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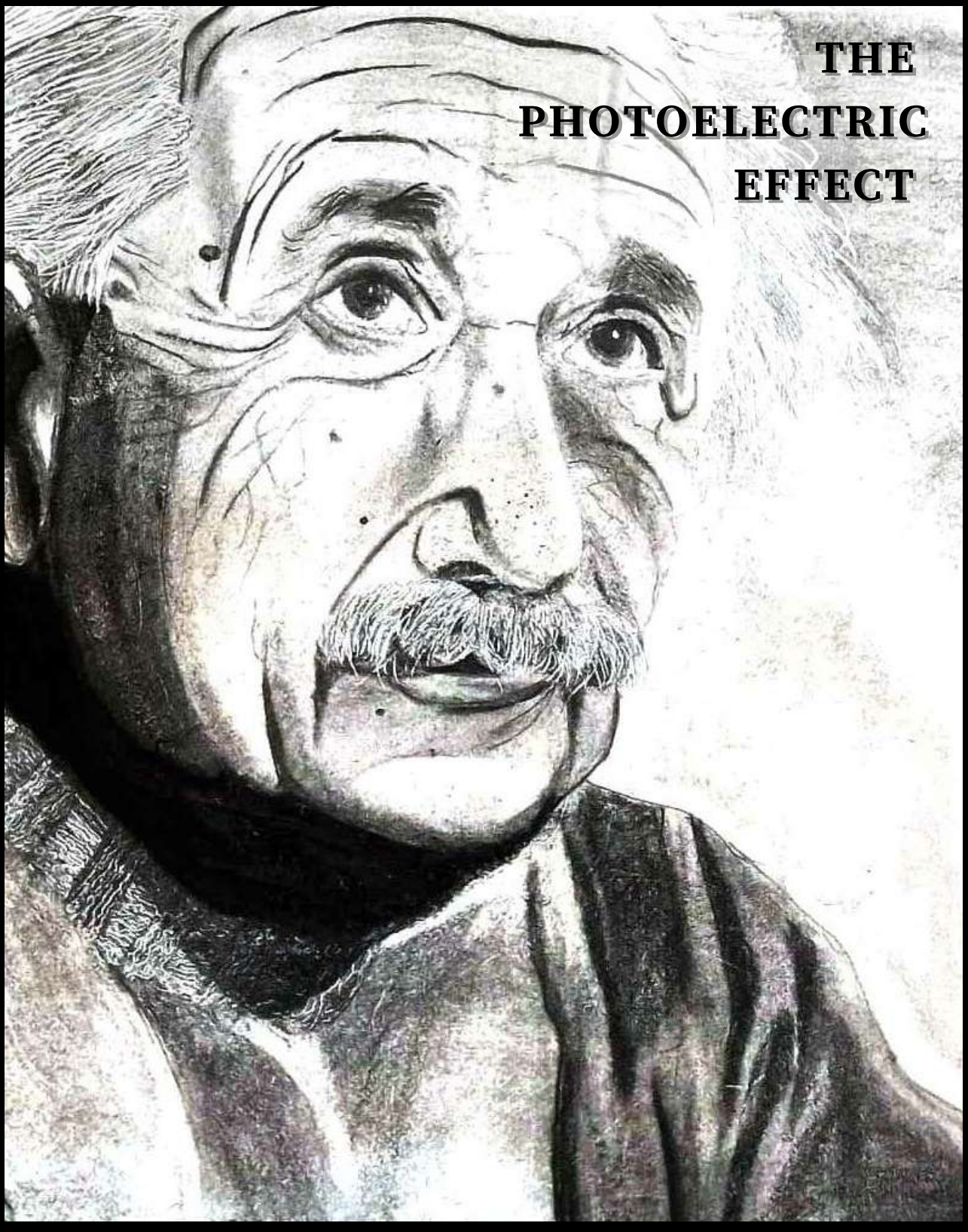
DEPARTMENT OF PHYSICS
GARGI COLLEGE

PHYSIKOS



THE PHOTOELECTRIC EFFECT

SKETCH BY VAISHALI BHASKAR,2ND YEAR, PHYSICS HONS

A REMARKABLE JOURNEY FROM OBSERVATIONS TO THE 1921 NOBEL PRIZE

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FROM THE PRINCIPAL'S DESK

I am delighted to know that department of Physics is releasing its annual magazine "Physikos 20-21". In the current year the human civilization across the world had suffered from the pandemic COVID-19 and it was a real challenge to remain calm and composed under these circumstances. Initially, there was panic but gradually people started certain good practices like Healthy lifestyle, Yoga, meditation which really helped them. The journey within oneself has started. This is a step towards self-actualization; "Blessings in disguise".

I wish to express my heartfelt thanks to all the faculty members for their dedicated contribution to the teaching and learning process during this critical phase. I acknowledge their extraordinary work they have done to manage the whole curriculum via online classes.

I also appreciate our students for taking part in online learning very enthusiastically and came out as young leaders who conducted various programs successfully through face to face interactions. It is remarkable that we managed to pull that off together, all of us, including parents, staff and students.

The entire Editorial Team & contributors deserve appreciation for this effort of releasing yet another issue of 'Physikos 20-21' through e-resources under these unprecedented circumstances. I look forward enthusiastically to read our students' perspectives on the topics undertaken.

Best Wishes
Prof. Promila Kumar

MESSAGE FROM THE TEACHER CO-ORDINATOR: PHYSIKOS

It has been another tumultuous year in a row when all of us are forced to work virtually and trying to adjust to the new norms. In these challenging times, it gives me great pleasure to see the hard-work and dedication of the organizing team for their relentless efforts to bring forth a wonderful edition of the Physics magazine Physikos 20-21. It is always a delight to see the creativity, talent, editorial and organizational skills of the team members accomplished with their profound passion. Well done Anjali, Namra, Megha Preetisha and Shruti. It is difficult to believe that one of our senior teachers, Dr. Indu Datt superannuated in the month of February. She has always been a pillar of support and a sincere physicist, esteemed colleague and mentor for the department and was a friendly and welcoming face for the students. We wish her a healthy and joyful journey ahead. It is also a momentous moment to share that Dr. Supreeti Das and I have both celebrated our Silver Jubilee as colleagues at Gargi College which indeed has been a pleasant journey coupled with amazing experiences. We indeed will cherish the golden moments spent so far.

Our Union members always make us proud by their meticulous organization of various events, handling all the events seamlessly and providing welcoming support to both old and new students of the Physics department. Kudos to Rishu, Romanpreet Kaur, Gunjan Bisht, Devanshi Sharma, Ms. Neha, Gursimran Kaur and volunteers.

This year's activities began with the online polling for the selection of union members. A virtual inaugural lecture on "Solar influences on the Earth" was held on 8th Nov 2020 which was delivered by an eminent scientist Prof. Rajmal Jain, a former professor at Physical Research Lab (Space Division), Govt. of India, Ahmedabad, Gujarat. The lecture provided the details about solar activities as well as motivated the students for the ongoing research in the field. An astronomy quiz was also organized in which students participated enthusiastically.

The new students were formally introduced to the department in the presence of all the teachers, union members and current students during the Virtual students' orientation that took place in November. An inter-college Click-n-Blink photography competition was organized with an open theme to stimulate students' creativity with judgement being placed on composition, narration and then synchronization of story. The panel of judges consisted of the esteemed faculty member Dr. Geeta Mehta and Dr. Joya Bhattacharya also provided an insightful review of the entries.

Quasar's regular annual event, The Talent Story, showcased the talent of students, ranging from music to singing to painting and acting amongst numerous others.

On Science day, i.e. on February 28, a quiz was conducted on "Celebrating the lives and contributions of Indian Scientists". In this event, students from different streams of our college participated with enthusiasm. It turned out to be a novel way to celebrate the passion and contribution of Sir C.V Raman to Science. The following day some of the 2nd year students presented short talks on topics such as Raman scattering, Mie Scattering and other related topics to highlight the work done by Prof. C.V. Raman, which was coordinated by Dr.Supreeti Das.

Also in February, a week-long workshop on "Extending Mathematical and Computational Skills using spreadsheets" was organized under the aegis of IQAC. Various talks were delivered by Prof. P.K. Ahluwalia, former Professor at Himachal Pradesh University, Dr. Sarmistha Sahu, formerly at mLAC, Bengaluru, Dr. Sapna Sharma, St. Bede's College, Shimla University and myself.

Dr. B. Vaijayanthi from Chemistry coordinated on the behalf of IQAC, myself as convener and Dr. Narender Kumar from the Mathematics department as the co-convener. The interactive, hands-on online sessions provided useful insights on spreadsheets for students.

Dr. Narender Kumar will always remain in our thoughts and prayers, as a young and bright colleague of the Mathematics department and enthusiastically guided and mentored the students.

A talk was organized jointly in assocation of HUES, the Fine Arts Society of our college on "Art Integration in Science and Mathematics" by Ankon Mitra with Dr. Alka Garg as the convenor. A hands-on workshop after the talk provided an enriching and enjoyable experience to all the participants.

Many students have worked on projects under the supervision of faculty members to get enriching research experience and have completed the internships. We congratulate all the achievers who have excelled in academics, cultural activities, sports and other activities and have brought laurels to the department and the college.

The theme of this year's magazine is Einstein's Centenary Celebrations of the Nobel prize of 1921. Thanks to Prof. H.C. Verma for his initiative for this theme and the planning of a range of activities for the faculty members and students under NANI, Anveshika. It is our proud privilege to add "Ask The Expert": Prof. Anirban Pathak, Quantum Technologies: Scopes and Beyond. He has conversed with me to provide insightful information on the overview of the field, opportunities and way forward for a career in the field. Many thanks to Prof. Pathak.

Our alumni always make us proud. It is a delight that our student, Jyotismita from 2019-20 batch is pursuing M.Sc from IIT Jodhpur and she has happily contributed a summary of her experiences for the benefit of her juniors.

A quiz on photoelectric effect was organized in collaboration with IAPT, Anveshika in which about 420 students from across the country participated. Many students have submitted articles on various aspects of the path-breaking work of a genius "Albert Einstein" and the applications of the photoelectric effect. The beautiful sketch of the genius by Vanshika Bhaskar of Physics (H) can't be better suited than the cover page of the magazine. Kudos to all the contributors for their valuable contributions and surely it will provide an enriching learning experience.

Our non-teaching staff has been the strength of our department as always. Last but not least, on the behalf of our department we thank our Principal, Prof. Promila Kumar for her consistent encouragement. We thank the administrative, office and accounts section for their constant support.

Hopefully, we will meet in person soon.

“The true sign of Intelligence is not knowledge but imagination.”
Albert Einstein

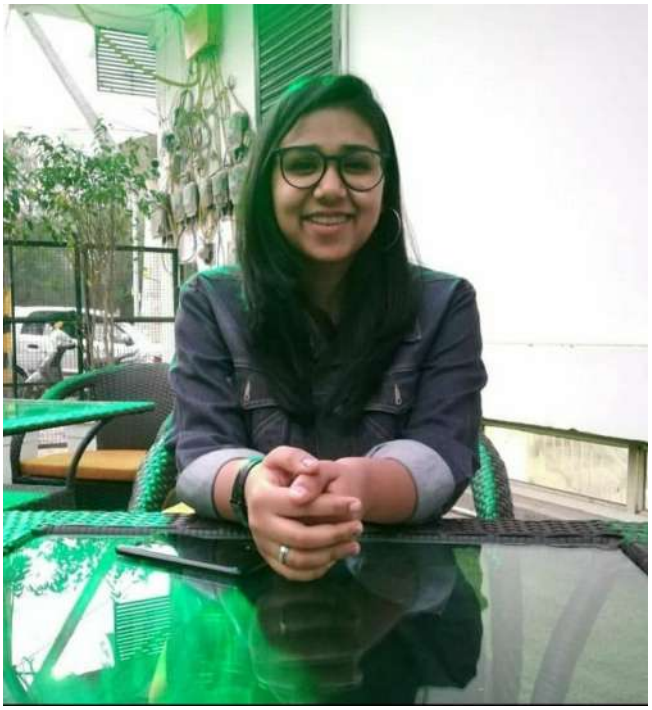
Dr. Vandna Luthra
Co-ordinator, Quasar (The Physics Society)
Teacher Co-ordinator (Physikos)

MESSAGE FROM THE TEACHER-IN-CHARGE

Our students of Gargi College should endeavour for an all-round development in their life. For this, the students should be given an opportunity to develop other skills over and above their routine academic activities. The departmental magazine is one such opportunity for the students to showcase their talent, their creativity and their opinion on various issues. I congratulate the teacher coordinator, Dr. Vandna Luthra and the entire editorial team of Physikos 2020-2021 for giving such an opportunity to the students and releasing successfully Physics Department magazine – Physikos 2020-2021.

I wish the team similar success in future too.

