Nonlinear Science Working Group

24th International Symposium on Disordered Systems: Theory and Its Applications

Istanbul University*, İstanbul, Türkiye

21-23 November 2024

*Istanbul University Rectorate Building,
Mavi Salon (Blue Room), Beyazıt, İstanbul

Abstract Booklet

Purpose of the Symposium

This scientific event will provide a good opportunity for complexity, nonlinear science & multidisciplinary field scientists and participants who are interested for information exchange. The objective of this symposium organized by Nonlinear Science Working Group which was founded 2001 is to bring together leading specialists and young scientists working on various aspects of complexity and nonlinear science, to discuss the most recent developments in that area.

This year, we are delighted to introduce two new initiatives to the symposium program. The first is the inaugural Gell-Mann Memorial Lecture Series, dedicated to honoring groundbreaking contributions to complexity science and inspired by the visionary legacy of Murray Gell-Mann. The second is a special session titled Women in Complexity Science, which aims to highlight and support the vital role of women researchers in the field.

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SYMPOSIUM PROGRAM

Nonlinear Science Working Group
for exploring complex worlds
Since 2001
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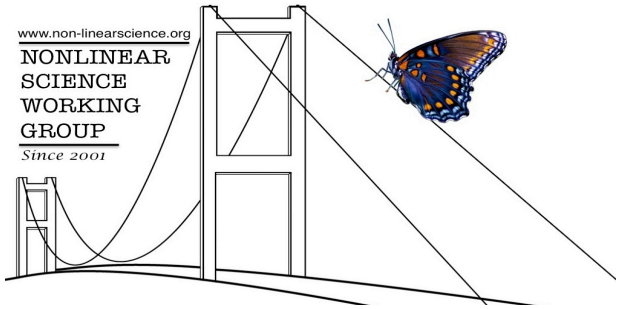

24th International Symposium on "Disordered Systems: Theory and Its Applications" (DSS-2024) 21-23 November 2024

Istanbul University*, İstanbul, Türkiye

21 November 2024 Thursday	
09:30 - 10:00	Registration
10:00 - 10:15	Welcome and Opening
	Women in Complexity Science Session
10:15 - 10:45	"Coupled dynamics on hypergraph: beyond pairwise interactions" **Sarika Jalan** Indian Institute of Technology of Indore, India
10:45 - 11:10	"Global challenges in environment as complex systems" **G.Cigdem Yalcin** Istanbul University, İstanbul, Türkiye
11:10 - 11:25	Coffee break
11:25 - 11:50	"Improving power-grid systems via topological changes, or how self-organized criticality can help power-grids" **Geza Odor** HUN-REN Centre for Energy Research, Hungary
11:50- 12:15	" "NMG" Instanton Universe" **Nazmi Yılmaz** Koç University, İstanbul, Türkiye

12:15 - 12:40	"A mathematical foundation of gradient harmonic grammar modeling of Greek lexical stress" **Ilias Mittas and Michael Kanetidis** Aristoteles University of Thessaloniki, Greece
12:45	Group photo
12:50	Campus tour
14:30 - 14:55	"Entropy-based measurements of self-organized complexity: A view on the dynamics of the dissipative standard map" **Sevda Saltık** Atatürk University, Erzurum, Türkiye
14:55 - 15:20	"Hydrogen bond networks reveal key residues in DHFR function" **Tandaç Furkan Güçlü** Sabancı University, İstanbul, Türkiye
15:20 - 15:45	"The impact of fractal calculus on Lyapunov exponents and memory effects" **Ozan Kıyıkcı** Atatürk University, Erzurum, Türkiye
15:45 - 16:00	Coffee break
16:00 - 16:25	"The effect of demographic stochasticity on predatory-prey oscillations" **Solmaz Golmohammadi** Institute for Advances Studies in Basic Sciences, Zanjan, Iran
16:25 - 16:50	"Integrated Science Technology Art and Mathematics: "I-STEAM" " **Burcu Türkkan** STEM Istanbul Provincial Coordinator, Türkiye
16:50 - 17:00	Wrap-up session

