918, Mar. 2023, doi: 10.3390/s23062918.

[5] H.-H. Lee and A. X. Chang, "Understanding Pure CLIP Guidance for Voxel Grid NeRF Models," ArXiv, Sep. 2022.

[6] P. Bharati, "Leveraging AI for Archaeological Insights: Generating Visual Representations of Historical Events - A Case Study of the Hastinapur Flood during the Reign of King Nichakshu," Int J Res Appl Sci Eng Technol, vol. 11, no. 10, pp. 142–145, Oct. 2023, doi: 10.22214/ijraset.2023.55951.

[7] H. A. Orengo, A. Krahtopoulou, A. Garcia-Molsosa, K. Palaiochoritis, and A. Stamati, "Photogrammetric re-discovery of the hidden long-term landscapes of western Thessaly, central Greece," J Archaeol Sci, vol. 64, pp. 100–109, Dec. 2015, doi: 10.1016/j.jas.2015.10.008.

[8] Y.-C. Hsu, Z. Yang, and M. J. Buehler, "Generative design, manufacturing, and molecular modeling of 3D architected materials based on natural language input," APL Mater, vol. 10, no. 4, Apr. 2022, doi: 10.1063/5.0082338.

[9] J. Ko, J. Ajibefun, and W. Yan, "Experiments on Generative AI-Powered Parametric Modeling and BIM for Architectural Design," Jul. 2023.

[10] F. Remondino, "Heritage Recording and 3D Modeling with Photogrammetry and 3D Scanning," Remote Sens (Basel), vol. 3, no. 6, pp. 1104–1138, May 2011, doi: 10.3390/rs3061104.

[11] M. L. Gualandi, G. Gattiglia, and F. Anichini, "An Open System for Collection and Automatic Recognition of Pottery through Neural Network Algorithms," Heritage, vol. 4, no. 1, pp. 140–159, Jan. 2021, doi: 10.3390/heritage4010008.

[12] C. Horn, O. Ivarsson, C. Lindhé, R. Potter, A. Green, and J. Ling, "Artificial Intelligence, 3D Documentation, and Rock Art—Approaching and Reflecting on the Automation of Identification and Classification of Rock Art Images," J Archaeol Method Theory, vol. 29, no. 1, pp. 188–213, Mar. 2022, doi: 10.1007/s10816-021-09518-6.

[13] J. Oppenlaender, "The Creativity of Text-to-Image Generation," in Proceedings of the 25th International Academic Mindtrek Conference, New York, NY, USA: ACM, Nov. 2022, pp. 192–202. doi: 10.1145/3569219.3569352.

[14] Y. Xie, Z. Pan, J. Ma, L. Jie, and Q. Mei, "A Prompt Log Analysis of Text-to-Image Generation Systems," Mar. 2023, doi: 10.1145/3543507.3587430.

[15] P. George, "AI trends in digital humanities research," Trends in Computer Science and Information Technology, vol. 7, no. 2, pp. 026–034, Jun. 2022, doi: 10.17352/tcsit.000048.

[16] R. Rombach, A. Blattmann, and B. Ommer, "Text-Guided Synthesis of Artistic Images with Retrieval-Augmented Diffusion Models," Jul. 2022.

[17] V. Liu and L. B. Chilton, "Design Guidelines for Prompt Engineering Text-to-Image Generative Models," Sep. 2021.

[18] P. Taveekitworachai, F. Abdullah, M. F. Dewantoro, R. Thawonmas, J. Togelius, and J. Renz, "ChatGPT4PCG Competition: Character-like Level Generation for Science Birds," Mar. 2023.

[19] Z. Elcheikh, "Palmyra: a story of ruins, struggle(s) and beyond," Chronos, vol. 39, pp. 105–123, Sep. 2019, doi: 10.31377/chr.v39i0.597.

[20] R. Raja and E. H. Seland, "The Paradox of Palmyra: An Ancient anomalopolis in the Desert," Journal of Urban Archaeology, vol. 5, pp. 177–189, Jan. 2022, doi: 10.1484/J.JUA.5.129848.

[21] G. Toubekis, M. Jansen, and M. Jarke, "LONG-TERM PRESERVATION OF THE PHYSICAL REMAINS OF THE DESTROYED BUDDHA FIGURES IN BAMIYAN (AFGHANISTAN) USING VIRTUAL REALITY TECHNOLOGIES FOR PREPARATION AND EVALUATION OF RESTORATION MEASURES," ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, vol. IV-2/W2, pp. 271–278, Aug. 2017, doi: 10.5194/isprs-annals-IV-2-W2-271-2017.

[22] A. Grün, F. Remondino, and L. Zhang, "Photogrammetric Reconstruction of the Great Buddha of Bamiyan, Afghanistan," The Photogrammetric Record, vol. 19, no. 107, pp. 177–199, Sep. 2004, doi: 10.1111/j.0031-868X.2004.00278.x.

[23] V. Asal, N. Avdan, and G. Ackerman, "Breaking taboos: Why insurgents pursue and use CBRN weapons," J Peace Res, vol. 60, no. 2, pp. 193–208, Mar. 2023, doi: 10.1177/00223433211057021.

[24] P. Pollegioni et al., "Ancient Humans Influenced the Current Spatial Genetic Structure of Common Walnut Populations in Asia," PLoS One, vol. 10, no. 9, p. e0135980, Sep. 2015, doi: 10.1371/journal.pone.0135980.

[25] J. E. Reade, "The ziggurat and temples of Nimrud," Iraq, vol. 64, pp. 135–216, Aug. 2002, doi: 10.1017/S0021088900003697.

[26] J.-F. Wotzlaw et al., "Garnet petrochronology reveals the lifetime and dynamics of phonolitic magma chambers at Somma-Vesuvius," Sci Adv, vol. 8, no. 2, Jan. 2022, doi: 10.1126/sciadv.abk2184.

[27] M. R. Senatore, A. Ciarallo, and J. Stanley, "Pompeii Damaged by Volcaniclastic Debris Flows Triggered Centuries Prior to the 79 A.D. Vesuvius Eruption," Geoarchaeology, vol. 29, no. 1, pp. 1–15, Jan. 2014, doi: 10.1002/gea.21458.

[28] M. Fulford and A. Wallace-Hadrill, "Towards a history of pre-Roman Pompeii: excavations beneath the House of Amarantus (I.9.11–12), 1995–8," Pap Br Sch Rome, vol. 67, pp. 37–144, Nov. 1999, doi: 10.1017/S0068246200004529.

[29] G. Scorrano, S. Viva, T. Pinotti, P. F. Fabbri, O. Rickards, and F. Macciardi, "Bioarchaeological and palaeogenomic portrait of two Pompeians that died during the eruption of Vesuvius in 79 AD," Sci Rep, vol. 12, no. 1, p. 6468, May 2022, doi: 10.1038/s41598-022-10899-1.

[30] K. Rajangam and A. Sundar, "Reading the Entanglements of Nature-culture Conservation and Development in Contemporary India," Journal of South Asian Development, vol. 16, no. 1, pp. 7–32, Apr. 2021, doi: 10.1177/09731741211013676.

[31] P. Pakkeerappa and J. Thomas, "Strategic Role of Hampi Development Authority in Promoting Tourism in Karnataka: a Study," Atna - Journal of Tourism Studies, vol. 1, no. 1, pp. 86–95, Jan. 2006, doi: 10.12727/ajts.1.8.

[32] P. Schettino, "Successful Strategies for Dealing With New Technology in Museums: A Case Study of Immersive Technology at the Immigration Museum, Melbourne," Museum International, vol. 68, no. 1–2, pp. 130–135, Jan. 2016, doi: 10.1111/muse.12091.

[33] S. Powell, "Etched in Stone: Sixteenth-century Visual and Material Evidence of Śaiva Ascetics and Yogis in Complex Non-seated Āsanas at Vijayanagara," Journal of Yoga Studies, vol. 1, pp. 45–106, May 2018, doi: 10.34000/JoYS.2018.V1.003.

[34] S. Knell, "Experimental museology: institutions, representations, users ," Museum Management and Curatorship, vol. 37, no. 3, pp. 330–332, May 2022, doi: 10.1080/09647775.2022.2068287.

[35] J. Angouri, M. Paraskevaidi, and R. Wodak, "Discourses of cultural heritage in times of crisis: The case of the Parthenon Marbles," Journal of Sociolinguistics, vol. 21, no. 2, pp. 208–237, Apr. 2017, doi: 10.1111/josl.12232.

[36] Y. Hamilakis, "The Other 'Parthenon': Antiquity and National Memory at Makronisos," Journal of Modern Greek Studies, vol. 20, no. 2, pp. 307–338, Oct. 2002, doi: 10.1353/mgs.2002.0025.

[37] D. Fincham, "The Parthenon Sculptures and Cultural Justice," SSRN Electronic Journal, 2012, doi: 10.2139/ssrn.2131825.

[38] M. Aubry et al., "Pharaonic necrostratigraphy: a review of geological and archaeological studies in the Theban Necropolis, Luxor, West Bank, Egypt," Terra Nova, vol. 21, no. 4, pp. 237–256, Aug. 2009, doi: 10.1111/j.1365-3121.2009.00872.x.

[39] H. Mahmoud, R. Alfons, and R. M. Reffat, "Analysis of The Driving Forces of Urban Expansion in Luxor City by Remote Sensing Monitoring," International Journal of Integrated Engineering, vol. 11, no. 6, Sep. 2019, doi: 10.30880/ijie.2019.11.06.031.

[40] J. Manning, "Thebes (Diospolis Magna), Ptolemaic and Roman periods," in The Encyclopedia of Ancient History, Wiley, 2012. doi: 10.1002/9781444338386.wbeah07107.

