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Editor's Note

Welcome readers, to yet another exciting edition of Zenith!

In this age where the world prioritizes speed over substance, we strive to bring you content that is both meaningful and worthwhile. This edition is packed with exciting updates and resources to help you in your academic journey.

For most of us students, the vastness of Physics may seem daunting and intimidating, but every great journey starts with a small step forward. So, I'd like to encourage my readers to take on challenges, win some and lose some, and finally your efforts will take Physics into new heights we have yet to discover. Where should you start your journey, you say? Why not read and keep up with the Physics trends! Our team members work hard to bring you the latest hits, so you can find the inspiration to explore further.

The PSP team encourages you to engage critically with our content, and stay active in your academic pursuit. Your interest and feedback are enough appreciation for the work that goes into each edition. So readers, stay curious and keep moving forward in this ever-changing world run by Physics.

Enjoy!

Imbsat Noor Hashmi

"I would rather have questions that can't be answered rather than answers that can't be questioned"

-Richard P. Feynman

Some New Areas in Physics

By Dr. Nasir Majeed Mirza

Emerging Areas In Physics

Students and Researchers are asking this question: what are the emerging and evolving fields in physics that reflect cutting-edge research and exploration and how multi-discipline physics is evolving. Here is a brief list of rapidly growing areas related to physics that I see maturing in next twenty years:

1. Quantum Information Science
This subject branch is to develop use of quantum mechanics for computation, communication, and encryption. It includes quantum computing, quantum cryptography, and quantum networks. Industries like IBM, Google, and Microsoft have heavily invested and this area is growing fast.

2. Topological Matter
The study of materials whose properties are defined by topology rather than geometry. Topological insulators and superconductors are leading examples, that can have applications in quantum computing and novel electronic devices.

3. Gravitational Wave Astronomy
The detection of gravitational waves was first achieved by LIGO in 2015. It has opened a new way of observing the universe. This field uses the gravitational waves to study black holes, neutron stars, and other cosmic phenomena.

4. Dark Matter and Dark Energy Research
Two biggest unsolved mysteries in physics include dark matter and dark energy. There may be particles that could explain dark matter and the nature of dark energy, which makes up about 68% of the universe and is driving its accelerated expansion.

5. Astrobiology and Exoplanetary Science
The search for life beyond Earth is becoming more and more sophisticated. New studies are being done for the exoplanets, planetary atmospheres and the conditions that could support life, leading to fascinating new discoveries.

6. Quantum Gravity and String Theory
Efforts to unify quantum mechanics and general relativity is growing. Theoretical physics is heavily involved in attempts to develop quantum gravity theories, including string theory and loop quantum gravity.

7. Metamaterials and Photonics
Metamaterials are engineered structures with properties not found in nature, used for manipulating light, sound and other waves. This has applications in invisibility cloaks, super-lenses and new forms of communication technology.

8. Neutrino Physics
Neutrinos are among the most abundant but least understood particles in the universe. Research into neutrino mass, oscillations and their roles in astrophysical phenomena are growing.

Multidisciplinary areas

When we look into Multidisciplinary areas in physics, then we notice that these bridge physics with other scientific fields. These are rapidly gaining momentum due to their wide-ranging applications and potential. A few multidisciplinary areas that are emerging now are:

1. Biophysics
This field combines biology and physics to study biological systems using the principles and methods of physics. In this field the research trends show the following streams are growing:

- Molecular dynamics: Understanding protein folding, DNA/RNA structure.
- Medical imaging: Techniques like MRI, CT scans.
- Biomechanics: Analysing the physical principles behind the mechanics of living organisms.

2. Nanotechnology
This field Integrates physics, chemistry, biology and materials science to manipulate matter on the atomic and molecular scale. Applications range from nanomaterials and nanomedicine to nanoelectronics and energy storage are becoming possible now.

3. Quantum Biology

A relatively new field that applies quantum mechanics to biological processes. New streams include the following:

- Photosynthesis: Quantum coherence in energy transfer.
- Olfaction: Quantum tunnelling in smell receptors.
- Enzyme catalysis: Quantum effects in biochemical reactions.

4. Medical Physics

There is a huge trend in the western world to use Applied physics in medicine, particularly in diagnostics and treatment technologies. This field includes:

- Radiation therapy: For cancer treatment and studies.
- Imaging technologies: MRI, PET scans, two- and three-dimensional models.
- Dosimetry: Measuring radiation exposure.

5. Environmental Physics

It combines physics with environmental science to understand and address environmental issues such as:

- Climate modelling: Using fluid dynamics and thermodynamics to model the climate.
- Atmospheric physics: Understanding weather patterns, ozone depletion.
- Energy sustainability: Research on renewable energy technologies.

