DEPARTMENT OF PHYSICS

Physics Pulse

IIT (ISM) DHANBAD

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When Simulations Lead: Is Experimental Science at a Crossroads?

By SRIMAYA SAHU, M.SC. 2 ND YEAR

The 2024 Nobel Prizes in Physics and Chemistry have sparked discussions among young scientists, as the awards recognized groundbreaking work primarily reliant on computational techniques.

Geoffrey E. Hinton and John J. Hopfield were honored in Physics for their contributions to artificial neural networks and machine learning, while David Baker, Demis Hassabis, and John Jumper received the Chemistry prize for advancements in protein science via computational methods. Baker was acknowledged for his pioneering work in computational protein design, and Hassabis and Jumper were recognized for their work with AlphaFold, which significantly enhanced AI-based protein structure predictions.

Rather than competing over the Nobel committees' choices, we should recognize the vital role of computational science in contemporary research.

Computational techniques allow scientists to model and analyze complex systems where traditional methods may fall short, such as simulating atomic interactions in materials research or chaotic climate dynamics. These methods provide insights into long-term trends and conditions that are difficult to replicate in a laboratory setting, enabling researchers to explore uncommon molecular interactions and test various hypotheses without the limitations of physical experiments.

Despite their advantages, computational models cannot entirely replace experimental methods, as they rely on certain assumptions about underlying processes. Validating these models with real-world experimental data is essential to ensure accuracy and reliability. This iterative validation process helps identify gaps in the theory on which the model is based. Additionally, in fields like biology and medicine, experimental validation is critical for safety and ethical considerations.

In conclusion, while computational methods greatly enhance research, many challenges necessitate a blend of experimental and computational approaches. The collaboration between computational and experimental scientists leads to more accurate, efficient results and innovative

An Interview with Prof. Jairam Manam

Prof. Jairam Manam joined the institute as a Lecturer in 1985. After nearly four decades of inspiring students and advancing research, he now serves as an Emeritus Professor. In a recent interview with the Department Newsletter team, Prof. Manam shared invaluable insights from his distinguished career, highlighting the milestones, challenges, and unforgettable moments of his service.

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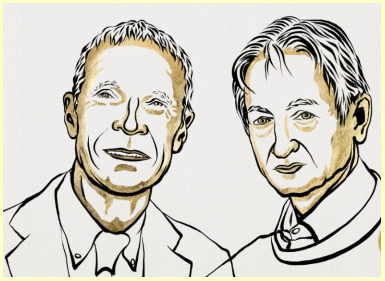
Physics News

Nobel Prize in Physics or AI?

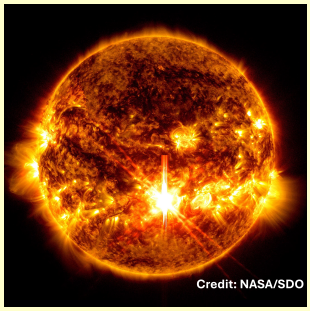
On October 8th, The Nobel Prize in Physics 2024 was awarded to John Hopfield and Geoffrey Hinton.



John Hopfield and Geoffrey Hinton

Strongest Solar Flare in 7 Years

Sun emitted an exceptionally powerful X 9.0 solar flare.



NASA Launches Europa Clipper Mission

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Integrity Pledge

Vigilance Awareness Week was observed with the theme **Culture of Integrity for Nation's Prosperity**. On 28th October 2024, faculty, staff, and students of the department assembled at Raman Hall and took the integrity pledge.

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

solutions. Integrating these methodologies is vital for addressing complex challenges across various disciplines.

Physics News

Nobel Prize in Physics or AI? Understanding the Intersection of Disciplines

On October 8th, The Nobel Prize in Physics 2024 was awarded to John Hopfield and Geoffrey Hinton for foundational discoveries that enable machine learning with artificial neural networks. A neural network works similarly to how your brain learns to recognize words. It takes in information, processes it, forms patterns, and makes decisions, learning from experience. A common question raised is why AI researchers who developed neural networks received the Nobel Prize in physics.

