

An-Nisa Volume 3. 2024



Dedicated to - Palestinians carrying out education and research in STEM disciplines despite unfavorable suppressed environment and poor resources,

and

- All Muslim Females in STEM



Cover page: Background shows historic the great Al Omari mosque at the top and Dome of the Rock mosque at the bottom while middle pictures are of optical device components and renewal energy that are prominent in research in Gaza

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AN-NISA

"We pray to Allah to bless us with the intellectual power to solve the mysteries of His creation for the benefits of humanities.

We dedicate our magazine to all those women, known and unknown, who endeavoring and contributing to the same cause.

This issue does not contain the stories of the pioneering women that we read in textbooks or history books. It contains stories and research of some extraordinary women who are making history at this time regardless of their places in the future, inventing the path of science through their dedication, intelligence and truly honest minds'

- ISMWS

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Message from OSU Co-Director, Prof. Sultana N. Nahar

Indo-US APJ Abdul Kalam STEM Education and Research Center of OSU and AMU Department of Astronomy, The Ohio State University, Columbus, OH 43210, USA

Assalamualaikum and a very Happy New Year to everyone!

We are very pleased to release our 3rd issue of An-Nisa magazine. It speaks out and share our thoughts, what we are, and we are doing. This forms a bond of understanding and support among us and forms an united front with strength and dreams to go ahead, seek knowledge, help each other, face challenges and bring advances.

This year, we are dedicating An-Nisa to two special groups:

- Palestinians, the wonderful and sophisticated people of the holy and of Palestine - gentle, caring, and robust, but going through the havoc of a brutal genocide by Israel. They do not and are not allowed to have defence mechanism, freedom to nurture their intellectual growth properly, freedom to expand their research to full fledge, yet they had been growing in education and research, and I feel fortunate to be with them. Now systematically and forcefully, Israel has destroyed their educational and research infrastructure. However, their spirits are admirably resilient, their passion for knowledge is everlasting. They are holding classes in tents of displaced, online even with problems in charging laptops. They WILL rise again. We are We salute their effort and bravery.

We have plan to be part of the effort for education and research in Palestine.

- We continue to dedicate our magazine to Muslim women in STEM. Our number is increasing. We are contributing more to advances in many sectors as demonstrated by some examples in this volume.

May Allah bless everyone with a peaceful, productive and successful 2025.







Message from OSU Director Prof. Anil K. Pradhan

Indo-US APJ Abdul Kalam STEM Education and Research Center of OSU and AMU Department of Astronomy, The Ohio State University, Columbus, OH 43210, USA

APJ Abdul Kalam Indo-US STEM Center Support for Education and Research in Palestine

Dear Colleagues,

The entire educational system of Ghaza has been destroyed during the past year of the Israeli genocide supported by western powers. More than 20,000 students were killed among over 50,000 Palestinians martyrs, mostly women and children. They include hundreds of teachers, professors and officials from Ghazan universities such as the Islamic University of Ghaza and AI Aqsa University. It is our solemn obligation to help rebuild the educational structure in Ghaza. The APJAK STEM-ER Center can and must play a role in this most humane endeavor. Given the absence of any physical infrastructure, we are in the process of setting up a mechanism to implement online distance education network for Ghazan students. We appeal to all AMU and OSU people to contribute to this effort as much as possible. Until the plans are formalized, please feel free to contact us to lend your support.

Thank You.





Martyrdom of Yahya Sinwar



A poem by Anil Pradhan, USA

From a wounded hand he threw Not a club but a flaming torch To light the way for Palestine To carry on the fight to win For liberation and for freedom And the world shall sing forever The martyrdom of Yahya Sinwar

Refused to accept the fate of slaves Kneeling on their quivering knees Begging oppressors for some mercy Knowing full well there is none So they rose on seventh October As the world will always remember The martyrdom of Yahya Sinwar

He lived the long tale of sorrow The brutal naqba continued From nineteen forty eight Never ceased never stopped He fought till he could no more People saw in a Ghaza corner The martyrdom of Yahya Sinwar From the concentration camp charged Under siege but full of fury Soldiers of Al Aqsa flood Forced the world to look and note In Palestine the holy land Martyrs shed their blood in war The martyrdom of Yahya Sinwar

Weak and bloody and all alone Had not eaten for three days Yet he gathered all his strength In last stand against his foes In a shining glorious moment History written in golden letters The martyrdom of Yahya Sinwar

Fighting with their heads held high Women children and the old Wounded killed or burned alive When the brave Palestinians tell Story of the dead who live For a thousand years and more The martyrdom of Yahya Sinwar







<u>A.P.J. Abdul Kalam STEM-ER Center</u> (Indo-US collaboration)

Message from AMU Director, Prof. Tauheed Ahmad

Indo-US APJ Abdul Kalam STEM Education and Research Center of OSU and AMU Aligarh Muslim University, India

It gives me immense pleasure to write a few words about the release of third edition of An-Nisa e-Magazine 2024. This is a joint venture on the platform of the International Society of Muslim Women in Science (ISMWS) and the Indo-US A.P.J. Abdul kalam STEM center of Education and Research. The motive behind this e-Magazine is to highlight the achievements of successful women in their carrier in the field of science and technology. The global participation of the women in the field of science technology engineering and math (STEM) field is 34 percent and in India it is 46 percent, a little better than global average. However, the women empowerment in the work force is only 14 percent. We have to go long way to balance the gender bias. Although, government is promoting and doing its best to boost the women participation in STEM education. On the occasion of International women's day, every year a theme is announced to promote and encourage the women to come forward and have equal participation. Last year's theme was DigitAll: Innovation and Technology for gender equality. A survey shows the least participation of women in the field of engineering and architect which is only 16.5% and highest in biological sciences at 46%. It is good news that India is among the top producers of the scientists and engineers globally, with STEM witnessing substantial growth in recent years. The government has initiated several schemes to boost the girl students coming forward and join STEM education like:

Vigyan Jyoti scheme for school girls.