6. Geophysics

This field arise from the merger of physics with geology to study Earth's physical properties and processes. Topics include:

- Seismology: Studying earthquakes.
- Magnetism: Investigating Earth's magnetic field.
- Planetary physics: Exploring the physical properties of planets and moons.

7. Materials Science

Involves physics, chemistry and engineering to study and develop new materials. This field covers:

- Condensed matter physics: Understanding properties of solids and liquids.
- Metamaterials: Creating materials with unique properties like negative refractive index.
- Superconductors: Developing materials with zero electrical resistance.

8. Neuroscience and Physics (Neurophysics)

Investigates the nervous system using principles of physics. Research areas include:

- Neural network modeling: Using computational models to simulate brain activity.
- Brain imaging: Techniques like fMRI and EEG to study brain function.
- Information processing: Understanding how the brain processes information from a physics perspective.

9. Econophysics

Applies statistical physics to economics to study complex systems like financial markets, wealth distribution and network theory in economics. This approach uses tools like:

- Nonlinear dynamics: To model economic systems.
- Stochastic processes: For predicting market fluctuations.

10. Quantum Chemistry

This field merges quantum mechanics with chemistry to understand molecular and atomic interactions. It is used in:

- Molecular simulations: Modeling chemical reactions at the quantum level.
- Drug design: Predicting the behavior of drug molecules.
- Catalysis: Understanding chemical catalysts through quantum behavior.

11. Computational Physics

A field that uses computer simulations and numerical methods to solve complex physical problems. It overlaps with:

- Data science: In analyzing large datasets.
- High-performance computing: For simulations in astrophysics, fluid dynamics, etc.
- Machine learning: Applying AI techniques to predict outcomes of physical systems.

12. Physical Chemistry

A bridge between chemistry and physics, dealing with the physical properties and changes in matter. It covers:

- Thermodynamics: Understanding transformations of energy.
- Spectroscopy: Analyzing interactions between matter and electromagnetic radiation.
- Kinetics: Studying the rates of chemical reactions.

These interdisciplinary fields do reflect the trends that are growing for new physics to develop modern technologies.

Dr. Nasir Majeed Mirza, an expert in Computational, Mathematical and Nuclear Physics, has over 30 years of research and teaching experience at PIEAS. He has served two terms as Rector PIEAS. He continues to inspire young minds with his passion for Physics.

STUDENT PROJECTS

A Hybrid Approach to Image Encryption using AES and BB84 Protocol of Quantum Key Distribution

Mohamamd Ahsan Ali (BS Physics 19-23, DPAM, PIEAS)

Supervised By: Dr Zaheer Asghar (DPAM, PIEAS)

In private key cryptography, also known as symmetric key encryption, secrecy of secure cryptographic generation and transmission of cryptographic keys is of upmost importance to ensure credibility of ciphers. It relies on the notion that cryptographic keys are unpredictable and transmitted securely between relevant parties. Chaos based encryption schemes are widely used to generate highly unpredictable and pseudo-random keys at efficient rate while quantum key distribution protocol are popular because of their secure communication channels safe from interception.

In this study, Mohammad Ahsan Ali aimed at developing a novel cryptographic technique that bridges chaos and BB84 protocol of Quantum Key to generate and transmit cryptographic keys for image encryption using substitution-permutation network in block cipher encryption scheme inspired by AES.

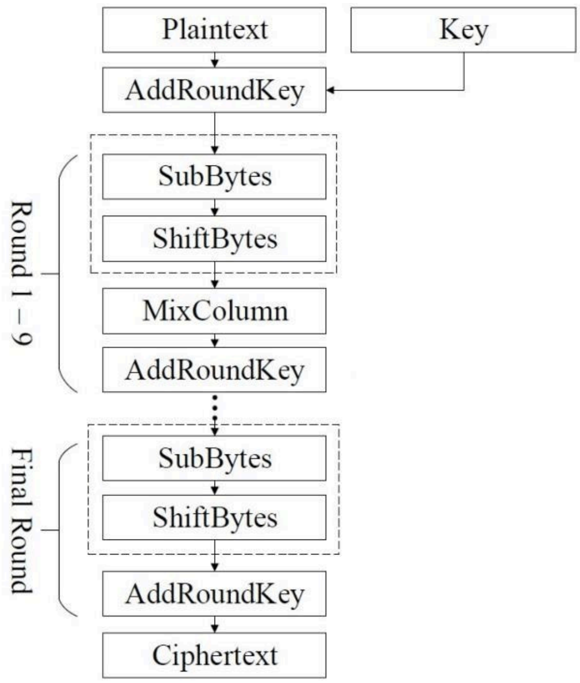


Figure 1: Working of AES Algorithm

Charles Bennet and Gilles Brassard introduced Bennett-Brassard (BB84) protocol in 1984. It was the earliest protocol of Quantum Key Distribution and laid the foundation for secure communication using principles of Quantum Mechanics. BB84 protocol operates on the principles of superposition and uncertainty, ensuring that during the communication process, any transmitted signal

