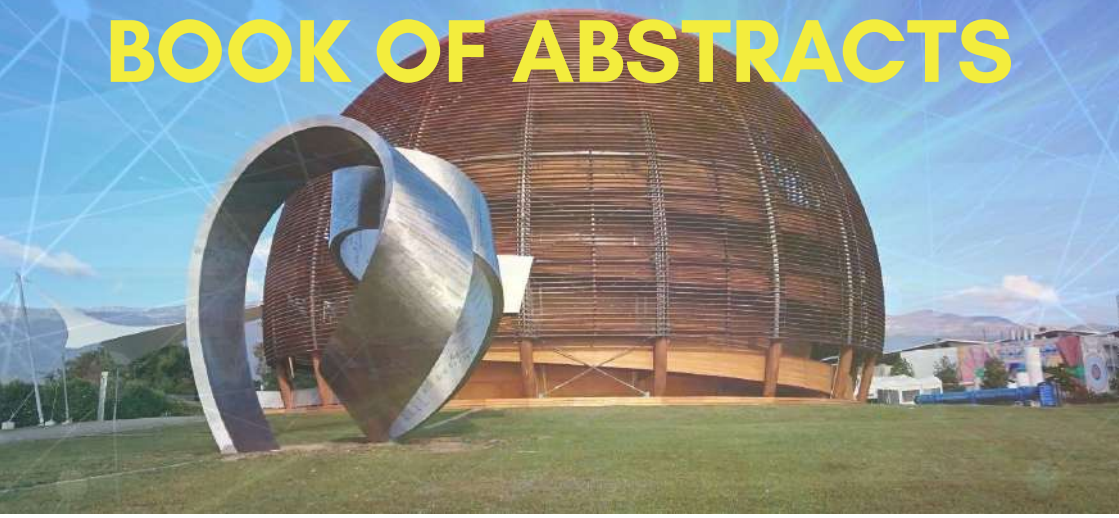
2025 ANNUAL
SYMPOSIUM & CEREMONY

SOCIETAL IMPACT
OF FUNDAMENTAL SCIENCES

17 – 18 DECEMBER
CERN - GENEVA, SWITZERLAND

BOOK OF ABSTRACTS



Gotion

中欧电子材料国际创新中心
China-Europe Electronic Materials International Innovation Center

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Presenter: GIANOTTI, Fabiola (Director General of CERN)

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Author: Prof. MAYOR, Michel (Geneva University)
Presenter: Prof. MAYOR, Michel (Geneva University)

Plurality of Worlds, Plurality of Inhabited Worlds?

Content

Since ancient times, human curiosity has led us to wonder about our place in the cosmos. Greek philosophers were convinced that an infinite number of "worlds"existed in the universe. And they already evoked the possibility that some of these "worlds"could harbor living species. In today's terms: do planets exist around other stars? Is life present elsewhere than on our Earth? Modern technology has enabled the discovery of thousands of exoplanets, some with conditions compatible with the complex chemistry required for the possible development of life. But: Does life exist elsewhere in the universe? Do we have the means to detect it? Will modern science answer these questions?

Author: Prof. FEYO DE AZEVEDO, Sebastiao (University of Porto)
Presenter: Prof. FEYO DE AZEVEDO, Sebastiao (University of Porto)

About the Impact of European Academies of Engineering in European social, economic and technological development

Content

The presentation will focus on the common features that can be understood in the missions of the European Engineering Academies, which are associated with the mission of Euro-CASE, The European Council of Academies of Applied Sciences, Technologies and Engineering, currently made up of 22 Academies of European countries, of which the Portuguese Academy is a member.

In a broad view, the mission of such Academies is to pursue, encourage and maintain excellence in the fields of engineering, applied sciences and technology, and promote their science, art and practice for the benefit of the citizens of Europe, indeed to promote economic and social development. This can be achieved, and is being achieved, through a number of policies and activities, namely (i) by developing studies on specific cases; (ii) by providing impartial, independent advice on engineering and applied science issues that affect Europe and its people to the European Commission and Parliament, very specifically through close cooperation with the European organization SAPEA –Science Advice for Policy by European Academies; or (iii) by ensuring that the societal impact of technological change is given proper attention with full consideration of environmental and sustainability aspects.

To flesh out this broad view, just a few current activities can be mentioned: (i) the very recent work (completed) in cooperation with SAPEA, on "Successful and Timely Uptake of Artificial Intelligence in Science in the EU"; (ii) studies concerning critical raw materials; (iii) studies on critically toxic per- and polyfluoroalkyl substances (PFAS); (iv) promoting a platform to foster engineering and technological innovation ecosystems with the overall goal of reinforcing technological innovativeness and the competitiveness of Europe.

Author: Prof. VIRDEE, Tejinder (Imperial College (GB))
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Impact on Society of Fundamental Science

Content

Progress in fundamental science allows us to get a deeper understanding of how Nature works through great scientific discoveries. Over the centuries this understanding has very much altered the way we live –giving us a better life –providing us with paradigm shifting technologies. From electricity and semiconductor electronics to telecommunications, medical imaging, GPS, and even the World Wide Web—first created at CERN just over 35 years ago—each leap in understanding has sparked technologies that revolutionized society.

In this talk, we'll explore a few of these paradigm-shifting technologies to show how fundamental science continues to power progress and improve our world.

Author: Prof. DINGWELL, Donald (University of Munich)
Presenter: Prof. DINGWELL, Donald (University of Munich)

Academia Europaea –contributions to societal impacts of fundamental sciences

Content

As the Academia Europaea approaches the 40th year of its existence the world's perception of fundamental sciences and their contributions to societal impacts have evolved remarkably since its creation.
In addition to the fundamental role of its members in the creation and exchange of knowledge the Academia Europaea has, increasingly, been recognised as a fundamental resource for knowledge-based advice for policy in Europe.
This trend has accelerated recently whereby the Academia Europaea, in addition to its traditional roles in several Europe-wide Academy consortia and working groups, is now a central facilitator for Europe in the Science Advice for Policy by European Academies (SAPEA) process and the G20 (S20) process.
These activities will be reviewed and discussed.