[41] G. Shelach-Lavi et al., "Medieval long-wall construction on the Mongolian Steppe during the eleventh to thirteenth centuries AD," Antiquity, vol. 94, no. 375, pp. 724– 741, Jun. 2020, doi: 10.15184/aqy.2020.51.

[42] M. Yang, "Crossing between the Great Wall of China and the 'Great' Trump Wall," Palgrave Commun, vol. 3, no. 1, p. 25, Nov. 2017, doi: 10.1057/s41599-017-0031-2.

[43] Y. Cao, M. A. Bowker, M. Delgado-Baquerizo, and B. Xiao, "Biocrusts protect the Great Wall of China from erosion," Sci Adv, vol. 9, no. 49, Dec. 2023, doi: 10.1126/sciadv.adk5892.

[44] A. K. Scherer, "Population structure of the classic period Maya," Am J Phys Anthropol, vol. 132, no. 3, pp. 367–380, Mar. 2007, doi: 10.1002/ajpa.20535.

[45] A. F. Chase et al., "Airborne LiDAR, archaeology, and the ancient Maya landscape at Caracol, Belize," J Archaeol Sci, vol. 38, no. 2, pp. 387–398, Feb. 2011, doi: 10.1016/j.jas.2010.09.018.

[46] C. Chen, "Angkor Wat: A transcultural history of heritages," J Southeast Asian Stud, vol. 52, no. 1, pp. 133–140, Mar. 2021, doi: 10.1017/S0022463421000230.

[47] D. H. Evans et al., "Uncovering archaeological landscapes at Angkor using lidar," Proceedings of the National Academy of Sciences, vol. 110, no. 31, pp. 12595–12600, Jul. 2013, doi: 10.1073/pnas.1306539110.

[48] C. Chen, A. Leask, and S. Phou, "Symbolic, Experiential and Functional Consumptions of Heritage Tourism Destinations: The Case of Angkor World Heritage Site, Cambodia," International Journal of Tourism Research, vol. 18, no. 6, pp. 602–611, Nov. 2016, doi: 10.1002/jtr.2077.

[49] A. K. Carter et al., "Temple occupation and the tempo of collapse at Angkor Wat, Cambodia," Proceedings of the National Academy of Sciences, vol. 116, no. 25, pp. 12226–12231, Jun. 2019, doi: 10.1073/pnas.1821879116.

[50] J. Pan, L. Li, H. Yamaguchi, K. Hasegawa, F. I. Thufail, and S. Tanaka, "FUSED 3D TRANSPARENT VISUALIZATION FOR LARGE-SCALE CULTURAL HERITAGE USING DEEP LEARNING-BASED MONOCULAR RECONSTRUCTION," ISPRS Annals of the Photogrammetry, Remote Sensing and Spatial Information Sciences, vol. V-2–2020, pp. 989–996, Aug. 2020, doi: 10.5194/isprs-annals-V-2-2020-989-2020.

[51] A. Denker, "3D VISUALIZATION AND PHOTO-REALISTIC RECONSTRUCTION OF THE GREAT TEMPLE OF BEL," The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, vol. XLII-2/W3, pp. 225–229, Feb. 2017, doi: 10.5194/isprs-archives-XLII-2-W3-225-2017.

[52] W. Wahbeh, S. Nebiker, and G. Fangi, "COMBINING PUBLIC DOMAIN AND PROFESSIONAL PANORAMIC IMAGERY FOR THE ACCURATE AND DENSE 3D RECONSTRUCTION OF THE DESTROYED BEL TEMPLE IN PALMYRA," ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences, vol. III–5, pp. 81– 88, Jun. 2016, doi: 10.5194/isprsannals-III-5-81-2016.

[53] W. Wahbeh, S. Nebiker, and G. Fangi, "COMBINING PUBLIC DOMAIN AND PROFESSIONAL PANORAMIC IMAGERY FOR THE ACCURATE AND DENSE 3D

RECONSTRUCTION OF THE DESTROYED BEL TEMPLE IN PALMYRA," ISPRS Annals of Photogrammetry, Remote Sensing and Spatial Information Sciences, vol. III–5, pp. 81– 88, Jun. 2016, doi: 10.5194/isprsannals-III-5-81-2016.

[54] J. Heikkinen, "Close-range constrained image sequences," ISPRS Journal of Photogrammetry and Remote Sensing, vol. 64, no. 3, pp. 267–274, May 2009, doi: 10.1016/j.isprsjprs.2008.10.001.

[55] M. G. Bevilacqua, G. Caroti, A. Piemonte, and D. Ulivieri, "RECONSTRUCTION OF LOST ARCHITECTURAL VOLUMES BY INTEGRATION OF PHOTOGRAMMETRY FROM ARCHIVE IMAGERY WITH 3-D MODELS OF THE STATUS QUO," The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, vol. XLII-2/W9, pp. 119–125, Jan. 2019, doi: 10.5194/isprs-archives-XLII-2-W9-119-2019.

[56] R. Spallone, F. Lamberti, L. M. Olivieri, F. Ronco, and L. Castagna, "AR AND VR FOR ENHANCING MUSEUMS' HERITAGE THROUGH 3D RECONSTRUCTION OF FRAGMENTED STATUE AND ARCHITECTURAL CONTEXT," The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, vol. XLVI-2/W1-2022, pp. 473–480, Feb. 2022, doi: 10.5194/isprs-archives-XLVI-2-W1-2022-473-2022.

[57] F. Maiwald, T. Vietze, D. Schneider, F. Henze, S. Münster, and F. Niebling, "PHOTOGRAMMETRIC ANALYSIS OF HISTORICAL IMAGE REPOSITORIES FOR VIRTUAL RECONSTRUCTION IN THE FIELD OF DIGITAL HUMANITIES," The International Archives of the Photogrammetry, Remote Sensing and Spatial Information Sciences, vol. XLII-2/W3, pp. 447–452, Feb. 2017, doi: 10.5194/isprs-archives-XLII-2-W3-447-2017.

[58] F. Biljecki, J. Stoter, H. Ledoux, S. Zlatanova, and A. Çöltekin, "Applications of 3D City Models: State of the Art Review," ISPRS Int J Geoinf, vol. 4, no. 4, pp. 2842–2889, Dec. 2015, doi: 10.3390/ijgi4042842.

[59] G. Gröger and L. Plümer, "CityGML – Interoperable semantic 3D city models," ISPRS Journal of Photogrammetry and Remote Sensing, vol. 71, pp. 12–33, Jul. 2012, doi: 10.1016/j.isprsjprs.2012.04.004.

[60] A. Mazzaglia, "The Information System of Pompeii Sustainable Preservation Project. A Tool for the Collection, Management and Sharing of Knowledge Useful for Conservation and Renovation of Archaeological Monuments," in ArcheoFOSS XIII Workshop—Open Software, Hardware, Processes, Data and Formats in Archaeological Research, Basel Switzerland: MDPI, Nov. 2021, p. 14. doi: 10.3390/environsciproc2021010014.

[61] L. Sbrogiò, "Parametric approach to the reconstruction of timber structures in Campanian Roman houses," Virtual Archaeology Review, vol. 13, no. 26, pp. 45–61, Jan. 2022, doi: 10.4995/var.2022.15319.

[62] A. Keyvanfar, A. Shafaghat, and M. S. Rosley, "Performance comparison analysis of 3D reconstruction modeling software in construction site visualization and mapping,"

International Journal of Architectural Computing, vol. 20, no. 2, pp. 453–475, Jun. 2022, doi: 10.1177/14780771211066876.

[63] M. Natampally, "Reconstrucción visual (gráfica, ilustrada y digital) del Templo Hampi," Virtual Archaeology Review, vol. 5, no. 10, p. 117, May 2014, doi: 10.4995/var.2014.4225.

[64] G. Hu, P. Mortazavian, J. Kittler, and W. Christmas, "A facial symmetry prior for improved illumination fitting of 3D morphable model," in 2013 International Conference on Biometrics (ICB), IEEE, Jun. 2013, pp. 1–6. doi: 10.1109/ICB.2013.6613000.

[65] P. Debevec, "The Parthenon," in ACM SIGGRAPH 2004 Computer animation festival on - SIGGRAPH '04, New York, New York, USA: ACM Press, 2004, p. 188. doi: 10.1145/1186015.1186041.

[66] J. Meister et al., "The Sacred Waterscape of the Temple of Bastet at Ancient Bubastis, Nile Delta (Egypt)," Geosciences (Basel), vol. 11, no. 9, p. 385, Sep. 2021, doi: 10.3390/geosciences11090385.

[67] B. Bennoui-Ladraa and Y. Chennaoui, "Use of Photogrammetry for Digital Surveying, Documentation and Communication of the Cultural Heritage. Example Regarding Virtual Reconstruction of the Access Doors for the Nameless Temple of Tipasa (Algeria)," Studies in Digital Heritage, vol. 2, no. 2, pp. 121–137, Dec. 2018, doi: 10.14434/sdh.v2i2.24496.

[68] S. Berto, E. Demetrescu, B. Fanini, J. Bonetto, and G. Salemi, "Analysis and Validation of the 3D Reconstructive Process through the Extended Matrix Framework of the Temple of the Roman Forum of Nora (Sardinia, CA)," in ArcheoFOSS XIII Workshop— Open Software, Hardware, Processes, Data and Formats in Archaeological Research, Basel Switzerland: MDPI, Dec. 2021, p. 18. doi: 10.3390/environsciproc2021010018.

