



Physics Pulse

IIT (ISM) DHANBAD

VOL.II No.9

SEPTEMBER 27, 2025

PHYSICS NEWSLETTER*

INERTIAL CONFINEMENT FUSION

By TANISHA SHUKLA

Einstein's famous equation

$$E = mc^2,$$

tells us that a small mass can be converted into a large amount of energy. This powerful equation is at the centre of fusion energy, the idea that light nuclei such as deuterium and tritium (isotopes of hydrogen) can be smashed together to form

mass. The lost mass is converted to kinetic or motion energy of the new particles according to Einstein's equation, which can then be used for producing electricity.

The odds of fusion occurring are a function of the fuel density and temperature, as well as the length of time that the density and temperature are maintained. Even under ideal conditions, the chance that a deuterium and tritium pair fuse is tiny. Higher density and longer times allow more encounters among the atoms. This cross-section is further dependent on individual ion energies. This combination, known as the fusion triple product, must reach the Lawson criterion to achieve ignition.

The inertial-confinement route to controlled-fusion energy is based on the same general principle as that used in the hydrogen bomb, where fuel is compressed and heated so quickly that it reaches the conditions for fusion and burns before it has time to escape. The inertia of the fuel keeps it from escaping, hence the name inertial-confinement fusion (ICF). The quantity of fuel has to be much smaller than that used in a bomb, so that the energy released in each micro-explosion will not destroy the surrounding environment. The quantity of fuel is also constrained by the amount of energy needed to heat it sufficiently quickly. In inertial confinement fusion using lasers, the blue arrows represent radiation, orange represents blowoff, and purple represents inwardly transported thermal energy. Laser beams or laser-produced X-rays rapidly heat the surface of the fusion target, forming a surrounding plasma envelope. The fuel is compressed by the rocket-like blowoff of the hot surface material. During the final part of the capsule implosion, the fuel core reaches twenty times the density of lead and ignites at 100, 000, 000 °C.

particles, for example a neutron and a helium nucleus, of even smaller combined

Upcoming Conference

The Department of Physics,
IIT (ISM) Dhanbad
is pleased to announce a 3-day
International Conference
on

**“Trends and Advances in
Reforming Green Energy
Technologies (TARGETs-2026)”**,

to be held during
Feb 13-15, 2026

The conference will address the global energy crisis and explore solutions through energy materials, processes, and technologies, covering a wide range of interdisciplinary topics.

We look forward to your contributions and active participation in TARGETs-2026.

Abstract submission is now open!

PhD Awarded

On February 27, 2025, **Manisha** successfully defended her thesis titled **Development and Characterization of Rare-Earth Doped BaGdO₄ Phosphors for Optoelectronic Applications** under the supervision of Prof. S. K. Sharma.

On August 12, 2025, **Sapna Mahla** successfully defended her thesis titled **Theoretical Investigation of Leptonic Collisions and Photoionisation of Molecules** under the supervision of Prof. Bobby Antony.

On 19 August 2025, **Md. Sarfaraz Ansari** defended his thesis titled **Fillers Unified Polypyrrole Composites as Symmetric Electrode Materials for Supercapacitor Application**, under the supervision of Prof. R. B. Choudhary.

*Send your feedback to: physicspulse@iitism.ac.in

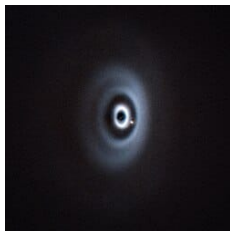
Physics News

The Emerging Quantum City - Bengaluru

Bengaluru, Karnataka, with its vibrant IT and startup ecosystem, is now developing a strong quantum technology ecosystem aligned with India's National Quantum Mission. To bring experts and researchers together, the Government of Karnataka is hosting Quantum India Bengaluru (QIB), a biennial event. QIB 2025 was held on July 31 and August 1 at the Hilton Hotel, Embassy Manyata Business Park. The conference covered five key quantum themes: Computing, Finance & AI; Healthcare; Security; Peripherals & Hardware; Society & Art. It aims to encourage collaboration among students, researchers, entrepreneurs, and government, with a vision to make Bengaluru the 'Quantum City' of the coming decade.

WISPIT 2b: A Rare Glimpse of a Planet Being Born

Astronomers have directly imaged a forming planet, WISPIT 2b, orbiting a young Sun-like star about 430 light-years away. The planet is just 5 million years old with a mass nearly five times that of Jupiter. Its host star, WISPIT 2, is surrounded by a multi-ringed disk extending almost 380 AU. WISPIT 2b sits inside one of the disk's gaps, exactly where theory predicts giant planets should carve out paths in the dust. Using ESO's Very Large Telescope with the SPHERE instrument, astronomers captured the planet in infrared light. Follow-up imaging in H-alpha revealed it is still accreting gas, clear evidence the planet is actively growing. This is the first clear detection of a planet in a multi-ringed disk around a Sun-like star, offering a rare glimpse of planet formation in real time.