Author: Dr TIEDJE, Jürgen (EU DG Research)
Presenter: Dr TIEDJE, Jürgen (EU DG Research)

The societal impact of fundamental research and technology sovereignty –two antipodes? The case of advanced materials in Europe

Content

In the last fifteen years, several Nobel Prizes in physics and chemistry have been awarded to material science discoveries –discoveries combined with the expectation to have an impact on our global economy and societies: graphene, gallium nitride, lithium-ion batteries, quantum dots, and metal-organic frameworks.

Since the last five years, global competition between economies on critical technologies is high on the agenda. Research and innovation in these technologies are exposed to a scrutiny against the risk of having choke points. Governments want to ensure 'technology sovereignty"for the benefit of their economies and societies. Materials –access to critical raw materials as a resource and access to advanced materials as a technology –are an intrinsic part of this discussion.

The European Union considers advanced materials as a priority where societal impact of materials science and technology sovereignty should not –in a figurative sense - turn into antipodes: on one side, a discussion amongst and for scientists and, on the other side, a focus only on technology sovereignty. In February 2022, a few important scientists, researchers and innovators set out their vision in a "Materials 2030 Manifesto"on how to avoid the two antipodes: accelerating research for the benefit of European societies, tackling strategic dependencies and using innovative markets as a launchpad for more growth and jobs.

The subsequent discussions have triggered a European strategy in February 2024 which the European Commission has been rolling out together with Member States. They will also clearly inform the future Advanced Materials Act which the Commission announced under its "Competitiveness Compass"in early 2025 and which it intends presenting later next year. Competitiveness of European industries which matter for advanced materials has become a defining challenge for all.

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Next-Gen Skills from Science to Industry empowered by the European Advanced Materials Academy

Content

The European Advanced Materials Academy is a transformative initiative to position the European Union at the forefront of advanced materials innovation, enabling the twin transition towards sustainability and digitalisation while ensuring global industrial leadership. Despite the critical role advanced materials play, the field is constrained by a lack of skilled talent. The Academy aims to address this challenge by equipping Europe with the current and future skills necessary to lead in this arena.

The Academy's goal is to become a globally recognised materials learning and talent hub. Led by EIT RawMaterials and in collaboration with the most important actors in advanced materials, the Academy is set to disrupt the traditional talent development landscape.

Its approach begins with a comprehensive needs analysis, then the creation of a high-quality solutions portfolio and credentialing system. Through partnerships with education and training providers across the EU, the Academy ensures wide access to its offerings. A massive marketing and communications campaign amplifies its reach, while stakeholder collaborations guarantee its long-term impact. Financial sustainability is built into the model, ensuring the Academy continues well beyond the project's initial phase. Project has a duration of 4 years starting July 2025.

With a focus on inclusivity and innovation, the Academy envisions a thriving community of skilled and future-ready talents driving Europe's advanced materials field. The initiative not only fills a critical skills gap but also lays the foundation to revolutionise global standards, aligning with the EU's broader sustainability and industrial leadership goals.

SCIENTIFIC TALKS

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How to Make Science Practically Useful

Content

The traditional account of making science practically useful goes back to Vannevar Bush's 1945 "Report to the President."This report promoted basic research "performed without thought of practical ends"(Bush 1945, chapter 3) as the linchpin for achieving practical utility. This approach has become known as the "linear model"; it places progress in epistemic or basic research at the center of technological progress. Novel procedures and devices are mostly created by relying on new scientific insights.

The linear model is now generally pronounced dead by economists and sociologists, but examples to this effect can be found. The discovery and use of giant magnetoresistence follows this pattern. However, it became clear in the past half-century that the path from scientific novelty to technological innovation suggested by the linear model was far less fruitful on a broad scale than Bush had imagined.

I suggest that there are three additional pathways of how scientific knowledge may be connected to technological novelty. One is the knowledge-driven mode of use-oriented research. This mode proceeds from existing knowledge. You start with what you know in order to find out what you can do. The invention of gas-discharge tubes or LEDs proceeded on the basis of earlier insights into the interaction of electricity and matter; the invention of liquid crystal displays owed much to earlier research on the effects of electrical fields on liquid crystals and on the properties of polarized light. In most cases, that knowledge needs to be expanded, and that is what practice-driven research seeks to accomplish. But the necessary knowledge-base and scientific understanding are already there beforehand; only the details are missing. No additional basic research spurs such utility-driven endeavors.

Furthermore, some practical achievements are based on mere observational regularities, or are the result of combining existing technology in new ways and thereby create new appliances. The dishwasher or the assembly line were conceived through engineering ingenuity, without consulting the latest advances in basic research. Such novelties are technology-driven, not research-driven. Some technological development proceeds independently of theory so that the spark of creativity does not reach the theory. This is the autonomy-of-technology mode of creating practical devices.

Finally, epistemically significant questions may be tackled within the framework of use-oriented research projects. In such application-innovative research, the fundamental knowledge required for a technological novelty is only generated in the context of practice. Some challenges of practice-driven research cannot be adequately mastered without addressing fundamental questions. Epistemic research is therefore also a –usually unintended –consequence of successful demand-driven research. For instance, the revolutionary concepts of retroviruses and prions were conceived in the context of identifying chains of infection. Application innovation is the temporal inverse of the linear model in that basic research is not the origin of technological development, but emerges at a later stage.

My claim is that basic research is sometimes productive in technological respect (in contrast to more recent claims to the contrary), but that additional modes of making science practically useful exist: knowledge-driven technology development, autonomy of technology, application-innovation.

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Solvay Institutes: Over a Century of Scientific Excellence & a Bright Future

Content

The Solvay Institutes are unique not only in their history and prestige, but also in their ability to identify emerging scientific themes and to bring together the best researchers from diverse backgrounds around them. Their exceptional added value therefore stems from the founding nature of their scientific activities and their resolutely forward-looking orientation. The Institutes are therefore actors in scientific research, unlike the Nobel Foundation, which essentially rewards major past discoveries. As newly appointed Director of the Solvay Institute for Chemistry, I would like to present the current activities and my vision for a collaborative and interdisciplinary approach of Science.