22 November 2024 Friday	
09:30 - 10:00	Registration
10:00 - 10:25	"Building network: the role of international academic relations in Istanbul University" **Feyza Nur Tuncer Kılıç** Istanbul University International Academic Relations Unit, İstanbul, Türkiye
10:25 - 10:50	"On the interplay of biological cell states, state dynamics and molecular information processing" **John Lock** University of New South Wales, Sydney, Australia
10:50 - 11:15	"Investigation of two-year COVID-19 pandemic spread behavior in the world using the nonlinear time series method" **Hasan Tatlıpınar** Yıldız Technical University, İstanbul, Turkiye

11:15 - 11:30	Coffee break
11:30 - 11:55	"Exploring non-linearity in prospective life cycle assessment: Insight from scaling up bioprocessess" **Mine Güngörmüşler** İzmir University of Economics, İzmir, Turkiye
12:30	Group photo
12:40	Süleymaniye Mosque visit
14:30 - 14:55	"Democracy of "dissensus" in thinking of a postmodern complex utopia" **Balca Arda** Kadir Has University, İstanbul, Türkiye
14:55 - 15:20	"Adaptation and resilience in urban complex systems: Istanbul's earthquake risk and the politics of the maybe" **Murat Güney** Özyeğin University, İstanbul, Türkiye
15:20 - 15:35	Coffee break
15:35 - 16:00	"The correspondence between Jung and Pauli on the search for a single world(Unus Mundus) and the theory of synchronicity" **Özlem Küskü** Destek Publishing House Editor, Türkiye
16:00 - 16:25	"Nothingness and zuhur" **Gediz Akdeniz** Nonlinear Science Working Group, Türkiye
	Murray Gell-Mann Memorial Lecture
16:25 - 16:55	"The biggest gap in science: Complexity… & How to close it" **Alberto Robledo** Universidad Nacional Autónoma de México, Mexico City, Mexico
16:55- 17:00	Wrap-up session

23 November 2024 Saturday
"**Complex$_c$ity** İstanbul Tour" guided by Gediz Akdeniz More details will be given at the opening.

Istanbul University*: Istanbul University Rectorate Building, Mavi Salon (Blue Room), Beyazıt, İstanbul

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ABSTRACTS

Coupled Dynamics on Hypergraph: Beyond Pairwise Interactions

Sarika Jalan

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Since long-modelling real-world complex systems are made up of a large number of interacting dynamical units, they incorporate only pairwise interactions. Increasingly, it has been realized that a variety of complex systems, such as the Brain, society, weather, etc., not only have their units forming higher-order interactions, but also such interactions might govern the associated coupled dynamics, yielding completely different behaviours than those predicted by pairwise interactions. Using phase-lagged coupled Kuramoto oscillators with higher-order couplings as a case study, we will demonstrate such a behaviour, that is, first-order transition to cluster synchronization along with associated numerical and analytical challenges.

References

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[4] Prolonged hysteresis in the Kuramoto model with inertia and higher-order interactions, NG Sabhahit, AS Khurd, S Jalan*, 4. Physical Review E 109 (2), 024212 (2024).

Global Challenges in Environment as Complex Systems

G.Cigdem Yalcin

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In this talk, we will take global issues in terms of real-world problems in different fields from health, technology, energy, economy and specially in environment. We will focus on how global issues are complex systems and explain what properties are of complex systems. How these properties cause the challenges with understanding and working with complex systems.

To understand better global issues, we will illustrate the properties of complex systems that are interactions, emergence, dynamics, self-organization, adaptation, interdisciplinarity, new methods. As methods which was created for specificly complex systems, we will shortly discuss, q statistics, superstatistics and complex networks. From there, we will discuss how global problems can be approached with techniques built for complex systems.