Dr. N. Chandrika Devi
Teacher in Charge
Physics Department
Gargi College
University Of Delhi



MESSAGE FROM THE EDITOR

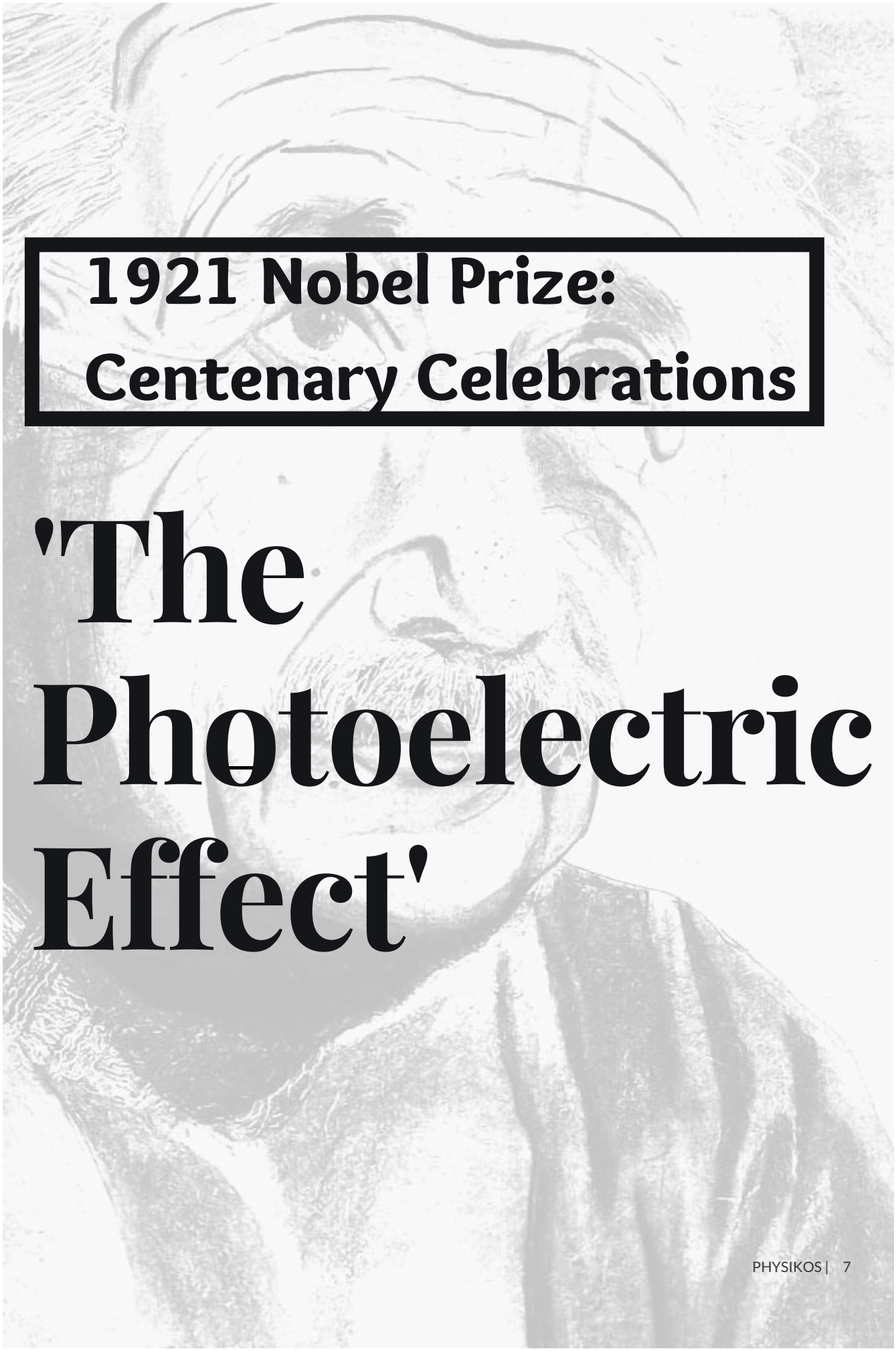
It gives me immense joy and pleasure to finally introduce the 8th edition of the annual magazine of the department of physics, PHYSIKOS.

Serving as the editor this year for the first time was a great experience for me. All this introduced me to new perspectives and helped me to enhance my skills. A lot of effort has been put into this, and everything was made successful with the sincere contribution by the team members. I shall always be thankful to Dr. Vandana Luthra Ma'am to have given me this opportunity.

PHYSIKOS is a reflection of the student's creativity and efforts throughout the year. This edition celebrates hundred years of Einstien's Nobel prize for the discovery of the photoelectric effect. Hope you will enjoy it and suggestions are always welcomed.

Happy reading!

-ANJALI KUMAR
2nd Year, Bsc(H) Physics
Editor



1921 Nobel Prize: Centenary Celebrations

'The Photoelectric Effect'

ASK THE EXPERT

Prof. Anirban Pathak

Prof. Anirban Pathak (FNASc, FIETE) is a theoretical physicist. He did his PhD from VisvaBharati, Santiniketan, India. Subsequently, he was a post-doctoral fellow in the Freie University, Berlin. He joined JIIT, Noida in 2002. At present he is actively involved in teaching and research related to several aspects of quantum optics and quantum information with a focus on quantum cryptography. He is a fellow of The National Academy of Sciences, India (NASI), Institute of Electronics and Telecommunication Engineering (IETE) and Optical Society of India (OSI). He is a visiting scientist at Palacky University, Czech Republic. He is also a member of the Editorial Board of Quantum Information Processing, Springer-Nature. He guided 6 PhD students and a number of Post-Doctoral Fellows. Currently, he leads a research group focused on quantum optics and quantum information with a specific interest in quantum cryptography. He has also completed several DST and DRDO funded projects and presently, he has ongoing projects funded by DST and DRDO. He has active research collaboration with different research groups in India and abroad. He is a recipient of the 2017 Shri O. P. Bhasin Award in the field of Electronics and Information Technology.

QUANTUM TECHNOLOGIES: SCOPES AND BEYOND IN CONVERSATION WITH DR. VANDNA LUTHRA

Ever since the inspiring work of many scientists on the Photoelectric effect, for which Albert Einstein provided an explanation a century ago, ushered a quantum era. Quantum technologies have emerged as an interdisciplinary field with a plethora of applications being developed in the foreseeable future. This brings many opportunities for not only students from scientific and mathematical disciplines but also from engineering sciences such as electrical engineering and computer science, material science and many more. It is a great honour to have conversed with Prof. Anirban Pathak, an eminent physicist at Jaypee Institute of Information Technology working with the cutting edge of quantum computation and related research and education.

We thank you for providing insightful information useful for the faculty members and students alike. I am sure many students will benefit immensely from this and will be oriented towards taking up this challenging field as a career option.

Dr. Vandna Luthra

Q&A

1. What is the current status of research and developments in the field of Quantum Technologies and some highlights of the work you have done? Can you briefly summarize quantum technologies?

Quantum technologies are already in use. Think of your laptop or mobile phone- basic building blocks of these devices are made up of semiconducting materials which are characterized by their band gaps. Classically energy is not quantized, so all energy levels are allowed and consequently, there is no forbidden energy level and band gap. Similar logic is applicable to laser. In short, the working of most of the fascinating technologies available today can be viewed as an outcome of the first quantum revolution that happened after the birth of quantum mechanics about 100 years ago. Now, we are looking at the second quantum revolution, where technologies will be developed by using more weird properties of quantum mechanics like a collapse on measurement, uncertainty principle, nonlocality. Using these properties, scientists have already developed and proposed many exciting ideas. Those ideas can be classified into three subdomains: (1) Quantum computing: Main aim is to build a scalable (large) quantum computer that will be able to solve a class of problems much faster than its classical counterparts. The basic problem in building such a computer is the decoherence. You can lucidly understand the problem as follows, a quantum state which is a superposition of a few possible states that interact with its environment and collapses to one of the possible states or just gets modified in an undesired manner. In theory, people have designed exciting algorithms and experimentalists have designed a set of quantum computers but they are still small in size. Interestingly, you can access a few of them for free using IBM Experience or Amazon Web Services. Things are improving fast and the size of the available quantum computer is increasing. (2) Quantum cryptography: This is a relatively more developed technology and it's extremely exciting as it can provide unconditional security, a desirable feature that cannot be achieved in the classical world. Several commercial cryptographic solutions are available and, in an exciting experiment, China has demonstrated a satellite-based quantum communication between China and Austria. We mainly work in this area. My work is theoretical with a small component of experiment. (3) Quantum metrology or quantum sensors: Use of quantum resources can considerably improve the accuracy of measurement and bit many existing bounds. Many devices are under development and these will revolutionize the science of measurement be it detection of a submarine or the construction of a handheld MRI

Our group mostly works on theoretical aspects of quantum information with a focus on designing new protocols for different cryptographic tasks using quantum resources. We have designed and analyzed various protocols of quantum key distribution, quantum voting, quantum auction, quantum e-commerce. I name a few tasks here to provide an idea of the domains in which quantum technologies can have applications.

Adding to the above, we may note that most problems of real-life are optimisation problems, be it investigating in the share market or designing a drug. Many such optimisation problems will be solved with an unparallel speed in a quantum computer. Such a speed will be a threat to certain classical technologies, for example, a quantum computer will do factorisation of bi-primes extremely fast, and that will be a threat to RSA cryptography system which uses difficulty of factorisation problem to provide security.

Currently, extensive research is going on in India and abroad. DST has launched a program called QUEST and GoI has announced a National Mission on Quantum Technology and Applications. These programs will further amplify the research activities in this domain in India.

2.Which higher studies/PG courses can be taken up by the students after completing B.Sc (H) Physics/ B.Sc (Physical Sciences) to adopt a career in this field? Is any specialization needed at the PG level?

The field of quantum information is extremely interdisciplinary. We need computer scientists, mathematicians, electronics engineers, and of course, physicists. Since there are different technologies for realizing qubit (quantum analogue of bit) e.g., superconductivity based, ion-trap based, NMR-based, photonic, training in many subdomains of physics are useful. However, if you have an opportunity to take a course on quantum information or quantum optics or quantum

computation as an elective or special paper, please join in that. In a general PG program in physics, students interested to continue research in this domain may be advised to concentrate more on mathematical physics, quantum mechanics and all the laboratory courses which improve their experimental skills.

3. Can you mention some of the institutes/courses which offer higher studies in this field in India?

Recently, DIAT, Pune and IISc, Bangalore have started MTech programs on quantum computing. As soon as National Mission on Quantum Technology and Application will start, more opportunities will come. In addition, students can plan to do summer schools or a summer project through various visiting students programs including the joint program of three science academies of India. In short, no specific specialisation is needed at PG level. Whatever specialization you do, do it sincerely. Further, students completing BSc(H) may appear in JEST and look for opportunities at HRI, IMSc and other places where excellent research is done on this domain. Also, they can try for IISc's integrated PhD programme. After MSc, students can apply to many institutes and universities and also look for the JRF positions announced by different groups for recruitment of JRF in their projects. Some of the good places to look for are (this list is not exhaustive), IISER Kolkata, IISER Pune, IISER Mohali, TIFR, PPISR, JIIT, IIT Jodhpur, IIT Mumbai, RRI, IISc, IMSc, HRI, IIIT Hyderabad, ISI Kolkata, SNBNCBS, Bose Institute, IIT Madras.

4. What are the current challenges in this field?

There are many challenges. The main challenge is to get rid of the noise. There are subdomain specific technological challenges like, the efficiency of single photon detectors are not high, there is no single photon on demand source, quantum memory and quantum repeaters are not yet available. And there is a general challenge to obtaining a regular supply of grants. The market is not yet big, so many strat-ups are facing problems.

5.What are scopes for students in this field currently and in near future in India?

As we have already mentioned, there are research groups in many institutes in India. Joining those groups as a PhD student, Post-Doc and subsequently as faculty is one option, but beyond that, ISRO and DRDO are extremely interested in this field and DRDO has already established a lab called Defence Young Scientist Lab on Quantum Technologies, Indian Army is also interested in adopting quantum technologies and offices in Signal are learning quantum technologies. Further, there are a few companies in India like QuNu labs and the big companies like Microsoft, IBM, Google etc., that are already pursuing this domain. In short, there are many scopes for students at the moment. A huge amount of new scopes will be created soon with the starting of the National Mission on Quantum Technologies and Applications. Apart from the possibilities of doing a PhD or Masters, that will open up possibilities for our young entrepreneurs.

Useful Web-links

https://quantum-computing.ibm.com/

https://www.quantiki.org/

A Revolutionary experiment:

PHOTOELECTRIC EFFECT

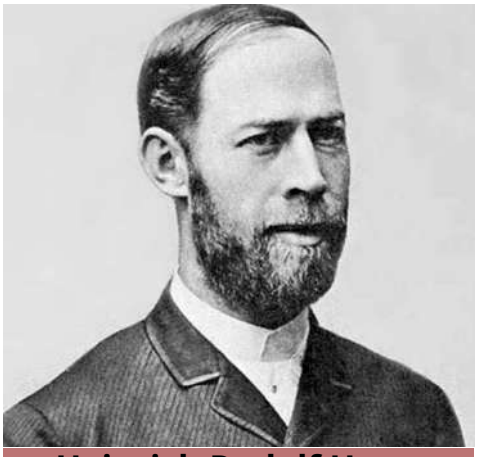
Shruti Rana
2nd year,Bsc(H)Physics

"If I put a hand over my left eye, I see a particle, If I put a hand over my right eye, I see a wave, If I open both eyes, I go mad."

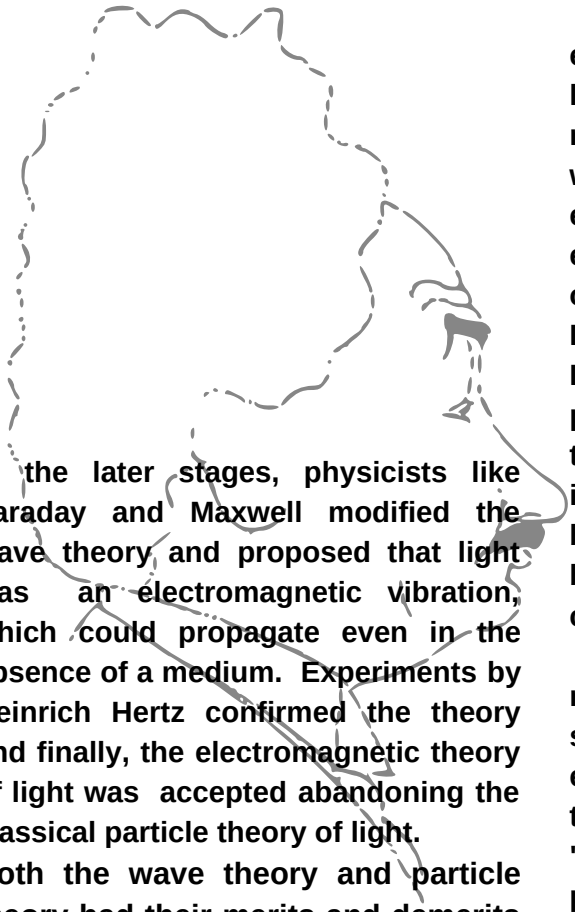
-Wolfgang Pauli, an Austrian Theoretical Physicist, and a pioneer in Quantum physics[1].