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Presenter: PARMESAN, Camille (CNRS)

Conservation planning for climate change amid deep uncertainties

Content

Recent climatic changes have already impacted biodiversity, but estimates of the percent of species threatened with extinction by 2100 range from 1% to 80%. This uncertainty stems partly from differences among algorithms used to estimate species' current and future projected ranges, and from differences among modeled projections of future climate. There is little agreement as to which species' distribution model or which climate model is "best", leaving conservation planners often lost in a sea of possible futures from which to choose a management pathway. Here, we used a Robust Decision Making (RDM) approach to look across a wide range of possible futures and identify robust conservation strategies for 20 different species of concern. We estimate the distribution of potential habitat for each species (both now and in the furture) using multiple Species Distribution Models (SDMs), with multiple sets of modeling parameters and GCM-RCM combinations, resulting in ~400-700 potential futures per species. We then analyse five different conservation strategies for their reliability and potential for regrets. We ultimately seek the most robust decision pathways, given known uncertainties. We found that (i) Climate change considerably affects the future distribution of all the species; (ii) There is considerable variation in the spatial distribution of each species amongst possible futures; (iii) Current state of understanding is not sufficient to estimate which of these futures is most likely; (iv) RDM approaches are helpful in navigating these uncertainties to identify robust management pathways for species conservation. The study offers a innovative conceptual framework that could be adapted to specific circumstances to produce actionable biodiversity conservation plans that are robust to highly uncertain climate futures.

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From CERN to Industry: Digital Twin Applications Powered by AI

Content

The integration of Digital Twin technology with AI Engine is transforming how research and industry understand, predict, and optimize complex systems. Building upon collaborative initiatives between CERN, InnoSuisse, and industrial partners, this talk explores how open-science can be extended into scalable, data-intelligent frameworks for real-world applications.

At the core lies the AI-enabled computational architecture that connects simulation, experimentation, and decision intelligence. By coupling CERN's high-fidelity modeling environment with industrial process data, this framework enables predictive control, dynamic optimization, and explainable risk management across domains such as supply chain, healthcare and finance.

The presentation will illustrate case studies where AI-powered digital twins accelerate innovation, improve operational resilience, and bridge the gap between scientific modeling and industrial deployment. It will also outline the vision for an applied mathematics alliance, fostering reproducible, transparent, and AI-augmented collaboration between academia and industry.

Author: ZHU, GuanNan (Gotion High-tech Co., Ltd.)
Presenter: ZHU, Guannan (Gotion High-tech Co., Ltd.)

High-Power Batteries for eVTOL Applications

Content

The low-altitude flight sector boasts enormous development potential and demands high-performance battery cells featuring "three highs and one fast". Gotion High-tech has launched large cylindrical battery products specifically designed for eVTOLs with an energy density of approximately 300Wh/kg. These products not only enhance power performance but also meet the flight requirements of eVTOLs. Having secured designated customers, the products have proven their adaptability, and are expected to be officially put on the market in 2026. Gotion High-tech will continue to deepen its focus on the 46-series cylindrical battery route in the eVTOL field, continuously launch products with an energy density of 400Wh/kg and above as well as high-power products, while steadily optimizing the endurance, power, load capacity and flight lifespan of eVTOLs.

Author: SURAUD, Eric
Presenter: SURAUD, Eric

How physics fundamentally limits promises of Artificial Intelligences

Content

Calculations, and more recently computations, have been intimately linked to physics since centuries. The 2024 Nobel prize in physics provides the latest illustration thereof. Modern physics really emerged when the use of mathematics was generalized to support the physical description of the universe. Computations nowadays have become a key tool of investigation in physics, both for modeling and for data analysis. Conversely, modern computers capabilities have been attained thanks to major physics-based developments, like the invention of the transistor. These relations between physics and computations are somewhat obvious and well documented.

The emergence of Artificial Intelligence (AI) both in science and all-day life might change the rules of the game. Fundamentally AI systems remain computer-based objects with all the above-mentioned links to physics. But AI now promises computations hardly conceivable only a few years ago. This might lead people to think that limits of AI will always be overcome, again and again. This would mean, on the long term, a strictly rational and deterministic viewpoint on the world and a latent hope to solve any "unsolvable"problem. Such a potential viewpoint may hold true in many sciences, not speaking of situations in all-day life issues.

However, it turns out that computations and AI suffer from intrinsic limitations, first due to technical issues in the representation of numbers they manipulate. These difficulties are well known, as well as strategies to overcome/control them, at least partially. More fundamentally, computational possibilities hit walls imposed by the laws of physics. The physical description of the world leads to address complex non-linear equations which allow chaotic behaviors. These chaotic features cannot be overcome, whatever accuracy is attained numerically, so that the practical description of the world is bound to integrate a chaotic component. Furthermore, quantum mechanics introduces a random component into the description of microscopic systems. This may have macroscopic consequences as for example a radioactive disintegration of a nucleus or the hit of a smartphone by a cosmic ray leading to an unexpected error in the system. All in all, to imagine a fully controlled, strictly rational and deterministic, access to the world by computational means is thus confronted with major physical impossibilities.

The aim of this contribution is to demonstrate and illustrate this fundamental impossibility. This is a key issue in our way we see and hope to understand the world. The premise of the analysis does not rely on vague arguments or on faith but on well-established, scientific, facts. It is thus important to keep in mind such limits whatever computations and AI might allow, both today and in the future. The point is not to dispute possible progress attained by AI, although caution should remain the rule, especially in terms of ethical and social issues. This latter aspect will of course also be discussed. But the major point is to identify the fundamental limits set by physics.

This concerns all of us. While physicists will in principle be aware of most of the aspects addressed here, it is clear that many scientists, users of AI in particular, are probably not. It is thus important that the scientific community, as a whole, becomes aware of these limits set by nature to AI and computations in general. More generally speaking, all educated people should integrate this aspect into their understanding of the world, as this very understanding is more and more mediated by AI's and computations. The societal impact of such a realization is thus crucial.