[69] M. Bassier, M. Yousefzadeh, and M. Vergauwen, "Comparison of 2D and 3D wall reconstruction algorithms from point cloud data for as-built BIM," Journal of Information Technology in Construction, vol. 25, pp. 173–192, Mar. 2020, doi: 10.36680/j.itcon.2020.011.

[70] X. Zeng and T. Jin, "3D reconstruction of buildings based on transformer-MVSNet," in 3rd International Conference on Applied Mathematics, Modelling, and Intelligent Computing (CAMMIC 2023), X. Chen and H. M. Srivastava, Eds., SPIE, Jul. 2023, p. 191. doi: 10.1117/12.2686276. Y. Zhou et al., "Building information modeling-based 3D reconstruction and coverage planning enabled automatic painting of interior walls using a novel painting robot inconstruction," J Field Robot, vol. 39, no. 8, pp. 1178–1204, Dec. 2022, doi: 10.1002/rob.22103.

[71] J. von Schwerin, H. Richards-Rissetto, F. Remondino, G. Agugiaro, and G. Girardi, "The MayaArch3D project: A 3D WebGIS for analyzing ancient architecture and landscapes," Literary and Linguistic Computing, vol. 28, no. 4, pp. 736–753, Dec. 2013, doi: 10.1093/llc/fqt059.

[72] M. Pierrot-Deseilligny, L. De Luca, and F. Remondino, "Automated Image-Based Procedures for Accurate Artifacts 3D Modeling and Orthoimage Generation," Geoinformatics FCE CTU, vol. 6, pp. 291–299, Dec. 2011, doi: 10.14311/gi.6.36.

[73] X. Wang et al., "Digital Heritage," in Manual of Digital Earth, Singapore: Springer Singapore, 2020, pp. 565–591. doi: 10.1007/978-981-32-9915-3_17.

[74] H. Shishido, Y. Ito, Y. Kawamura, T. Matsui, A. Morishima, and I. Kitahara, "Proactive preservation of world heritage by crowdsourcing and 3D reconstruction technology," in 2017 IEEE International Conference on Big Data (Big Data), IEEE, Dec. 2017, pp. 4426–4428. doi: 10.1109/BigData.2017.8258479

## Biography:

Miss. Kawsar Arzomand is a Ph.D. candidate in Civil Engineering at Brunel University London, specializing in the application of generative AI in architectural design through innovative Text to 3D Modelling techniques. With a robust academic background, including a postgraduate degree in AI and Machine Learning from Amity University India, she brings a wealth of over seven years of cross-disciplinary experience across various technological and engineering disciplines. Currently serving as an ICT Specialist at UNOPS, Arzomand applies her deep expertise in programming, data analysis, and data visualization to develop and implement dashboards and Information management systems. Her efforts are crucial in streamlining data interpretation and supporting the decision-making process. Her previous role as an Information Management focal point with UN-IOM stands as a testament to her ability to handle critical data and contribute significantly to humanitarian efforts. Arzomand is distinguished not only by her technical skills but also by her innovative contributions to safety in mining, having developed a nationally awarded Smart Helmet for Miners. A proven problem-solver and communicator, she adeptly manages project teams to ensure timely and budget-conscious delivery of project objectives. Her work spans the non-profit and for-profit sectors, showcasing her versatility and deep commitment to societal progress. As a speaker at the 2nd International Summit on Civil, Structural, and Environmental Engineering, Arzomand will offer insights into the integration of AI in civil engineering, reflecting her profound dedication to advancing this critical field of study.

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# The Reissner-Nordstrom Spaceitme with a Blackhole Surrounded of Dust

**Orchidea Maria Lecian**
*Sapienza University, Italy*

## Abstract:

The Reissner-Nordstrom-Spacetimes with a blackhole surrounded of dust are analysed. The velocity of the observer is discussed. After Hamiltonian analysis, the esistence of a generalized Carter constant and that o a generalized Carter function are discussed and calculated. The photon region(s) of the Astrophysical configuration are discussed.

## Biography:

Prof. Orchidea Maria Lecian graduated in Physics- Theoretical Physics in 2005 at Sapienza University of Rome, Italy, Physics Department and ICRA- International Center for Relativistic Astrophysics Relativistic Astrophysics, and completed her PhD in Physics- Relativistic Astrophysics (IRAP_-International Relativistic Astrophysics PhD) at Sapienza University of Rome, Physics Department and ICRA in 2008, Sapienza Unviersity of Rome, with an INFN (National Institute for Nuclear Physics) Postdoctoral Fellowship. Accomplished postdoctoral studies at IHES- Institute des Hautes E'tudes Scientifiques, Bures-sur-Yvette, France, and APC- Astroparticules et Cosmologies, Paris, France (2009-2010) with a Sapienza University Postdoctoral CUN2 Research Fellowship , an Angelo Della Riccia Postdoctoral Fellowship and an IHES Postdoctoral Fellowship; AEI-MPI (2009-2011), Max Planck Institute for Gravitational Physics- Albert Einstein Institute, Potsdam-Golm, Germany (2011 and 2013) with a Grant awarded to Foreign Postdocs and a Postdoctoral Research Grant; and Sapienza University of Rome (2011-2013 and 2013-2014) with a Sapienza University Postdoctoral Fellowship. Has been Assistant Professor at Sapienza University of Rome, Architecture Department, SBAI (Department of Fundamental Sciences and Engineering), DIAEE (Department of Astronautics Engineering, Electric and Energetic) (2007-2017). Has been Researcher at Comenius University in Bratislava, Faculty of Mathematics, Physics and Informatics, Department of Theoretical Physics and Physics Education- KTFDF and appointed Erasmus Lecturer with a SAIA- NS'P (Slovak Academic Information Agency- National Stipendium Program me of the Slovak Republic) grant for International University Researchers (2017-2018).

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# BRIDGES AND UNESCO

**Enzo Siviero**
*Rector of the eCampus University, Italy*

## Abstract:

The aim of this paper is to present some bridges inscribed in the Unesco World Heritage List and their Outstanding Universal Values, which explain the importance of these works of art in terms of engineering, technology, culture and technical development. The Iron Bridge, the first metal bridge in the history of construction, is of considerable importance, not only in historic, technological and constructive terms: here, architecture and engineering are revealed to the full, making the bridge into a place. The Forth Bridge is a globally-important triumph of engineering, representing the pinnacle of 19th century bridge construction and is without doubt the world's greatest trussed bridge. The Vizcaya Bridge, completed in 1893, was the first bridge in the world to carry people and traffic on a high suspended gondola and was used as a model for many similar bridges in Europe, Africa and America, only a few of which survive. The Mostar Bridge is an exceptional and universal symbol of coexistence of communities from diverse cultural, ethnic and religious backgrounds. The Oporto bridges, interpreted in Vitruvian terms, represent a heritage, a "set of spiritual, cultural, social or material values that belong, through inheritance or tradition, to a group of people...", a complex grouping that marks and symbolises an era, the Eiffel's masterpiece. Because the bridge is not only a work of art, but also a thought.

**Keywords:** Bridge; Development; Values; Culture

## Biography:

Prof. Enzo Siviero was born in 1945 in Padua, Italy. He graduated in Civil Engineering in 1969 and began his teaching career at IUAV, the University of Venice, in 1972. In 1994, he became a full professor of Theory and Design of Bridges at IUAV. Currently, he serves as the Rector of the online University eCampus Italy, where he teaches Bridge Theory and Design. Additionally, he holds positions as a Consultant Professor at the College of Civil Engineering of Tongji University, Shanghai-China, and as an Adjunct Professor at Fuzhou University and Chang'an University, Xi'an-China. Throughout his career, Enzo Siviero has been actively involved in academic and professional endeavors related to bridge engineering. He has conducted extensive research on bridges, focusing on the integration of structure and form, mechanical behavior, and aesthetic features. His work emphasizes the conceptual design of bridges and their integration into the landscape to achieve sustainable and less invasive infrastructure development. As an

expert in structural mechanics and concrete structures, Siviero has contributed significantly to research at both national and international levels. He has designed numerous structures, including bridges, flyovers, and footbridges, and has authored numerous books and articles on reinforced and prestressed concrete, structural management, and bridge design. Siviero's exhibitions, "Enzo Siviero: the theme of the bridge" (1999) and "Ponteggiando – Bridging" (2009), have been showcased in various universities across Italy, Europe, China, India, Africa, and America. He remains active in the field of building industry, structures, and infrastructure, particularly in Italy and abroad. In 2019, he inaugurated his third exhibition, "Enzo Siviero: The Bridge Men" in Reggio Calabria, Italy.

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# Mathematical Problems of Neural Networks

**Brunello Tirozzi**
*Department of Physics, University of Rome, Italy*

## Abstract:

The problem of learning and retrieving of neural networks is analyzed as a stochastic process. Neural networks must be prepared in order to accomplish their function. The set of patterns in the learning process is considered as a collection of i.i.i.d. random variables, with values 1, -1. The retrieval is measured using the overlap parameter which is the projection of the state variables of the network on the space of patterns. The equation of the overlap parameters and other parameters of the network is solved in some particular case. The capacity of the neural network is analyzed for some cases.

**Keywords:** Learning; Retrieval; Capacity; Overlap Parameters

## Biography:

Prof. Brunello Tirozzi, Full Professor of Mathematical Physics, Department of Physics Rome University. Retired on 2015. He worked on different topics, elementary particle physics, statistical mechanics, phase transitions, probability theory, disordered system.