Pragati through the all India Council for Technical Education.

Gender Advancement for Transforming Institution (GATI)

Consolidation of University Research for Innovation and Excellence (CURIE) Women in Engineering, Science and Technology (WEST) scheme Indo-US Fellowship scheme.

We should make a habit to work together with equal partnership to make the future more sustainable. The data from 2015, 16 to onward show that there has been continuous trend of increasing percentage of women in STEM workforce. Let us pray and work for its faster growth.

With best wishes Prof. Tauheed Ahmad



WOMEN IN STEM









INTERNATIONAL WOMEN'S DAY 2024

By Indo-US APJ Abdul Kalam STEM Education and Research Center of OSU and AMU, and International Society of Muslim Women in Science (ISMWS) Hybrid Platform at AMU, March 30, 2024 * Report by Sultana N Nahar, The Ohio State University, USA

The Indo-US APJ Abdul Kalam STEM Education and Research Center (APJAKSTEMERC) of OSU-AMU and International Society of Muslim Women in Science (ISMWS) organized a successful <u>International Women's Day (IWD) symposium</u> on a hybrid platform at the Physics Conference room of Aligarh Muslim University (AMU) with international participants from eight countries on March 30, 2024. In-peson participants were largely from AMU in India. Other participants joined from Cairo University in Egypt, Central University of Kashmir in India, Ingham Institute of Applied Medical Research in Australia, Islamic University of Gaza in Palestine, King Abdul Aziz University in Saudi Arabia, King Fahd University of Petroleum and Mineral in Saudi Arabia, New York University Abu Dhabi in United Arab Emirates, NIT-Srinagar in India, The Ohio State University in the USA, Universiti of Putra Malaysia in Malaysia, University of Karachi in Pakistan, University of Kashmir in India.

Starting with telawat from the Quran, all co-directors read their welcoming messages along with highlighting contributions of women in STEM and what the STEM Center has been doing to promote women to science. The event was presided by Chief Guest Vice Chancellor Prof. Nilofer Khan of Unversity of Kashmir. Guests of Honor Principal Pro. Saheen of AMU Polytechnique Institute, Prof. Subuhi Khan of AMU Mathematics, Prof. Syed Jabin of AMU Physics, Principle Ms. Maleka of AMU Girls High School, and Co-Director Prof. Sultana Nahar made presentations on experiences, perspectives of women in STEM, current research interest and objectives of women in STEM. There were a number of international invited speakers who made online presentations. Current devastating status of women in Gaza under Israeli genocide was specially addressed. Following the event tradition, participants were given time for comments and a number of women were recognized. There was an art competition on the theme of STEM participated by high school female students. Winner was Aakifah Hasan, but all participants received cash prizes sponsored by Prof. Pradhan.

Seventeen women were recognized through nominations for contributions in STEM education and research under categories i) Pioneer woman for considerable contributions, ii) successful in professional contributions, iii) Rising Star for students with high prospective to be successful scientists. They are:

- Aalia Hasan, "Rising Star", Aligarh Muslim University, India
- Afifa Jamal, "Rising Star", Aligarh Muslim University, India
- Farah Naz, "Rising Star", Aligarh Muslim University, India

*Introduced by Sultana Nahar, the STEM Center and ISMWS together have been holding the annual IWD symposium at AMU since 2014

--<u>Lana Alabbasi, "Rising Star", King Abdulaziz University, Saudi Arabia,</u>

<u>-Mahbuba Aktary, "Rising Star", King Fahd University of Petroleum and Minerals,</u> Saudi Arabia

-Mehnaj Parween, "Rising Star", Aligarh Muslim University, India

- <u>Midhat Shafi</u>, "Rising Star",Aligarh Muslim University, India
- Prof. Nilofer Khan, "Pioneer Woman", Vice Chancellor of University of Kashmir, India
- Prof. Norazian M Adjahan, "Pioneer Woman", Universiti of Putra, Malaysia
- <u>Prof. Ola Hassouneh</u>, "Inspiring Woman", University of Jordan, Jordan,
- Dr. Safa Yousef, "Inspiring Woman", Cairo University, Egypt
- Prof. Shabana Urooj, "Pioneer Woman", Princess Norah University, Saudi Arabia
- <u>Dr. Shadma Fatima</u>, "Inspiring Woman", Ingham Institute of Applied Medical Research, Australia
- Prof. Sultana N Nahar, "Pioneer Woman", The Ohio State University, USA
- <u>Dr. Zeba Qadri</u>, "Inspiring Woman", New York University Abu Dhabi, UAE
- Zeenat Khatoon, "Rising Star", Aligarh Muslim University, India

Some pictures of the event are given below:









Figure 1: Left: T: IWD 2024 symposium in hybrid platform,M: in-person session was held at AMU, B: Sample of STEM arts by students, Right: AMU Director Prof. Tauheed isgiving awelcoming speec**h**



The Gems of Scientific Innovations

Fatima Khan B.Sc. Hons, Biochemistry Aligarh Muslim University Aligarh

Every silence carries within it a narrative yet to unfold,

honouring the women, whose keen intellects influenced the world.