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Presenter: Prof. ANGRISANI, Leopoldo (Dept. of Information Technology and Electrical Engineering, University of Napoli Federico II)

Ensuring Trustworthy and Sustainable Measurements in the AI Era: Quantifying Uncertainty and Environmental Impact

Content

Artificial intelligence (AI) is revolutionising measurement systems in electrical and electronic engineering, enabling advanced data analysis, real-time decision-making, and automation of complex measurement tasks. However, the deployment of AI-based models in measurement contexts introduces critical challenges, particularly regarding the reliability and traceability of their outputs and the sustainability of the measurement processes themselves.

This work addresses these challenges by developing rigorous methodologies to quantify the uncertainty associated with AI models used in measurement tasks. Traditional measurement systems rely on well-established physical models with defined uncertainty budgets and metrological traceability. In contrast, AI models are often treated as black boxes, lacking explicit evaluation of their measurement uncertainty, thereby limiting their acceptance in safety-critical or regulated contexts. Our research proposes the integration of metrological uncertainty quantification methods with AI model validation, enhancing the credibility and interpretability of AI-based measurements. The developed approach combines sensitivity analysis, probabilistic modelling, and performance metrics to provide comprehensive uncertainty budgets for AI-assisted measurements, thus enabling their integration into industrial, healthcare, and scientific applications that demand high confidence levels.

Furthermore, this work explores the evaluation and improvement of the environmental sustainability of measurement processes. Measurement activities, while typically considered low-impact, involve instrumentation, power consumption, maintenance, and data processing infrastructure that contribute to environmental footprints, particularly in large-scale or continuous monitoring applications. We introduce a systematic framework to assess the energy consumption and environmental impact of measurement systems, identify key contributors to unsustainable practices, and propose mitigation strategies, such as optimising measurement protocols, enhancing equipment efficiency, and adopting eco-design principles in instrumentation development.

By combining uncertainty quantification and sustainability assessment, this research contributes to building trustworthy, resource-efficient, and socially responsible measurement systems, thereby enabling safer and more sustainable adoption of AI technologies in critical sectors and aligning with global goals for industrial innovation and environmental protection.

Author: MANSUY, Isabelle
Presenter: MANSUY, Isabelle

How life experiences influence health across generations: An epigenetic perspective

Content

Behavior and physiology in mammals are strongly influenced by life experiences and environmental factors, particularly those encountered in childhood. While positive factors can favor proper development and mental and physical health, adversity and traumatic events increase the risk for psychiatric, cardiometabolic and autoimmune diseases and cancer in adulthood. These complex disorders can affect directly exposed individuals and their descendants, in some cases across generations. The biological mechanisms underlying the inheritance of environmentally-induced (acquired) traits are unlikely to involve changes in the DNA sequence but rather depend on epigenetic processes. To study these mechanisms, we developed a mouse model of traumatic stress in early postnatal life that causes symptoms across generations1–3. The symptoms include increased risk-taking, depressive-like behaviors, cognitive and social deficits, as well as metabolic and cardiovascular dysfunctions that persist across life in exposed animals. Further, some symptoms are manifested by the offspring of exposed individuals e.g. risk-taking behaviors up to the 5th generation in the patriline 4. In humans, childhood trauma also affects mental and physical health, suggesting conserved effects across species5, 6. At a molecular level, exposure is associated with epigenetic changes involving RNA and DNA methylation in somatic cells across the body and in germ cells, with sperm RNA being causally linked to the transmission of symptoms from father to offspring3. MiRNAs are also affected in extracellular vesicles in blood and the reproductive tract7. Circulating factors were identified as mediators of alterations in germ cells. Chronic injection of serum from trauma-exposed mouse males into control males recapitulates metabolic phenotypes in the offspring, suggesting information transfer from serum to germ cells. Pathways involving peroxisome proliferator-activated receptor (PPAR) are causally involved, with pharmacological PPAR activation in vivo affecting sperm transcriptome and metabolic functions in the offspring and grand-offspring6. Together, these findings suggest the existence of an ensemble of factors and mechanisms that can carry information about past experiences from the periphery to germ cells and mediate the inheritance of acquired traits8–11.

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FLOGEN NEW SUSTAINABILITY FRAMEWORK AND THE SOCIETAL IMPACT OF FUNDAMENTAL SCIENCE

Content

The FLOGEN sustainability framework, developed by the author in 2015, clarified the confusion that existed in the definition of sustainability by making a clear distinction between criteria, actors and objectives of sustainable development. Since its development, due to its unified, universal and all-inclusive nature, it has been applied in many fields of science and technology and has been presented as an opening plenary lecture at the United Nations Meeting in Geneva and turned into law by various municipalities, which made it the first time ever that a scientific concept is turned into law.

During this conference, this unique framework of sustainability will first be presented as well as its 3 pillars which are: (1) science & technology (2) governance & management, and (3) education & civil society. Secondly, it will also analyze the many applications of this framework on fundamental science and its impact on society development and how fundamental scientific knowledge can be used to achieve sustainable development for the benefit of humanity. Finally, the progress and difficulties that arise as well as opportunities in this field in the context of this unique framework, as well as the essential and irreplaceable role of science and technology.

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From a material developed for solar cells applications to innovative helium targets´ fabrication for fundamental nuclear reaction studies.

Content

The connection between fundamental research and societal applications may play a major role in both directions. In this contribution we present the fabrication and characterization of "solid-gas" nanocomposite films, initially developed for antireflective coatings in solar cells applications. Firstly, it was found that the nanoporous silicon films, obtained by magnetron sputtering (MS) deposition in helium plasma, showed the required reduction of refractive index [1]. The IBA (Ion beam analysis) and TEM-EELS (Transmission Electron Microscopy) techniques showed that the films contained however high amounts of helium trapped inside the nano-pores. The formation of He nano-bubbles was demonstrated [2]. This methodology could also be extended to other matrix elements and to the use of the 3He isotope using a low gas consumption procedure [3]. Helium contents achieved 3.25E18 at/cm2 in a thickness of 1,4 µm for the Si matrix with Helium release starting at 625 K by heating in vacuum [4]. This behavior allowed to propose these films, initially developed for optical applications, as "helium solid targets" for nuclear reaction studies relevant in astrophysics and nuclear structure. These targets avoid the use of cryogenic or high-pressure cells, making them easier to use, reducing energy straggling effects and simplifying the geometry for calculations. Results will be presented from earlier experiments carried out at LNL [3] to recent experiments at TRIUMF-EMMA facilities [5-6].