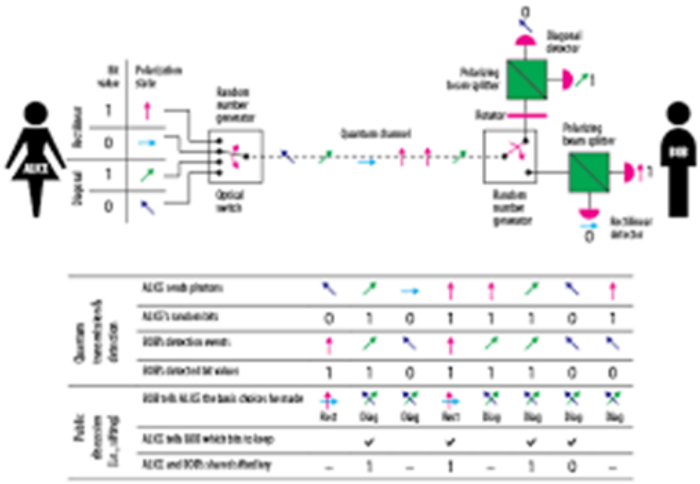


Figure 2: Working of BB84 Protocol

is safe from interception and presence of an eavesdropper (interceptor) is detectable. This makes it a very promising channel for sharing cryptographic keys in private key encryption. Key sharing using BB84 protocol requires that both parties, generally referred to as Alice (sender) and Bob (receiver), must have random arrays of basis for key transmission so that generated keys are unpredictable.

In this study, we utilize unpredictable and pseudo-random behavior of chaotic maps to generate random basis for key sharing between Alice and Bob. Length for the array of basis is selected such that after the communication process, both Alice and Bob have 128-bits keys that are safe from brute force attacks and interception while maintaining the efficiency in the process.

Total of 11 keys, each containing random arrangement of 128-bits, are generated and utilized in a substitution-permutation network (SPN) of block ciphering for encryption of digital image. The SPN in the encryption algorithm is similar to the 128-bit block encryption scheme of Advanced Encryption Standard (AES). Chaotic maps are utilized again to generate a suitable substitution box (S-box) for the encryption process, which has excellent cryptographic properties. Encrypted images are tested for their cryptographic properties such as histograms, entropy, key sensitivity and correlation analysis and results indicate that proposed scheme is resistant to brute force attacks, linear attacks and differential attacks.

Generation, Stabilization, and Manipulation of Kerr Cat States in Superconducting Resonators

Muhammad Shuraim (BS Physics, DPAM' 19-23)
Supervised by: Dr. Muhammad Irfan (DPAM, PIEAS)

In classical computers, information is processed as binary digits (bits) – if a switch is ON, it is represented as 1, and if it is OFF, it's 0. However, in quantum computation, something strange happens: a quantum switch can be ON and OFF simultaneously. This is due to a phenomenon called superposition, where the information is stored as a combination of both states, such as (ON + OFF)/c, where c is a normalizing constant. In classical computation, a switch corresponds to the presence or absence of an electrical signal in wires. But in quantum computing, the "switch" is an atom, which can be in either a ground state (OFF) or an excited state (ON), and this unit of quantum information is called a qubit. The challenge here is that excited atoms don't stay excited forever; they decay. If an atom decays before a calculation is completed, it causes what's known as a bit-flip error. Another type of error, called a phase-flip error, happens when the phase of the quantum state (related to the atom's energy levels) changes over time, altering the encoded information.

Managing both types of errors at once is extremely challenging. However, if we can suppress one type of error and focus on controlling the other, the computation becomes more stable. One promising approach is using coherent states for quantum computation instead of relying solely on atoms in their ground or excited states. Coherent states, like laser light, decay, but much more slowly compared to atomic states, making them more reliable for quantum computations. However, the challenge is: how to generate, stabilize and manipulate these coherent states?

Muhammad Shuraim, from the Department of Physics and Applied Mathematics (DPAM) at PIEAS, demonstrated that non-linear interactions inside a cavity or resonator can generate what are called Schrödinger cat states (SCS) – superpositions of two out-of-phase coherent states. These states can be thought of as quantum versions of ON and OFF, like classical bits. In Shuraim's work, the vacuum and one-photon state of the cavity evolve into even and odd parity SCS, which serve as the ground and excited states for logical operations.