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# Reciprocally Supported Elements (RSE) Space Structure Configurations

**Joseph P. Rizzuto**[1]*, Ibrahim G. Shaaban[1]
[1]*School of Engineering and Computing, University of West London, UK*

## Abstract:

Creative, imaginative and inventive engineered architectural forms can be achieved when using multiple circuit arrangements of reciprocally supported elements (RSE). The appearance of the resulting family of space structures can often be similar to woven basket assemblies. Structural elements of various cross-sections and materials can be used for RSE circuit construction. When a circuit of RSEs is formed, only pairs of the reciprocally supported elements are required to be connected to one another as they rely on one another for mutual support. Potential applications of the MSE system range from the construction sector to aid work as these can be mobile and rapidly assembled structures. This potentially results in an economic advantage over the more traditional connection systems used in space structures where, for example, machined cast ball-joints connectors are employed. By comparison, the connection between RSE pairs can be considerably simplified, in many cases, to the use of single bolts. When carrying out numerical modelling of RSE space structures, the connection stiffness of the joints is found to be an important factor in the resulting design. The joint connection stiffness associated with the use of cylindrical elements is investigated and reviewed with practical aspects of assembly discussed.

**Keywords:** Reciprocally Supported Elements; Space Structures; Joint Connection Stiffness

## Biography:

Prof. Joe Rizzuto brings a wealth of experience from his extensive work with consulting engineers and contractors both in the UK and abroad. At the University of West London (UWL), he has held various key roles, including Professor of Civil Engineering, Head of Engineering and Built Environment, and Interim Head of School from September 2022 to February 2023. Currently, he serves as the Head of the UWL Sustainable Civil and Structural Engineering Research Group, which focuses on finding ways to reduce the environmental impact of construction-related activities. Joe's research interests are diverse and encompass novel space structure systems, numerical modeling, experimental investigations, structural behavior, sustainable materials, concrete ground-supported slabs, masonry arches and vaults, and structural design method applications. He actively contributes to academia as a reviewer for journal and book publishers and serves on the UK's Institution of Structural Engineers Academic Qualifications Panel. Additionally, he serves as a guest editor for Applied Sciences. Currently, Joe is working on a book titled "Project-based Structural Steel Design" for CRC Press, further showcasing his commitment to advancing knowledge in the field of civil and structural engineering.

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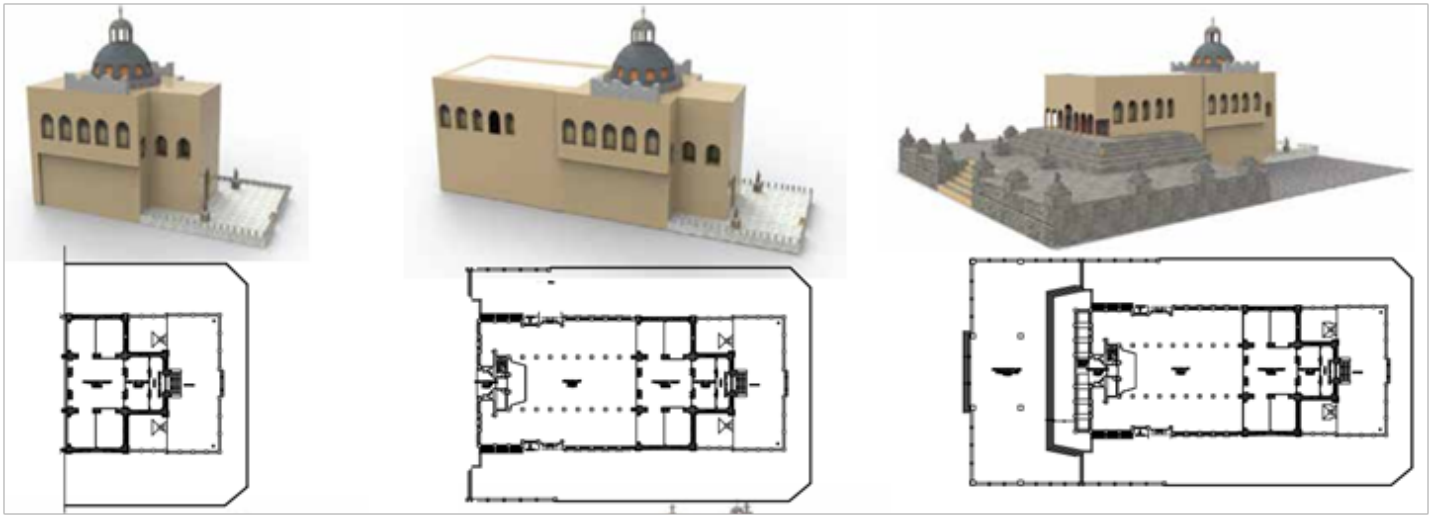
# Structural Integrity Assessment and Retrofitting for Holy Trinity Cathedral Building

**Habtamu Getu Mihret**
*CEO-Menen Engineering PLC, Addis Ababa, Ethiopia*

## Abstract:

Holy Trinity Cathedral, also known in Amharic as Kidist Selassie, is the highest-ranking Ethiopian. Orthodox Tewahedo cathedral in Addis Ababa, Ethiopia Built in 1942.



**The Holy Trinity Church has undergone three major phases of construction, with the first phase(I).**

Involving the Mahelet dome built around 1928, the second phase (phase II) extending east-west, and the third phase (phase III) providing the current appearance. The building is initially constructed using concrete and masonry materials, with the extension methodologybeing strong enough to maintain the new load. The dome part is constructed using masonry support andsupported by I section steel framing and wood truss. The extension of columns creates weaken joints andreduce column capacity, but the overall structure's layout and bracing beams and precast arches create aconfined box-like structure. Masonry columns are designed for roof loading, while concrete slab and lateralforce are exposed. The upper dome is constructed using steel, timber, and copper sheet cladding, making itlightweight and easy to restore. The ring beam transfers loads from the dome to the columns and beamsbeneath it. The construction on the extension for the phase two is a material with heterogeneous behavior other than the dome structure. The columns on the existed row are constructed with concrete material whereas the other side is fully

masonry. The roof is constructed with a reinforced concrete waffle slab system. Which contains 400mm- 600 mm beam running in shorter side with a bracing beam in average 2 m distance. Preliminary inspections show durability-related cracks due to corrosion and time-dependent movements. To classify the defects encountered, a legend was formulated for the survey and defects classified as High Priority, Medium Priority and Low Priority. The Ethiopian Building Standard code is used for detail design considering the church is based on the Low ductility class assessed for axial bearing capacity, lateral stability and degree of carbonation. After studying the material property of each structural member, the geometry of the structure, and an analysis of the existing structure using various software's such as FEM Abaqus, ETABS and CSI Column, continue andidentify the failure mechanism to discover every defect on every phase by different examination methodsand conduct tests to determine the structural system, construction material, type of foundation, andbearing capacity needed to create the restoration mechanism, optimal decisions were pursued, taking intoaccount the local technology, time, economy and social aspects without affecting the structural strengthand architectural look because it is a heritage protection principle. The first step to do was to investigate the construction process, the material, the code and the drawing theyuse to build. In general, after taking by most reliable and well-established methods, apply the effective Retrofitting measures suitable for each defect.

**Keywords:** Heritage; Retrofitting; FEM; Carbonation

## Biography:

Mr. Habtamu Getu obtained his MSc in Design and Construction project management from Chalmers university of technology, Sweden 2019. Habtamu has attended structural dynamics seminar at University of Messina,Italy. He also accomplished his MSc in Structural Engineering from Addis Ababa Institute of Technology, Addis Ababa, Ethiopia 2017 and his BSc in Civil Engineering from Bahir Dar,Ethiopia 2014. Among the biggest projects he works as a senior structural engineer and conservation engineer with Fasil Ghiorghis CAE include, National palace Conservation, Holy Trinity Cathedral Conservation, Jima Aba Jiffar Conservation, and multiple mixed use, apartments, education and hospitality projects. He has an ample experience in structural design and supervision for large scale real-estate projects in Ethiopia. Habtamu is currently the CEO of MENEN Engineering and working as a senior structural engineer contributing his immense experience in the built environment including design, supervision and project management. His research interests include structural consolidation and retrofiting.

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# Black Holes: Thermodynamics and Geometry

**Ahmed Daassou**
*Cadi Ayyad University, Morroco*

## Abstract:

In this plenary talk, we will delve into the captivating world of black holes, exploring their formation, recent observations, and the intriguing interplay between thermodynamics and geometry. We will begin by examining the mesmerizing process of black hole formation, shedding light on the collapse of massive stars and the conditions necessary for the birth of these cosmic enigmas. Through captivating visuals and accessible explanations, we will unravel the mysteries of their gravitational pull and the event horizon that characterizes their profound nature. Next, we will embark on a thrilling journey through recent groundbreaking observations of black holes. From the awe-inspiring image captured by the Event Horizon Telescope to the detection of gravitational waves emanating from their violent mergers, we will showcase the unprecedented insights gained into these celestial objects. We will discuss the implications of these observations. Finally, we will explore the captivating connection between thermodynamics and geometry in the realm of black holes. Through conceptual exploration, we will unravel the fundamental principles of black hole thermodynamics, including the laws of black hole mechanics and the enigmatic concept of Hawking radiation. Additionally, we will delve into the geometrical aspects of black holes, highlighting their warped space-time and the profound implications for our understanding of the universe.

**Keywords:** Black Holes; Thermodynamics; Geometry

## Biography:

Dr. Ahmed Daassou in 2015, obtained a Ph.D. in Astrophysics. From December 2018 to June 2023, he worked as an Assistant Professor at the Physics Department, Polydisciplinary Faculty, Cadi Ayyad University, Morocco. In recognition of his expertise and contributions, in June 2023, he was promoted to the position of Associate Professor at the same university. Furthermore, Dr. Daassou serves as the Deputy Director of the Fundamental and Applied Physics Laboratory (FAPL) at Cadi Ayyad University since 2020, where he actively contributes to research and academic leadership.