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Impact of physical properties of nanomaterials in the next generation diagnostic devices

Content

The rapid advancement of nanotechnology has opened new frontiers in the design of diagnostic devices with unprecedented sensitivity, selectivity, and speed. Central to this progress are the unique physical properties of nanomaterials—including size-dependent optical, electrical, mechanical, and surface characteristics—which enable innovative mechanisms of signal generation and transduction. Metallic nanoparticles with localized surface plasmon resonance, semiconductor nanocrystals with quantum confinement effects, and 2D materials with high carrier mobility have all been exploited to push detection limits down to the single-molecule level. In addition, tunable surface area, porosity, and flexibility allow the seamless integration of nanomaterials into miniaturized and wearable devices, paving the way for personalized and point-of-care diagnostics. This presentation will demonstrate how tailoring the physical properties of nanomaterials can be strategically leveraged to develop next-generation diagnostic platforms, with emphasis on optical, electrochemical, and hybrid biosensing strategies. Particular attention will be given to their roles as labels in biosensing formats and as modifiers in label-free transduction platforms for detecting cancer biomarkers, neurodegenerative diseases, and pathogens—including viruses.

Finally, future perspectives will be discussed, including challenges of reproducibility, large-scale manufacturing, and regulatory approval, as well as opportunities for integration with artificial intelligence and digital health technologies. Importantly, the intrinsic compatibility of nanomaterials with sustainable architectures—such as nitrocellulose membranes, biodegradable plastics, and low-cost, scalable fabrication methods like inkjet printing, screen-printing, and stamping—will be highlighted as a pathway toward affordable, eco-friendly, and widely deployable diagnostics.

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Wetland's biogeochemistry: a framework driving from basic research to climate change mitigation

Content

Our planet is nowadays experiencing an unprecedented situation of accelerated climate change linked to the exacerbated anthropogenic emissions of greenhouse gases (GHG). Additional to the natural biogeochemical exchanges between the biosphere and the atmosphere, the huge increase of GHG fluxes deriving from fuel burning has produced a sharp increase of CO2 concentrations in the atmosphere, but also of other GHG such as CH4 and N2O, which are very much related to biogenic activities. Undoubtfully, anthropogenic GHG emissions need to be drastically reduced to net zero emissions, but further to fuel burning emissions, the focus needs also to be set on the way ecosystems work biogeochemically, as this can strongly influence its role in climate change mitigation or, instead, in its enhancement.

Due to the presence of water, wetlands are among the most biogeochemically active ecosystem types on Earth, enabling them to manage with huge amounts of GHG. Several natural factors, such as the hydrology, water salinity, inorganic and organic nutrients availability, among others, regulate the carbon and GHG exchange between these ecosystems and the atmosphere. Basic research on the carbon cycle has provided the foundational knowledge to interpret not only how these natural factors are determining the role of different types of wetlands in increasing or reducing the GHG concentrations in the atmosphere, but also how and which way the alteration of these characteristics by anthropogenic impacts causes changes in its climate regulatory capacity. As a general pattern, ecologically degraded wetlands may enhance climate change mainly because of the alteration-related increase in the emissions of the GHG with higher radiative forcing capacity, CH4 and N2O. Instead, healthy wetlands can help in climate change mitigation when minimising the emissions levels of both GHG.

Here we jump from basic research to societal contributions of science. Since healthy wetlands may act as climate allies, the use of appropriate management measures and ecosystem's restoration aiding to enhance their climate change mitigation role needs to be based on sound scientific foundations. But we, as scientists, also need to adapt our research questions in order to target humankind needs to preserve our common home, The Earth. Furthermore, policies, such as those dealing with biodiversity conservation, climate, and any other type of policy (for example, the EU Nature Restoration, the EU climate policy, and the EU Common Agriculture Policy), must be linked in such a way that, apart of their own specific targets, they can jointly contribute to human efforts to face climate change. In this talk I show a workflow to scale-up from the basic biogeochemical research to effective climate change mitigation by wetland ecosystems while also enhancing other ecosystem services, in benefit of humankind wellness and a healthy planet.

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POSTERS

Author: Dr SHEVCHENKO, Sergey (Institute of Physics of NAS of Ukraine, ret., now independent researcher)
Presenter: Dr SHEVCHENKO, Sergey (Institute of Physics of NAS of Ukraine, ret., now independent researcher)

Planck scale informational physical model and fundamental problems in physics

Content

This poster is a review of developed in 2007-2025 years Planck scale informational physical model that is based on 3 main points. First of all on the 2007 "The Information as Absolute"conception, where the fundamental phenomena/notions "Matter", "Consciousness", "Space", "Time", "Energy", "Information", which are fundamentally transcendent in conventional philosophy and sciences, are rigorously scientifically defined. The conception completely rigorously scientifically legitimates the outstanding C. F. von Weizsäcker "Ur hypothesis", and E. Fredkin "Digital Philosophy/Physics", which posit that Matter is constructed from some binary reversible logical elements; and on all reliable experimental data. Correspondingly in the model it is postulated that Matter's ultimate base is the [4+4+1]4D dense lattice of primary [4+4+1]4D binary reversible fundamental logical elements [FLE], which is placed in the corresponding Matter's fundamentally absolute "Cartesian"[4+4+1]4D spacetime with metrics (cτ,X,Y,Z, g,w,e,s,ct), while everything in Matter is/are some specific disturbances in the lattice. Basing on the above in the model a number of physical problems are either solved or essentially clarified, e.g. of what is real Matter's spacetime above, what are the physical sense of Lorentz transformations; uncertainty and wave-particle duality in QM; particles and antiparticles, etc. Besides initial Planck scale models of fundamental Gravity, Electric, and Nuclear/Strong Forces are developed, where it is shown that these Forces strengths ratio is in accordance with experimental values only if the FLE size and FLE flip time are Planck length and Planck time; the model rather probably really scientifically clarifies some cosmological problems, including the "matter-antimatter asymmetry: one. Etc. more of the problems see in the poster