With armour–like courage; female scientists stood resolute.

Eager to implement knowledge and skills, creating a scientific outlook for generations to come.

From astrophysics to neurology's flight,

Their inputs glimmer, a symphony of light.

In laboratories, their sharp minds lit up like stars, With endeavour, extending beyond life's confines.

Their calm determination and foresight for success, Makes every discovery a murmur that breaks the

darkness,

From initial developments to advancements in science

Either the ocean's depths or the sky's height, Within a span of time, women emerged as a guiding light.

In the realm of science, for each discovery, Women's voice and role will always ascend, A tapestry of heritage creating a route to education, Their aspirations in every vast field resemble diamonds,

Sisters in science, challenge every limit,

the women who research every aspect,

to understand the intrinsic details of every phenomenon.

In the narrative written by hands yet strong, they are the pulses of progress.

The sparks that remind, that wisdom is the ultimate strength, and in unity, we belong.

In fields where the biological phenomenon and the algorithms meld,

With hard work as a compass, determination held, Women of science, bold pioneers they be,

Charting the currents of possibility.

Here's to the women, forever we'll cheer,

For in every discovery, their essence is found,

in the language of science, their brilliance resounds.





LOST DREAMS

Dr. M.Jahanara Momin Assistant Prof. of Zoology Dr. Abdul Haq Urdu University, Kurnool, India

** Lost Dreams**

That broken roof is mine, as a bunch of flowers we lived there(GAZA) sharing laughter, Now a mere pile of broken bricks. Iron columns pierce the rumble of dilapidated house, blanket of fog clouds everything. Hours pass by, new layer of dust rises again.

The richest empire of the world With its mouth wide open, wrecked our shelter, Now a sac of rubbish. Wonder where my little window with toys has gone! My ears filled with songs of Mom's love, echo bomb blasts every now and then .

Dear Dad's long legs that swiftly pedal our bicycle, Lost the right leg to rain of bullets on the way.

> A foul smell crawls into stomach, whopping my bowel loops all over. Unknown enemy, for unknown reasons,

celebrates massacres, and we flee to hide in tunnels. Miss you dear motherland!

My first touch of earth, My first cry of life for breath, Who stole them?! Wiping away love, Painting black hatred? Soil,cloud and water set ablaze, and then, plans for Journey to Mars! Amazed, I count planets from my geography lesson. Alas! my school was bombed an year ago! War the big monster gulped our childhood. Shattered dreams scattered all around.





Indo-US STEM Educationa dn Research Center of OSU-AMU



When your faith shakes

Dr. Mehroosh Fatema, Ph.D. Physics, Aligarh Muslim University, Aligarh India

By, Mehroosh Fatema, Ph.D. Physics, Aligarh Muslim University, Aligarh

When doubt creeps in, and your faith shakes, When all dreams appear fanatical, Your determination breaks.

> The more you try to conquer, The more conquered you are, Despite Patience, Perseverance, hope, Your dreams appear so far.

These negative emotions drown you, To the deepest depths of despair, But remember, "No shoulder is ever burdened beyond it can bear"

> So keep working like hell, Till you defeat yourself, Set a target, make up your mind, Each one of you is special, It's time to get unwind.





The uncanny similarity..

By MEHNAZ PARWEEN M.Sc. 1st Year IIT-Bombay, Bombay India

My eyes get filled when I look at these leaves

The wrinkles on their faces show torment and Grieves.

Alike groans arise , similar pain is felt By a heart when it breaks and a leaf when it cleaves

I wonder u could feel, I wish you could see The close affinity between them and me. My heart got stopped, their vains got stiff When I let you go and they left the tree. It's been long , it's been a while The pain we got has now become a pile. I still long for you,they still look for the tree They yearn for the flowers and I for your smile.

We thought that the agony shall pass too But the wound got deeper as it grew. They are dispersed, I am shattered They long for the tree and I for you.



A poem redefined



Adiba Ph.D. Physics student, Aligarh Muslim University, Aligarh, India

And because I am not some poem, perfectly strung, defined. It is okay to be different: not all can fit in a line. And the way it makes sense togetherword and word and all those rhymes, It does not need to be outlined, outshined. I am not some finished poem, etched on the canvas of time. It is okay if the ink is smeared; it is okay if there are a few extra lines. Wait on it let it disappear: the glorification, the escape, the running away all this time. Wait on it until it's calm: the storm, the rain. this undoing of mine. On the shore, until it is fine. Until I am a poem, redefined.