These neural networks are based on three principles from physics—Biophysics (how the brain works), Statistical physics (how data is processed), and Computational physics (how computers solve complex problems).

NASA Captures Strongest Solar Flare in 7 Years

On October 3, 2024, the Sun emitted an exceptionally powerful X9.0 solar flare, peaking at 8:18 a.m. ET. This event, captured by NASA's Solar Dynamics Observatory, is the most intense solar flare of Solar Cycle 25, which began in December 2019, surpassing the previous high of X8.7 in May 2024. Solar flares are intense bursts of radiation from magnetic energy associated with sunspots. They are among the most powerful phenomena in our solar system, releasing energy equivalent to millions of 100-megaton hydrogen bombs.

Flares occur when magnetic field lines near sunspots tangle and reorganize, causing sudden changes in brightness. The flare ejects clouds of electrons and ions into space, which can interfere with magnetic fields, radio communications, and power grids upon reaching Earth.

NASA Launches Europa Clipper Mission to Explore Jupiter's Icy Moon

NASA successfully launched the Europa Clipper mission on October 14, 2024, at 12:06 p.m. EDT from Kennedy Space Center, Florida, aboard a SpaceX Falcon Heavy rocket. The mission aims to explore Jupiter's moon Europa, which has an icy surface and a potential subsurface ocean, making it a key target in the search for extraterrestrial life. The spacecraft is expected to reach Europa by 2030 using gravity assist from Mars and Earth.

The spacecraft will conduct 49 close flybys of Europa while orbiting Jupiter, collecting data on the moon's ice shell, ocean, and habitability. With instruments like ice-penetrating radar, high-resolution cameras, and spectrometers, Europa Clipper will map the surface and search for signs of life.

Project Sanctioned

Prof. Sudipto Singha Roy was awarded a research project entitled "**Quantum metrological advantages of non-Hermitian systems**" of Rs. 20 lakhs under the "Faculty Research Scheme" of IIT (ISM) Dhanbad.

Departmental Seminar

Dr. Dhritiman Banerjee, an alumnus (M.Sc. 2012-14, Ph.D. 2014-20), visited the department on 3rd October 2024 and delivered a talk titled "Physics at the Core: Shaping the Semiconductor Industry's Next Frontier". Dr. Banerjee is currently working as Product Certification & Benchmarking Physicist at Infineon Technologies AG, Germany. He has completed his Ph.D. under the supervision of Prof. A. K. Kar.

Dr. Nirmalendu Patra, an alumnus (M.Sc. 2010-2012), visited the department on 24th October 2024 and delivered a talk titled "Local structural exploration of metal ions as fission and corrosion products in molten salt reactors (MSRs) via X-ray absorption spectroscopy". He is currently working as a research associate in the Nuclear Science and Technology Department (NSTD) at Brookhaven National Laboratory (BNL), New York, USA.

As a part of the refresher course on ***"Advanced Concepts in Biophysics and Soft Matter: Foundations and Frontiers"***, three lectures were organized in the Department on 28th October 2024.

Prof. P. K. Mohanty from IISER Kolkata presented a talk on how humans

can perceive their surroundings even with their eyes closed. In another talk, he discussed the statistical perspective on how the micro world relates to the macro world.

Prof. Monalisa Mishra from NIT Rourkela delivered a talk on the analysis of phenotypic defects in model organism Drosophila.

Prof. Chandan Dasgupta from the Indian Institute of Science, and International Centre for Theoretical Sciences, Bengaluru delivered two highly insightful lectures on the physics of active matter systems.