Improving Power-Grid Systems via Topological Changes, or How Self-Organized Criticality can Help Power-Grids

Géza Ódor[1], Bálint Hartmann[1], István Papp[1], Kristóf Benedek[1], Shengfeng Deng[2], Jeffrey Kelling[3],

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[2] Shaanxi Normal University, School of Physics and Information Technology, China
[3] Helmholtz-Zentrum Dresden-Rossendorf , Germany

Cascade failures in power grids occur when the failure of one component or subsystem causes a chain reaction of failures in other components or subsystems, ultimately leading to a widespread blackout or outage. Controlling cascade failures on power grids is important for many reasons like economic impact, national security, public safety and even rippled effects like troubling transportation systems. Monitoring the networks on node level has been suggested by many, either controlling all nodes of a network or by subsets. We identify sensitive graph elements of the weighted European power-grids (from 2016, 2022) by two different methods. We determine bridges between communities and point out "weak" nodes by the lowest local synchronization of the swing equation. In the latter case we add bypasses of the same number as the bridges at weak nodes and we compare the synchronization, cascade failure behavior by the dynamical improvement with the purely topological changes. We also compare the results on bridge removed networks, similar to islanding, and with the addition of links at randomly selected places. The synchronization improves the best by the bypassing, while the average cascade sizes are the lowest with bridge additions. However, for very large or small global couplings these network changes do not help, they seem to be useful near the synchronization transition region, where self-organization drives the power-grid. Thus, we provide a demonstration for the Braess' Paradox on continental sized power grid simulations and uncover the limitations of this phenomenon. We also determine the cascade size distributions and justify the power-law tails near the transition point on these grids.

References

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NMG Instanton Universe

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In our recent work [1], we (NMG) investigated the formation of the Universe's first particles through the lens of the massless Thirring model, used as a theoretical framework to simulate early Universe dynamics. For this we examined entropy, Lyapunov exponents, and cyclic attractors within the Thirring model. The cyclic attractor shows a fixed point solely in instanton solutions of the Thirring model, with no entropy, indicating a zero-energy state. As the system undergoes slight changes, quantum fluctuations and entropy resume, leading to a sudden increase in entropy that marks the creation of fermionic particles, hence the birth of the Universe. By this theoretical approach, we proposed that the Universe began from a zero-energy state, 'zuhur'—unpredictable emergence—characterized by the absence of entropy and quantum fluctuations. According to our results we suggest that this model parallels the Hawking-Turok instanton framework, providing insights into the pre-Hawking-Turok state and offering a unique perspective on the chaotic processes at the Universe's inception.

References

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A Mathematical Foundation of Gradient Harmonic Grammar Modeling of Greek Lexical Stress

M. Kanetidis[1], I. Mittas[1,3], K. Kosmidis[1], A. Revithiadou[1], G. Markopoulos[2], P. Argyrakis[1], M. Tsouchnika[1], Ei. Apostolopoulou[1,4], V. Apostolouda[1]
[1]AUTh, [2]University of the Aegean, [3]NKUA, [4]UiT

This study explores the complexities of stress assignment in the Greek lexical stress system, focusing on the phonology-morphology interface. Greek has lexically determined stress (Revithiadou 1999) (cf. languages with phonologically determined stress, Hayes 1995). Variability in stress assignment is influenced by factors like word size and inflection/noun class. In Greek, stress may fall on any of the last three syllables, as in [ˈðaskalos] 'teacher', [kuˈɲaðos] 'brother-in-law', [ceraˈvnos] 'thunder'. Prior studies suggest that stress assignment in adult native speakers is affected by word size and noun class, with a preference for antepenultimate stress in trisyllabic nouns ending in *-os* or *-o* (e.g., Apostolouda 2018). These findings align with data from lexical resources like the *2002 Reverse Dictionary* and an annotated version of *Clean* (Propopapas et al. 2012) (Apostolouda 2018).