This non-linearity is introduced by placing a Transmon qubit inside the cavity. A Transmon qubit is a type of

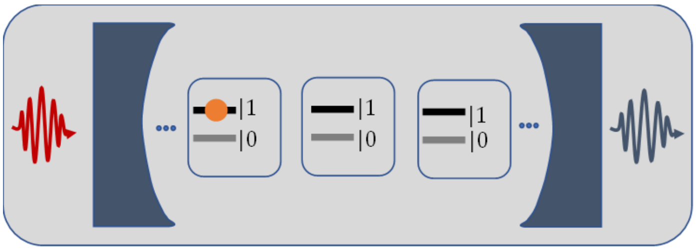


Figure 1: General structure of Quantum computer chip processor

artificial atom built from capacitors and non-linear inductors. The amplitude of non-linearity helps control the amplitude of the SCS, and as the amplitude increases ($\alpha \approx 3$ or 4), bit-flip errors are exponentially suppressed, though phase-flip errors increase linearly. This balance allows us to perform computations with high accuracy—coherent states can be generated with a fidelity of 99.9%. (Fidelity measures how closely the experimental or simulated results match the theoretical target.)

Stabilizing these coherent states is key to making them useful for quantum computing. By applying two orthogonal electric drives to the system, these states can remain stable long enough for most quantum operations to be performed. In simulations, they are stable for a period $t = \pi/8K$, where K is the non-linearity amplitude, typically in the kilohertz range.

To perform quantum computations, gates like classical logic gates (OR, AND or NOT gate) are used. For example, an X-gate flips the qubit's state from ground to excited, with a fidelity of 99.7%. The Hadamard gate transforms the state into a superposition, enabling more complex operations.

Shuraim also explored methods for generating and stabilizing Schrödinger cat states through adiabatic and non-adiabatic processes. In adiabatic processes, the system evolves slowly, allowing it to naturally reach the desired cat state. Non-adiabatic processes, on the other hand, involve rapid changes, requiring precise control to avoid disrupting the quantum state. Once these cat states are stabilized, they can be used to implement essential quantum logic gates like the X, Z, and CNOT gates, which are critical for quantum computation.

Now, you may wonder: if bit-flip errors are highly suppressed, how can we apply an X-gate? To understand this better, feel free to reach out to me for further explanation! 😊

An Integrated method utilizing Quantum Key Distribution for Image Encryption using different Protocols

Mohamamd Ayaz (MS Physics 22-24, DPAM, PIEAS)

Supervised By: Dr. Afshan Irshad (DPAM, PIEAS)

Information security has been crucial since the early days of human civilization and has become even more vital in today's digital age. Both individuals and the government prioritize securing their communication data from malicious entities. This information includes everything from the birthday photo you shared last week to the confidential messages exchanged between two allied nations. Modern cyber security relies on traditional algorithms that are difficult to decrypt using current standard computers. But what type of computers can we expect to see in 100 or 200 years given the ongoing scientific and technological progress? Quantum computers present the threat to the existing principles of cryptography. Luckily, the well-established theory of physics Quantum Mechanics offers a solution to the issue. This research explores using the unique properties of quantum particles for secure communication between authenticated parties, such as Alice and Bob. Quantum particles can be in multiple places at once, exhibit simultaneous properties and have instantaneous correlations over vast distances. We could use this strangeness of the quantum world to our advantage. To begin, let's go over some essential background information required to grasp quantum cryptography. Alice wants to communicate with Bob, but there is an eavesdropper named Eve who is trying to intercept their messages. Traditional cryptography is not secure against Eve's capabilities, which are limited only by the laws of physics. However, Alice and Bob can outsmart Eve by using quantum key distribution. They exchange random and secure keys using quantum particles, and this key is used for encryption and decryption of the secret message. If Eve tries to intercept the key by measuring the quantum particles, it will disturb the particles and be detected by Alice and Bob. This process, known as quantum key distribution (QKD), ensures secure communication between Alice and Bob.