Empowering India's "Quantum Future": The Launch of National Quantum Mission and Thematic Hubs

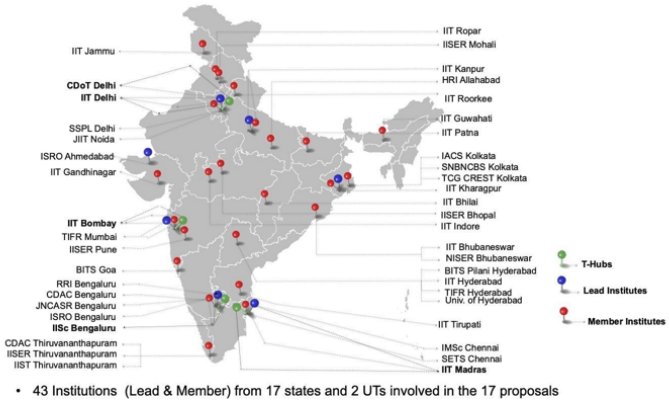
By PROF. SUDIPTO SINGHA ROY

Quantum mechanics has long intrigued scientists for its foundational insights, but its impact extends into transformative technologies. In recent decades, we've seen a shift from theoretical studies to real-world applications of quantum mechanical principles that are reshaping fields like computing, communication, sensing, and new material design.

In this context, on 30th September the Indian government launched the National Quantum Mission (NQM), a significant initiative aimed at establishing Thematic Hubs (T-Hubs) in leading research institutions, Quantum Computing HUB at Institute Indian IISc, Quantum Communication Hub at IIT Madras, Quantum Sensing and Metrology Hub at IIT Bombay, and for Quantum Materials and Devices Hub at IIT Delhi.

Creating these T-Hubs represents a pivotal step in positioning India as a leader in quantum technology, focusing on key areas like quantum computing, communication, sensing, and materials. Exploiting a Hub-Spoke-Spike model, these centers will facilitate a network of collaborative research environments between people coming from diverse communities: Physics, Mathematics, Computer Science, Engineering, and many more.

Backed by government support, the NQM aims to nurture startups, build industry partnerships, and encourage international collaboration to drive progress in this timely field. As the Indian IIT(ISM) Dhanbad, we look ahead to explore future opportunities to contribute to this exciting initiative and play a part in the nation's aspirations in quantum technology.



- 43 Institutions (Lead & Member) from 17 states and 2 UTs involved in the 17 proposals

Physics Openings

1. **PhD Internship in Quantum Computing at Cambridge, UK.**
2. **PhD Position in Electronics and Electromagnetic Compatibility Graz University of Technology.**
3. **PhD Position: Quantum-Limited Holographic Sensing of Nanoparticles.**
4. **Doctoral Fellowship in Information Technology at Ghent University.**

An Interview with Prof. Jairam Manam

By NEWSLETTER TEAM

Professor Jairam Manam is a distinguished Professor (Emeritus Fellow) in the Department of Physics at IIT(ISM) Dhanbad. He completed his Ph.D. at IIT Kharagpur and has extensive experience in the fields of luminescent materials, Thermally Stimulated Luminescence, Photoluminescence, and Defect Solid State studies. His career highlights include substantial contributions to the study and development of advanced luminescent materials, particularly their applications in optoelectronics. Additionally, he has supervised numerous doctoral

theses and was actively involved in research projects funded by organizations like UGC DST and AICTE. Let's start with some formal talks. Good day, Professor. We are from the editorial team of the department's newsletter, Physics Pulse. Thank you for taking out time to speak with us today. We are looking forward to hearing about your journey and sharing your insights with our readers. To start with,

Q. *Would you mind telling us a bit about your early education?*

A. I did my schooling in Kharagpur, West Bengal, from Andhra High School. It was a Telugu-medium school in the primary section and then an English medium. I passed the matriculation examination under the West Bengal Board of Secondary Education. After that, I completed my pre-university

(one-year course) and B.Sc. Physics Honours from Kharagpur College, Kharagpur, under Calcutta University. Then I earned my M.Sc. from Ravi Shankar University, Raipur, Madhya Pradesh, and now Chhattisgarh. I got the second rank in M.Sc. (Physics) in the university. After completing my Master's, I joined IIT Kharagpur for a Ph.D. program in 1980. I completed my PhD in 1985 under the supervision of Professor V. V. Ratnam. Then, I joined here.