To model this variation, we use *Gradient Harmonic Grammar* (GHG) (Smolensky & Goldrick 2016), which is built on a system of weighted constraints. The employed constraint set includes DEP ("do not insert structure"), MAX ("do not delete structure"), TROCHEE ("display stressed-unstressed pattern"), and ALIGN-R ("align trochee with the right edge"). Each constraint bears a weight, i.e., a numerical value that reflects its importance in the evaluation of linguistic forms. Higher weights lead to greater penalties in case of a violation. The degree of violation is also influenced by the *activity level*, i.e., the strength, of a stress property. The total penalty score incured by a stress pattern corresponds to its *harmony*, which translates into a probability of occurrence. GHG ranks the possible stress patterns according to their harmony.

This study provides a mathematical framework for computing stress probabilities, offering a detailed modeling of stress distribution across noun classes based on their endings. We construct three sets of GHG based on stress patterns in the Lexicon, the annotated Clean corpus, and a lexical database, i.e., *HelexKids* (Terzopoulos et al. 2016), respectively. These combine to give a fine-grained view of stress assignment across Greek noun classes. Significantly, our mathematical approach reveals a flexibility in constraint weights, suggesting novel insights into constraint behavior not previously thought in GHG models.

This interdisciplinary approach emphasizes the importance of integrating linguistic theory into computational models and applying complex systems theory to real-world challenges. Our findings highlight GHG's strength as a stochastic model for capturing variable stress patterns, paving the way for AI systems to produce more natural speech and better interpret prosody.

Entropy-Based Measurements of Self-Organized Complexity: A View on the Dynamics of the Dissipative Standard Map

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[2]Ataturk University, Faculty of Science, Physics Department
[3]Ege University, Faculty of Science, Physics Department

Entropic measures play a critical role in understanding self-organized complexity, particularly in dynamic systems. The dissipative Standard Map, originating from a one-dimensional atomic chain model, serves as an ideal framework for studying these phenomena. In this work, we employed the q-Renormalized entropy, a recently developed entropy-based complexity measure, to investigate the transitions between equilibrium and non-equilibrium states within the system. This measure has demonstrated its effectiveness in distinguishing the distinct phases of the system and identifying key transition points. Our study highlights that atomic chains, initiated with randomly selected conditions, exhibit a pathway to chaos characterized by periodic bifurcations. We also observed a correlation between entropy and organizational order: as entropy decreases, organizational order increases, peaking near the edge of chaos. Beyond this point, as the system enters a more chaotic regime, increasing entropy corresponds with a decline in organizational order.

References

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Hydrogen Bond Networks Reveal Key Residues in DHFR Function

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In this study, we investigate the underlying changes in protein dynamics by employing graph theory to generate 'hydrogen bond networks' [1], where residues are represented as nodes and hydrogen bonds as edges. Our system of focus is the enzyme dihydrofolate reductase (DHFR) which forms a model system for investigating antibiotic resistance with its natural substrate, dihydrofolate (DHF), as they play a vital role in folate metabolism essential for DNA synthesis. To understand the molecular mechanisms of resistance emerging under the evolutionary pressure of drugs, mutations in DHFR have been extensively studied. Computational studies using molecular dynamics (MD) simulations have shown that hydrogen bond occupancy and their time-dependent behavior significantly impact drug resistance [2, 3]. Here, we focus on the time evolution of hydrogen bond paths traversing the substrate DHF throughout the MD trajectory and find that residues 109–114 are consistently connected to this substrate. Additionally, we compute the shortest paths, constructed based on time latency over the simulations, and show that residues directly interacting with DHF (27–30), along with residues 109–114 which we propose have long-range interactions, exhibit the shortest latencies in forming paths to DHF. Our findings align with co-evolution and cryptic site analyses, offering new insights into the allosteric effects governed by hydrogen bonds.

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[3] Cetin E., Atilgan A. R., Atilgan C., J. Chem. Inf. Model., 2022, DOI: 10.1021/acs.jcim.2c00507

The Impact of Fractal Calculus on Lyapunov Exponents and Memory Effects

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The study of chaotic dynamics in disordered systems often relies on the analysis of Lyapunov exponents, which measure the sensitivity of the system to initial conditions. This presentation explores the intricate relationship between Lyapunov exponents and the fractional order parameter α within the context of fractal calculus. In particular, the focus is on how the introduction of fractional derivatives can capture memory effects, a key feature in disordered systems.