Dr. Daassou holds esteemed memberships in prestigious international scientific organizations. Currently, he is a member of the Division J (Galaxies and Cosmology), as well as the Division F (Planetary Systems and Astrobiology), within the International Astronomical Union (IAU). With a deep passion for astronomical research, Dr. Daassou has been an associated member of the Oukaimeden Observatory at Cadi Ayyad University since 2009, actively engaging in collaborative projects and furthering astronomical knowledge. Not only is he actively engaged in research, but he also contributes significantly to the scientific community through his role as a referee in various scientific journals. His expertise and knowledge have led to co-authorship of over 60 publications in internationally renowned scientific journals.

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# Transmission Line System Dynamic Response Under Synoptic and Non-Synoptic Winds

**Amal Elawady**[1], Mohamed Eissa[1]
*1 College of Engineering & Computing, Florida International University*
*2 Extreme Events Institute, Florida International University*

## Abstract:

Transmission line systems are vulnerable to damage during severe wind events such as hurricanes and downburst thunderstorms. Although downbursts are spatially localized wind events that affect relatively small areas compared to other wind hazards, the failure of one tower can have a negative impact on the adjacent towers and may lead to a progressive collapse of the towers. The power network infrastructure plays a crucial role in our modern society, where electricity is an essential part of our communities' welfare. Therefore, the resilience of our communities against high-intensity wind events such as hurricanes, downbursts, and torn does depends largely on the resilience of transmission line systems (TLSs). However, existing guidelines and standards for designing transmission lines are deemed adequate in effectively describing the loading pattern of synoptic winds on Transmission Line Structures (TLSs). Still, they lack considering the natural differences between downburst and atmospheric boundary layer (ABL) winds, indicating the inadequacy of the current standards for describing the downburst load pattern on TLSs. There have been several experimental studies conducted to investigate the response of TLSs under downburst loads. Nonetheless, these studies face difficulties due to limited testing space and the challenge of using an appropriate joint scaling of TLSs and the downburst event, which may ultimately affect the results. Thus, in this study, to eliminate possible scaling limitations, the authors utilized the newly developed large-scale downburst simulator at the Wall of Wind (WOW) Experimental Facility (EF) in Miami, Florida. Thisstudy involves aeroelastic modeling and testing of a multi-span transmission line system that consists of four bays spanning 1300ft along with three identical self-supported towers that are 196ft tallat full scale. Each tower carried three conductors, with two conductors bundled on each cross-arm and the third suspended at the mid-point of the top girder.To support three conductors, two end frames were placed at the far ends of the TLS.

Preliminary results indicate that the along-wind response on the top of the middle tower in the case of downburst wind has increased by 44% than its counter part in the case of ABL winds. On the other hand, the across-wind response in the case of ABL is higher than in the case of downburst wind by 15%, which could be a result of the vortex-shedding phenomenon in the tower itself. However, this significant increase in the downburst-associated along-wind response indicates a potential increase in the dynamic response factors as well. The outcomes of this studyare considered a step forward in understanding the influence of downburst winds on TLSs and proposing more thorough guidelines and recommendations for designing TLSs.

**Keywords:** Transmission Lines; Aeroelastic Model; Downburst; Synoptic Wind

## Biography:

Department at Florida International University (FIU). She is a Fellow of FIUâ€™s Extreme Event Institute. She is also a co-PI of two NSF-national centers at FIU: the NHERI Wall of Wind Experimental Facility and the IU-CRC Wind Hazard and Infrastructure Performance Center. Dr. Elawady is conducting ground breaking research on hurricane and thunderstorm effects on different structures and urban trees. Dr. Elawady has published over 20 journals and 40 conference papers and presentations. Her work at the Wall of Wind enabled expanding the capability of the national facility to simulate thunderstorm downbursts in addition to hurricanes. Dr. Elawady has graduated 4 PhD students and is currently supervising other 5 PhD students. Dr. Elawady has received over $2M in research funding as PI from different federal, state, and industry agencies in addition to several multi-million dollars as a co-PI. Dr. Elawady is the recipient of the 2022-Faculty Early Career Development Program (CA-REER) Award from the National Science Foundation. Dr. Elawady received her PhD from The University of Western Ontario in Canada (2016) and M.Sc. (2012) and B.Sc. (2008) degrees from Ain Shams University in Cairo, Egypt.

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# Quartic Equation and Proportion of Physical Reality

**František Lomoz**
*Observatory of Josefa Sadila v Sedlcanech, Czech Republic*

## Abstract:

Considering a qurtic equation as polynomial of the 4th order with non-zero coefficients a,b,c,d & e can be considered as a sum of partial equations. In order to express coefficients of these equations with the help of functional dependence on a given parameter K, solution of individual partial equations can be found, using the numerical values for the sizes of regular 4-dimesinal polyhedron surfaces will then determine their volume ratios. These ratios will also be matching the mass ratios of fundamental particles of the physical realm as for example is the mass ratio of a proton and an electron or the mass ratio of Higgs boson and an electron including the Planck and the electron mass ratio. These mass proportionality in physical realm in terms of elementary particles then enables the solution of partial equations to determine black hole the final "gravity" after the collapse of two mass objects. By these proportions the most massive objects are determined whereas from the initial mass of two objects the mass of gravitationally collapsed object can also be established. From those equations a new elementary particle representing the dark matter could be found with likelihood of finding other particles that could explain the essence of dark energy. On the bases of gravitational objects represented by a black hole, the property of those initial objects that exclude collapse into singularity could be determined.

**Keywords:** Qurtic Equation; Elementary Particles; Black Hole; Dark Matter

## Biography:

Mr. František Lomoz Completed his education in 1962 at the School of Electrotechnics in Kutná Hora, Czech Republic. From 1962 to the present he is gaining work and professional experience in the field of designing and developing electrical equipment and air conditioning. From 1965 to the present he is Acquiring a practical and theoretical basis of astronomy at Josef Sadil's observatory in Sedlcany (Czech Republic). He is the Head of Josef Sadil´s observatory in Sedlcany from 1982 to the present. And a Member of the Czech Astronomical Society, Section of Variable Stars and Exoplanets. Mr. Lomoz is an Active Member and lecturing on Astronomy and Physics in the Cosmological Section of the Czech Astronomical Society. Mr. Lomoz is a co-author of 16 publications.

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# UHECR Reading Key

**Daniele Fargion**[1], Pier Giorgio De Sanctis Lucentini, Maxim Yu. Khlopov[2]
*Rome University, Italy*

## Abstract:

Cosmic Rays are an open puzzling problem since a century. The most energetic ones, UHECR, Ultra High Energy Cosmic Rays, being possibly undeflected have been expected, to point finally toward their original sources: SNs. AGN. Jets . Most authors suspected that galactic and cosmic sources must be shining, respectively, as CR and UHECR signals. However even largest array as AUGER and TA has be offering hundreds of UHECR events, they did not lead to any wide accepted consensus. Our main reading key and result, since 2008-2018, is that UHECR are mostly lightest nuclei, reaching us mainly from nearest Local (few Mpc) edges, by CenA, M82, NGC 253. We underline also that the same UHECR, contrary to common views, might be even polluted by a few, well known , galactic transient sources.

**Keywords:** Cosmic Rays1; UHECR 2; Light Nuclei 3; AGN 4

## Biography:

Prof. Daniele Fargion Active in Astroparticle since 1978 I, I considered the neutrino mass role in SN-graviton-Neutrino Burst, in cosmology, in galaxy formation and in UHECR by nu-nu scattering (Z-Burst model). I considered on 1999 the Tau Airshower to discover UHE neutrinos at PeV-EeV. I am studying UHECR map and composition, favoring He-Cen A connection and pointing also to possible UHECR-TeV gamma connections by UHECR Ni decaying in flight. Testing Neutrino mix beaming and crossing along the Earth.

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# Thermal Preconditioning of Carbon FRCM Strips on a Masonry Support

**Andrea Nobili**
University of Modena and Reggio Emilia, Italy

## Abstract:

The effect of thermal preconditioning at 300ºC of carbon FRCM strips applied onto a masonry support is experimentally investigated, with special regard to the support adhesion, in direct shear tests. It is found that thermal preconditioning degrades the bond capacity to a limited extent (especially in comparison to FRPs), although the conversion rate (i.e. the maximum achievable stress in the fabric against its ultimate strength) of the whole system remains unsatisfactory due to the intrinsic limitations of the cementitious matrix. Pre-emptive coating of the carbon fabric with diluted epoxy enhances mechanical performance of the system and increases its conversion rate. As expected, the added organic phase proves susceptible to thermal degradation and consequently the bond capacity is greatly impared. Nonetheless, performance after thermal preconditioning in the coated group remains significantly higher than that in the uncoated group.

## Biography:

Dr. Andrea Nobili graduated in Engineering at the University of Modena and Reggio Emilia, Italy, where he obtained his PhD in Material Science in 2002 and he is currently Associate Professor in Solid Mechanics. He's been invited professor at the Aberyst with University (UK), Keele Univeristy (UK), Liverpool University (UK), Sheffield University (UK), Mathematisches Forschungsinstitut Oberwolfach (DE) and Faculty of Industrial Engineering Novo mesto (SI). His research interest covers wave propagation and diffraction in elastic solids, fracture mechanics, asymptotic methods, complex materials with microstructure, the mechanics of brittle matrix composite materials and of bio-materials. He co-authored 68 papers in international scientific journals (Scopus), more than 50 conference proceedings, 1 book on Structural Dynamics and 3 patents.