Q. *As you mentioned you did your PhD from IIT Kharagpur in 1985, at that time, there was no internet, and it was very tough to access materials. So how do you think doing PhD then and now is different?*

A. There is a vast difference, actually. At that time we had no computers. We used to have bound volumes of journals and also current issues of journals. In the institute library we used to have archives of 30 or 40 years of bound journals. Of course, more journals have come, but at that time, the number of journals was very limited. We used to go through the journals in the library. All the latest copies were displayed in the library. So we used to go to the library for literature surveys and to refer to 20-30 years of journals. The hard copies were available there.

Back then, for data processing and computations, we used to have punching cards, and we had to punch those cards manually. If something went wrong, we had to bring back all the cards and re-punch them. This process used to take a long time as there would be a long queue to get the cards. Computers were not as fast as they are now. Publications were also very time-consuming. We wrote everything manually and gave it to a person for typing. He used to type it and after rechecking, He would retype the whole page even if there was a single mistake. Thus, we used to get the manuscripts typed. For the graphs, we had to draw them manually and then get a blueprint of them. We used to send the hard copy of the typed manuscript, graphs, and tables to the journals, of course by airmail only. So, it took 15 days to reach the journal. We used to get the acknowledgment after another 15 days. Finally, after three to four months, we would get the response with whatever comments and all. So, for everything, it used to take time. For experimental work, we had to manage time. We used to work late at night as four to five research scholars had to share the same laboratory instruments.

Physics in History

- It's the birthday month of our own Nobel laureate **Sir C V Raman**, known for the Raman effect and uncle to another Nobel laureate, S Chandrasekhar, who got all research papers and books with the help of C. V. Raman. Now you know what to gift your nephew and niece.
- Although Einstein's paper on relativity was published in September 1905, the equation people love the most, $E=mc^2$, was added later. On 21 Nov 1905, it was published in Annalen der Physik.
- On 9 November 1921, Albert Einstein got the Nobel Prize for his explanation of the photoelectric effect. Imagine giving groundbreaking equations, challenging Newton on the theory of gravity, yet getting the Nobel prize for explaining the running away of electrons as soon as the light falls.
- On 8 November 1895, Wilhelm Röntgen discovered X-rays.

Q. *Could you please also tell us about your research work during your PhD?*

A. Broadly speaking, my research work is based on luminescence studies of phosphor materials. As you know, there are different types of luminescence. At that time, I used to work on thermally stimulated luminescence, which occurs due to some defects formed in solids.

We have to create some defects, and the energy will be stored in the defects. In thermal luminescence, what we have to do is, expose the samples to either X-rays or Gamma Rays. By doing so, the energy is stored in the material near the defects. The defects are the traps, so all the energy will be trapped there. When you heat up the sample, whatever energy is stored will be released. The energy released is recorded as a function of time. So, the emission intensity versus time and temperature is measured. Basically, we studied the different types of defects, like electron defects, hole defects, and impurities that are

present in the material.

Q. *So, what is the story behind joining ISM?*

A. You see, everything is destiny. One fine morning after my Ph.D., I saw a small advertisement in the newspaper that the Indian School of Mines was inviting applications for the lecturer post. At that time, I didn't even know that the Indian School of Mines existed in Dhanbad. I applied and got the call, and I was selected among many aspirants. The number of posts was fixed, unlike now. At that time, there were three categories of faculty positions: lecturer, assistant professor, and professor. I had just completed my Ph.D., submitted my thesis, and got my provisional degree. Then I joined here as a lecturer.