Light and its nature are the greatest mysteries one has ever faced. For centuries it has puzzled philosophers and scientists. What is it? How does it travel? What is its nature? Does it have particle nature or wave nature? For years, several theories were given to answer these questions and many experiments were done to support the same. Initially, in the 1600s, many well-known physicists like Pierre Gassendi (The particle theory) and Isaac Newton (the corpuscle's theory of light) believed that light has a particle nature. In the meantime, physicist Christian Huygens published his mathematical wave theory of light. He proposed that light emits as a wave in a medium called the luminiferous ether. But due to the lack of any experimental evidence and as it was opposite to the great physicist Sir Newton, it did not get much support.

The 19th century was a momentous time, where on the one hand, Étienne-Louis Malus with his mathematical particle theory of polarization and Jean-Baptiste Biot, by explaining all known phenomena of light polarization with these theories, gave a solid proof that light has a particle nature. On the other hand, Thomas Young by the means of his diffraction experiment and Augustin-Jean Fresnel via mathematical methods showed that light is a wave.



Heinrich Rudolf Hertz



In the later stages, physicists like Faraday and Maxwell modified the wave theory and proposed that light was an electromagnetic vibration, which could propagate even in the absence of a medium. Experiments by Heinrich Hertz confirmed the theory and finally, the electromagnetic theory of light was accepted abandoning the classical particle theory of light.

Both the wave theory and particle theory had their merits and demerits along with experiments supporting it. Few phenomena like interference, diffraction etc. were only explained by considering that light has a wave nature whereas phenomena like, scattering of light, Tyndall effect etc. were only explained considering light as a particle. But was the electromagnetic wave nature being really the last answer to all the questions? Not long after this, in 1887, Heinrich Hertz observed a spark between the leaves of his electroscope detecting electromagnetic waves.

While attempting to study it more efficiently, he observed that the spark length was maximum when UV-radiation is used for the receiver. For a while, it came to be known as the Hertz effect (later known as the photoelectric effect) and with this new effect, a series of investigations started.

During the years 1886–1902, Philipp Lenard investigated the phenomenon of photoelectric emission and concluded that the intensity of light plays no role in the energy of the emitted electron but frequency does. This was a big breakthrough as it was completely contradictory to light being a wave.

In 1900, during the study of black-body radiation, the physicist Max Planck suggested that the energy carried by electromagnetic waves are released in the form of small packets called "quanta". Later in one of his papers published in 1905, Albert Einstein used the idea of quanta to explain the phenomenon of the photoelectric effect, the emission of electrons when radiation like UV light hits the surface and suggested that these light quanta had a "real" existence. Einstein theorized that the energy in each quantum of light was equal to the frequency of light multiplied by a constant, later called the Planck's constant and gave "the law of photoelectric effect".

$$E = h.f-h.f0$$

E = kinetic energy of emitted electron,
f = frequency of light,
f0 = threshold frequency,
h = Planck's constant.

As of November 9, 1921, one of the greatest minds that ever existed "The Albert Einstein" received the Nobeprize for his work on the photoelectric effect for "his discovery of the law of the photoelectric effect", and Robert Millikan, who spent years to prove it wrong but ended by proving it correct, was awarded the Nobel Prize in 1923 for "his work on the elementary charge of electricity and the photoelectric effect".

But whenever we think about Einstein things like Relativity... Black holes... etc. first come to our mind in which his contribution was magnificent.

So, what made his "the law of photoelectric effect" so special that it reasoned him to won a Nobel Prize? Well, the answer to this is that it is so important and Nobel Prize worth because Einstein suggested for the first time that light is both a wave and a particle. Not only this, with the wave-particle duality of light, the foundation for a new era in the world of physics, the quantum revolution, something that no one had ever thought or believed to be possible, was laid off. But as Einstein said, "We cannot solve our problems with the same thinking we used when we created them."

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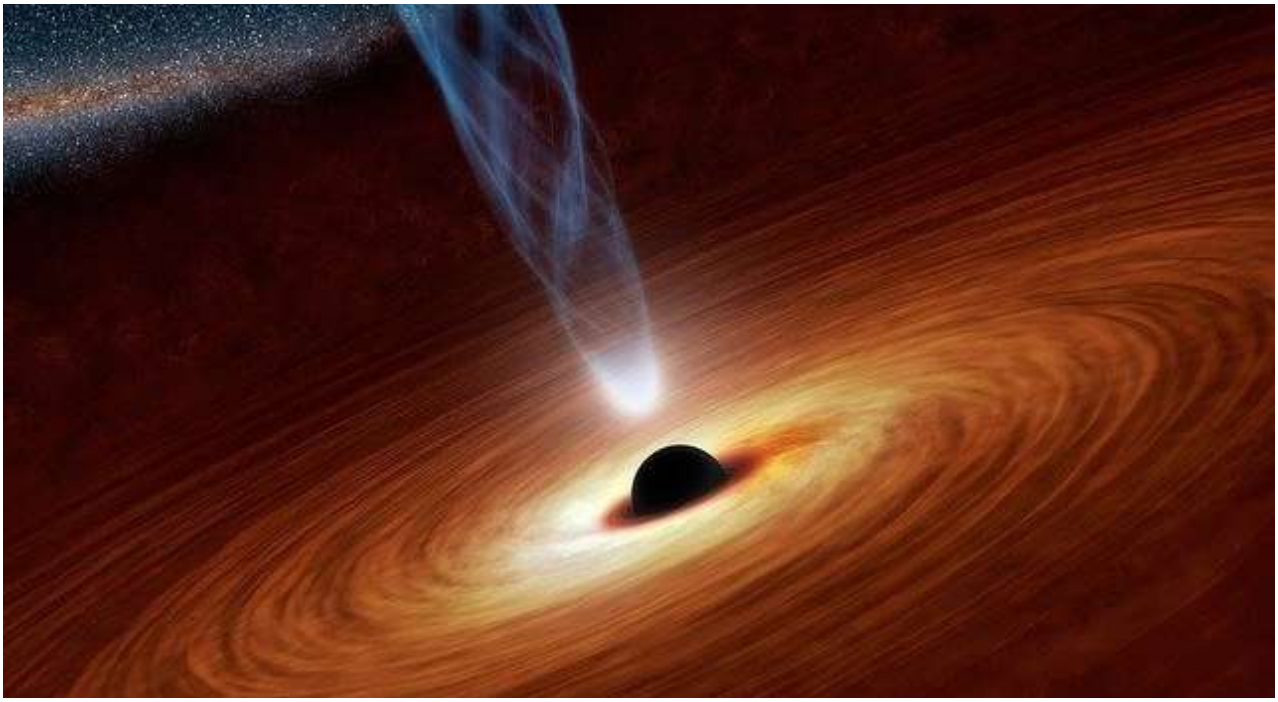


HAWKING RADIATION

Priyanshi Mishra
2nd year,Bsc(H)Physics

In the 1970s, Stephen Hawking had proposed a theory about the emission of thermal radiation of black holes in which he had explained that if two black holes merge and form a single one then, the area of the event horizon of the resultant black hole will be greater than the sum of the areas of the event horizon of the parent black holes. Later he realized that the area of the horizon can be related to its entropy (degree of randomness) but that would mean that it has some temperature and any body having a temperature above zero kelvin would radiate or some emission will be there on its surface. But black holes are not supposed to emit anything due to their intense gravity. So he developed a theory that says that space is not empty which means that there will be some kind of quantum fluctuations i.e. all the fields cannot be zero because that would mean that the value of the field, as well as its rate of change with time both, are zero which is against the uncertainty principle. And these fluctuations can be assumed as pairs of particles of light (virtual particles) that can appear together or can move away from each other, then again can come closer and annihilate each other. And by the law of conservation of energy, one particle has positive energy and the other has a negative one. In the presence of the black hole, the particle with negative energy will fall into the black hole and become a real particle and the other virtual particle having positive energy can escape from the surface of the black hole. And for an observer outside the black hole, it will appear like it has been emitted from the black hole.

The positive energy of the escaped particle is balanced by the negative energy of the particle going into the black hole and by Einstein's mass-energy equivalence relation, the negative energy of the particle would reduce the mass of the hole which will eventually decrease its entropy but, this decrease of entropy is balanced by the emitted radiation, as a result, lower the mass of the black hole, higher will be its temperature.

BUSINESS AND PHYSICS

Bhawana Yadav
2nd year,Bsc(H)Physics

On the face of it, physics and advertising and marketing appear like very one-of-a-kind disciplines. People think about physics as being dominated through accepted laws that may be carefully studied to recognize the whole thing from the unfathomably small to the extraordinarily large; advertising and marketing are visible as an "arts and crafts" feature that comes up with jingles, throws parties, and prints colouration brochures. One strong – and possibly alternatively biased – opinion I keep is that an excellent physics background is a wonderful vicinity to begin for almost any profession. Making use of physics in an extensive variety of sectors, which include healthcare, space, quantum computing, communication and defence. As the world passes towards the business utility of quantum information, quantum computing, and realistic programs of nano-technology, the twenty-first-century commercial enterprise might be led through physicists within the lab and in industry. In a direct fashion that is frequently via Research and Development in which diverse bodily disciplines may be carried out inside a business enterprise. Some examples are semiconductor device manufacturing (electronics, lighting, photovoltaics), electromagnetism (wi-fi communique), photonics (light-primarily based totally information switch and communique, fluid dynamics (all types of waft and heat-associated method control) and plenty of different disciplines. A similarly essential utility is that of Computational and Mathematical Modelling in which physicists frequently carry out simulations associated with something starting from the only physics-associated disciplines to finance.

ONE OPINION I KEEP IS THAT AN EXCELLENT PHYSICS BACKGROUND IS A WONDERFUL VICINITY TO BEGIN FOR ALMOST ANY PROFESSION.

The revel in making use of arithmetic to real-global phenomena is going very far. For instance, the very famous data science and machine learning fields also include many physicists for this reason. In general, a physics diploma teaches skills that might be extraordinarily treasured to everyone thinking of a start-up:

• Quantitative capabilities and an intuition to look at the world in phrases of factors that may be measured.

• The ability to model complex structures with easy fashions that offer insight.

• An instinct to check hypotheses through accomplishing experiments. The remaining of those is specifically essential for start-ups. Many organizations fail within the early years due to the fact their commercial enterprise version is invalid and that they can't adapt. That's like persevering with to trust in a theoretical version that's been discredited experimentally or failing to give you an opportunity version. In this case, fast and flexible thinking is the important thing to survival. Business is all approximately analyzing complicated troubles and growing and enforcing a strategic plan for business gain. As all strategic plans get altered over time by changing circumstances, to achieve success a commercial enterprise needs to be able to cope with the unexpected. Physicists are skilled to do this. Physicists love problems due to the fact problems want solutions. Physicists aren't discouraged through setbacks. Elon Musk is a physics graduate who's now the CEO of SpaceX, a business enterprise that designs, manufactures, and launches superior rockets and spacecraft, and additionally Tesla, a business enterprise making electric-powered cars. He commenced his commercial enterprise profession with Zip2, a business enterprise presenting an online-publishing software program earlier than shifting directly to determining net massive PayPal. When asked how physics helped his profession, Musk replied, "I think physics gives you a mental framework for problem-solving. It also teaches you to be willing to admit you are wrong". In general, I suppose physicists have a very wide background but are not too specialized once they graduate so they have the opportunity and necessity to creatively think about what they want to apply both in finding a job and starting their very own businesses.

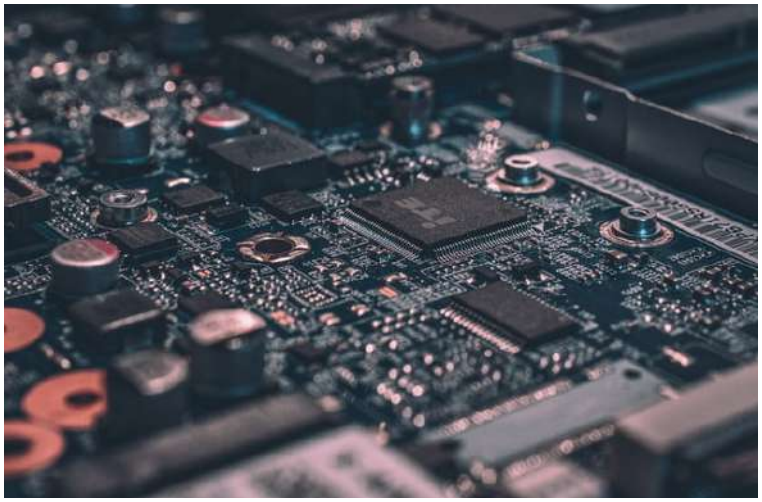


Photo by Alexandre Debiève on Unsplash .

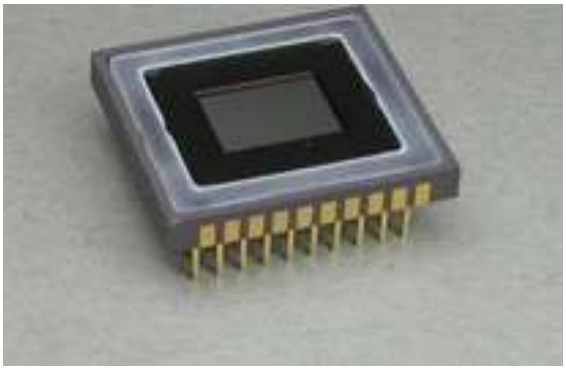
Photoelectric effect in ASTRONOMY

Nidhi Gupta
3rd year,Bsc(H)Physics

The development of semiconductor technologies within the last half of the 20th century led to exciting new detector technologies like photomultiplier tubes where the electron photo-multiplier tube uses the photoelectric effect to convert light of small intensities into electrical currents which may then be analyzed, here electrons dislodged by the photoelectric effect travel down a special tube collecting more electrons. By the time they get to the tip, one electron can have gathered 1,000,000 other electrons. And charged couple devices (CCDs) which are special plates analogous to film, but instead keep electrons in a two-dimensional array. So, here both supported the photoelectric effect to convert incident photons into a charge which will then be measured and recorded.