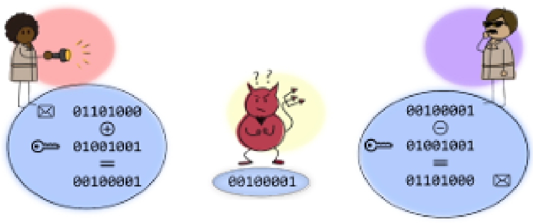


Figure 1: Quantum key distribution

We typically utilize photons for key distribution purposes, encoding information in either discrete or continuous degrees of freedom of the photons. Discrete degrees of freedom are comparable to a limited menu at a restaurant, where you can only choose one option at a time, such as polarization in a specific direction. In contrast, continuous degrees of freedom are akin to an unlimited menu, allowing for a range of choices. Photons can occupy any position in space with any momentum, serving as analogies for understanding. There are two types of quantum key distribution (QKD) based on these principles: discrete and continuous variable QKD. My research focuses on utilizing the continuous variables of photons for key distribution between two parties. This involves encoding random variables in the degrees of freedom of photons or leveraging the inherent randomness of the quantum system. Opting for the latter approach, I explore the use of a noisy light source, such as a thermal source, and its intrinsic randomness for key distribution. As depicted in Fig. (2), the thermal source's output is divided into two using a beam splitter. Alice measures one output of the beam splitter, while the other is sent to Bob for the same measurement. The correlated beams should result in identical measurement outcomes for Alice and Bob. My objective is to conduct a security analysis of the entire protocol and determine the distance over which communication will remain secure against the most powerful adversary. To achieve this, security parameter "Secret key rate" was computed.

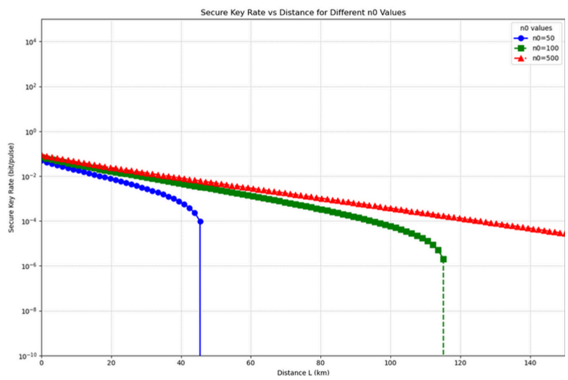


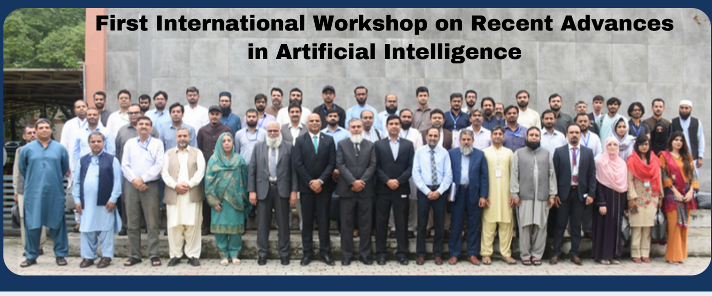
Figure 2: Secret key rate against communication length

As shown in figure 2, the communication length increases with the brightness of the source. The passive scheme is effective for high transmission rates, streamlines the setup by eliminating the need for modulators, and is cost-efficient. A chip-based passive QKD setup has been recently suggested, but it is currently limited to shorter distances and requires secure measurement devices to protect against all potential attacks by Eve.

Events

First International Workshop on Recent Advances in Artificial Intelligence

Center for Mathematical Sciences collabrated with PIEAS Artificial Intelligence Centre to organize the First International Workshop on Recent Advances in Physics. The workshop spanned over two weeks from 5th to 16th August, 2024. Three eminent international speakers namely Dr Tariq Mahmood, Dr Saima Rathore and Dr Fayaz Minhas delivered lectures for two weeks on various topics of the emerging field of Artificial Intelligence. The workshop was attended by students, researchers and professionals belonging to different institutes. The closing ceremony was held on 16th August 2024 in Lyceum PIEAS, where rector PIEAS Dr Naseem Irfan was Chief Guest. He appreciated the interest of the participants in this interesting field and expressed desire for PIEAS to organize this type of event every year.



From Classical to Quantum Computing: A paradigm shift

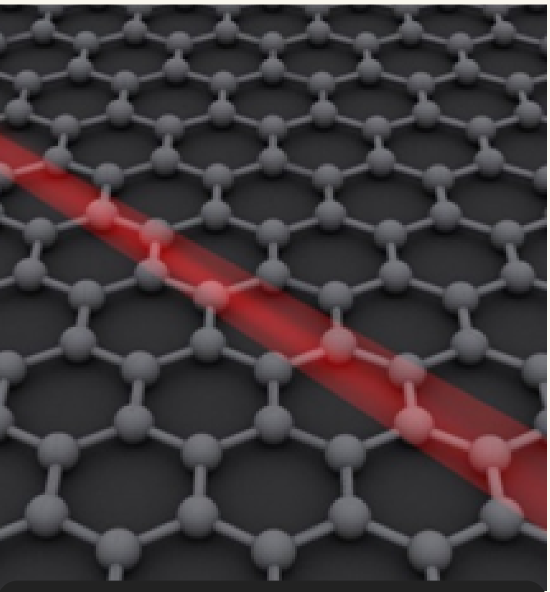
PSP recently hosted a fascinating talk as a part of 'Let's Talk Physics' lecture series. The topic was “From Classical to Quantum Computing: A Paradigm Shift,” and it was presented by the renowned quantum optics researcher Dr. Shahid Qamar. The talk was specifically designed for junior undergraduate students. The motive was to spark their interest in the exciting world of quantum science and technology. We hope that these young minds will be inspired to pursue careers in this field and contribute to Pakistan's future as valuable resources in quantum research and development.