Q. *Professor, you joined the institute in 1985; it has been almost four decades! How would you say the Department and the Institute have evolved over these years?*

A. There is a sea of changes, a vast change, which you cannot imagine. I'm fortunate to have witnessed so much development. I'm going to complete 40 years here in 2025. At that time, the department was very small. It was a supporting department, and I joined the Department of Applied Sciences. In the Applied Sciences Department there were three wings, physics, chemistry, and mathematics. It was in the science block. The first floor was chemistry, the second floor was physics, and the third floor was mathematics department. I joined as the fifth faculty in the physics section. There were only four faculty at that time - two professors, one assistant professor, and one lecturer.

At that time the focus of the department was on teaching because it was a supporting department, not a research department, though research work is being pursued by faculty members. There were a few branches at that time, one is x-ray crystallography, another is atomic and molecular spectroscopy and third one was physics of rocks and minerals. There were few research scholars when I joined. We were teaching Prep, B.Tech (common), and M.Sc (Tech) students. We had three papers for the B.Tech., which kept us busy with teaching. Additionally, I started my research work on Thermoluminescence with a small kit, and then I applied for externally funded projects. I got a project from AICTE, and then I purchased an instrument called the Thermoluminescence Dosimeter.

About the Institute, a lot of growth has taken place. We used to have our own ISM entrance examination during that period. We used to set question papers and check the answer scripts. We used to carry the question papers and answer books in a big box to near about 20-25 centers across India, Chennai, Bombay, Calcutta, Delhi, Jamshedpur, Patna, etc. Later we adopted admission of BTech students through IIT JEE. After that, the ISM became IIT (ISM). After becoming an IIT, a lot of changes have taken place.

We had increased our research publications and the number of research scholars and faculty members. When I joined, there were less than 100 faculty in the institute. Now it's more than 380 or so. It's a lot of change actually. Many new buildings and a lot of infrastructure have come up. There used to be barracks here (at the site of the new academic complex). First-year students used to stay there and in each room there used to be three students. The hostel accommodations were very limited at that time. There were only three boys' hostels, Diamond, Opal, and Emerald, and one girls' hostel(Ruby Hostel), and subsequently, other hostels have come up.

Q. *Moving to your academic profession, Professor, you've supervised a significant number of PhD students over the years. It's an impressive legacy! What do you believe is the most important quality in a successful researcher?*

A. Perseverance is the key. You must work continuously and seize opportunities. Determination is essential; even if results don't come as expected, maintaining a positive mindset is crucial. Eventually, you will reach your goal. Hard work and sincerity are essential, without them, success is unattainable.

Q. *You have taught for nearly four decades. You must have so many memories with your students and with your research scholars. Would you like to share with us some of them*

A. I used to be very simple in teaching. I used to tell them in the simplest way so that they could understand. Naturally, students used to like my teaching. I used chalk and board method of teaching. That way, I had good interaction with the students. When I was dean of students' welfare, students used to come up with a lot of issues and would take my advice. I was student-friendly, listened to their problems, and solved them. Moreover, I was very cordial with my research scholars. They were very sincere and hardworking and are well-placed now.

Q. *Professor you are an emeritus professor now. What achievements from your professional or personal life, are you most proud of ?*

A. I am really proud of whatever I have achieved till now. In fact, I never anticipated that I would become a professor, at least at the beginning of my career. But my hard work, sincerity, and simplicity helped me to achieve whatever is possible in teaching, research, and administration. With the help of externally funded research projects, I could purchase research equipments and develop my own research lab in the department. We could publish research papers in reputed journals. I have visited countries like Germany, Italy, the USA, and France for research collaboration and attending international conferences. In addition, as Dean (Students Welfare) and Dean (Faculty), I have made a considerable contribution to the institute.