Charged Couple Devices (CCDs):

A memory module charged couple devices or CCDs were adapted for imaging.
CCDs have revolutionized astronomy within the last 20 years, replacing photography and photomultiplier tubes in the professional astronomy community and most of the astronomy laboratories. It is also adopted by keen amateur astronomers telescope due to that:



A charged coupled device

- Enthusiastic amateurs now have the power to use backyard telescopes to detect objects as faint as those at the limit of long photographic exposures on the world's largest telescopes only a couple of decades ago.
- NASA's reaction propulsion Laboratory took the primary CCD astronomical image of Uranus in 1975. Since then, the technology has been refined and are available to dominate professional astronomical applications of imaging, spectroscopy, photometry and astrometry.

How it (CCDs)works?

In basic terms, CCD may be a thin sliver of a semiconductor like silicon arranged during a two dimensional array of picture elements or pixels which employ the photoelectric effect. If a photon of sunshine hits a pixel thanks to the photoelectric effect an electron-hole pair forms. Then a little electrode can trap the electron during a potential well. As more photons hit the pixel, more pairs are formed and more electrons get trapped within the well in order that the entire charge accumulates. Once the exposure is finished the charge within the well are often read out and therefore the pixel is reset ready for additional exposure.
Now, for a single-pixel CCD, it could measure flux from a source, very similar to a photomultiplier tube. CCDs however in a 2d array have an outsized number of pixels. Spatial information is often obtained by reading out the charge in each pixel separately and matching it with its location, the knowledge is then downloaded directly into a computer, stored on disk and analyzed using image analysis and processing software.
To describe the process of accumulating light and reading out charge there's one common analogy that's to think about a CCD as a series of buckets on a variety of side-by-side conveyor belts and the quantity of water in different amounts in different buckets when it rains is similar to the charge a CCD pixel contains at the end of an exposure. Once the exposure is finished (or the rain), the primary conveyer belt moves, emptying each bucket thereon call at become a trough that runs to a measuring vessel. Once each bucket from the primary belt has had its amount of water measured the second conveyer belt moves, emptying buckets successively, then the third then on. If a bucket gets filled up with water then a number of it can spill over to the encompassing area. This too reflects what can happen, when the potential well fills up with the utmost amount of charge in some CCDs. Excess charge leads to streaks (called blooming) on the read out signal. An example of this is often when a CCD image is overexposed by a bright star.

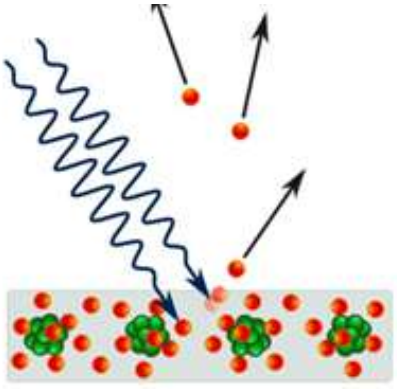


Image showing Photoelectric effect in solids

Advantages of CCDs for Astronomy--

- **High Quantum Efficiency:** Astronomical CCDs can reach quantum efficiencies max of greater than 90%. This suggests that nine out of ten photons hitting a pixel, form an electron hole pair which will be detected and counted.
- **Broad Spectral Response:** Early generation CCDs were sensitive within the red part and fewer within the blue or ultraviolet regions of the spectrum but due to improved technology, current chips have a broader spectral response.
- **Large Dynamic Range:** They are useful for imaging astronomical objects where there's naturally an outsized dynamic home in the sources.
- **Low Noise**
- **Physically stable**
- **Digital Readout:** At the top of exposure the knowledge obtained during a CCD exposure is directly read out into a computer or digital memory device, without the necessity of a

plate as photography requires, which data are often easily protected on tape or disk and even transmitted via the web.

Problems with CCDs for Astronomy:

- **Small Size and Field of View:** With the development in technology, their sizes are increasing but still the sector of view is smaller than plate.
- **Cost:** Professional grade CCD chips are expensive.
- **Calibration:** CCD's performance changes with temperature, additional frames or exposures like flatfields and dark frames must be also accounted.
- **Cooling:** To minimize noise on an astronomical image, a CCD chip must be cooled. So, care must be taken to make sure the camera stays cooled after adding cryogenic material (liquid nitrogen) beforehand .

Apart from revolutionizing astronomy CCDs, also are widely utilized in other applications. The overwhelming majority of digital cameras and digital video cameras round the world have a CCD as their detector (others use the related CMOS technology).

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https://www.atnf.csiro.au/outreach/education/senior/astrophysics/photometry_photoelectricastro.html

Image source:
https://commons.m.wikimedia.org/wiki/File:Photoelectric_effect_in_a_solid_-_diagram.svg
https://commons.m.wikimedia.org/wiki/File:CCD_Image_sensor.jpg

SCINTILLATION DETECTORS

Preetisha Goswami
3rd year,Bsc(H)Physics

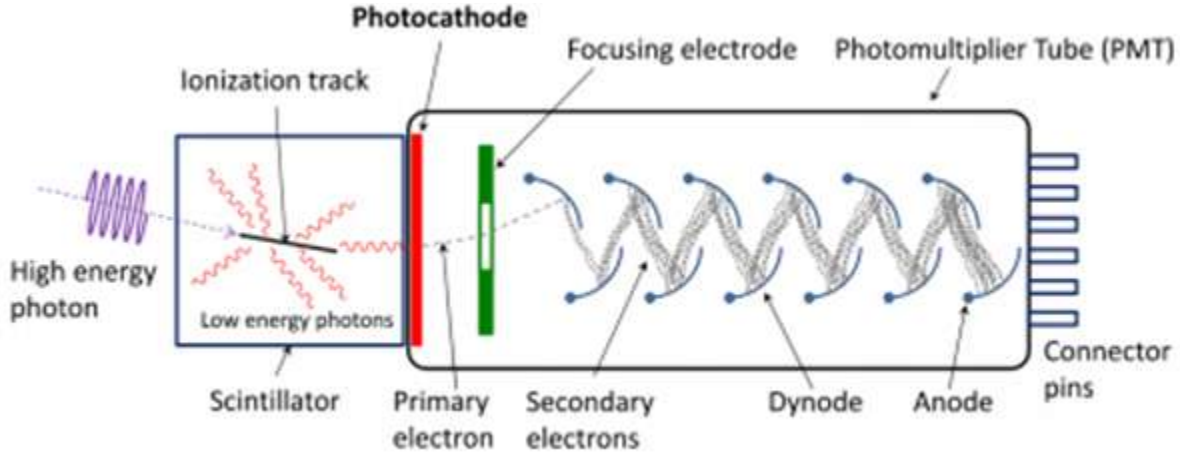
Scintillator, a device that emits light when it detects radiation from source, is an important application of the photoelectric effect. These materials are capable of converting high energy radiation such as X-rays or gamma rays to a near-visible or visible light and are widely used as detectors in medical diagnostics, high energy physics and geophysical exploration. Scintillation detectors are composed of a scintillator material and a photodetector, whose role is to convert the outcoming light of the scintillator to an electrical signal. Photomultiplier tubes are the most common photodetectors.

The physical phenomenon of the scintillation process can be divided into three main sub processes - conversion, energy transfer and luminescence. The interaction of electromagnetic radiation with the matter occurs through three mechanisms depending on the energy of the incident radiation - Photoelectric effect (dominant for energies below 100keV), Compton scattering (dominant for energies between 100keV and 1MeV) and electron-positron pair creation (dominant for energies above 1.02MeV). To enhance the probability of the photoelectric effect to occur, materials with high atomic number (Z) and a high photoelectric fraction (proportion of incoming photons that interact with the matter by the photoelectric effect) are preferred.

MECHANISM

When radiation is absorbed by the scintillator material, primary electron-hole pairs are created which then generate secondary pairs and so on by a cascade effect. Thermalization takes place when the energy of the electronic excitations becomes less the ionization threshold. At the end of this stage, which concludes within less than a picosecond, all the electrons are at the bottom of the conduction band and the holes at the top of the valence band. After the thermalization stage, the free electron-hole pairs migrate through the material to transfer their energy to the luminescent centers which can be done in 10^-12 to 10^-8s. Once the energy transfer is done, the last stage of scintillation takes place – luminescence - the duration of which depends on the luminescent centers and can take more than 10^-10s. [1]

There are mainly 2 types of scintillators: organic/plastic scintillators and inorganic/crystalline scintillators. Inorganic scintillators are crystals grown in high-temperature furnaces. Some examples are



Ahttps://upload.wikimedia.org/wikipedia/commons/e/e8/PhotoMultiplierTubeAndScintillator.svgxt

Lithium iodide (LiI), sodium iodide (NaI), Cesium iodide (CsI), zinc sulfide (ZnS) and most widely used is NaI (Tl) (thallium-doped sodium iodide). Scintillation in inorganic crystals is comparatively slower than in organic ones but they are better at detecting gamma rays and X-rays than organic scintillators due to their high density and atomic number (high electron density). A disadvantage of some inorganic crystals is their hygroscopicity, tendency to absorb moisture from the surrounding atmosphere, which requires them to be stored in airtight containers. Organic Scintillators consist of a transparent host material doped with a scintillating organic molecule. There are three types of organic scintillators: pure organic crystals, liquid organic solutions & plastic scintillators. Radiation is absorbed by the host material mostly via Compton Effect due to low density and Z value of organic materials. [2]

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[1] https://web.stanford.edu/group/scintillators/scintillators.html
[2] https://www.nuclear-power.net/nuclear-engineering/radiation-detection/scintillation-counter scintillation-detector/scintillation-materials-types-of-scintillators/

QUANTA OR WAVE ?

A glimpse of Einstein's groundbreaking theory

Ananya Shankar
3rd year, Bsc(H)Physics

In 1921, the Nobel Prize in Physics was awarded to Albert Einstein "for his services in theoretical physics, and especially for his discovery of the law of the photoelectric effect."
Einstein's Paper on the Photoelectric Effect, titled "***On a heuristic viewpoint concerning the production and transformation of light***" was part of 4 revolutionary papers submitted to a scientific journal in 1905, which are also called the *Annus Mirabilis* papers (Annus Mirabilis: Miracle Year; 1905 is referred to as Einstein's miracle year). This article touches upon two of Einstein's points substantiating his claim for the particle nature of light.
He starts the paper by presenting the Maxwellian theory of electromagnetic radiation, which operates under the consideration that energy is a continuous spatial function in the case of all electromagnetic radiation, while that of a macroscopic object can be represented as a discontinuous or discrete sum of atoms and electrons. This wave theory, which can be experimentally confirmed by the phenomena of reflection, refraction, etc. fails when it is applied to the "emission and transmission of light", such as the phenomena of blackbody radiation, fluorescence, etc. as these optical experiments only measure time-averaged values as opposed to instantaneous values.
He then introduces his bold claim that if the energy of light is composed of a finite number of "quanta" which are localized in space and light can only be emitted or absorbed as multiples of this unit.
He supports this claim by firstly introducing the discrepancy known now as the 'Ultraviolet Catastrophe'. Consider a cavity enclosed with completely reflecting walls, with freely moving gas molecules and electrons, which exert conservative forces on each when they come into close contact. These bound electrons, called oscillators, emit and absorb EM waves.
Using Planck's Formula of the average energy of an oscillator

$$(\bar{E}_\nu) = \left(\frac{L^3}{8\pi\nu^2}\right)\rho_\nu$$

(Where Ēν is the average energy per degree of freedom, L is the speed of light, ν is the frequency of the oscillator, and ρν is the energy density of radiation dν.)
and equating it to the average energy of a linear component of an oscillator as given by the Kinetic Theory of gases,

$$\bar{E} = \left(\frac{R}{N}\right)T$$

(Where Ē is the average energy per linear component of the gas molecule, R is the universal gas constant, N is Avogadro's Number)
he obtained what is called the Rayleigh-Jeans Law,

$$\left(\frac{R}{N}\right)T = \bar{E} = \bar{E}_\nu = \left(\frac{L^3}{8\pi\nu^2}\right)\rho_\nu$$

which in the limit of infinite frequency implied that the energy density was also infinite, which

was catastrophically wrong, thus giving us the name ‘Ultraviolet Catastrophe’.

$$\int_0^\infty \rho_\nu d\nu = \frac{R}{N}\frac{8\pi}{L^3}T\int_0^\infty \nu^2 d\nu = \infty$$

Now, in the parameter space of large wavelengths and energy densities, Planck's Law, given by

$$\rho_\nu = \frac{\alpha\nu^3}{e^{\frac{\beta\nu}{T}} - 1}$$

reduces to,

$$\rho_\nu = \left(\frac{\alpha}{\beta}\right)\nu^2 T$$

also called Wien's Law.
Einstein now equates this coefficient (α/β) with the coefficient obtained earlier from the Rayleigh-Jeans law, and obtains the value of the Avogadro Number, concluding that these theoretical principles, though upheld in this region, fail for small wavelengths and radiation densities

$$\left(\frac{R}{N}\right)\left(\frac{8\pi}{L^3}\right) = \left(\frac{\alpha}{\beta}\right)$$

$$N = \left(\frac{\beta}{\alpha}\right)\left(\frac{8\pi R}{L^3}\right) = 6.17 \times 10^{23}$$

Coming to the most familiar outline of Photoelectric Effect that we know, in 1902, Phillip Lenard discovered that when a metal plate is illuminated with ultraviolet light, the maximum velocity of the electrons emitted are independent of the intensity of light used, culminating in a statement that “in the process of emission the light only plays the role of triggering a motion which already exists with full velocity inside the atoms of the body.”

This phenomena cannot be elucidated if light is considered as a continuous distribution over space, but if considered as quanta, then this effect can be explained as when quanta strike the surface and their energy is converted partly or completely to kinetic energy of the electrons. When leaving this body, an electron must also perform work characteristic of the body used.
This then gives us the legendary equation:

$$\Pi e = \frac{R\beta\nu}{N} - P$$

where Π is the positive potential applied, ε is the electronic charge of an atom, Rβν/N is the magnitude of the energy quanta, and P is the work function.
This was one of the founding bases of quantum mechanics in the turn of the 20th century and this paper beautifully demonstrates how Einstein used both thermodynamic and statistical perspectives to arrive at this conclusion.