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STEM education and research in

Palestine



Sultana N. Nahar

Dept of Astronomy, The Ohio State University, Columbus, OH 43210, USA

My connection with STEM education and research in Gaza, Palestine started in 2015. I wrote a news article on them in APS (American Physical Society) newsletter in 2017. It reported the flourishing research and devotion beating the suppressing condition and limited resources. However, in December 2023 An-Nisa I reported about the set-backs in STEM programs caused by the Israeli genocide. After a year, in December 2024 the horrible genocide continues killing Palestinians where about 13 thousands are only ystudents, too many teachers and faculty members, and destroying all research labs, libraries, and universities by Israeli bombs.

Palestinians are a nation of pioneering courage, steadfastness, tolerance, and inspiration. Even with their most downgraded inhuman conditions, they don't curse, file law-suits for extortion of money, make sharp remarks insulting the sentiment, do not make selfish demands. The other novel quality they have is the passion for seeking knowledge, explore creative ideas. I will give a few examples of Palestinians to demonstrate their resilience..

RESEARCHER

I will quote a few statements of a person whom I will call Researcher to avoid the risk of target killing. In an extreme inhuman condition of crowded tent and with a traumatic mind by deaths around including over 50 from the Researcher's families by heavy bombings, the Researcher sought to respite some by engaging mind in scientific research and admirably made advance fast. I was not able to cope with the progress the Researcher made due to my other commitments. Gaza is just a land of destruction. Managing research, Researcher made statements some of which are given below:

" ... the laptop is not charged and all the time I am looking and thinking about a place to charge the laptop, so returning to our original In addition, I woke up to the news that my co-worker was killed as a result of an air strike on her and her family, so I cannot speak a word now. I apologize to you, Professor. Because we live in a despicable world...a world that deserves from God the most severe types of torment...because it stands by and watches our suffering and does not lift a finger. We sleep under bombing and wake up to painful news of the killing of our friends... We live in a waterfall of blood,"

"I am tired and I cannot bear any more. I cannot hear anyone and I cannot think of anything. I feel hopeless and I feel extreme fatigue taking over myself. I feel restrictions imprisoning my thoughts and ambition. There is no hope and no benefit to my existence in life. I want to return to northern Gaza through the Netsarim checkpoint. If the army fires bullets, I will be a martyr before God, better than the life we live, and this is what I am thinking...because our life and its absence are the same. A life without pride and dignity is not considered a life that is tired, and by God, by God, it is tire"

"When the soul can no longer bear the weight of pain, and the heart is burdened with what cannot be spoken, writing to friends like you becomes a relief for my suffering. I write because in words, there is refuge, and in letters, a solace for a wound that does not heal. I write when the eyes can no longer cry, and words erupt from the volcano of pain. Connecting with you is the thread of light I follow in the darkness of sorrow; it is the lifeboat in a sea of turbulent waves and pain, hoping to find in you what eases the burden of suffering or pours a touch of tranquility over my wounds. I apologize for disturbing you."

"Please do not write that I am suffering from psychological shock. I am fine, thank God, but I do not have the circumstances that enable me to search because there is no electrical source to charge the laptop and I am not in my home. I am displaced due to the war."

I do intend to go back to Researcher's project.

TENT CLASS FOR GIRLS

Dr. Salem Abumusleh, a physicist, high school teacher and coordinator for Astrophysics Program of the Ministry of Education in Gaza, has introduced Hope and Inspiration Intuitive, Activity for the female students in tents where they learn the vast realm of stars and galaxies, and draw pictures of the sky to relax and take the minds away from the trauma of genocide.



Figure 1: Palestinians female students draw the sky for relaxation



Figure 1: Astronomy class for tent female student

ONLINE CLASSES OF ISLAMIC UNIVERSITY OF GAZA

Israel started bombing IUG in October 2023.The faculty member who build a lab for cancer research in cancer cell watched with deep pain how his yearrs of of effort and devotion to carry on the research jut got vanished in moments. then he wrote he was going to build it up again after the war and that I should help in it. Israeli soldiers kep part of f IU to live theirwhile carrying out operations of destructions in the area. When they were done, they were happyly destroyed this rest of the structures with bobms and posted video of happiness at thecomplete demoliktion of the buildings. So there is nothing left for IUG members to continue on campus. However, their passion did not stop the education. For the 2024 sessions, IUG engaged students to take online classes . Students with laptops and source to charge the laoptops signed up. Classes are going on..



Picture (above): A female student is accepting her award at the Recognition ceremony at Islamic University in Gaza where best students and faculty members in STEM disciplines are awarded for their academic excellence and research.

Recent research carried out by Palestinian Scientists

1.Prof. Suleiman M. Baraka

Al Aqsa University, Gaza (currently at NASA-USA and Calgary, Canada) Below are his recent important research findings published in a series of 3 papers

i) Modeling the Sun-Earth-Moon plasma environment: I- Particle-In-Cell Simulations of the Magnetopause during Active Solar Conditions

Context:

Understanding the plasma environment of the Sun-Earth-Moon system is vital for assessing space weather impacts on the Lunar surface and unlocking the mysteries of the Moon's water cycle. This series of papers investigates the transport of solar wind and Earth's ionospheric ions to the Moon and the charging of its surface by the plasma sheet, in the full moon phase as a reference.