Q. *Please share some of your key achievements as the head of the Department.*

A. As far as the department is concerned, I tried my best to bring more research facilities to the department. The faculty number has been enhanced to 19 during that period. We were awarded the UGC SAP program, for which we purchased one XRD machine. This was the first of its kind in the department. The research facilities and publications enhanced exponentially since then.

Q. *Professor, I've heard that you're fluent in Bengali, even though you're originally from Hyderabad. Could you tell us how you came to learn so many languages?*

A. My father came to Kharagpur for service, just like I have come to Dhanbad for my service. As the local language was Bengali, I picked it up from my friends. But, at home, we always spoke Telugu. My school was Telugu medium. In

Kharagpur, about 30 percent of the people are Telugu speaking at that time. So the Telugu culture was inherently present there.

Q. *Knowing all that you've achieved, I'm curious—what are your thoughts on retirement?*

A. I have no plan, as such. I have already been working for the past two years after retirement as an Emeritus Fellow, and I will stay here until 2025. After that, I will think, but I will try to get in touch with academics.

Q. *Will you be staying here in Dhanbad?*

A. My roots are in Andhra Pradesh, so maybe I will go back to Andhra Pradesh.

Q. *As we wrap up, you've dedicated decades to this department. How do you envision the department and the institute evolving in the coming years?*

A. You see, the department has come a long way. The faculty strength, number of students, and research scholars have increased. A lot has developed, and new recruitments have been made. Most of the faculty have research experience from abroad. New faculty members have come with research experience from abroad. So I am confident the department will reach great heights. At one time, there were only four faculty members in the department; now, it is around 30.

We have to not only sustain the growth, but we have to grow further with new research activities. Nowadays, getting research facilities is a big issue because of the kind of advanced work being done with the latest technology. Such instruments cannot be installed individually. One has to go to the Central Research Facility for research studies. So everyone should strive hard to get high-end projects and develop research facilities in the department. The department has a bright future. Currently, our Institute's all-India NIRF ranking is 15 which is a big achievement.

Q. *To conclude, could you offer some advice for students and young scholars aspiring for a career in physics?*

A. A lot of research is going on in physics. If you have a passion for studying and have something in mind, try to achieve them.

Ending the interview, we thank Prof. Manam for sharing valuable insights with us about how PhD used to be in the 80's, and how ISM was like before becoming an IIT and his academic life. We hope our readers found it interesting and look forward to more such interviews in the upcoming newsletters.

[The interview is conducted by Aminul Hussain and Sanchari Biswas, Research Scholars, and Divya Bhengra and Gaurav, M.Sc. 2nd Yr Students. Acknowledgment: Chandni Kumari and Prashant Singh Lohiya, Research Scholars, and Dr. Ram Gopal, Assistant Professor, Department Of Physics, Panjab University.]

Research Publications

1. Smita Manjari Panda, Nandeshwar, and **Umakanta Tripathy**, In Silico screening and Identifying phytoconstituents of Withania somnifera as potent inhibitors of BRCA1 Mutants: A Therapeutic against Breast Cancer, International Journal of Biological Macromolecules

2. Debasish Paul, Priyadarshi Sahoo, Arunava Sengupta, and **Umakanta Tripathy**, Soumit Chatterjee, Revealing the Role of Electronic Effect to Modulate the Photophysics and Z-Scan Responses of o-Locked GFP Chromophores, Journal of Physical Chemistry B

3. Deenbandhu Sharma, and **S. K. Sharma**, Optimizing the properties of $CsPbCl_3$ perovskites using a solvent-based synthesis approach, Optical Materials, Elsevier

4. Mohd Fahad, Byungki Kim, Dongkyou Park, Sujeet Kumar, and **P. M. Sarun**, Enhanced dielectric and electrical properties of $Ba_{(1-x)}Nd_{2x/3}Zr_{0.1}Ti_{0.9}O_3$ ($0.00 \leq x \leq 0.04$) electroceramics for high temperature-based energy storage devices, Journal of Alloys and Compounds