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Growth and sculpting of nanotips and their use in Biology, Materials Science and Nanomagnetism

Content

Investigations in fundamental science require advanced tools. In particular, the field of Nanoscience uses scanning electron and ion microscopes that allow imaging and patterning materials with resolution in the range of 1 nm [1, 2]. These microscopes are known as the Scanning Electron Microscope (SEM) and the Focused Ion Beam (FIB). Besides, Nanoscience studies often rely on the Atomic Force Microscope (AFM), which allows investigating the physical properties at the nanoscale of materials [3, 4] and of biomolecules [5, 6]. In this contribution, we will show how the set of these microscopes (SEM, FIB, AFM) can be smartly used to investigate fundamental aspects in Biology, Materials Science and Nanomagnetism. In particular, we will show examples where the SEM and FIB microscopes are used to grow and sculpt nanotips at the apex of an AFM. These nanotips are subsequently applied to the investigation of the functional properties of magnetic thin films, nanopatterned structures, proteins and DNA.

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Innovation and Application of Delivery Systems of Insoluble Drugs

Content

The quality of clinical medications is closely tied to the health of people all over the world. However, over 40% of drugs currently on the market are poorly water-soluble, and these insoluble drugs continue to pose significant challenges in clinical practice. These include inadequate efficacy, notable toxic side effects or poor patient tolerance, low oral bioavailability, and poor medication adherence (often requiring daily injections or frequent administration). Additionally, there is a severe imbalance between their clinical effectiveness and treatment costs. In the field of drug development, water insolubility remains a major bottleneck. More than 70% of small-molecule candidate drugs struggle with poor water solubility. A substantial proportion of these candidates also suffer from issues such as poor oral absorption, insufficient stability, or difficulty in being formulated into injectables. These problems not only hinder the progress of subsequent research and development but also force many candidate drugs to be abandoned. This is also one of the key reasons why the overall success rate of drug development is less than 0.05%. Therefore, addressing the aforementioned critical issues of water-insoluble drugs has become an urgent priority. After more than 20 years of dedicated research, we have leveraged key technological innovations in nanomedicine to tackle the challenges and pain points associated with water-insoluble drugs. Our efforts have yielded systematic and innovative outcomes, along with significant economic and social benefits, particularly in enhancing drug efficacy, improving patient medication adherence, and boosting the druggability of candidate drugs. These achievements have substantially elevated the formulation development standards of water-insoluble drugs.

Author: Prof. WANG, Chuanyi (Shaanxi University of Science and Technology)
Presenter: Prof. WANG, Chuanyi (Shaanxi University of Science and Technology)

Defect engineering of photoactive materials towards improved performance for energy and environment sustainability

Content

Defect engineering of photoactive materials towards improved performance for energy and environment sustainability

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Abstract

Photocatalysis driven by solar energy has proven to be a promising technology in addressing the challenges faced by mankind, such as energy crisis and environmental pollution. However, the practical application of photocatalysis is still limited by its intrinsic factors, such as photocatalysts' light response, and the recombination of photogenerated charge carriers. From this prospect, many efforts have been invested, aiming to break through the bottleneck of photocatalysis for practical applications. One strategy we employed is "Defect Engineering". By means of defect engineering with nanostructured semiconductor photocatalytic materials, we explored the effects of defect microstructure regulation on the polarization piezoelectric properties, photo absorption range, photogenerated carrier behaviour, adsorption and activation ability of target molecules, and photocatalytic reaction pathways at typical perovskite composite oxides and carbon nitride, with the purpose of eventually improving their photocatalytic performance in energy and environmental application prospects. The correlation between defect microstructure and photocatalytic/multi-field catalytic activity was revealed. For example, full spectrum response of Bi4Ti3O12 was developed through defect engineering, and it exhibits excellent photocatalytic conversion activity in removing air pollutant NO under irradiation of broad wavelength range of light, up to near infrared (850 nm). In addition, the manipulation of defect microstructures can significantly improve the polarization and piezoelectric properties of materials, thereby improving the efficiency of multi-field catalytic degradation of antibiotics; the synergistic effect can increase the efficiency of antibiotics' degradation by more than 7 folds. Furthermore, we extended our "Defect Engineering"strategy to photocatalytic synthesis of NH3 and H2O2, and photo-thermal catalysis for selective conversion of CO2 and plastics etc. Our work shows that defect engineering plays a vital role in photocatalysis, but its precise control and mechanistic understanding are still challenging.

Keywords: Photocatalysis; Defect engineering; Charge Separation; Spectral response; Surface/interface process.

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Advanced Formulations Potentiate AAV Vectors for Cancer Gene Therapy

Content

Background: Adeno-associated virus (AAV) vectors have become a cornerstone platform for gene therapy and vaccine development due to their high safety profile, sustained transgene expression, and broad infection tropism. However, they still face challenges such as insufficient targeting specificity and limited therapeutic efficacy at safe dosage levels. The synergistic application of formulation technology and AAV holds promise for systematically overcoming these bottlenecks. We outline two synergistic strategies that integrate AAV and formulation technology to enhance anti-tumor immunity.

Methods and Results: First, to overcome PTEN-loss-mediated immunosuppression, we used AAV-PTEN to restore tumor-cell expression, trigger immunogenic cell death (ICD) and boost infiltration. Subsequently, we combined AAV-PTEN with immune checkpoint blockade (ICB) using a phospholipid-based phase-separation gel (PPSG) that steadily releases anti-PD-1 peptide for 42 days as an in-situ depot. The combined therapy of AAV6-PTEN and PPSG@anti-PD-1 demonstrated a synergistic effect, inducing complete tumor regression and establishing potent immune memory to prevent recurrence.

Furthermore, we developed a universal AAV-based therapeutic vaccine platform. This platform genetically engineers in-situ tumor cells to enable sustained expression of the highly immunogenic SARS-CoV-2 receptor-binding domain (RBD). This design innovatively leverages the body's pre-existing RBD-specific immunity—formed through prior infection or vaccination—to rapidly and efficiently eliminate engineered tumor cells. To further enhance efficacy and address potential safety concerns, we encapsulated the entire vaccine system (AAV vector and adjuvant) within a thermos-responsive hydrogel, creating a universal therapeutic vaccine that can be injected in situ and released gradually. This in-situ therapeutic vaccine increased AAV retention at the tumor site and effectively suppressed tumor progression, achieving a 40% complete response rate in the CT26 model.