Traditional integer-order models fail to account for the long-term dependencies present in many physical systems. Using a fractional-order framework, this research investigates how varying the parameter α influences the dynamics and stability of the system. As α deviates from 1, the memory effect induced by the fractional derivative becomes more pronounced, leading to observable changes in the Lyapunov spectrum. The study explores how systems with varying degrees of memory effects (different values of α influence chaotic behavior, providing insights into complex interactions within fractional-order systems.

This work contributes to the broader field of disordered systems by providing insights into the non-local interactions and memory-dependent behaviors inherent in fractional-order systems. By employing numerical simulations and theoretical analysis, the presentation will demonstrate how fractal derivatives introduce a new dimension to the study of chaos, potentially offering new perspectives for future research in disordered systems.

The Effect of Demographic Stochasticity on Predatory-Prey Oscillations

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The ecological dynamics of interacting predator and prey populations can display sustained oscillations, as for instance predicted by the Rosenzweig-MacArthur predator-prey model. The presence of demographic stochasticity, due to the finiteness of population sizes, alters the amplitude and frequency of these oscillations. Here we present a method for characterizing the effects of demographic stochasticity on the limit cycle attractor of the Rosenzweig-MacArthur. We show that an angular Brownian motion well describes the frequency oscillations. In the vicinity of the bifurcation point, we obtain an analytical approximation for the angular diffusion constant. This approximation accurately captures the effect of demographic stochasticity across parameter values.

Integrated Science Technology Art and Mathematics: “I-STEAM”

Burcu Türkkan

STEM Istanbul Provincial Coordinator, Türkiye

Yirmi birinci yüzyıl becerileri eleştirel düşünme, karmaşık problem çözme, yaratıcı düşünme, iletişim ve iş birliği olarak beş temel kapsamda incelenebilir. Bu becerilerin gelişmesinde eğitimde bilim, teknoloji, mühendislik ve matematik disiplinlerinin proje tabanlı öğrenme çerçevesinde (El Sayary vd., 2015); sanat (Mobley, 2015), gerçek dünya problemleri, mühendislik tasarımı, bağlam entegrasyonu, içerik entegrasyonu, otantik uygulamalarının bütünleştirilmesiyle tanımlanan entegre STEAM (i-STEAM) katkı sağlamaktadır (Hiwatig vd., 2022).

Bu çalışmada dinamik bir sistem olan eğitim sisteminde, öğrenme doğrusal olmayan süreç olarak ele alınarak; düzensizliğin içindeki düzen olarak tanımlanan kaotik sistemlerle (Bağcı, 2020: 2806) özdeştirilmiştir. Kaotik sistemlerdeki başlangıç koşullarına hassas bağımlılık ilkesi (Lorentz, 1963) eğitim sisteminin başlangıç koşullarını i-STEAM ile biçimlendirme ile bütünsel açıdan ne gibi değişiklikler olabileceği araştırılmıştır.

On the Interplay of Biological Cell States, State Dynamics and Molecular Information Processing

John Lock

University of New South Wales, Sydney, Australia

Imaging (microscopy)-based single cell systems biology, or 'systems microscopy', enables the measurement of single (biological) cell states, the inference of state dynamics in cell populations, and assessment of how cell states influence (and respond to) molecular-scale information processing – all with spatial resolution at cell population, single-cell and sub-cellular scales. This presentation will introduce several systems microscopy datasets, outlining the types of biological and clinical questions currently addressed, while also highlighting more fundamental questions regarding the computational capacity (total data volume, parallelisation, fidelity) of cells, and how this can be adequately characterised via experimental and analytical techniques. These questions are significant in terms of our understanding of cells as physically embodied 'computers', and more practically, may help optimise measurement strategies that inform disease diagnostics and treatment strategies.