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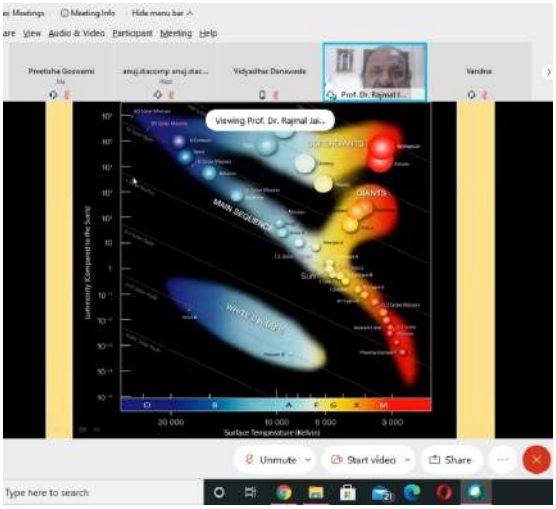
1. Arons, Arnold B., and M. B. Peppard. "Einstein's Proposal of the Photon Concept—a Translation of the Annalen der Physik Paper of 1905." American Journal of Physics 33.5 (1965): 367-374.
2. Veisdal, Jørgen. “Einstein’s 1905 paper on the Photoelectric Effect.” Medium: Cantor's Paradise, 2019, https://www.cantorsparadise.com/einsteins-1905-paper-on-the-photoelectric-effect-d258739ef8d1. Accessed 28 June 2021.
3. Wheaton, Bruce R. “Philipp Lenard and the Photoelectric Effect, 1889-1911.” Historical Studies in the Physical Sciences, vol. 9, 1978, pp. 299–322. JSTOR, www.jstor.org/stable/27757381. Accessed 30 June 2021

THE INAUGURAL LECTURE

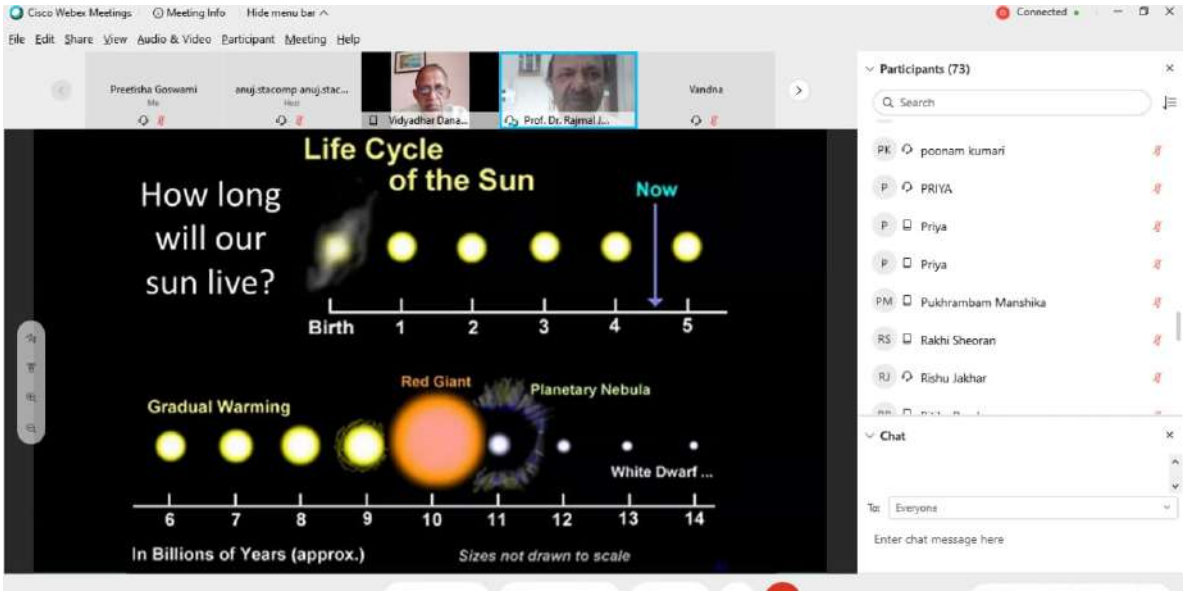
THE FIRST VIRTUAL INAUGURAL LECTURE
8 NOVEMBER 2020

Each year Quasar, the Physics society of Gargi College, University of Delhi organizes its Inaugural Lecture for the session in mid-September. But the year 2020 has been a revolution on its own with everything shifting to the online platforms due to the global pandemic. So, Quasar organized its first-ever "virtual" inaugural lecture on *"Solar Influences on the Earth in the 21st century"* dated Nov 8, 2020. The speaker for the event was Prof. Rajmal Jain, former Professor Physical Research Lab (Space Division), Govt. of India, Ahmedabad, Gujarat. The event was open to all students and faculty members of all colleges and it was held on the virtual platform - Cisco WebEx. Students and teachers from various departments joined us in the lecture.

The event started at 3.30 pm and Ms Rishu Jakhar, President, Quasar Union 2020-21, welcomed the speaker and the audience to the meeting. Meenakshi, a student of 2nd year, Physics department dedicated prayers to Goddess Saraswati Vandana as per the rituals. It was followed by the introduction of the faculty members and non-teaching staff by the host. Dr. Deepti Lehri, our senior faculty, then introduced the previous and newly elected union. Rishu Jakhar as the President, Romanpreet Kaur as the Vice-President, Devanshi Sharma as the General Secretary and Gunjan Bisht as the Treasurer will be carrying on the legacy of QUASAR for the session 2020-21. The hard-working team behind the department magazine, Physikos (2019-20) was introduced next with Preetisha Goswami as the Editor, Megha Kandari and Nikita Saini as Creative Writers, Prerna Sharma and Anjali Kumar as the Designers and Ritika Pandey, Gunjan Bisht and Ayushi Choudhary as Volunteers. It was followed by the inauguration of the department magazine, Physikos 2019-20. The announcement that the applications are open for the Physikos team (2020-21) was made.

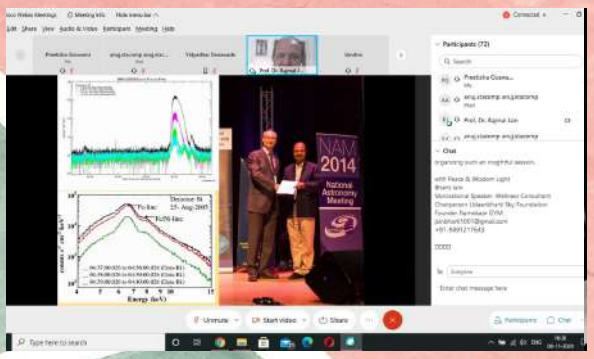


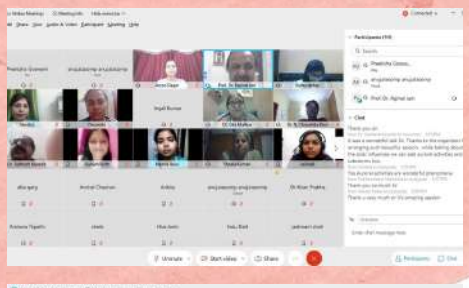
A screenshot from the event

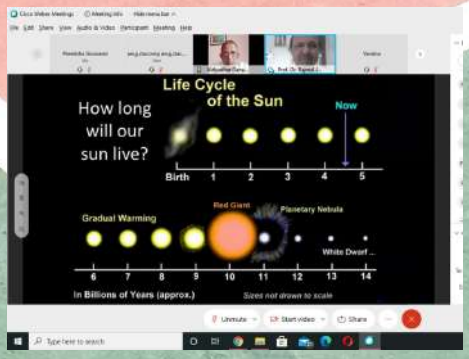


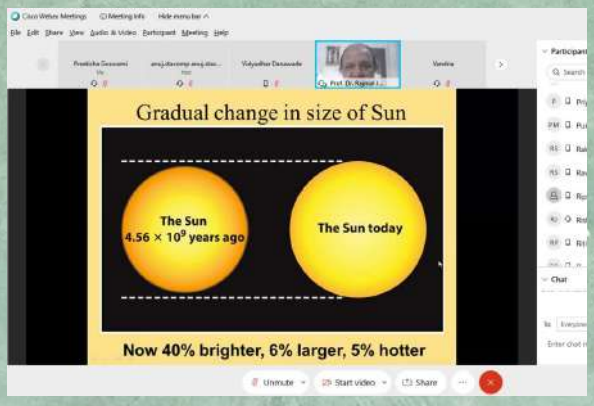
Our Teacher-in-charge of the department, Dr.N Chandrika Devi, welcomed the guest and addressed all the enthusiasts who had joined in, and the Teacher Convener, Dr. Vandna Luthra then gave a brief introduction of the speaker of the day- Prof. Rajmal Jain. After that, Prof. Rajmal started his presentation. He gave an insightful lecture and described the formation of the sun, solar activity, and its influences on the Earth. The beautiful visuals of Earth, Solar Flares and the launch of the Solar X-Ray Spectroscopy launch have surely helped to vast our horizon towards the topic. Later, we proceeded to a Q-n-A session where Prof. Jain answered and cleared the doubts asked by faculty members and the students. A vote of thanks by Gunjan Bisht, student of 2nd year, Physics department wrapped up the event at around 6pm. The guest speaker, teachers, technical and non-technical staff were acknowledged for their immense support and patience. The audience was thanked for their participation. The first event of the session 2020-21 was carried out successfully by Quasar.

-Gunjan Bisht
2nd year, Bsc(H)Physics

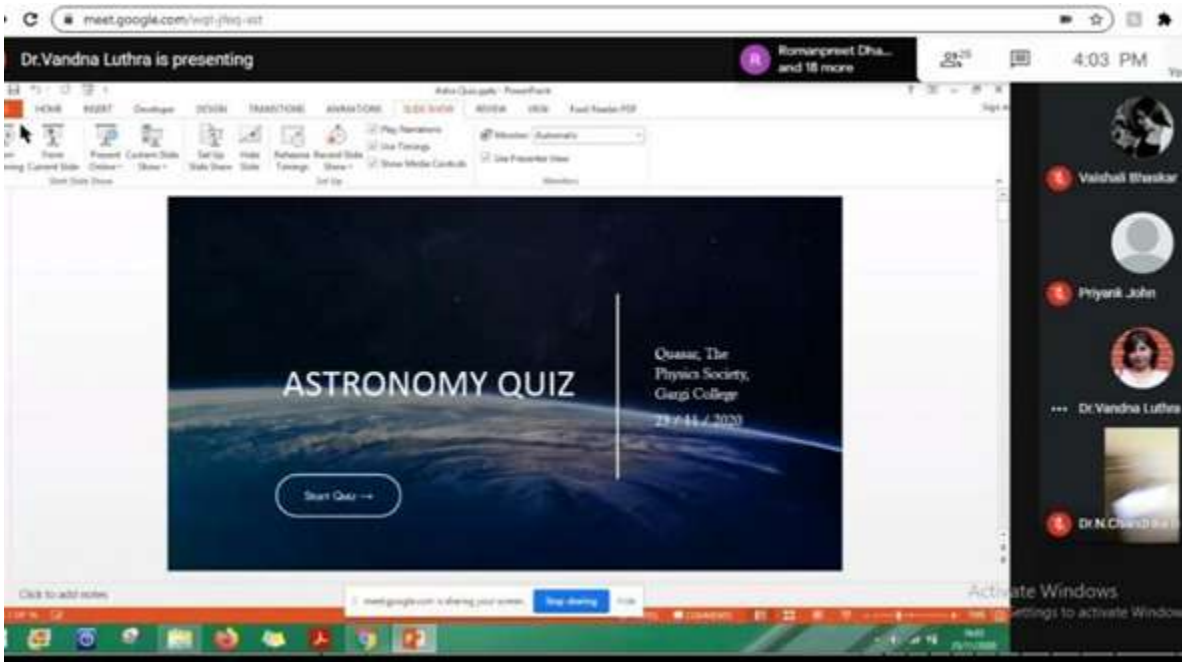








GLIMPSES FROM THE EVENT



An Astronomy Quiz based on the Inaugural Lecture and Astronomy was organized by Quasar, dated Nov 23, 2020. Interested participants were mailed the set of instructions for the quiz on Nov 8. The participants were also sent a link to Google meet prior to the quiz. The meeting started at 4 pm on Nov 23, 2020. After a brief introduction and explanation of the event, Dr. Vandna Luthra, the Teacher Convener of Quasar, mailed the Google form for the quiz to the participants. A PPT was also displayed showing the questions on the Google meet. The responses were collected through the Google form on first-cum-first-serve basis. The top three scorers were set to be given certificates of merit. On Nov 26, 2020, the result was declared and sent to all the participants via mail. The top three scorers were:

Ms. Ananya Shankar

Ms. Rishu Jakhar

Mr. Priyank John.

A feedback form was also shared with the result. Quasar thanked the participants for such active participation.

CLICK 'N' BLINK-

The photography and storytelling competition

28 DEC,2020

A Photography & Storytelling Competition was organized on 28th Dec, 2020, by the Physics Society of Gargi College - Quasar.

A Google form was circulated through which the participants submitted their entries as Round 1 by 26th Dec, 2020. A minimum of 3 and a maximum of 5 entries per participant were allowed. The event was not theme bound. A Google Meet link was mailed to the participants and the audience before the event. The event was held on the online platform- Google Meet on 28th Dec, 2020. The host- Romanpreet Kaur, welcomed everyone and introduced the judges- Dr. Geeta Mehta and Dr. Joya Bhattacharya. She then announced the rules which strictly stated that plagiarism was not allowed and that unedited pictures will be given preference over photo-shopped ones.

Round 2 began, in which every participant was required to narrate a story using the pictures they have submitted within 2 minutes. The criteria of judgement were-

Photographs- Based on theme and creativity.

Story- Based on composition, narration and sync with the photographs.