Significance:

Paper 1 marks a major milestone by presenting the first-ever simulation to include the Earth and Moon in the same simulation box. This innovative approach provides unprecedented insight into ion dynamics and velocities before and after reaching the Lunar surface while also revealing the distinct presence, size, and shape of key features such as the bow shock, foreshock, and magnetopause along the Sun-Earth line (Figure on the right).



Figure (left): A 2D X-Z slice of the simulation box illustrates the presence of a foreshock (left arrow), a bow shock (middle arrow), and the magnetopause along the Sun-Earth line - the linear plot on top is shown for clarity and reference.

ii) Modeling the Sun-Earth-Moon plasma environment: II – Tracking Escaped Cold Ionospheric H+ & O+

Context:

Understanding plasma transport from Earth to the Moon is essential to determine how space weather affects the Lunar surface. The objective is to characterize and track Earth's cold ionospheric ions, understand their influence on magnetospheric dynamics, and assess their impact on the Lunar surface.

Significance:

In Paper II, for the first time, we have coupled Earth's magnetosphere and ionosphere with the Moon in a single simulation box. This provides an transformative framework to



Figure (Left): Ionospheric H⁺ and O⁺ ion energies overlaid on XZ (left) and XY (right) plane magnetosphere contours confined to the polar caps and dayside cusps show that thermal velocities don't drive ion escape. Despite no initial acceleration, ions reach ± 15 R_e with average energies of 2.9 keV (H⁺) and 3.5 keV (O⁺).

study the transport of O⁺ and H⁺ ions from Earth to the Moon, which could contribute to additional water formation and influence volatile cycles in the Lunar environment.

iii) Modeling the Sun-Earth-Moon plasma environment: III – Kinetic Simulations of Plasma Sheet Interaction with Lunar Surface

Context:

Plasma-lunar surface interactions are vital for understanding lunar exploration and water formation. While the Moon spends 27% of its orbit in Earth's magnetotail, it was unclear if this shields the surface from solar wind and impacts H₂O generation.



Figure (above): Ion and electron build-up shows the process generates non-gyrotropic plasma at the lunar surface, disrupting quasi-neutrality. This leads to charge separation —positive on the day side and negative on the night side—inducing an electric field

Significance:

The results in Paper III shows the magnetotail does not shield the Moon, allowing plasma to impact the surface, enabling wake formation, ion acceleration, and surface charging. The Moon generates electric fields from plasma interaction and

Significance: photoionization and backstreams about 10% of the plasma.



Figure (above): The solar wind distribution, having Earth and the Moon in the same simulation box, is based on results from Paper I. Ion escapes from Earth's ionosphere into the magnetosphere and beyond are used from Paper II results. Lunar surface charges and lunar wake dynamics are from the findings in Paper III.

2. Dr. Hala Jarallah El- Khozondar Distinguished Professor, Fellow: TWAS-UNESCO, IAS Electrical Engineering and Smart Systems Departments Islamic University of Gaza, P.O.Box 108 Gaza, Palestine



M.S. and Ph.D. New Mexico State University, USA Post-doc and collaboration: Max Planck Institute, Germany

Her research covers a broad spectrum and is aimed at developing technical solutions for the world of tomorrow. For example, she is working on innovative solar system problems, developing optical fibres for faster data transmission, and on optical sensors for more precise diagnosis of diseases. Moreover, she has made major contributions to studying wireless communication, optical communication, nonlinear optics, optical fibre sensors, magneto-optical isolators, optical filters, MTMs devices, biophysics, electro-optical waveguides, and numerical simulation of microstructural evolution of polycrystalline materials.

3. Prof. Sufiyan Tayeh Islamic University in Gaza, Palestine President (killed with his family by Israel in 2023)

He was recognised among the top 2 percent of researchers globally in a study conducted by Elsevier and Stanford University.



Tayeh earned his bachelor's, master's and PhD degrees in physics from the Islamic University. He was the head of that university's physics department from 2008 to 2011, and was appointed president of the university in August 2023. His research had earned him international recognition: Tayeh was winner of the Palestine Islamic Bank Award for Scientific Research for the years 2019 and 2020, recipient of the Abdul Hameed Shoman Award for Young Arab Scientists and the Islamic University Award for Scientific Research for the year 2021. He had recently been appointed the UNESCO Chair for Physical, Astrophysical and Space Sciences in Palestine. Tayeh's research interests included optical waveguides, optical waveguide sensing, ellipsometry, dye-sensitized solar cells, and OLEDs.

• The Indo-US STEM Center plans for STEM teaching and research training for Palestinian students and researchers.





Sir Syed (founder of AMU) Mosque of Aligarh Muslim University. The Indo-US STEM Education and Research Center of the Ohio State University in the USA and Aligarh Muslim University(AMU) in India, founded in 2013, is located at AMU.

Empowering Education through AI: My Journey in STEM Nimra Idris Siddiqui Oak-Hill Collaborative Youngstown, Ohio, USA

Empowering Education through AI: My Journey in STEM

By Nimra Idris Siddiqui | https://www.linkedin.com/in/nimraidris/

Born and raised in India, I've always been fascinated by technology and its potential to solve real-world problems. After earning a bachelor's degree in engineering from Aligarh Muslim University, I pursued a Master's degree in computer science at Youngstown State University, USA. This is where my passion for artificial intelligence (AI) truly took off.