Conclusion: The synergistic application of adeno-associated virus (AAV) vectors and formulation technology provides an innovative solution to the challenges faced during the in vivo application of AAV, including poor targeting accuracy and the negative impact of pre-existing neutralizing antibodies. This combined strategy establishes a promising technological framework for developing more effective and durable cancer immunotherapy regimens.

Author: Prof. WEI, Di
Presenter: Prof. WEI, Di

Controlled Charge Flow in Nanoconfined Iontronics

Content

Controlled charge flow is fundamental to many areas of science and technology, serving as charge carriers of energy and information, and probes of material properties and reaction kinetics. In nanoscale systems, particularly those with confinement below 2 nm, classical continuum theories, such as the Navier–Stokes, Kelvin, and Hertz–Knudsen equations, begin to fail, and a range of non-classical ionic phenomena emerge, including electrical double layer (EDL) overlap, ionic Coulomb blockade, and ultra-low resistance ion transport.

Nanoconfined iontronics, which harnesses ions as charge carriers, offers a promising platform to manipulate charge flux, enabling tunable directionality and magnitude of ionic currents in ways reminiscent of biological neural signaling. In this talk, Wei will present recent advances from his group in the design and understanding of nanoconfined iontronic systems, highlighting their potential in energy, information, and probing chemical reaction kinetics.

Author: Prof. KAREEM, Ahsan (University of Notre Dame); Dr WANG, jiayao
Presenter: Prof. KAREEM, Ahsan (University of Notre Dame)

Role of Natural Hazards Mitigation Engineering in Reducing Social Vulnerability: A Case Study of Tropical Cyclones in Hong Kong

Content

Tropical storms—potentially intensified by the impacts of climate change—pose escalating threats to the resilience of both physical and social infrastructure in coastal cities worldwide. Although significant investments are often directed toward strengthening physical infrastructure and improving early warning systems, a critical dimension of urban resilience is frequently overlooked: social vulnerability. This concept reflects the inherent socioeconomic and demographic characteristics that influence a community's capacity to withstand and recover from disasters. Factors such as poverty, language isolation, and a high proportion of elderly residents can all heighten a community's susceptibility to hazard impacts. This study seeks to address this gap by developing a generalized framework for quantifying and mapping social vulnerability, using Hong Kong—a high-density global metropolis—as the case study.

This study develops a localized Social Vulnerability Index (SoVI) by analyzing twelve key census variables across Hong Kong's neighborhoods. The analysis identifies three principal dimensions shaping community resilience. (1) Language and economic capacity—including indicators such as income level, language proficiency, and literacy—reflects a community's ability to mitigate disaster risks. (2) Socioeconomic and cultural integration challenges, captured through variables like birthplace, educational attainment, and employment participation, tend to heighten vulnerability. (3) Demographic susceptibility, defined by age and gender composition (e.g., proportions of elderly, youth, and gender balance), further influences a community's exposure to risk. Spatial mapping of the SoVI reveals pronounced geographic disparities in vulnerability. Neighborhoods characterized by high-density public housing and lower-income populations exhibit the highest vulnerability scores, while areas with stronger socioeconomic advantages and more professionally integrated residents demonstrate significantly greater resilience.

The findings emphasize that while engineering and technological solutions are essential, they alone cannot guarantee equitable disaster protection. Achieving true urban resilience requires a comprehensive understanding that encompasses not only the physical dynamics of tropical storms but also the social fabric of affected communities. This study illustrates how fundamental scientific approaches—such as spatial statistics and index construction—can transform complex social data into actionable insights. By making hidden vulnerabilities visible, the framework offers city planners and policymakers a practical tool to support more equitable resource allocation, targeted emergency preparedness, and the development of cities that are not only physically resilient but also socially just in the face of environmental threats.

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Presenter: Prof. XU, Jianbin (The Chinese University of Hong Kong)

Heat Transfer and Thermal Management in Low-Dimensional Structures and Beyond

Content

In the contemporary development of information and communications technology (ICT), thermal management is one of key factors for sustainability. In the field of integrated circuits (ICs) in ICT, utilization of low-dimensional structures, e.g., nanomaterials in gate-all-around field-effect transistors (GAAFETs) and heterointerfaces, poses critical challenges on thermal properties of devices and functional units on a nanoscale. Enhancing heat transfer in these structures and understanding heat transport mechanisms are essential for in-device and chip-scale thermal management, laying foundations for electro-thermal co-design of future chips at large. Here we will address several related technical topics.
(1) Phonon hydrodynamics in 1D nanowires; (2) Interfacial thermal transport; (3) Thermal interface materials (TIMs); (4) AI for thermal science; (5) Progress in near-field radiative heat transfer.

The efforts to understand the related issues will collectively advance thermal management solutions for low-dimensional structures, by addressing critical challenges in electro-thermal co-design for next-generation integrated circuits (ICs) and nanoscale devices. This will significantly sustain the long-term development of ICs and ICT, which is highly valuable for the sustainable development of the society.

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Presenter: MICHAEL, singer (cnrs)

Evolutionary overcompensation for climate change generates protective climate "credit"

Content

Evolutionary responses to current climate change are both expected and observed but typically lag behind the change itself, creating "climate debt". We provide the first example of the opposite phenomenon, that we dub "climate credit", driven by evolutionary overshoot. Two populations of Euphydryas editha butterflies have independently overcompensated for rising heat stress, protecting their most thermally-vulnerable life stage, the eggs, for decades ahead. Traditionally, females dropped after identifying acceptable hosts, ovipositing just above the hot ground. This protected eggs from predation by grazing vertebrates but risked exposing them to lethal temperatures. Between 1993 and 2024 an increasing proportion of females lost the dropping behaviour, instead balancing on leaves near their landing sites to lay. Mean distance of eggs from the ground has risen, increasing predation risk while cooling eggs by ~7°C. Regional warming has been ~1.8°C. Theory predicts that evolution of traits controlled by genes of large effect may "overshoot" targets of selection. Here, we found this phenomenon. Egg placement behaviour is bimodal and its simple genetic control, with dropping recessive to balancing, has allowed evolution to surge ahead of environmental change rather than lag behind. Behavioural evolution has circumvented the frequently-low evolvability of physiological tolerance to thermal extremes.