We received a total of 27 entries with 7 of those being from other colleges. After the presentation of all entries, an attendance form and a feedback form was shared with everyone present in the meet. The judges and the teachers spoke a few words about the event and gave their feedback and summarized their experiences. It encompassed a wide range of themes from the real-life and represented many societal issues.

The winners of the competition were:-

1st Prize: Geetu, BJMC, RLA College

2nd Prize: Pooja Singh, BA Skt. (H), Gargi College

Sahla Siraj, BA Applied Psychology (H), Gargi College

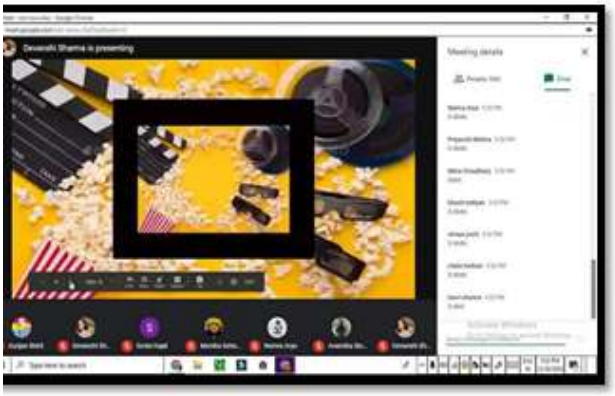
3rd Prize: Anusha Mahapatra, BSc Physics (H), Gargi College

Vanshika Gupta, BSc CS (H), DDU College

The winners were awarded e-certificates.

Dr. Vandna Luthra- the convenor of Quasar, thanked the esteemed judges for sparing their valuable time, keen observations and further summarizing it for the benefit of all. She thanked all the participants for making the event a success. It was followed by a vote of thanks by Gunjan, thanking the judges, all the teachers, the participants and the audience for their benevolent presence. The department endeavours to organize many more such events in near future.

-Gunjan Bisht
2nd year, Bsc(H)Physics



THE TALENT STORY SHOW

30 DEC,2020

QUASAR, The Physics Society of Gargi College organized its Annual Talent Show: The Talent Story on 30th Dec, 2020.
The event was open only for the students of the Physics department.
Interested participants were required to submit their entries via a Google form by 28th Dec, 2020. They had the choice between sending a prerecorded performance or performing live. A Google Meet was scheduled on 30th Dec, 2020 where the event was conducted and the entries were displayed.
The link for the same was shared beforehand.
The meeting started at 5 pm on 30th Dec, 2020. The host- Gunjan Bisht welcomed all the teachers and the students. With a short introduction of the show and its rules, we proceeded to the first entry by Anamika Sinha, 1st year (Dance). Next, there was a poem recitation by Harshita, 1st year. Then we had Priya Kumari, 1st year giving a speech. After that, Sugandhi Kalra, 3rd year, gave a spectacular dance performance. Ritu Sengar submitted her work as an artist. It was followed by singing performances by Priyanshu Mishra, 2nd year; Priya, 3rd year; Rachayita Bhusal, 1st year and Rishu Jakhar, 3rd year.
Everyone appreciated the amazing performances by students. It was followed by a game- "Guess the Movie" meant for the students. Audio clips of dialogues were played and the audience had to guess which movie the dialogues are from. The first one to write the correct answer in the chatbox would get a point. Namra Arya, 2nd year and Sugandhi Kalra, 3rd year scored the highest in the game. Feedback and attendance forms were shared. Since it was not a competition but a show, so every participant would get a certificate.

It was followed by feedback from all the teachers of the department. Everyone wished each other a Happy New Year and the event was concluded.

-Gunjan Bisht
2nd year, Bsc(H)Physics

NATIONAL SCIENCE DAY QUIZ-

"Celebrating lives of Indian scientists"

28 Feb,2021

QUASAR, the Physics society of Gargi College organised a Quiz on the occasion of National Science Day on 28th February, 2021. The quiz was based on " Celebrating the lives and contributions of Indian Scientists".

Interested participants registered themselves through a Google form which was made available to all. The last date to register was 26th Feb, 2021. The event was open to all the Science students of Gargi College regardless of their course or subjects. The event was conducted on the platform - Google Meet. The link for the same was mailed to the participants beforehand. The meet started at 4 pm on 28th February 2021. The President of Quasar's Student Union hosted the event. A presentation of all the questions ran through the meeting. Dr. Vandna Luthra, Convenor of Quasar, also dictated all the questions. The first person to write the correct answer in the chatbox of the meet would get a point. A feedback form was shared to get valuable feedback from the audience.

Results were announced the day after and the top scorers were:

1. Arzoo(B.Sc. Physics Honors, 2nd year), Divya (B.Sc. Botany Honors)
2. Sakshi Sharma (B.Sc Chemistry Honors)
3. Priyanshi (B.Sc Physics Honors, 2nd year).

-Gunjan Bisht
2nd year, Bsc(H)Physics

WORKSHOP

ENHANCING MATHEMATICAL AND COMPUTATIONAL SKILLS USING SPREADSHEETS

Megha Kandari
3rd year,Bsc(H)Physics

Amidst this pandemic, the Physics Department of Gargi College under the aegis of IQAC, organized an interactive and free 7 days workshop on 'ENHANCING MATHEMATICAL AND COMPUTATIONAL SKILLS USING SPREADSHEETS' giving participants an opportunity of fully hands-on and live online interactive session with some esteemed resource persons. Starting from 21-02-2021 every day; 5:00 pm to 6:00 pm till 27-02-2021; according to participants, not a single day went without learning a new concept or tricks to make spreadsheets better.

Every day was a new day, a new concept, a new task as homework with a new presenter. Talking about the presenters, participants were fortunate enough to listen and learn from great minds as the list of resource persons includes professors like Prof.P.K. Ahluwalia (Formerly at HP Uni), Dr. Samistha Sahu (Formerly at MLACW, Banglore), Dr. Sapna Sharma (Physics Dept. HP Uni) and our very own Dr. Vandna Luthra with Dr. B. Vaijayanthi (Member IQAC & chemistry dept. Gargi College). Along with students some teachers also joined this workshop and enjoyed the sessions thoroughly. According to Ananya (3rd year student of Gargi College, Physics dept.), " this workshop was a great initiative by the dept. and as a physics student, some of the concepts and way of representation would be really helpful for students and teachers alike as experimental data could be easily plotted and reviewed almost immediately using Spreadsheets." Day one was kick-started by the inaugural speech and blessings of Dr. Promila Kumar (Principal, Gargi College) with introductions of our fascinating speakers. Concepts like Cell referencing, Ms Excel Sheet specifications, plotting graphs and analyzing them, setting trend line on graphs and calculating errors and deviations using built-in commands were elaborately explained by presenters mentioned above in the subsequent days of the workshop. The last 2 days of the workshop were dedicated to 'Google Sheets' and its comparison with Ms Excel. Each day ends with some homework for students to be submitted on google classroom and every new session begins with a discussion of the previous session's homework with each resource person giving his/her opinion on the quality of work and presentation. "The matchstick experiment simulation by Dr. Samistha Sahu was very fascinating where she determines the value of pi using probability", a comment by workshop's participant.

This workshop was a success and the Convener and Co-Convener, Dr. Vandna Luthra and (Late) Dr. Narender Kumar (Mathematics dept. Gargi College) respectively were overwhelmed by the response of students and teachers further stating their intentions of organizing such workshop often in near future.

WEB SERIES REVIEW: THE BIG BANG THEORY

Namra Arya
Vaishali Bhaskar
2nd year ,B.Sc. (H) Physics

GENRE: SITCOM, TELEVISION COMEDY

Created by Chuck Lorre and Bill Prady, The Big Bang Theory revolves around the lives of five people; three Physicists; Dr. Sheldon Cooper, Dr. Leonard Hofstadter and Dr. Rajesh Koothrappali, an MIT engineer Howard Wolowitz and a Cheesecake factory waitress and a struggling actress Penny.

Sheldon is a theoretical physicist who was a child prodigy, is somewhat overly intellectual, germaphobe, has an eidetic memory, general lack of empathy and loves to tell facts and correct people. He shares an apartment with Leonard, an experimental physicist and a much kinder person.

The show starts when Penny, a free-spirited beauty, moves in across the hall from them and they invite her over. Then enters Howard, an aerospace engineer who is Jewish and lives with his mother and Rajesh-a.k.a. Raj- an astrophysicist originally from India, who has selective mutism, making him unable to talk to women.

The four friends spend most of their time working on their individual projects, reading comic books, playing video games and Dungeons & Dragons having nothing to do with the outside world at all. Penny, on the other hand, is very social and helps these four men to get out of their shells as they become friends and learn about each other's world.

SPOILERS ALERT
(cause there's a bit more than one here)

Leonard, as shown in the pilot, enamoured of his new neighbour, gets closer with Penny slowly with a lot of ups and downs in their path because of being very different persons in every aspect possible, but they eventually get married.

Afterwards, Sheldon, who has a peculiar personality, meets Dr. Amy Farrah Fowler, a neuroscientist, who at first seems much like Sheldon but later after becoming friends with Penny and Bernadette, gets better at socialising and understands how relationships work. She also teaches Sheldon about the ways of the world and to be humane to others.

Just like that Penny sets Howard with one of her co-workers at The Cheesecake factory, namely Bernadette Rostenkowski, a microbiologist, currently a part-time waitress, who pursues her PhD later in the show. She also has an impact on Howard and they get married and grow a family together.

Whereas Rajesh, who claims to be metrosexual couldn't find a forever lasting romance, but bromance with Howard.

With Jim Parsons (as Sheldon) in the lead, the show focuses on how he grows and becomes a better person under the influence of Amy but balancing and also focusing on what was going on in other characters' lives. The series shows how they grow fond of each other with their ups and downs and together make a

breakthrough in Physics, also with a bit of ups and downs, leading them towards The Nobel Prize.

A lot of guests appeared on the show; scientists and actors from the Star Trek franchise, Star Wars franchise, and the most famous person in the comics universe or shall I say, the multiverse. I won't tell you the names to keep it interesting and astounding.

There's a lot of representation of different scientific phenomena like Doppler's Effect, and scientific equipment like lasers and more. In an episode, Sheldon gives a really great explanation of Schrödinger's cat. David Saltzberg, a professor of physics and astronomy at the University of California, consulted and gave his best to get all the science right in the show and on the whiteboard. He also pointed out where the writers, despite their knowledge of science, made a mistake. For biology related stuff, he sometimes needed the assistance of Mayim Bialik (Amy) who is a neuroscientist in real life and the only person in the cast who actually understands what she's saying.

The show goes on for 12 seasons with a great reception. Although there was mixed reception in the starting, still the show aired for further seasons and the ratings just got better and better, with TBBT being placed first in all of the syndication ratings in the 2012-13 season. The series wasn't planned to end after the 12th season, but with Jim opting out because of some personal reasons, you really couldn't imagine someone else playing Sheldon or the show without Sheldon, so they had to shut down the series, but with a satisfactory ending.
A spinoff series of The Big Bang Theory was created in 2017, named Young Sheldon, which is narrated by Jim Parsons.

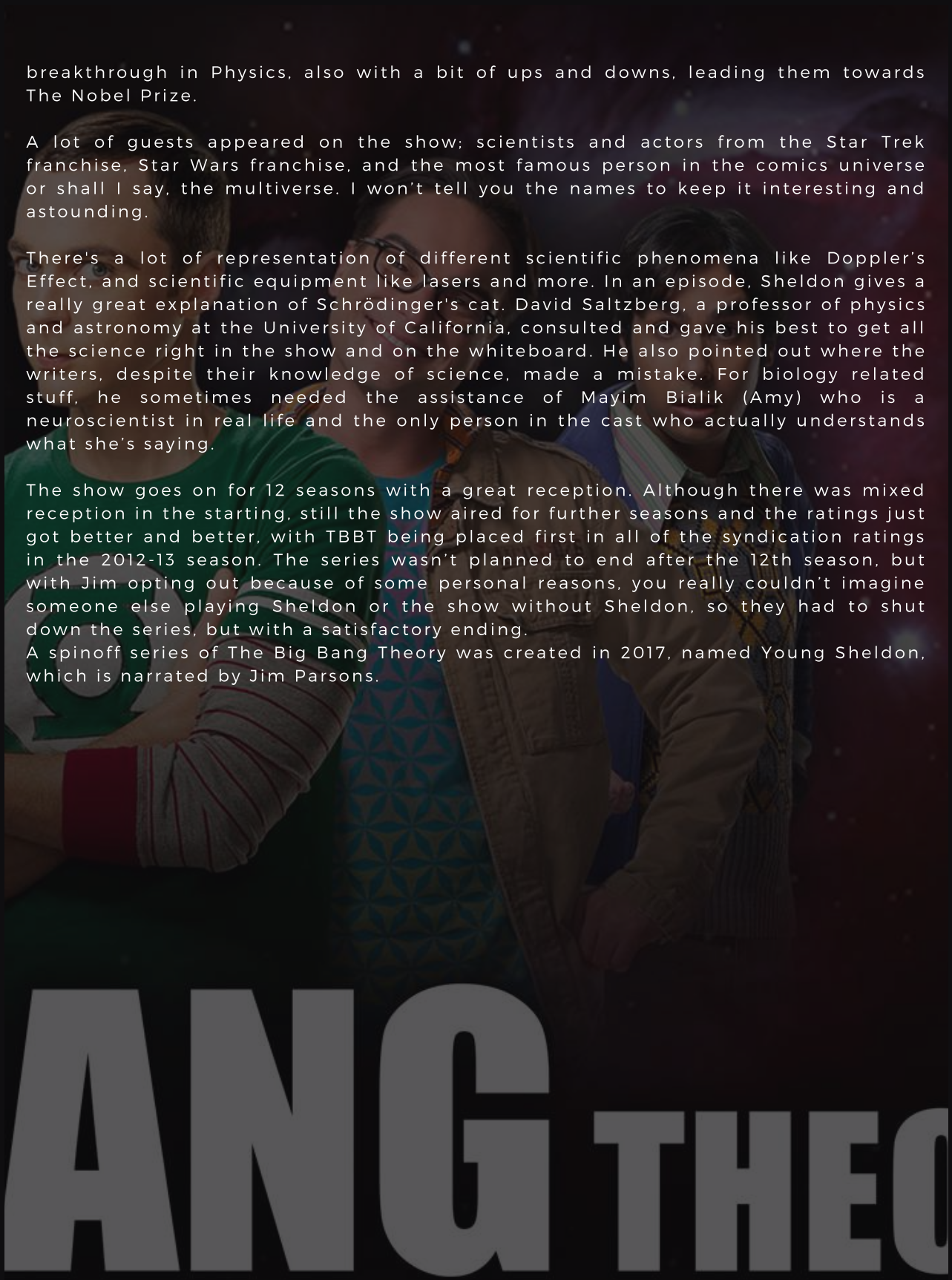


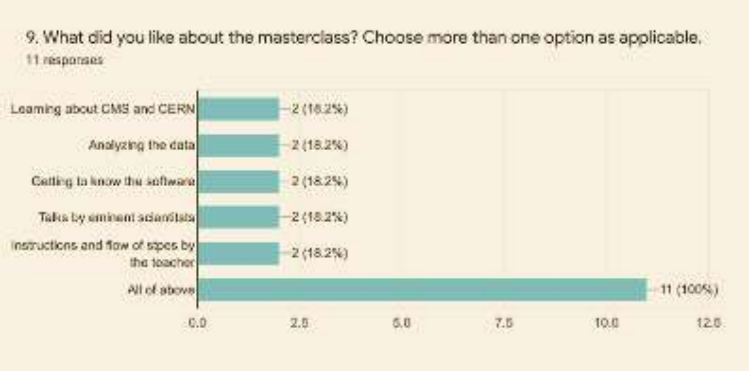
Image source
https://images6.alphacoders.com/783/thumbbig-783333.webp