Investigation of Two-Year COVID-19 Pandemic Spread Behavior in the World Using the Nonlinear Time Series Method

Hasan Tatlıpınar[1], Mesut Kaval[1]

[1]Yildiz Technical University, Physics Department, Istanbul, Türkiye

The COVID-19 pandemic, which lasted for more than two years, was a very vital duration that affected the entire world. For this reason, many scientific studies have been done from its beginning to the present day to understand the chaotic nature and spread of the pandemic. Nonlinear time series method (NLTSM) is also one of them. In this context, 2-year daily Covid-19 data of several countries selected from different continents and the world average were taken as a time series and analyzed with the NLTSM method. Accordingly, Fourier power spectra, Lyapunov exponents and phase space portraits of the time series showed that the pandemic spread in the countries were divided into different complex behavioral groups.

Exploring Non-Linearity in Prospective Life Cycle Assessment: Insights from Scaling Up Bioprocesses

Mine Güngörmüşler

Department of Genetics and Bioengineering, Faculty of Engineering, Izmir University of Economics, Izmir, Türkiye

This study focuses on addressing the challenges of non-linearity and uncertainty in prospective Life Cycle Assessment (LCA) models, particularly in the context of biohydrogen production. Scaling up bio-based systems, such as biohydrogen processes, introduces significant complexity due to variations in system dynamics and environmental performance at larger scales. The project investigates how the scaling up of bioprocesses impacts resource efficiency, emissions, and overall system sustainability, incorporating dynamic LCA methodologies that account for non-linear behaviors and uncertainties.

The study aims to offer insights into how scaling bioprocess systems can lead to unexpected environmental outcomes and variability in economic performance. By analyzing these challenges, the project contributes to the development of more robust LCA models that are better equipped to assess large-scale biohydrogen production systems, thus improving the long-term sustainability of bio-based technologies.

Keywords: Life cycle assessment, non-linear systems, bioprocesses, scale-up

Democracy of “dissensus” in thinking of a postmodern complex utopia

Balca Arda

Visual Communication Design, Kadir Has University

This paper analyzes Jacques Rancière's conceptualization of dissensus and disruption of the perceptual regime through a critical reading of complex utopia modeling. Social imaginaries of utopia, emancipation theories, and ideal visions of humankind are based on identifying dynamics of communal livelihoods and formulating emergent structures at the level of society. Karl Marx once explained reality purely in terms of efficient causes, namely class conflict. Due to the taken-for-granted persistence of unrest and disorder, attempts to make the complex phenomenon comprehensible by pinpointing essential emergent structures [2] have become doubtful today to capture societal history theoretically and so that construct utopic communal visions. In that matter, Rancière's dissensus distinguishes itself for its own term of "surplus" sensorium to provoke unpredictable dynamics without following a causal political paradigm. However, dissensus revokes precedent consensual consideration of power and assumed relation of act and actors in the phenomenological realm. Such reframing the field of the given permits an aesthetic democracy, the only way of politics in Rancière’s lens, which means open-ended transformation through the activation of sense-making in the political realm[3]. Gediz Akdeniz already put forward modeling a postmodern complex utopia that disengages duality with dystopia while fully characterized by simulation through digital media in the era of digitally enabled connected Occupy Movements [1]. I contend that dissensus from an aesthetic approach affirms such theoretical promise to formulate a contemporary complex utopia. In this paper, I will compare dissensus vis-a-vis other precedent utopic envisionments in relation to a perceptual regime in which the complexity of the contemporary mediasphere settles in, thereby pursuing reimagining future society once again.

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Adaptation and Resilience in Urban Complex Systems: Istanbul's Earthquake Risk and The Politics of the Maybe

K. Murat Güney

Özyeğin University, Anthropology Department

The paper focuses on Istanbul as a complex urban system and discusses possible ways to adapt to the earthquake risk and make Istanbul more resilient through alternative politics disclosed by the complexity of the disaster risk.

While the urbanization rate is increasing globally, cities as complex systems become the center where disaster risk is concentrated. This paper explores how disasters shape and are shaped by the complexity of the politics, economy, urban expansion, and social structure, and what makes a natural event a disaster.