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# Zero-Gravity as Game-Changer to Extend Human Longevity and Advance Knowledge on the Universe

**Carlo Viberti**
*President, SpaceLand Africa, Italy*

## Abstract:

Humankind exists thanks to gravity. We have now understood that our universe was formed as we know it and is further evolving according to laws regulating gravitational forces and correlated space-time matrix dynamics.

Since the dawn of spaceflight less than 600 human beings have been orbiting the Earth, working for researchers not only in biomedical, material sciences and technology innovation to support robotic and human exploration of celestial bodies (e.g. for developments and tests related to reaction mechanisms, forces and momenta acting on rovers, drillers, penetrators, deployable booms, solar panels and all the other hardware which have to function in low-gravity), but also to expand knowledge in gravitation, astrophysics and cosmology thanks to the unique experimental conditions generated by artificial weightlessness. Since 2002, the Italian group SpaceLand helps democratize the access to such opportunities: the group's ground and flight campaigns, also conducted from the NASA Space Shuttle Landing Facility, for the first time in history have included kids, elderly and individuals with 100% physical disabilities. Such microgravity, Lunar and Mars gravity test-flights accelerate potential breakthrough discoveries about our existence, not only to help colonize outer space but also to address a myriad other sectors: from progress in 3-dimensional biomanufacturing and pharmacology to the creation of novel composite alloys and bio-materials thanks to molecular, cells, proteins and crystal growth in zero-gravity. Ditto as above for R&D on fluid coalescence or behaviour and aggregation of matter, striving for a better understanding of stars and galaxies formation, evolution and collaps; such unique research avenues go on side-by-side with microgravity-related studies aiming at a better understanding of human body and brain mechanisms to extend a healthy lifespan. In order to centralize in one user-friendly location all the myriad tools, laboratories and facilities needed to maximise progress related to all such challenges, SpaceLand is developing a unique multi-disciplinary infrastructure in Italy, mirroring back the SpaceLand Center being conceived for Africa in Mauritius, as presented by a renowned African scientist in her role as Head of State at the United Nations together with this paper's author (www.youtube.com/watch?v=2RthuFMcdfg). Such a first open-door Center of Excellence for Microgravity will be a reference destination for scientists and innovators. Ad-hoc designed ground, underwater and flight facilities will thereby provide

unparalleled opportunities for analysis and concurrent engineering to develop and test microgravity-S.T.E.A.M.M. (Science, Technology, Engineering, Arts, Math and Medicine) experiments and prototypes to be operated in weightlessness. People at any age and STEAMM hardware will be prepared for Mars-gravity, Moon-gravity and Weightless Flights on specially-modified large turbo-jet aircrafts. At the local airport, subsequent launch campaigns will enable STEAMM users to mimic microgravity kinematics and dynamic phenomena related to cosmic objects and their fractal-like interactions. Among such experiments, there will be room for the first batch of STEAMM payloads including satellite test-equipment to fly on history-1st sub-orbital microgravity flights from South of Europe, paving the way to Europe's first satellite aero- launching. This initiative hinges around seveal SpaceLand records set during research and educational flights conducted also on behalf of the winner of the Nobel Prize for Medicine, Rita Levi-Montalcini. This presentation will provide further details on such a unique Space Knowledge Economy hub and on the upcoming microgravity research and educational opportunities which SpaceLand for more than 20 years has opened to All.


## Biography:

Dr. Carlo Viberti Graduated with Honours at 24 years of age as Doctor in Aeronautical Engineering at the University Politecnico Torino (Italy), in 2010 has been proposed by the President of the Italian Space Agency as first sub-orbital astronaut-engineer for sub-orbital research flights. In 2005 became the first non-U.S. citizen authorized to fly from the NASA Space Shuttle L.F. at the Kennedy Space Center (Cape Canaveral-Florida) for the first NASA Microgravity Pathfinder Flights. So far he has worked in weightlessness almost three times longer periods than Iuri Gagarinâ€™s spaceflight; during such test-flight programs, he trained and brought on board representatives of the general population, including the worldâ€™s oldest (93 years of age), the first disabled woman and the youngest-ever (11 yr-old) life-sciences test subjects in zero-gravity, for experiments involving Nobel Prize-winning scientists with spin-off biomed and technological applications for kids, disabled and elderly.

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# Searching for Fast Infrared Bursts

**Alessandro Drago**
*University of Florence, Italy*

## Abstract:

The gravitational wave GW170817 from the merger of two binary neutron stars and the simultaneous electromagnetic detection by Fermi Gamma-Ray Space Telescope and by other experiments, opened a new era in multi-messenger astronomy after the SN1987A event with visual and neutrino detection. Furthermore, the well-known GRBs (Gamma-Ray Bursts) and the mysterious FRBs (Fast Radio Bursts), together with the multi-messenger astronomy, have started interest to develop new detectors and telescopes for the time-domain astronomy in all the ranges of the electromagnetic spectrum. The time-domain astronomy has the goal to acquire fast astronomical transients or bursts in the temporal range from few seconds to 1 ns. This contribute describes a new detection system working in the mid-infrared range to search for astronomical infrared bursts (FIRBs). FIRB is a type of signal that has been little or not studied at all, also due to a lack of adequate tools. Experience done in the diagnostics for lepton circular accelerators can be used to design longitudinal diagnostic devices for astronomy. In the jargon of the accelerator physics, a longitudinal diagnostic system acquires bunch-by-bunch particle signals in the temporal direction. Vice versa, in the same jargon, a transverse device integrates the beam signal in the horizontal and vertical coordinates. A conceptual design has been developed by tests carried out at Sinbad, the infrared beam line of DAFNE, the INFN electron-positron collider located at Frascati in Italy. Sinbad releases pulsed IR light with 2.7 ns separation. The detector system is able to detect infrared signals in the range 1-10 microns with 1 ns of rise time. Performances have been evaluated at Sinbad. The future goal is to place the HgCdTe detector in the focal plane of a reflecting telescope, as a Cassegrain or a Ritchey-Chretien. The telescope shall point toward astronomical objects of interest as for example the supermassive black hole SGR A*. Programs based on artificial intelligence techniques will select automatically the most interesting recorded tracks.

**Keywords:** Multi-Messenger Astronomy; Time-Domain Astronomy; HgCdTe Detectors; Infrared Telescopes

## Biography:

Dr. Alessandro Drago has achieved the Master Degree in Physics with “Magna cum Laude” in 1978 at “La Sapienza” University of Rome. Since 1992 he gets a permanent position at the Laboratori Nazionali di Frascati (LNF) of the Istituto Nazionale di Fisica Nucleare (INFN). In May 2020, he retired becoming Senior Research Associate. From 2011 to 2020 he has been Contract Professor for the course of Cybernetics, in the Department of Physics, at the Rome “Tor Vergata” University. At LNF he has worked mainly on the design and commissioning of DAFNE, the Italian electron/positron circular collider. As accelerator physicist he has collaborated with SLAC (Stanford Linac Accelerator Center, USA), with ALS (Advanced Light Source, at the Berkeley University, USA) and with CERN (Geneve, Switzerland). At LNF he has also made part of the SPARC (a Frascati free electron laser) team designing the timing system. He has coordinated other important researches in the accelerator beam diagnostics developing mid-infrared devices with time resolved capability. At the University of Florence, in the physics and astronomy department, he is currently working on fast mid infrared detectors by using ground-based telescopes, developing a preliminary design study to search for astronomical FIRB (Fast InfraRed Bursts).

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# A Kinematic Analysis of WIMP Dark Matter in Milky Way Satellites

**Raees Noorbhai**
*Wits Centre for Astrophysics, South Africa*

## Abstract:

The WIMP Dark Matter hypothesis, first proposed in the 1970s, has received no empirical support in the decades since. Successive instances of non-detection by direct detection experiments, collider searches and indirect detection experiments have placed stringent upper bounds on the velocity-averaged Annihilation cross-section $(\sigma v)_\psi$ of WIMPs$_\psi$, with lighter WIMPs and WIMP-Hadron interactions empirically ruled out.From the equation for $(\sigma v)_\psi$, equations are derived hereinfor the Mean Free Path$(\lambda)_\psi$ and Mean Annihilation Period $(T)_\psi$ of the WIMPs in their respective Halos.This derivation is done for the case where the Halo boundary is set to an arbitrary radius, along with the special case with the boundary at the virial radius. In conducting the kinematic analysis, the upper bounds on $(\sigma v)_\psi$ imposed by the ASKAP/EMU indirect radio search in the Large Magellanic Cloud are first considered.Thereafter, the upper bounds imposed by the ATCA indirect radio search in the Ultrafaint dwarf Reticulum II are considered. By solving the equations for $(\lambda)_\psi$ and $(T)_\psi$, we determine that for both Dark Matter-dominated Milky Way satellites, the lower limits on both theWIMP Mean Free Path and the Mean Annihilation Period exceed by many orders of magnitude the Hubble distance in the case of $(\lambda)_\psi$, and the Hubble time in the case of $(T)_\psi$. Moreover, at the virial radius boundary, the equation derived for$(T)_\psi$ is independent of all Halo parameters and hence can serve as a physical quantity illustrating the severe extent to which the WIMP Annihilation channel has been empirically suppressed.