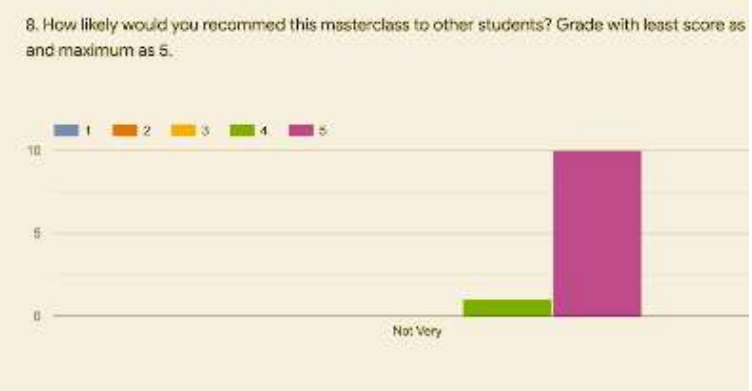
BAMC MASTERCLASS:

ANALYSING ORIGINAL DATA FROM CERN

DR. VANDNA LUTHRA

BAMC International Masterclasses have provided an enriching learning experience for 12 of our students from B.Sc. Physics (H), 1st Year, 2nd Year and Physical Sciences 2nd Year. Under my supervision, they attended BAMC masterclasses to learn about CERN, CMS experiment, attended three webinars, performed data analysis on the original data from CERN to identify the nature of muons generations as 1-muon, 2-muon and 4-muon processes. They got to know about the standard model, ongoing research in the field, working on a software and then finding the ratio W+/W-, and many other evaluations. This activity has motivated the students to take these topics for higher studies in High Energy Physics, Particle Physics and many other interdisciplinary fields.





CROSSWORD

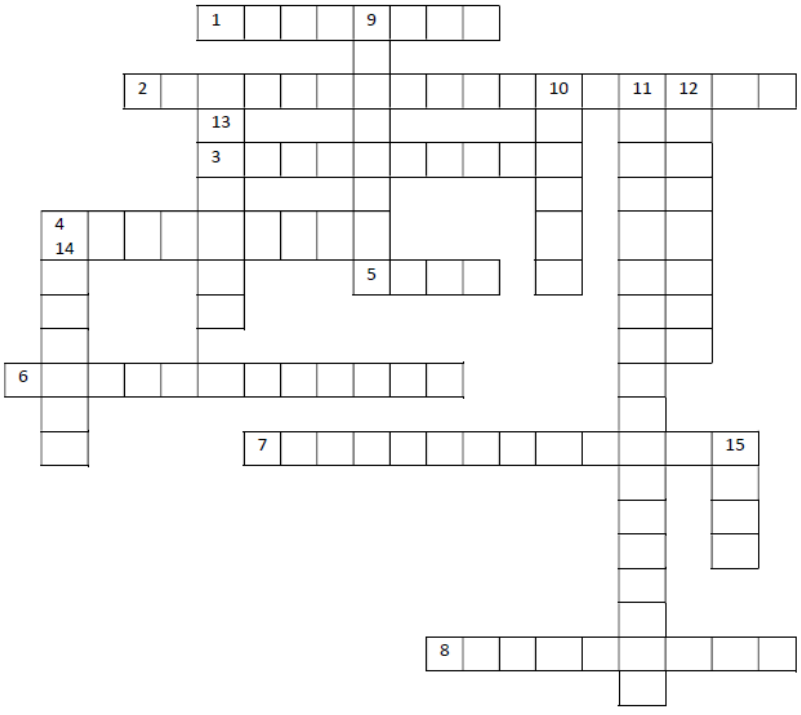
Khushi baliyan
2nd year,Bsc(H)Physics

ACROSS:

1. Used to measure intensity of light (8)
2. When frequency of incident radiations is increased in photoelectric effect, which quantity increases (17)
3. Particles emitted in photoelectric effect from metal surface (9)
4. Nature of light considered for the justification of photoelectric effect (8)
5. Gas filled inside solar cell (4)
6. Minimum amount of energy required to release an electron from its bondage (12)
17. Who was the first person to see photoelectric effect (13)
8. Application of photoelectric effect (9)

DOWN:

19. Awarded noble prize for photoelectric effect (8)
10. Which quantity is conserved in photoelectric effect (6)
11. Frequency below which photoelectric effect does not occur (18)
12. What is the effect on photocurrent when intensity of incident radiations is increased in photoelectric effect (8)
13. Best suitable metal for photoelectric effect (6)
14. Quanta of energy (7)
15. Rest mass of photon (4)



ANSWERS-Across-1. Lux meter 2. Stopping potential 3. Electron 4. Particle 5. Neon 6. Work function 7. Heinrich hertz 8. Solar cell
DOWN:9. Einstein 10. Energy 11. Threshold frequency 12. Increase 13. Cesium1 4. Photons 15. Zero

MESSAGE FROM THE ALUMNI

Hello Everyone! This is Batch 2017-2020. Though our graduation was completed amidst the pandemic, we spent quite a jolly good time at Gargi College and by God's grace all of us passed out with flying colours. However, it is well said that the journey is always much more beautiful than the destination and the same is the case with us as well. After our graduation, we all are heading in different fields and this diversification is the manifestation of moral as well as academic excellence imparted to us by *the Department of Physics "QUASAR", Gargi College*. Many of us are pursuing a career in physics only and doing M.Sc. Physics from Department Of Physics and Astrophysics, Delhi University. Many are preparing for competitive government exams like SSC CGL, UPSC CSE, SSB, Banking etc. Anshulika Rajput who is preparing for UPSC CSE has taken Geography as her optional subject and Krati Gupta who is pursuing M.Sc. Tech Applied Geophysics from KUK, reiterates proudly that the module of Physics of Earth that they studied during their graduation is helping them potentially and providing them with an edge over others. Ananya Gupta who has secured 91.67% and 95.17% as her CAT and SNAP scores respectively is all set to take admission in IIM Nagpur for MBA. Arjyama Bordoloi and Jyotismita Adhikary who are pursuing M.Sc. Physics from IIT Guwahati and IIT Jodhpur respectively, are *also going to start their research work in Artificial Intelligence based wave function ansatz at PRL, Ahemdabad and in high energy physics, respectively.* Surabhi Maheshwari and Tanya Agarwal are pursuing their career in law and are doing LLB. Some are doing B.Ed. from various institutes. All of us are very thankful to our esteemed professors who have really helped us in not only grasping the concepts of physics in the smartest and most efficient way but also encouraged us always to participate in extracurricular activities. This can be easily seen as from 2017-20, our department after getting motivated by our seniors and encouraged by professors, has put its heart and soul in Sports' Day March Past and other events and bagged prizes and positions every year. In Gargi Olympiad also we bagged various prizes. To put it in a nutshell, we enjoyed our journey in our college to the fullest and are immensely grateful and highly obliged to our college and department for providing us appreciable and wonderful opportunities and incorporating the cultural and academic excellence in us.

Thank you
Best Regards
Batch 2017-2020, B.Sc Physics (H), Gargi College

We as a student community are greatly impacted because of the much-abhorred virus which needs no introduction. But although the situation looks grim in the current scenario, what matters is how we keep ourselves moving forward, yes, absolutely looking after each other but on top of that, also being motivated to pursue our dreams. Among countless hours of online classes, we need some time to sit alone and reassure ourselves of our motivations. As a student of physics, I want to share my experiences of the past and present year, hoping that it could be of help to students of the community.

Around mid-March, I was just finished with my JAM exam and was busy exploring the nooks and corners of Delhi when the news of lockdown came and I had to flee Delhi to my hometown Guwahati. Everything stood still for a while. All the daily routines of going to college, classes and labs were far from my reach. Despite the constraints, we did have online lectures. That time made us understand that there is nothing more pleasant than going to college to attend classes in physical mode.

Through two of my most loved courses one of which was introduced in my 5th semester named "nuclear and particle physics" and the second one in my 6th semester named "physics of earth", I became closer to the arena of high energy physics. I had gotten the opportunity to give a presentation in class regarding the big bang theory which made me explore that area which in turn made me realize how intricately it is related to particle physics. This one concept, one idea kept me indulged. I was particularly interested in matter-antimatter asymmetry that arose during the formation of the universe. I am thankful to be given enough opportunities by our professors to learn things that are not bounded to the syllabus. What I have learned through that time along with the concepts of physics is that we should not confine ourselves to what is in the syllabus which most of us tend to do. We should always look for recent advancements on topics that interest us. This part is really crucial to keep us motivated to learn that specific topic. We should not treat physics as some abstract concept. Rather, as a vibrant arena of brilliant opportunities to provide for the betterment of the species as a whole or to understand the fundamentals of the universe itself like the origin of mass or how two particles exactly interact.

Following the timeline, I got admitted to the Indian Institute of Technology Jodhpur and I was really excited to learn about new things. Within the span of one year, I have found new rigor to pursue my humble goal to understand matter-antimatter asymmetry of the universe along with a newfound interest in neutrinos. I have been introduced to Relativistic quantum mechanics, General theory of relativity and High energy physics within this year which has done miracles for me to understand the various concepts in this arena. For example, the existence of spin of electrons has its roots in relativistic quantum mechanics and that it was not at all embarrassing when you could not imagine what spin is in your undergrad days because no one can as it has no classical analog as such!! I would also like to point out that the subjects that we study in our undergrad may seem arbitrary at first but moving along the line connecting the dots you find how important every subject is in the grand scheme of things so it is important to learn every subject keeping that in mind.

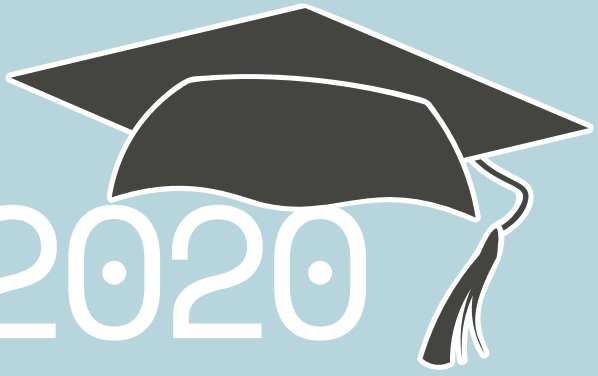
I further want to add that if you are really interested in physics then masters would only add to that interest no matter from which institute you choose to pursue it. It would open doors to view the concepts that we learned at the graduate level with a different perspective and this perspective is gorgeous. In order to emphasize my remark on learning out of the syllabus, I would like to mention the importance of internships. An internship always teaches us something beyond the syllabus and it opens a doorway for future ideas and their executions.

This year (2021) I had gotten a chance to experience it firsthand with an admission to summer school of IUCAA, PUNE and I learned a whole new plethora of topics in-depth in the school starting from cosmology to black holes to dark matter and dark energy.

Before concluding anything, I would like also to add that as much as studying your subject is necessary it is equally important to give time to yourself and your hobbies. I had the opportunity to learn a new language (German) during the summer of 2020. I also developed an interest in creating poetry and I am pursuing it still. More important still is your bonding with the physics lovers whom you call your classmates. I have come across some of the wonderful minds in the three years that I had spent there and having said that I had the luck to discuss all sorts of things with them be it non-academic or academic. Preparations for competitive exams were also fueled by the collective enthusiasm of the class. This is a bond you create which not only helps you on the academic front but it does also make you a better person still.
The time is difficult and scary but we have a very strong tool to bring change in the form of physics. Yes, we are bound to sit at home and sometimes we are lost as we are unable to contribute to the betterment of the situation but we should keep learning with fierce determination because what we learn today, would be useful in making the world better if not now then ten to twenty years from now. At that time we should be able to contribute immensely and this itself should be the greatest motivation to keep moving forward.