PIEAS Acheivements

Three PIEAS Faculty members in top 2% scientists

Every year, Stanford University publishes a prestigious list of the top 2% scientists worldwide. This list recognizes researchers whose work has made a significant impact on the fields of science and engineering.
We proudly announce that three PIEAS faculty members have once again been included in this elite group. Dr. Muhammad Aftab Rafiq from the Department of Physics and Applied Mathematics, Dr. Asifullah Khan from the Department of Computer and Information Sciences and Dr. Muhammad Rehan from the Department of Electrical Engineering have been honored for their outstanding contributions. Their research has undoubtedly advanced their respective fields and brought great credit to our institution. PSP congratulates the respective faculty members for this achievement.

Physics Bulletin



The world’s fastest microscope makes its debut

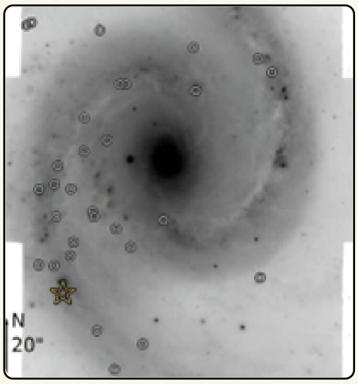
Researchers have created "attomicroscopy," a laser-based microscope that captures electron movements in just 625 attoseconds. This new technique offers unprecedented precision, allowing scientists to visualize how electrons behave in materials like graphene. While individual electrons can't yet be imaged, the method creates stop-motion sequences that could enhance our understanding of chemical reactions and lead to advancements in materials and medicine.

Source: *https://www.sciencenews.org/article/world-fastest-microscope-attoseconds*

Astronomers discover 307 new supernova remnants

A team led by Timo Kravtsov has identified 307 new supernova remnants (SNRs) using the Multi Unit Spectroscopic Explorer (MUSE) on the Very Large Telescope, including seven rare oxygen-rich remnants. These findings highlight the scarcity of oxygen-rich SNRs, previously only eight known. The innovative detection method, based on the shapes of emission lines, revealed that most identified SNRs correspond to ultra-luminous X-ray sources. The researchers aim to apply this method to other nearby galaxies to further investigate the origins of these remnants.

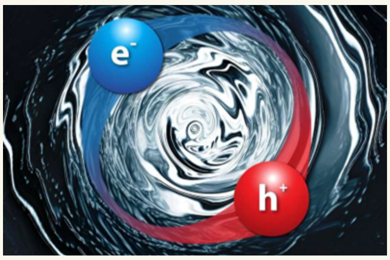
Source: *https://phys.org/news/2024-09-astronomers-hundreds-supernova-remnants-method.html*



Quantum sensing revolutionizes Brain imaging

Margot Taylor at the Hospital for Sick Children is using optically pumped magnetometry (OPM-MEG) to map brain activity in children. This wearable technology enables non-invasive scans while allowing movement, crucial for young patients. Taylor's research explores brain function differences between autistic and non-autistic children, aiming for earlier diagnoses. Developed by Cerca Magnetics, OPM-MEG also has potential applications in dementia detection and concussion assessment, with aspirations for broader medical use.

Source: *https://physicsworld.com/a/quantum-brainwave-using-wearable-quantum-technology-to-study-cognitive-development/*



Physicists predict existence of new exciton type

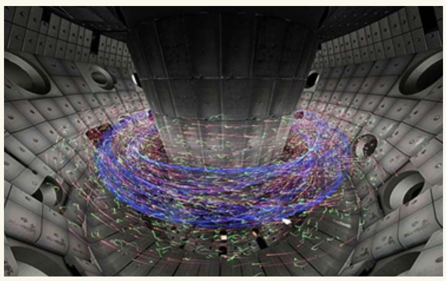
Researchers at the University of Oklahoma have predicted "topological excitons" in Chern insulators, where electrons and holes form excitons with unique properties. These excitons could emit circularly polarized light, enabling advanced optical devices for quantum computing and communication. This discovery may lead to new technologies that utilize excitons' vorticity for entangled qubits.