The urban development projects in rapidly growing cities such as Istanbul prioritize economic growth and ignore an adaptation and resilience perspective for disaster risk reduction. Therefore, this research focuses on the "resilience" approach that pursues adaptation to disasters in complex systems. Unlike the sustainable cities discourse that deals with long-term goals, resilience is a dynamic concept related to risk management and is about adaptation to the risks and mitigation of the damage in complex systems.

At this point complex systems approach helps to explore how massive urban risks such as earthquakes disclose non-market-oriented other possible ways to make the population resilient, such as using thousands of vacant apartments to settle low-income residents who live in risky buildings or on-site urban transformation that targets strengthening the housing stock while not displacing the neighbours. I call those disclosed policy alternatives to overcome the disaster risk 'the politics of the maybe' that might work for life's interest. This paper argues that the politics of the maybe discloses a wide range of alternative solutions to think further about earthquake resilience in Istanbul's complex urban setting.

The Correspondence Between Jung And Pauli On The Search For A Single World (Unus Mundus) and The Theory Of Synchronicity

Özlem Küskü

Destek Publishing House Editor, Writer

While a handful of scientists in Copenhagen had been exploring the new physics for some time, a revolution was taking place in the field of consciousness and the psyche. Together with Freud and Carl Gustav Jung, whom Freud regarded as his heir, a serious team in Vienna had already put the human psyche on the couch and embarked on a voyage of discovery into the depths of consciousness.

Wolfgang Pauli (1925, Nobel Prize in Physics), at the time considered Einstein's heir, had been thrown adrift by a series of painful events in his life and turned to Jung to analyse his dark dreams and experiences. Without going to an interview, he read his work and was intrigued by the similarities between what he was proposing in analytical psychology and quantum physics. After more than 20 years of correspondence, this meeting would not only be a friendship between a physicist and a psychologist. It would also open the doors to an intellectual exchange of extraordinary depth, exploring the intersection of physics and psychology, the nature of dreams and their relationship to reality, the common ground of the collective unconscious and quantum physics, the principle of simultaneity and the unity of atom and archetype.

In this presentation, we will discuss this exchange, which will continue with the analysis of nearly 1000 dreams. And by this we will seek answers to the following questions to inspire us about reality -What can quantum physics and analiytic psychology revelation tell us about the existence of a common ground (Unus Mundus) behind the universe in the search for a single world? -What are the possibilities of the physics and psychology of the unconscious, the unexplored region between matter and spirit? Can ancient Greek philosopher Plato's concept of *chora* tell us something about this region?-What was Schopenhauer telling us in his essay *Transcendental Speculation on Apparent Design in the Destiny of the Individual*?

Nothingness and Zuhur

K. Gediz Akdeniz

Non-linear Science Working Group, Türkiye

In recent years, we see that Complexity Science metaphors have initiated new philosophical discussions. In particular, they have revitalized philosophical contemplation on the nothingness-existence binary, one of the important discussions in Metaphysics that transcends the Cartesian dualism. On the other hand, articles and science fiction narratives have emerged, suggesting that the philosophical equivalent of instantons [1], which appear as zero-energy solutions in conformalist theoretical models of cosmology and subatomic physics, could be consider as metaphor for the nothingness.

In this presentation, we will endeavor to interpret Martin Heidegger's thoughts on the duality of Nothingness and Existence [2] in the light of the NMG Instanton Universe model [3], which has been proposed very recently regarding the zuhur of the Universe.

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The Biggest Gap in Science: Complexity… and How to Close It

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To begin with, we comment briefly on the current state of complexity science to conclude that it thrives through an empirical, prescientific, stage. Next, we mention a dozen central questions on complex systems that await full understanding. Then, we delineate our formalism, with a statistical-mechanical starting point and an onset of chaos nonlinear dynamical endpoint, which we employ to design models with predictive power for complex systems. Finally, we retake the dozen topics to show that our research methodology provides the answers in demand. To end up we remark on the phenomenological, next, stage in the study of complex systems.