-Jyotismita Adhikary
MSc Physics, 1st year
IIT Jodhpur
(Gargi batch 2020)

BATCH 2017-2020



HERE'S WHAT OUR ALUMNI ARE DOING

NAME	CURRENT STATUS
Ruchika	M.Sc. Physics (DU)
Nikita Saini	M.Sc. Physics (DU)
Riya	M.Sc. Physics (DU)
Meemansha Bahuguna	M.Sc. Physics (DU)
Srishti Dehmiwal	M.Sc. Physics (DU)
Ankita Singh	M.Sc. Physics (Amity)
Parnika Dhillon	Preparation(Banking)
Anshulika Rajput	Preparation(Civil Services)
Sakshi Jaglan	M.Sc. Physics(DU)
Prerna Sharma	M.Sc. Physics (DU)
Arjyama Bordoloi	M.Sc. Physics(IIT Guwahati)
Pooja Yadav	M.Sc. Physics (CRSU)
Yukta Gaur	M.Sc. Physics (DU)
Surabhi Maheshwari	LLB, lawcenter 1 (DU)
Vaishali yadav	M.Sc. Physics (DU)
Jyotismita Adhikary	M.Sc. Physics(IIT Jodhpur)
Pooja	B.Ed+ govt exams preparation
Upasana Pant	M.Sc. Physics (DU)
Muskan Khanna	M.Sc. Physics(DU)
Krati Gupta	M.Sc. Tech Applied Geophysics(KUK)

NAME	CURRENT STATUS
Shruti Gupta	M.Sc. Physics(DU)
Ananya Gupta	MBA IIM Nagpur
Jocelyne Sohkhlet	M.Sc. Physics (DU)
Anjali	B.Ed+Govt. Service preparation
Riya Verma	MBA (IP University)
Vidhi Jain	M.Sc. Physics (NIT Jalandhar)
Tanya Agarwal	PGDB (IMA), LLB (CCS)
Sonali Bhardwaj	B.Ed (HNBGU)
Parul	M.Sc. Physics (DU)
Priyanka Gupta	M.Sc. Physics (DU)
Chanchal	B.Ed + Govt. exam preparation
Kalpana Sharma	B.Ed + Govt. exam preparation

STUDENTS' ACHIEVEMENTS

NAME	BATCH	ACHIEVEMENTS
Gurmeet kaur	2020-2023	• "Creative Head" of Physics Department-Quasar
Romanpreet Kaur	2019-2022	• "Vice President" of Physics Department-Quasar. • Secured 2nd position in best out of waste competition organized by Mata Sundri College.
Shruti Rana	2019-2022	• Secured 2nd position in AMFLIX - The Binger's Tournament, Overload++ 2021, the annual fest of Computer Science Department, Acharya Narendra Dev College.
Namra Arya	2019-2022	• Secured 2nd position in AMFLIX - The Binger's Tournament, Overload++ 2021, the annual fest of Computer Science Department, Acharya Narendra Dev College.

NAME	BATCH	ACHIEVEMENTS
Priyanshi Mishra	2019-2022	• Secured 3rd position in quiz on the occasion of science day organized by Quasar, the Physics Department of Gargi college. • Secured 2nd position in the paper presentation organized by Anusandhan , the physics society of Motilal Nehru college. • Qualified the physics quiz organized by Kanya Maha vidyalay, Jalandar .
Gunjan Bisht	2019-2022	• "Treasurer" of Physics department-Quasar • "General Secretary" of The White Rose Club (Center for Diversity and Inclusion). • Elected as the President of the White Rose Club for the session 2021-2022
Kashish Bhatia	2018-2021	• Internship at Unschool • Internship at Investment Tree Fincorp • Editor, College Magazine (Voices)
Ayushi Choudhary	2018-2021	• Submitted a group project on SIR Modeling on Covid Data

NAME	BATCH	ACHIEVEMENTS
Neha	2020-2023	• "Joint secretary" of Physics department-Quasar. • Participated in Polaroid completion organized by SRCC • Internship at younger.in • Scholarship by Sakshat for educational help.
Rishu Jakhar	2018-2021	• Served as volunteer in DULS 2020 • "President" of Physics Department-Quasar • Secured 2nd position in Astronomy Quiz organized by Quasar • Qualified Quiz organized by KMV, Jalandhar • Secured consolation Prize in Annual fest quiz organized by MLNC, DU • Selected as Campus Ambassador for Boeing-IIT National Aeromodelling Competition (BNAC) 2021- North Zone
Teesha Khandelwal	2018-2021	• Submitted a group project on SIR Modeling on Covid Data

NAME	BATCH	ACHIEVEMENTS
Preetisha Goswami	2018-2021	• Awarded Best Oral Presenter (of research paper) in the 5th International Conference on Recent Advances in Material Chemistry (ICRAMC-2021). • Co-author of paper entitled "First principle investigations of half metallicity in Heusler compounds with X2TiZ(X = V, Cr, Mn, Fe, Co, and Ni; Z = Si, Ge)" published in the AIP Conference Proceedings. • Presented paper in the 5th International Conference on Recent Advances in Material Chemistry (ICRAMC-2021). • Presented paper in the 5th National e-Conference on Advanced Materials and Radiation Physics (AMRP)-2020. • Selected to attend the virtual Introductory Summer School in Astronomy and Astrophysics (ISSAA) organized by Inter-University Centre for Astronomy and Astrophysics (IUCAA). • Participated in a workshop on “Enhancing Mathematical and Computational Physics using Spreadsheets”, organized by Quasar, the Department of Physics, Gargi College.
Komal Kumari	2018-2021	• Secured Third position in poetry competition. • Currently doing an internship in Doubtnut.

NAME	BATCH	ACHIEVEMENTS
Sugandhi	2018-2021	• Participated in the Quiz on celebration of 142nd birthday of Albert Einstein • Participated in COMIC SCIENCE- Stand up comedy competition • Participated in Talent story organized by the Physics Department, QUASAR
Ananya Shankar	2018-2021	• "Convenor" of Quiz society, Quizzito. • Attended ISSAA Summer School 2021. • Presented paper in ICRAMC Conference 2021. • Presented paper in AMRP Conference 2020. • Co-author of paper entitled "First principle investigations of half metallicity in Heusler compounds with X2TiZ (X = V, Cr, Mn, Fe, Co, and Ni; Z = Si, Ge)" published in the AIP Conference Proceedings. • SSERD Contrast Analysis of Exomoon Candidates. • Participated in a workshop on “Enhancing Mathematical and Computational Physics using Spreadsheets”, organized by Quasar, the Department of Physics, Gargi College.

STAR ACHIEVERS

BATCH 2017-2020

MUSKAN KHANNA
9.74

ARJYAMA BORDOLOI
9.70

1.JYOTISHMA ADHIKARY
2.UPASANA PANT
9.41

BATCH 2018-2021

RITIKA PANDEY
10

SHABANA KHATOON
9.89

KASHISH BHATIA
9.79

BATCH 2019-2022

POONAM KUMARI
9.32

ARZOO DAGAR
8.82

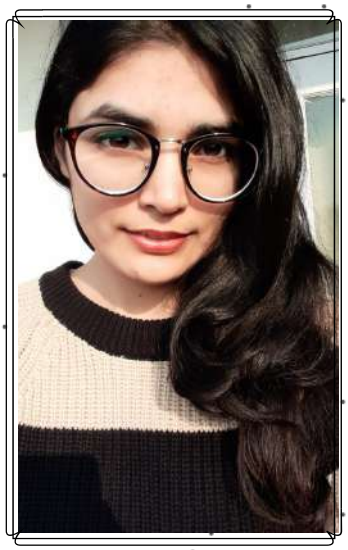
MAHENOOR FATIMA
8.68

STUDENTS' UNION 2020-21

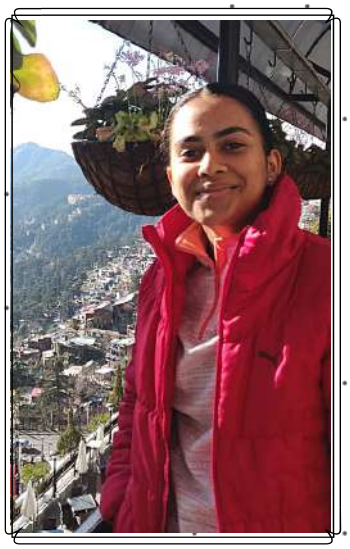
Rishu Jakhar
(President)

Gunjan Bisht
(Treasurer)

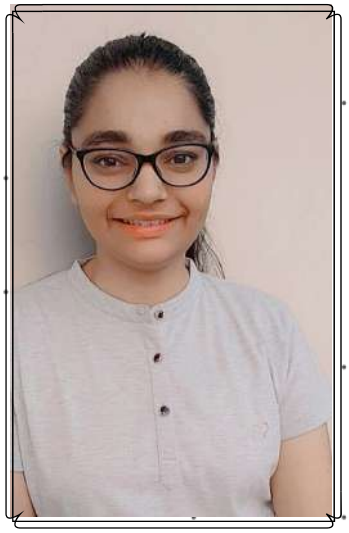
Neha Choudhary
(Joint Secretary)



Romanpreet Kaur
(Vice President)



Devanshi Sharma
(General Secretary)



Gursimran Kaur
(Creative Head)

OUR NATIONAL CADET CORPS

Junior Under Officer Preeti Redhu

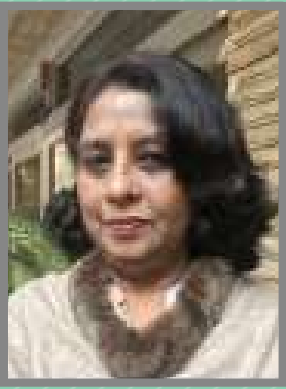
Corporal Devanshi Sharma

Sergeant Shikha Gaur

Cadet Swati Bajia

THE TEACHING FACULTY

Dr. Deepti Lehri



Dr. Indu Dutt
(Superannuated
Feb 2021)

Dr. Alka Garg

Dr. Vandna Luthra

Dr.Supreeti Das

Mrs. Anita Singh

Dr. N.Chandrika Devi

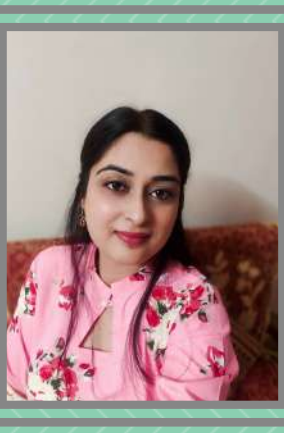
THE TEACHING FACULTY

Dr. Hira Joshi

Mr. Munish

Dr. Archana Tripathi

Ms. Mansi Agrawal



Dr. Manvi

Dr. Surendra Kumar

Mr. Man Raj

THE LAB FACULTY

From left to right: Mr. Shekhar Chand, Mr. Santosh, Mr. Sushil, Mr. Vinod Dubey, Mr. Sher Bhadur, Mr. Baleshwar Prasad, Mr. Hemraj, Mr. Sanjeev Kumar

BATCH 2018-2021

Aditi

Ananya

Anju

Ankita

Ayushi

Bhavna

Divya

Ekta

Eshangi

Janvi

Kashish

Sushmanjali

BATCH 2018-2021

Komal

Komal

Kumud

Kusum

Laxita

Manju

Mansi

Mansi

Megha

Muskan

Navita

Neha

BATCH 2018-2021

Neha

Nidhi

Nikita

Palak

Parul

Prachi

Preeti

Preetisha

Priya

Priya

P. Manshikha

Ripundi

BATCH 2018-2021

Rishu

Ritika

Sakshi

Samiksha

Shabana

Shreya

Shweta

Sugandhi

Swati

Sweety

Tannu

Teesha

BATCH 2018-2021

T.Reha

Vanshikha

Y. Kalpana

Tanvi

MESSAGE FROM THE PHYSIKOS TEAM

NAMRA ARYA, 2nd Year
(DESIGNER)

Being in the audience and being a part of something that is presented in front of an audience are two very different things. Being a part of Physikos was just amazing! The teacher coordinator and the team members were so great and I learned about a lot of new things, even on the day of the interview. When I saw the last issue and all those published articles by the students, I just knew that I wanted to be a part of the magazine. And as I am now, it's just wonderful. You guys would have read the series review I wrote for 'The Big Bang Theory'. I feel so proud that it got published. I'd like to say that everyone should contribute to the magazine because when you see your name and content in it, you get that proud feeling. IT'S WORTH IT!
In the end, I just want to say that being a part of Physikos was LEGEN-wait for it-DARY!
(By Barney Stinson, How I Met Your Mother)

"Physikos" has given me the chance to write my heart out. It's not just any other magazine but it's a place for all young and curious Gargi people to explore new science based themes via art or writing.
Being a creative writer for Physikos, I came across many profoundly researched articles and beautifully depicted art work in this entire journey. It was a privilege for me to share those beautiful ideas and introduce them to my peers and teachers.
I love working with this team and wish them all the best for all their further endeavours.

MEGHA KANDARI , 3rd Year
(CONTENT WRITER)

MESSAGE FROM THE PHYSIKOS TEAM

PREETISHA GOSWAMI,
3rd Year (Content Editor)

3 years with Physikos was an extremely unique learning experience for me. While 'creating a magazine' may seem to be an easy task at first glance, but in reality, it's so much more than just designing layouts and collecting articles, which seemed like the easiest job to me when I first joined the team, only to later realize it was the toughest part. The hurdles that we faced in the process, later turned out to be the actual learning experiences for me. I joined Physikos to pursue my interest in editorial designing and now 3 years later, along with my designing skills, my writing, editing and research skills have enhanced along with communication skills. I have learned about plagiarism and how to check it, the rules that we need to follow while creating a magazine along with some golden tips so that the process does not go off track (something which you learn after several mistakes), addressing and tackling issues that one cannot even imagine to arise unless part of something like this and most importantly, working successfully in a team. Best wishes to my teammates in carrying Physikos forward successfully!

The last session when I got to see our departmental magazine "PHYSIKOS" it was fun, but now, being a part of it was far more interesting. The moment I saw it, I wanted to be a part of it. Honestly, I am so happy to be a part of it. I have learned so many new skills that I would have missed if I wasn't been a part of the team. And being a part of it has educated me in many ways, be it plagiarism check, proofreading, or working as a team. And I am thankful that I could contribute to the magazine and, my piece got to the final print.

In the end, I would thank you for providing me the opportunity to be a part of the team and, I hope to do the same next year as well with the same excitement, keenness, and enthusiasm and get to work with new people too.

SHRUTI RANA , 2nd Year
(DESIGNER)


“
IMAGINATION IS EVERYTHING
It is the preview of life's coming attractions.
”
ALBERT EINSTIEN