During my graduate studies, I designed an AI-powered

tutoring system that helps students evaluate their coding projects. The AI tutor provides real-time feedback, identifies errors, and suggests improvements, making learning more accessible and effective. This innovative work earned me the prestigious *Diversity of Scholarship* award, recognizing my efforts to blend AI with education.

Now, as a Software Engineer, I'm focused on developing scalable AI solutions that drive innovation across industries. From machine learning and natural language processing to cloud-based deployments, I'm constantly exploring ways to harness AI's potential. Beyond my technical role, I'm passionate about promoting diversity in STEM and inspiring the next generation of innovators.

Looking ahead, I am also excited about exploring new opportunities where I can apply my expertise, continue learning, and drive meaningful innovation.







Ohio State astronomy researcher unveils the sun's secrets with OSC support

Sultana Nahar at Goddard-NASA, Greenbelt, USA

Source provided: Sultana N. Nahar Dept of Astronomy, The Ohio State University, Columbus, Ohio, USA

The article is adapted from the press release of Ohio supercomputer Center (OSC) as titled above on October 17, 2024. It presents the summary report in layman's language on years of research to understand the Sun published in 2024.

The Sun is our star, a very hot and thick ball of plasma. A gaseous medium of charged particles. The Sun is the source of energy for survival for us. It also makes our earth beautiful - blue sky during the day, red horizon in the morning and evening, brings seasons. The Sun is the standard to study other stars in the galaxy. 98 percent of the stars will go through the same life cycle as the Sun. Other stars are calibrated using the information of the Sun. So if an information has some uncertainty, it will introduce a cycle of uncertainties in predicting information of other stars. Hence accurate information on the Sun is required. We have been studying the Sun for a very long time, Yet we don't have most of its information accurately. The accuracy depends on the underlying science of its elements or atomic and molecular species. This has been the the long term investigation for Sultana Nahar.

Sultana Nahar reveals new details about the sun's opacity and iron processes, advancing understanding of solar physics and its potential impact on technological and medical advancements Everything in the universe follows a life cycle—humans, plants, planets and even the sun, which has an estimated lifespan of another six to seven billion years before using all its hydrogen fuel. Sultana Nahar, a senior research professor in the Department of Astronomy at The Ohio State University, has dedicated decades to the study of the sun's composition and evolution, with significant support from the Ohio Supercomputer Center (OSC).

"I started working with OSC because these initiatives are largely computational and need high performance, powerful computers," Nahar said.

Among her primary research endeavors are the <u>Opacity</u> and <u>Iron Projects</u>, which require accurate atomic data.

Nahar, Professor Anil Pradham and their colleagues study a fundamental quality of the sun called the opacity of the plasma. It determines how much radiation is absorbed by the plasma particles and also determines the sun's elemental abundances, which are crucial to the study of astronomical objects. Elemental abundances tell researchers what elements exist in a star and what their abundances are relative to hydrogen, which is the most abundant element in the universe. This information helps Nahar and her team learn about the sun's chemical evolution and its physical conditions.

The sun has three regions: the core, the radiative zone and the convective zone. The core, where nuclear fusion occurs, powers the sun's heat and light. Surrounding the core, the radiative zone transmits energy outward as radiation. The convective zone, the outermost layer of the sun's interior, is where expanding hot plasma transports energy toward the sun's surface. As the plasma moves away from the core, it cools, eventually reaching around 5,700 degrees Celsius (10,290 F) at the top of the convection zone.

Iron's abundance is crucial in determining a star's opacity of the plasma, due to its high capacity for radiation absorption.

"Inside the sun, there is a large amount of iron," Nahar explains. Most stars and astronomical objects display iron lines, which are created in stars and supernova explosions.

Initially, the international Opacity Project, which is dedicated project to provide accurate information for astronomical objects, included iron in its studies, but lacked important physics information about it. The calculated opacity of the Sun could not provide observed phenomena precisely. The complexity in studying iron warranted dedicated research, leading to the formation of the Iron Project. There are three iron ions: Fe XVII, Fe XVIII and Fe XIX, which have been the focus of this project.

Nahar and her team have studied two main atomic processes known as photoexcitation and photoionization, each determining opacity. Iron goes through both processes via absorbing radiation by its electrons and these cause opacity.

Initially, the data did not match the expected observations until OSC's resources were utilized. "We knew something was wrong somewhere in the model but needed more computational power," Nahar explained.

Figure 1. L: Updated photoionization expectations after use of OSC (red line) compared to previous expectations (black line) show the impact of improved physics models on ability to predict opacity. Photo credit: Professor Sultana Nahar.



The findings since utilizing OSC for the Iron Project have been substantial. With OSC's support, Nahar and her team have conducted the most comprehensive study of photoionization processes, which are most common in stars, focusing on the most relevant iron ions in the sun. They have also identified several key characteristics of photoionization that were previously unknown, later verified by experiments at ALS-Livermore and BESSY-Germany.

"We have obtained a vast amount of high accuracy and complete sets of atomic data compared to

tcurrently available data for these processes by carrying out the largest R-matrix calculations not possible before using the high performance computers of OSC," Nahar said. "These computations revealed new physics of characteristic features not realized before."