Source: *https://phys.org/news/2024-08-physicists-exciton.html*

3D Visualisation brings Nuclear Fusion to life

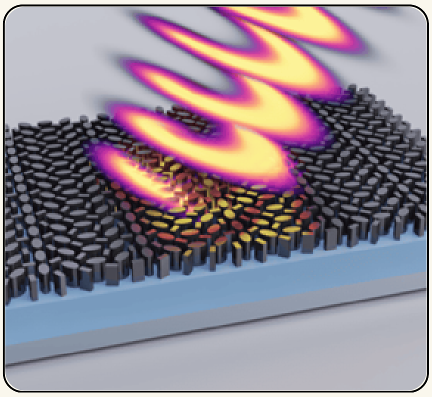
EPFL researchers have developed a stunning 3D visualization of a nuclear fusion reactor, or tokamak, showcasing how particles move within it. This advanced technology turns complex data into an immersive experience, revealing detailed images of the reactor’s interior. The project offers a fascinating look at potential clean energy and helps scientists better understand nuclear fusion processes.

Source: *https://phys.org/news/2024-07-3d-visualization-nuclear-fusion-life.html*



Physics Bulletin

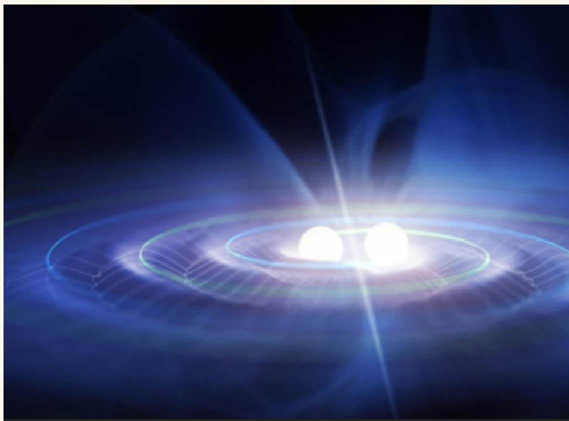
Thermal emission control by metasurface



Researchers at CUNY, led by Andrea Alù, have created a metasurface that transforms incoherent thermal emissions into coherent, directed light, similar to lasers. By using a periodic structure with tailored perturbations and a gold backing, they overcame traditional optical limitations. This breakthrough allows for control over emission direction and polarization, with potential applications in lighting, imaging, and thermal management. Experts believe this is a significant advance toward mastering thermal radiation control.
Source: *https://physicsworld.com/a/metasurface-makes-thermal-sources-emit-laser-like-light/*

New insights into the origins of matter

Scientists have discovered that over 70% of certain particles, like charmonium, come from reactions that happened after the first moments of the universe, not just from the initial hot soup of particles. This finding, shared in Physics Letters B, helps us better understand how matter formed after the Big Bang. It means that when studying particle collisions, researchers need to consider these later reactions to get an accurate picture of how early matter was created. Overall, this research moves us closer to understanding the origins of the matter around us.
Source: *https://phys.org/news/2024-07-discovery-early-universe.html*



Cold atoms simulate gravitational waves in the lab

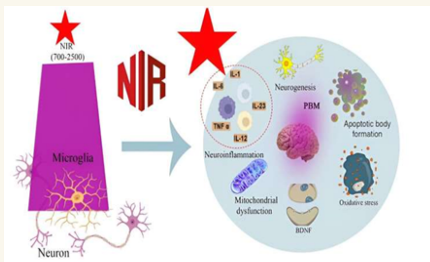
Researchers from the Okinawa Institute for Science and Technology and collaborating universities have successfully simulated gravitational waves using cold atom quantum condensates. This innovative approach provides a laboratory-based method to study gravitational waves, which are typically generated by cosmic events like black hole collisions and are difficult to observe directly. The team focused on a specific state of Bose-Einstein condensate called spin nematics, where the wave properties mimic those of gravitational waves. Their findings, published in Physical Review B, highlight the potential for simplified experimental setups to enhance our understanding of these fundamental cosmic phenomena.
Source: *https://scitechdaily.com/einsteins-theories-come-alive-cold-atoms-shed-light-on-gravitational-waves/*

New Method Achieves High Control of Chiral Molecules

Researchers at the Fritz Haber Institute have demonstrated 96% control over the quantum state of chiral molecules, challenging previous assumptions about their manipulation. Using tailored microwave fields and UV radiation, they significantly advanced molecular beam experiments. This breakthrough opens doors for studying fundamental physics, including parity violation, and could lead to new applications in molecular physics and chemistry.
Source: *https://www.sciencedaily.com/releases/2024/08/240829132503*