**Keywords:** Dark Matter; WIMPs; Indirect Detection; Dwarf Galaxies

## Biography:

Mr. Raees Noorbhai is an astrophysicist, writer and activist, with academic research interests in Dark Matter, multi-messenger astronomy, theoretical astrophysics and Milky Way satellites in the Local group, including dwarf galaxies and the Magellanic clouds. In 2019, he was the chairperson of the student councils for both the School of Physics and the Faculty of Science at Wits University in Johannesburg, as well as the chairperson of the Wits Student Forum. He is the founder of the Decolonisation of Science reading club and has also published a number of essays on Climate Justice. In 2023, he received a Master's in Astrophysics cum laude from Wits university for his dissertation on particle Dark Matter, focusing on multi-messenger searches for Dark Matter in Milky Way satellites, utilising next generation telescopes with unprecedented detection capabilities. These include CTA in the gamma ray domain, KM3NeT in the neutrino domain and MeerKAT in the radio domain. He also served as chairperson of the Amnesty International chapter at Wits university from 2015 to 2018 and is currently the National Co-ordinator of the Socialist Youth Movement in South Africa.

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# The Effects of Gravitational Wave Recoil on Black Holes

**Karan Chawla**
*Ashoka University, India*

## Abstract:

In space, a black hole is a region where gravity is so strong that even light cannot escape. Because the substance is compressed into such a small area, the gravity is extremely intense. While a star is dying, this may take place. Furthermore, the asymmetric emission of gravitational waves that results from the merger of two black holes gives the merged system an impulse; this gravitational-wave recoil velocity can reach up to 4000 km/s, which is more than fast enough for the black hole to leave its host galaxy. One can observe that a lot more study is needed on the impact of gravitational wave recoil and its impact on the evolution of the supermassive huge black hole after doing extensive amounts of systematic literature research on these issues. Most research makes the assumption that the black hole is stationary, which is problematic since recoil can be altered by the black hole moving in an opposite, identical, or parallel direction. The shape of the primordial globular cluster, the amount of mass in low metallicity systems, the impact of few body-black hole interactions on the emergence of the early globular structure, and other factors are all the subject of extensive research on the current methods for determining the characteristics of a black hole. In addition to considering the growth and evolution of the host galaxies of the host black hole, this review paper investigates the effects of gravitational recoil on three different types of black holes, namely Massive, Intermediate, and Supermassive Black Holes. The paper also provides recommendations for future work that will aid in understanding how gravitational wave recoil affects the development of the galaxy that contains the host black hole.

**Keywords:** Black Hole; Gravitation; Recoil; Universe; Intermediate Black Hole; Supermassive Black Hole

## Biography:

Mr. Karan Chawla - Born in 2002 in Jaipur, India, Karan is a student at Ashoka University pursuing his 3rd year as an undergraduate with a specialisation in computer science, economics, and physics. Physics is a passion for him, and while he has taken several physics courses in college, his keen interest in the subject is reflected in the published papers on topics like space propulsion, black hole physics, black hole computing, and exoplanet detection. He has worked as a research intern at NELCO (a satellite VSAT provider). His main area of research was VSAT access methods: uplink, downlink, SCPA, and TDMA terminals.

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# On a Possible Solution of Nordstrom-Einstein Paradox Referring to the Nullity of Stress-Energy Tensor Invariant of EM Field and Consequences

**Constantin Sandu**
*Physics of Flight-Aerospace-Turbomachinery, Romania*

## Abstract:

This paper presents a possible solution of Nordstrom-Einstein paradox observed 111 years ago referring to the nullity of stress-energy tensor invariant of electromagnetic field and emphasizes some important consequences in the progress of Physics. In 1913, Nordstrom blamed Einstein's General Theory of Relativity that cannot explain why the electromagnetic waves confined in a mass-less box with reflective walls have a gravitational mass while the invariant of the stress-energy tensor of the electromagnetic field is zero.
Really, it is well known that when Einstein's field equations,

$$R_{ik} - \frac{1}{2} \cdot g_k \cdot R = -\frac{8\pi G}{c^4} \cdot T_k$$

are 'contracted' by multiplying the equations in the covariant form with the metric tensor gik (i, k=0, 1, 2, 3) expressed in counter-variant form followed by summation, provides a new form of Einstein's field equations which is given by:

$$R = \frac{8\pi G}{c^4} T$$

where R is Ricci's scalar curvature, G is the gravitational constant, c is the speed of light and T is the invariant of the stress-energy tensor (a scalar, too).

As T is always null scalar in the case of electromagnetic waves travelling free in space, Ricci's scalar curvature R must be null, too. This means that the electromagnetic waves travelling free in space cannot distort the continuum space-time as the condensed matter does.

During the intense debates between Nordstrom and Einstein from that time on the above subject, the single explanation given by Einstein was that: "...the electromagnetic radiation enclosed within a mass-less box with reflective walls would not acquire a gravitational mass although that radiation would exert a pressure on the walls of the box. These walls would become stressed and, simply because of this stress, the walls would acquire a gravitational mass". At present it is clear for everybody that a mass-less wall cannot be stressed simply because of the absence of mass, i.e. such a 'stress' cannot have any physical sense.

So, while in the case of a sphere made of condensed matter it can be admitted that the gravitational field is generated in every point of the sphere, in the case of a sphere with mass-less reflective walls filled with electromagnetic waves, the gravitational field can be generated only on sphere's surface, i.e. during the reflection of the electromagnetic waves by its surface because inside the sphere R=T=0. This outstanding feature of matter which has not been considered by now must have important consequences in the progress of Physics. A first consequence is that inside Theory of General Relativity must be admitted that a body composed of condensed matter must generate gravitational waves which distort the continuum space-time. A second consequence is that the gravitational field generated by the condensed matter should have an electromagnetic origin.

**Keywords:** Gravitational Waves Radiation; Gravitation Field Radiated by Condensed Matter; Conversion of EM Waves in Gravity

## Biography:

Dr. Constantin SANDU is an esteemed Aerospace Engineer with a Ph.D., renowned for his expertise in theoretical physics, aerospace engineering, and aerodynamics. Currently serving as a Senior Researcher and Project Manager at COMOTI in Bucharest, Romania, he has amassed a wealth of experience and knowledge throughout his distinguished career. Prior to his tenure at COMOTI, Constantin held key positions at prominent organizations including S.C. Turbomecanica SA, General Electric, and SMCPFA. His extensive collaboration in European Commission Research and Development projects with leading aerospace entities such as Airbus, SAFRAN, Rolls-Royce, and DLR underscores his significant contributions to the field. With a prolific publication record, Constantin has authored over 75 papers covering diverse topics ranging from theoretical physics to aerospace engineering and aerocoustics. His groundbreaking research has yielded seminal insights, including the theorem of conversion of electromagnetic waves into gravitational waves, and elucidation of phenomena such as the equality between inertia mass and gravitational mass. Notable contributions also include innovative explanations for mass increase with speed as a relativistic Doppler effect, and advancements in gravitational propulsion for spacecraft. In addition to his scholarly achievements, Constantin holds over 20 patents in aerospace propulsion, reflecting his ingenuity and creativity in advancing the frontiers of aerospace technology. Constantin SANDU's remarkable career trajectory and profound contributions to the field of aerospace engineering exemplify his unwavering commitment to innovation and excellence in scientific research and development.

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# The Role of Strategic Environmental Assessment in Precautionary Protection of the Environment During the Development of Renewable Energy Projects

**Boško Josimovic[1]***, Bocidar Manic[2], Saša Milijic[3], Ljubiša Bezbradica[4], Nikola Krunic[5]
*Institute of Architecture, Urban and Spatial Planning of Serbia, Serbia*

## Abstract:

Despite numerous undeniably positive effects of using renewable energy sources on space, and the reduction of energy sector environmental impact and carbon footprint, certain side effects renewable energy projects could implicate in space still pertain. The intensity of negative effects is in direct correlation with the project type (a wind farm, a solar power plant, a biomass power plants, etc.), predominantly impacting biodiversity, population (e.g. noise, shadow flicker effect), landscape, repurposing of land, etc. Such impacts often come as a consequence of inappropriate spatial positioning of power plant facilities that use renewable energy sources and/or inadequate solutions applied in the project planning stage. That is why applying the principle of precautionary protection in the earliest phase of project developing, while it is still being planned, is of utmost importance, allowing minimisation or elimination of all negative effects by opting for most favourable spatial solutions. The paper underscores the significance of Strategic Environmental Assessment (SEA) process in renewable energy sources project planning as a globally adopted instrument in precautionary protection of the environment and spatial planning. The focus is on the role of the SEA process in selecting the optimum solutions for preventing potential conflicts in space, simultaneously reducing risks for the investors in the project development process. Such an approach enables sustainable solutions in renewable energy use, on the one hand, and creates a sound base for investment in such projects, on the other. Of particular importance in SEA are the holistic approach and the use of semi-quantitative method of multicriteria assessment of planning solutions, but also building foundations for the implementation of EIA and ESIA processes based on precautionary environment protection solutions. That is exactly the way the EIA and ESIA processes, which are the continuation of the SEA process, can be effectively implemented in the final phases of project development, simultaneously reducing investment risks, which is of no less importance.

**Keywords:** Strategic Environmental Assessment; Precautionary Protection; Renewable Energy Projects; Planning

## Biography:

Dr. Boško Josimovic, PhD, graduated from the Faculty of Geography, Spatial Planning Department, at Belgrade University in 2000. He obtained his MSc degree in 2003 and completed his PhD in 2008. Since 2003, he has been employed at the Institute of Architecture, Urban and Spatial Planning of Serbia (IAUS), where he has held various positions, including Research Fellow, Senior Research Fellow, and Principal Research Fellow. In his role at IAUS, he coordinates national and international scientific and professional cooperation projects focusing on environmental protection and spatial development. Dr. Josimovic specializes in interdisciplinary research, particularly in environmental assessment methodologies for strategic development policies and projects related to spatial and urban planning, energy, and renewable energy sources. He has published over 100 research papers in prestigious international scientific journals and authored books on topics such as the impact of wind farms on the environment. Dr. Josimovic has led numerous scientific projects financed by Serbian ministries and international bodies, including an international research project under HORIZON 2020. He has also contributed to technological development in renewable energy sources and serves as a reviewer for leading international journals such as Energy and Science of the Total Environment.