National Visits

Pritam Biswas, a Research Scholar, working under the supervision of Prof. T. K. Dey, visited **Prof. Kaushik Sen's lab at IIT Delhi** to perform low-temperature Raman scattering experiments. The visit was highly beneficial in gaining a deeper understanding of the technique. One can probe anharmonic effects, temperature-induced phase transitions, spin-phonon coupling, and other emergent phenomena like quasiparticle excitations in correlated materials by monitoring the temperature evolution of phonon frequencies, linewidths, and intensities.



Event organized

Physics in History

- **September 1, 1804:** Discovery of Juno, one of the largest main belt asteroids, was discovered by German astronomer Karl Ludwig Harding.
- **September 7, 1908:** Ernest Rutherford began the alpha-particle scattering studies (with Geiger and Marsden) that later led to the discovery of the nuclear atom model in 1911.
- **September 14, 2015:** LIGO detected gravitational waves (GW150914) for the first time in history.
- **September 28, 1925:** Werner Heisenberg's paper introducing matrix mechanics, the first formulation of quantum mechanics, was published.

Introduction to Quantum Technology

An interactive session on "Introduction to Quantum Technology" was organised on September 3 by the students of the 2nd and 3rd year B.Tech. The session was taught by Prof. Sumit Kumar, who introduced participants to the fundamentals of quantum technologies, their potential, and the opportunities this field presents. Prof. Kumar began with the basics of quantum science and gradually explored its far-reaching possibilities, keeping the audience, which ranged from first-year B.Tech students to PhD scholars, actively engaged. A key emphasis of the session was that quantum technology is inherently multidisciplinary, not limited to physics alone. This was reflected in the diverse organising committee and participants, which included B.Tech students from Physics, Computer Science, Electrical, Applied Geophysics and Mechanical Engineering. The session also discussed the future potential of quantum initiatives at our institute, including a club solely for the purpose of quantum

research, along with the role students can play in enabling these opportunities.



Research Publications

1. Dinesh Kumar, **Aditya Singh** and Ankit Anand: Effect of a nonextensive parameter on the Page curve. *Phys. Rev. D*.
2. **Meenu Pandey and Bobby Antony**: Theoretical Study of Electron Interaction from Glucose Molecule in Aqueous Phase. *J. Phys. Chem. B*.
3. **Ashutosh Yadav and Bobby Antony**: Investigation of Electron Collisions with Organic Phosphates. *J. Phys. Chem. A*.
4. **Meghana N, Vishakha Zimba, Jhasaketan Nayak**: Enhanced ammonia gas sensing properties of hexagonal

phase graphitic carbon nitride in moist atmosphere in the near room temperature ambience. *Materials Letters*.

5. **Nitesh Kumar Pathak, Nandeshwar, Priyadarshi Sahoo, Amit K. Pradhan, Tara Singha, Prasanta K. Datta, Umakanta Tripathy**: A novel insight into the femtosecond induced nonlinear response of monoamine neurotransmitters through experimental and in silico approaches. *Scientific Reports*.
6. **Nandeshwar, Umakanta Tripathy**: Diosgenin Reduces β -sheet Content in Mutated α -Syn Aggregation Insights from Conformational Dynamics at Intracellular and Extracellular Neuronal Salt Concentrations. *Journal of Molecular Graphics and Modelling*.
7. Saeed Noori Gashti, Ankit Anand and **Aditya Singh**: Thermodynamic curvature and topological insights of Hayward black holes with string fluids. *Physics of the Dark Universe*.

Physics Job Openings

1. **Process Engineer at Lam Research-Bengaluru, Karnataka, India** : Lam research is hiring a Process Engineer in Bengaluru. Requires B.E./B.Tech or M.E./M.Tech in Electronics, Materials Science, Physics, or related fields. Bachelor's with 2–4 years or Master's with relevant experience preferred. Work on semiconductor process development, equipment integration, and optimisation. Strong problem-solving skills and a passion for advanced technology are essential.
2. **Quantum Device Characterisation Engineer at Scouto. AI-Bengaluru, Karnataka, India**: Scouto.AI is seeking a Quantum Device Characterisation Engineer to join their R&D team in Bengaluru. Candidates should possess a B.E./B. Tech or M.E./M.Tech in Electronics, Physics, or related fields. Experience in quantum device characterisation, measurement techniques, and data analysis is preferred. Strong analytical skills and a passion for quantum technology are essential. This role offers the opportunity to work on cutting-edge quantum research and development projects.

Editorial Board: **Chief Editor**: Prof. V. K. Rai (HOD), **Editors**: Prof. Tusharkanti Dey, Prof. Sudipto Singha Roy, **Assistant-Editor**: Mr. Mithilesh Mishra,

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