In addition, researchers have established foundational physics for opacity calculations, detailed in a series of four papers published in the Journal of Physics in 2024, which the astronomy community has highly praised. All atomic data are available in Nahar's database, NORAD-Atomic-Data at Ohio Sate, and many findings are illustrated in Pradhan and Nahar's book "Atomic Astrophysics and Spectroscopy" (Cambridge University Press, 2011).

"OSC has had to make special arrangements for us because we are using so many computational resources," Nahar said. "OSC has helped us not only with resources but also with any technical problems we've encountered."

As technology and OSC's resources advance, Nahar and her team delve deeper into studying the sun. Their discoveries have significant applications not only in space but also here on Earth.

"The research will be invaluable in engineering, nuclear fusion energy devices, and medical facilities for radiation therapy," Nahar said.

Written by Lexi Biasi, OSC





University Hall, The Ohio State University

Capturing the beauty of Nanoscience

Adiba

Ph.D. Student, Dept. of Physics, Aligarh Muslim University, Uttar Pradesh, India



The Blue Rose Figure 1. L: Electron microscopic image of nickel oxide sheets grown on nickel foam



The Unshaken Lady R: Electron microscopic image of reduced graphene oxide

Note: The left image above "The Blue Rose" is the winner of International Nanoartography Competition 2024, Drexel University, USA

Growing up, I was fortunate to have parents who always prioritized my education and nurtured my love for science. Their progressive vision allowed me to pursue research in STEM, challenging the common perception in many Indian households that the arts stream is the best fit for a girl. I feel immensely proud to study at AMU and to pursue physics, a subject that sparked my curiosity the most during high school. Currently, I am working towards my PhD in the Department of Physics at AMU and am soon to become Dr. Adiba. During my PhD journey, the opportunity to carry on my research at the state-of-the-art nanofabrication lab at the serene and beautiful campus of IIT Guwahati made this journey even more enriching and worthwhile.

As a researcher at AMU, my work spans advanced energy storage solutions, such as supercapacitors with high energy density, and flexible memory devices for next-generation wearable electronics, using oxides, chalcogenides, and other emerging materials. Beyond their functionality, these materials often reveal breathtaking beauty. One such discovery came through scanning electron microscopy in my work on nickel oxide sheets grown on nickel foam. When the SEM image is color rendered, these nanosheets revealed clusters that resembled delicate blue roses (as shown in top left fig)—a striking image that recently won the international Nano-Artography contest hosted by Drexel University, USA.

This nano-art piece not only celebrates the intersection of science and aesthetics but also serves as a powerful tool to engage broader audiences, sparking curiosity about the unseen world of materials science. By showcasing the natural artistry hidden within cutting-edge technology, it invites people to appreciate both the challenges and the beauty of scientific discovery. For me, this image is a reminder that science is not just about solving problems, but also about finding unexpected beauty in the pursuit of knowledge.

Supercapacitors: A Key to Sustainable Energy Storage

One of the greatest challenges we face today is how to store and generate energy efficiently. Renewable energy sources like solar and wind are promising, but they are not always available—think of cloudy days or calm nights when the sun is not shining, or the wind is not blowing. To make these energy sources reliable, we need advanced technologies that can store energy when it is abundant and release it when needed.

This is where my research comes in. I focus on developing advanced materials to enhance energy storage systems like batteries. capacitors and which are essential for enabling the transition to a energy sustainable future. Supercapacitors, in particular, are an exciting class of energy storage devices. Unlike traditional batteries, which store chemical energy through reactions. supercapacitors store energy physically or through surface reactions, allowing them to charge and discharge rapidly while maintaining long cycle life. By working on optimizing the physical and chemical properties of nanomaterials, I aim to create energy storage solutions that are not only efficient but also scalable for real-world applications. These advancements have the potential to power everything from renewable energy grids to portable electronics, ensuring that clean energy can be utilized effectively across various sectors. The structures I develop, such as the NiO nanosheets showcased in the image, play a pivotal role in advancing this technology. Nickel oxide, with its high stability, excellent electrical properties, and compatibility with nanoscale fabrication, is an ideal material for energy applications.

Resistive Switching Memory: The Future of Data Storage

While energy storage tackles the challenge of sustainable power, the rapid growth of data in our digital world brings a different challenge: how to store and access information more efficiently. My research addresses this with a focus on resistive switching memory devices— next-generation data storage technologies set to revolutionize the way we store and access information.

These devices operate on the principle of resistive switching, where the electrical resistance of a material changes in response to an applied voltage. This unique property allows them to store data in a highly efficient and scalable manner, and also retain data even without powermaking it ideal for energy-efficient computing with the potential to replace traditional memory systems like flash memory and Dynamic RAM. Additionally, these devices offer faster data access speeds, higher storage density, and lower power consumption compared to conventional memory systems. This could lead to a new generation of longer-lasting, faster computers, significantly improved smartphones, and wearable electronics capable of handling increasingly complex tasks, all while reducing energy consumption and improving overall system performance.

Through translational research, I aim to contribute to the development of these groundbreaking devices, bridging the gap between fundamental materials science and practical applications that can transform modern computing, drive innovation & research, and shape the future of digital technologies.