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# Insight into Growth Rate of the Universe from Galaxy Correlation Functions

**Siddharth Satpathy**
*Element Energy, USA*

## Abstract:

We present a measurement of the linear growth rate of structure, f, from the Baryon Oscillation Spectroscopic Survey (BOSS) Data Release 12 (DR12) of the Sloan Digital Sky Survey III (SDSS-III). We model the two-point statistics of BOSS galaxies in DR12 using convolution Lagrangian perturbation theory (CLPT) with Gaussian streaming redshift space distortions (GSRSD). There are 1198 006 large galaxies in the BOSS-DR12 data collection, distributed along the redshift range of $0.2 < z < 0.75$. Three redshift bins are used to group these galaxy samples. We give values of $f\sigma 8$ for the three redshift bins based on our analysis of the combined sample of the three redshift bins using CLPT-GSRSD. At zeff = 0.38, $f\sigma 8 = 0.452 \pm 0.057$ at zeff = 0.51, and $f\sigma 8 = 0.457 \pm 0.052$ at zeff = 0.61 are the values we observe. The results align with the forecasts of Planck's $\Lambda$ cold dark matter-general relativity theory. Our limitations on the speeds of structure formation in the Universe at various redshifts provide a helpful tool for differentiating between dark energy-based and modified gravity-based models of the Universe. This study is one of a series that examines the last batch of BOSS galaxy clustering data. Together with additional measurements and likelihoods from Alam et al., these results provide the definitive BOSS cosmological constraints.

**Keywords:** Dark Energy; Dark Matter

## Biography:

Dr. Siddharth Satpathy is a senior member of the technical staff responsible for AI battery algorithms at Element Energy in California. He has worked as a senior machine learning engineer for reputable firms like Deepfence and Cisco before joining Element Energy. He received his PhD in astrophysics from Carnegie Mellon University in Pittsburgh (CMU), as well as master's degrees in physics, machine learning (ML), and another master's degree in physics from the National Institute of Science Education and Research (NISER) in India. He worked at Deepfence, a company that provides services in cloud security and observability. In Deepfence, he designed machine learning platforms for the detection of network communication anomalies and irregularities. He also created FlowMeter, a well-known open-source AI application that uses machine learning to analyse and organise network packet samples. His work, Flowmeter, has about 1,000 GitHub stars and has been widely adopted by the machine learning community. Dr. Satpathy worked on the Cisco team that created the Predictive Networks (now known as WAN Insights), which allowed networks to forecast user experience. The Cisco 2023 Tech Innovator Award went to WAN

Insights. During his doctoral studies at CMU, Dr. Satpathy examined the large-scale structure of the cosmos and the existence of dark energy. Here, he classified photos from telescopes using deep learning architectures to find proof of dark energy. Additionally, he created estimators to investigate enormous datasets of galaxies and quasars in order to glean knowledge about the composition and development of the cosmos. One of his significant works, which demonstrated how NASA's Nancy Grace Roman Space Telescope could gaze back in time to observe where sound waves from the early universe left traces, was the subject of a press release from NASA.

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# Time Scales of Chemical Processes from Analytical Expressions form Markov Chains in the Galerkin Representation

**Orchidea Maria Lecian**
*Sapienza University, Italy*

## Abstract:

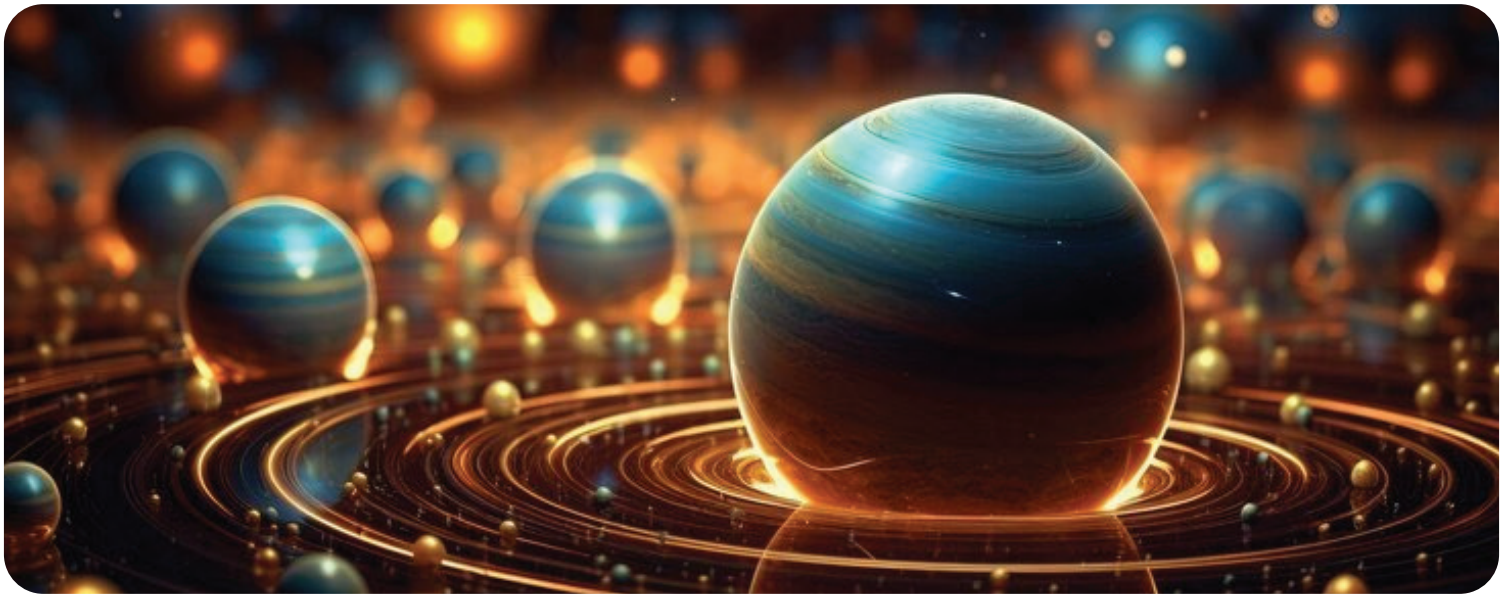
The processes from [I.L. MacDonald, Simple examples of continuous-time Markov-chain models for reactions. Reac Kinet Mech Cat 136, 1 (2023)] are newly provide with analytical expressions of time evolution chains states. The lumping hydrocraking with metallic-Nikel catalysts on alumina from [D. Bouzouita, A. Lelevic, C. Lorentz, R. Venderbosch, T.H. Pedersen, C. Geantet, Y. Schuurman, Co-processing bio-liquids with vacuum gasoil through hydrocracking, Applied catalysis B: Environmental 304, 120911 (2022)] are newly ndowed with analytical expressions of Markov chains theory.

The new methods are newly applied to answer the interrogations from [I.L. MacDonald, E.A.D. Pienaar, Continuous-time Markov-chain models for reaction systems: fast and slow processes, Reac. Kinet. Mech. Cat. 136, 1757 (2023)] about hydrocracking and those about [J. Yang, W.J. Bruno, W.S. Hlavacek, J.E. Pearson, On Imposing Detailed Balance in Complex Reaction Mechanisms, Biophysical Journal 91, 1136 (2006)].

## Biography:

Prof. Orchidea Maria Lecian graduated in Physics- Theoretical Physics in 2005 at Sapienza University of Rome, Italy, Physics Department and ICRA- International Center for Relativistic Astrophysics Relativistic Astrophysics, and completed her PhD in Physics- Relativistic Astrophysics (IRAP_-International Relativistic Astrophysics PhD) at Sapienza University of Rome, Physics Department and ICRA in 2008, Sapienza Unviersity of Rome, with an INFN (National Institute for Nuclear Physics) Postdoctoral Fellowship. Accomplished postdoctoral studies at IHES- Institute des Hautes E'tudes Scientifiques, Bures-sur-Yvette, France, and APC- Astroparticules et Cosmologies, Paris, France (2009-2010) with a Sapienza University Postdoctoral CUN2 Research Fellowship , an Angelo Della Riccia Postdoctoral Fellowship and an IHES Postdoctoral Fellowship; AEI-MPI (2009-2011), Max Planck Institute for Gravitational Physics- Albert Einstein Institute, Potsdam-Golm, Germany (2011 and 2013) with a Grant awarded to Foreign Postdocs and a Postdoctoral Research Grant; and Sapienza University of Rome (2011-2013 and 2013-2014) with a Sapienza University Postdoctoral Fellowship. Has been Assistant Professor at Sapienza University of Rome, Architecture Department, SBAI (Department of Fundamental Sciences and Engineering), DIAEE (Department of Astronautics Engineering, Electric and Energetic) (2007-2017). Has been Researcher at Comenius University in Bratislava, Faculty of Mathematics, Physics and Informatics, Department of Theoretical Physics and Physics Education- KTFDF and appointed Erasmus Lecturer with a SAIA- NS'P (Slovak Academic Information Agency- National Stipendium Program me of the Slovak Republic) grant for International University Researchers (2017-2018).

# UPCOMING EVENTS



## 3rd International Summit on Gravitation, Astrophysics and Cosmology

***March 13-15, 2025 | Valencia, Spain***

&

## 3rd International Summit on Civil, Structural and Environmental Engineering

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