Author: KARIMI, Hamid Reza
Presenter: KARIMI, Hamid Reza

Learning Frameworks for Fault Diagnosis of Rotary Machinery

Content

The rapid advancement of deep learning has significantly transformed fault diagnosis in rotary machinery, offering enhanced accuracy, automation, and adaptability in detecting and classifying equipment faults. This talk delves into the development and application of AI-driven frameworks for fault diagnosis, focusing on how deep learning techniques—such as convolutional neural networks (CNNs), recurrent neural networks (RNNs), and transformer-based architectures—can effectively identify complex fault patterns from raw sensor data. These models have demonstrated strong performance in learning discriminative features from time-series signals such as vibration, acoustic, and temperature data.

However, several challenges hinder the widespread deployment of deep learning in industrial settings. These include the scarcity of labeled fault data, especially for rare or early-stage failures; the black-box nature of deep models that limits interpretability; the difficulty of generalizing models across different machines and operating conditions; and the need to fuse information from multiple heterogeneous sources for more reliable diagnostics. The talk also examines strategies to address these challenges, including data augmentation, transfer learning, self-supervised learning, attention mechanisms, and multimodal data fusion.

Looking forward, the integration of explainable AI, edge computing, and domain adaptation techniques will be crucial in building scalable, robust, and interpretable diagnostic systems for real-world machinery health monitoring applications.

Author: Prof. WANG, Li
Presenter: Prof. WANG, Li

Ferrocene-Based Polymer Network Burning-Rate Catalysts for Solid Propellants

Content

Composite solid propellants have been widely employed in the propulsion systems of spacecraft and aerospace launch vehicles due to their characteristics of high specific impulse, excellent mechanical properties, and superior safety factors. As one of the commonly used oxidizers, ammonium perchlorate (AP) typically constitutes approximately 70% of the total mass of composite solid propellants. Consequently, its thermal decomposition characteristics directly impact the ultimate burning performance. Research indicates that enhancing the thermal decomposition properties of AP through burning-rate catalyst addition is an effective approach to improving the burning performance of composite solid propellants. However, conventional ferrocene-based burning-rate catalysts (such as Catocene) exhibit issues like migration propensity, which severely compromises the storage stability and operational safety of composite solid propellants. To address these challenges, we introduced reactive groups into ferrocene-based compounds. By co-crosslinking with the binder system of the solid propellant, ferrocene-based polymer networks were constructed and the ferrocene-based burning-rate catalyst showed zero migration. This innovation effectively resolved the migration issue of ferrocene-based burning-rate catalysts within composite solid propellants, while also exhibiting outstanding catalytic efficiency for burning rate.

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INVESTIGATION OF THE ELASTIC SCATTERING PROCESSES 11B(p,p)11B AT LOW ENERGIES

Content

One of the current tasks of nuclear astrophysics is to clarify the reasons for the increased abundance of light elements (Li, Be, B) in the Universe. These elements cannot be effectively synthesized in stars during standard nucleosynthesis processes, since already at temperatures of about $2–5 \cdot 10^6$ K they are intensively destroyed in reactions of the (p,γ) and (p,α) type. According to theoretical calculations, under such conditions the content of lithium, beryllium, and boron isotopes should not exceed 10^{-13} relative to hydrogen. However, astronomical observations show that their actual amount is 100–1000 times higher.

Direct measurement of nuclear reaction cross sections, such as (p,γ), (α,γ), and others, on light nuclei at very low energies corresponding to temperatures of about 10^7 K, makes it possible to test various theoretical models explaining the observed distribution of chemical elements in the Universe. In addition, the study of elastic scattering processes of protons on light nuclei at low energies is necessary to obtain accurate parameters of proton-nucleus potential models used in the calculations of nuclear reactions of astrophysical importance.

Of particular interest is the study of proton elastic scattering on the isotope ^{11}B, given its important role in promising thermonuclear energy systems. In particular, radiative captures on ^{11}B provide information about the concentration of this isotope and the features of its burning in thermonuclear reactions.

The experimental part of this work was carried out using the proton beam line of the UKP-2-1 accelerator of the Agency of the Republic of Kazakhstan for atomic energy "Institute of nuclear physics"Republican state enterprise on the right of economic management. As targets, thin self-supporting foils of ^{11}B with a thickness of 313 μg/cm² and known isotopic enrichment were used, prepared by electron-beam deposition using the VUP-2 setup.

A detailed measurement of the differential cross sections of proton elastic scattering on the ^{11}B nucleus was performed in the angular range from 10° to 168° with a step of 10° at incident proton energies of 1200, 1000, 800, and 600 keV. The uncertainty of the experimental data on the differential cross sections of proton elastic scattering on 11B is 10%.

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Nanoscience & Nanotechnology Approaches to Biotechnology, Medicine, & Sustainability

Content

Biology functions at the nanoscale. Thus, there are special opportunities not only to make biological measurements using nanotechnology, but also to interact directly in order to influence biological outcomes. I describe how we fabricate and use nanostructures to advance high-throughput gene editing for cellular therapies targeting genetic diseases and cancer immunotherapy. We exploit molecular recognition and phase transitions to create molecular treadmills to grow three-dimensional co-cultured tissue efficiently for personalized medicine, testing potential therapeutics, and growing meat and fish sustainably. Nanoscience and nanotechnology developed from chemistry, physics, biology, engineering, medicine, toxicology, and a host of other fields. Along the way, we taught each other our problems, challenges, and approaches. The interdisciplinary communication skills that were developed and are now part of our training remain unique to the field. As a result, nanoscience contributes to a wide range of other fields, such as neuroscience, the microbiome, oncology, cellular agriculture, and more.

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