Bridging the Gap Between Science and Society

I hope my work helps to bridge the gap between the scientific community and the broader public. Often, the complexities of science can seem distant or difficult to understand, but images like this show that science can also inspire wonder and connection to nature.

Ultimately, the work I do has far-reaching implications—for advancing renewable energy and neuromorphic computing. At its core, my work is about creating solutions for a greener, more sustainable world, where energy can be harnessed more efficiently and data storage is energy and time-efficient. And along the way, it's also a reminder that beauty lies in the small, the unseen, and the everyday materials that power our future.



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The Power of Physics

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As a young child with lots of time and endless curiosity, I found myself questioning everything around me. As I grew older, I could find some answers to a few of my questions: this fascination pushed me to pursue higher education in Physics.

Physics is a powerful knowledge that governs our universe. Just as the universe is endless, the study and exploration of physics are endless, too.

The Big Bang Theory, which explains the advent of our universe, the motion of our planets and stars, the stability that we have on this planet, the efficiency of transport systems, nanotechnology, supercomputers – if anything our existence – all are governed by the Laws of Physics.

What I love most about Physics is how it bridges gaps between fields. It is the thread that connects science, technology, engineering, and math – space, satellites, telescope, renewable energy solutions, medical equipments, robotics, nanotechnology – Physics is at the heart of it. Today, the lines between disciplines are blurring, opening up exciting opportunities for collaboration and innovation: this is a golden period to be in.

As a Master of Science in Physics graduate trying to step into the research field by aspiring to pursue a PhD next, this phase of my life is as exciting as it is nervewracking. I am grateful for the opportunities, hard work, and resources that have shaped and empowered me to be here. While I am grateful, I am also conscious of my responsibility as a Muslim to be the best that I can be while also being a source of goodness for others. I am very thankful to Dr Sultana Nahar Ma'am, for building an incredible society for Muslim women. Ma'am, you truly are an inspiration!





DiscoverSTEM: Nurturing Young Innovators

Dr. Hashima Hasan NASA Headquarters, Washington DC, USA

In 2016, I received an invitation from aerospace engineer, Mirza Faizan, to visit Dallas, TX to give a talk on astronomy to young students . My trip was sponsored by the Islamic Center of Irving, TX. When I reached Dallas, I was pleasantly surprised at the initiative that Faizan had started together with his brother, Mirza Rizwan. They started working with a small group of young students primarily from the Indian American Muslim community to encourage students to go into STEM careers, think innovatively and develop skills to invent new technology. He had invited me to be a role model to the students, particularly to girls. In addition to the astronomy talk I gave to the students and the parents at the Islamic Center, he also arranged a meeting for me with the female students and their mothers.

Every year since then, he invited me to address the students at their annual program, DiscoverSTEM Innovation Day, which I saw drawing sponsors such as the Institute for Medieval and Post Medieval Studies (IMPMS), and recognition by local leaders. In 2018, the event was graced with the presence of dignatories, which included Harry LaRosiliere, the mayor of Plano, and Col. Richard Graham, a decorated colnol of the U.S. Air Force and SR-71 pilot. I presented certificates to students who had won awards at a NASA sponsored innovation competition. The last event I attended in February 2020, just before the Covid lockdown, was held at the University of Texas, Dallas. The students had poster presentations and models of their inventions, some of them so sophisticated that they had received patents from the U.S. Patent Office. I visited again in August 2024, after a pause of 4 years. I was amazed to see that what had started as a dream in a one-room laboratory to breed innovation has grown to a full-fledged institution with classrooms and well-equipped laboratories. It was almost like walking into a Star Trek movie. DiscoverSTEM Research and Innovation lab in Plano-TX has advanced research labs for middle and high school kids which includes AI-ML and Robotics Research Lab, Neurotechnology and Brain-Computer Interface Research Lab, Aerospace Research Lab, Genomics and Biotechnology Research Lab and Energy and Enviroment Research Lab. The centre also proudly displays US patents certificates of over 250 kids. A couple of innovations are even commercialized in startups launched by these kids and seed funded by DiscoverSTEM.

As in 2020, the annual event this year was held at the University of Texas, Dallas. A young innovator Ali Humaid AlLoghani, funded by the UAE, was also present with an award winning innovation at a competition in London. The list of innovations by the DiscoverSTEM students that had received patents had grown, the youngest innovator being a six-year old girl. These young innovators have shown that their minds can fly high and the sky is the limit for them. When Mirza Faizan started this project, he told me that his bold vision was for the students to get patents and for some of them to eventually win a Nobel Prize. They are already well on their path to winning patents – we now have to see them go for the ultimate recognition.



Figure: Dr. Hasan is with the 2024 winners DiscoverSTEM.



COLLAGE; AN-NISA and ISMWS events



An-nisa 2024 editorial session: Adiba and Sultana on the zoom



Adiba communicating with Sultana at An-nisa session 2024



Global teaching and research training by STEM centre of OSU-AMU 2024



Celebration of International Women's Day 2024 at AMU by ISMWS and STEM centre



Mehroosh, Sultana and Neelam at AMU



Sultana and Nimra at OSC

Symposium 2024



Research Experience for Undergraduates (RAU) at the STEM Centre 2024