Promising light therapy for neurodegenerative diseases

Researchers have developed a light treatment called photobiomodulation (PBM) that could help combat neurodegenerative diseases like Alzheimer's and Parkinson's. Using a special phosphor, SrGa12O19+, this therapy emits near-infrared light for over two hours, reducing harmful inflammation in brain cells. This innovative, noninvasive approach offers a potential alternative to traditional treatments, providing hope for millions affected by these conditions.
Source: *https://phys.org/news/2024-07-infrared-photobiomodulation-technique-brain-inflammation.html*



Pinboard

Nobel Prize in Physics Announcement

It's that time of the year again! The Nobel Prize in Physics will be announced at the Royal Swedish Academy of Sciences in Stockholm, Sweden. The announcements will be broadcast live on the official digital channels of the Nobel Prize. Don't forget to tune in for the exciting revelation of outstanding contributions in Physics!

Deadline: 8th October (2:30pm)
Link: https://www.youtube.com/watchv=SBGG4WNweEc

Commonwealth Scholarship

Commonwealth Master's Scholarships are currently being offered in UK, funded by UK Foreign, Commonwealth and Development Office (FCDO). It covers tuition fees, airfare, living expenses and other allowances and is targeted at students who cannot afford to study in the UK without financial aid. It focuses on fields related to development, like science, technology, health and governance.

Deadline: 15 October 2024
Link: https://cscuk.fcdo.gov.uk/scholarships/commonwealth-masters-scholarships/

School on Advanced Topics in High Energy Physics, NCP

The Experimental High Energy Physics (EHEP) department at the National Centre for Physics (NCP), Islamabad, is organizing a workshop designed to offer a platform for Pakistan's high-energy physics community, especially young students and researchers, to engage with and explore recent advancements in tracking detector technologies and their applications in high-energy physics experiments.

Duration: 22 - 24 October, 2024
Link: http://ncp.edu.pk/iwtd-2024.php

CERN Technical Student Programme

The CERN Technical Student Programme is an opportunity for undergraduate and graduate students pursuing technical fields to gain hands-on experience at CERN. The program offers a chance to work at the forefront of scientific research, particularly in the unique environment of particle physics and cutting-edge technology. The contract of Association will last about 4 to 12 months with a monthly stipend of 3452 Swiss Francs per month.

Deadline: 4th November, 2024
Link: https://careers.smartrecruiters.com/CERN/tech

Inertia '24

The grand annual event dedicated to introducing the PIEAS Society for Physics (PSP). This event aims to showcase our objectives, activities, and provide you with an opportunity to become a part of our community. Get ready to immerse yourself in fascinating talks and engage in stimulating conversations with like-minded peers. Join us for an unforgettable evening of knowledge, camaraderie, and endless possibilities!

Venue: Inam-ur-Rehman Auditorium
Date: 4th December, 2024 (Tentative)
Link: https://www.pieas.edu.pk/proclaim-detail.cshtml?ProclaimId=168

Chinese Government Scholarships

Chinese Scholarship Council offering fully funded Scholarship under Chinese Government Scholarships (CGS) program to study bachelor's degree programs, master's degree programs, and doctoral degree programs in 274 Chinese Universities. The admission process starts from December to April, with the deadline varying for each university. The scholarship includes full coverage of tuition fees, free on-campus accommodation, monthly stipends for living expenses and comprehensive medical insurance.

Deadline: February to April, 2025
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Physics Problems

Question 1

Why do heavier objects fall at the same rate as lighter ones in a vacuum?

Question 2

Why we can not achieve absolute zero temperature?

Question 3

Why are black holes “black”

Answers to problems in Previous Issue (Quarter I 2024)

Answer 1

Quantum entanglement is a phenomenon where pairs or groups of particles interact in ways such that the quantum state of each particle cannot be described independently of the state of the others. This results in instant correlations between entangled particles, regardless of the distance separating them. This seemingly "spooky action at a distance" is a fundamental aspect of quantum mechanics, challenging our classical understanding of locality and separability.

Answer 2

The arrow of time is a concept describing the one-way direction or asymmetry of time. It is closely related to the second law of thermodynamics, which states that the total entropy (disorder) of an isolated system can never decrease over time. This gives a thermodynamic arrow of time. While time reversal symmetry exists in some physical laws, the macroscopic arrow of time appears to be driven by initial conditions and entropy.

Answer 3

Cooking methods affect food texture and flavor by altering the molecular structure of ingredients. Boiling transfers heat through water, causing starches to gelatinize and proteins to denature. Baking uses dry heat, leading to Maillard reactions that brown and flavor food. Frying cooks food quickly at high temperatures, creating a crispy exterior through dehydration and caramelization. Each method involves heat transfer and chemical reactions that change the food's properties.

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