THE PARTICLE

Issue No. 17 | January – June 2021

SAVING OUR CITIES WITH DATA DRIVEN POLICYMAKING

BREAKTHROUGH IN IN-SILICO BIOLOGY

روشنی، کوانٹم فزکس کے آئینے میں

Syed Babar Ali
School of Science and Engineering

Late March 2020
119 million kms
Mag -4.17
58%

Late April 2020
71 million kms
Mag -4.40
31%

Phases of Venus, as seen from Lahore

These images were captured through a Nikon D5100 camera attached to a 4.5-inch aperture reflecting telescope.

All images were taken between March 28 and May 21, 2020 and were arranged to create a golden spiral, for aesthetic reasons only.

Collage by Roshaan Bukhari

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گُلِ نخُستیں

انسانی تہذیب کی ضرورتیں سائنسی رجحانات کو جنم دیتی ہیں۔ مثلاً قدیم زمانوں میں سفر اور تجارت نے ستارہ شناسی اور علمِ نجوم کی داغ بیل ڈالی۔ اسلام کی فقہی ضروریات نے علمِ ہندسہ، علم ہیئت اور الجبرا جیسے علوم کی راہ ہموار کی۔ آبادی کے پھیلاؤ نے صنعتی پیداوار اور خام مال کی ترسیل اور نقل و حرکت کا التزام پیدا کیا جس کی رُو سے حراریات[1] کا علم پیدا ہوا اور بھاپ کا انجن ایجاد ہوا جس نے انسانی تہذیب کی کایا پلٹ دی۔

بیسویں صدی میں بجلی کی ایجاد، مواصلات اور برقی آلات کے پھیلاؤ اور سفر و حضر کی سہولتوں نے عالمی آبادی کو دیہات کی کُشادہ اور فطرت کے قریب کی زندگی سے دُور کو سمینٹ اور لوہے میں ڈوبے ہوئے شہروں میں منتقل کر دیا۔ اِس مدنیاتی ہجرت نے نئے مسائل کو پیدا کیا۔ آبادی کی گنجانی نے صحت، آمد و رفت، آلائشوں کی اِتلاف، اور سب سے بڑھ کر ماحولیاتی آلودگی جیسے عفریتوں کو اُبھارا۔ سائنس اور حرفت کی کرشمہ سازیوں کو دیکھیں تو اسی زہر میں تریاق بھی چھپا کے رکھا ہے۔ ڈیٹا کے وفور، مصنوعی ذہانت، کمپیوٹر ٹیکنالوجی اور کم خرچ آلات کی دستیابی نے ریاضیاتی نظاموں کے ساتھ مل کر انسانی تہذیب کو شہروں سے وابستہ مسائل کا حل بھی پیش کیا ہے۔

اِسی پسِ منظر کے تحت ہمارے نہایت قابِل ڈاکٹر مومن اُپل کو پاکستان کے اعلیٰ تعلیمی کمیشن نے تمدنی مسائل کے حل تلاش کرنے کے بارے میں ایک خطیر رقم مہیّا کی ہے۔ ڈاکٹر مومن کی کثیر الجہتی ٹیم جس میں عمرانیات، مدنیات، معاشیات، کمپیوٹر ٹیکنالوجی، اور برقی انجینئرنگ کے شعبوں کے ماہرین شامل ہیں، ہماری شہری زندگی سے مخصوص مسائل کے حل کے لیے پُرعزم ہیں۔ مثال کے طور پر ڈاکٹر مومن کی ٹیم یہ دیکھے گی کہ لاہور شہر میں نقل و حمل کی تنظیم کے لیے کون سی راہیں اور کون سے اوقات موزوں ترین ہیں؟ صحت کی سہولتوں کی مساوی تقسیم کیسے ممکن ہو سکے گی؟ انسانی فُضلات کے اتلاف کے لیے کیا نظام درکار ہوگا؟ دی پارٹیکل کے شمارے کا سرِ ورق اور اس میں موجود ایک کہانی اِسی منصوبے کو شرح و بسط کے ساتھ بیان کرتی ہے۔

زیرِ نظر جریدے میں آپ کو کہانیوں، نظموں، تصویروں، اور تحقیقی رُوداد وں کا حسیں گلدستہ نظر آئے گا۔ ان صفحوں میں ہمارے اساتذہ اور طلبہ کی تحقیق کا عرق، ان کی تدریس کا نقشہ اور ان کی سوچ کے بعض پہلو، آپ کے پیش خدمت رہیں گے۔ اسی لیے میں نے اس گلدستے کے اداریے کو "گُلِ نخُستیں" یعنی "بہار میں کھلنے والے پہلے پھول" کا عنوان دیا ہے۔ اس چمن زار کے گلُوں کی باس، امید ہے، دیر تک آپ کے ذہن میں گھومتی رہے گی۔

خیر اندیش

محمد صبیح انور

ڈین اور احمد داؤد چیئر

سید بابر علی اسکول برائے سائنس اور انجینئرنگ، لمز

[1] Thermodynamics

Taking the next giant leap in communication and cybersecurity with

6G & BLOCKCHAIN

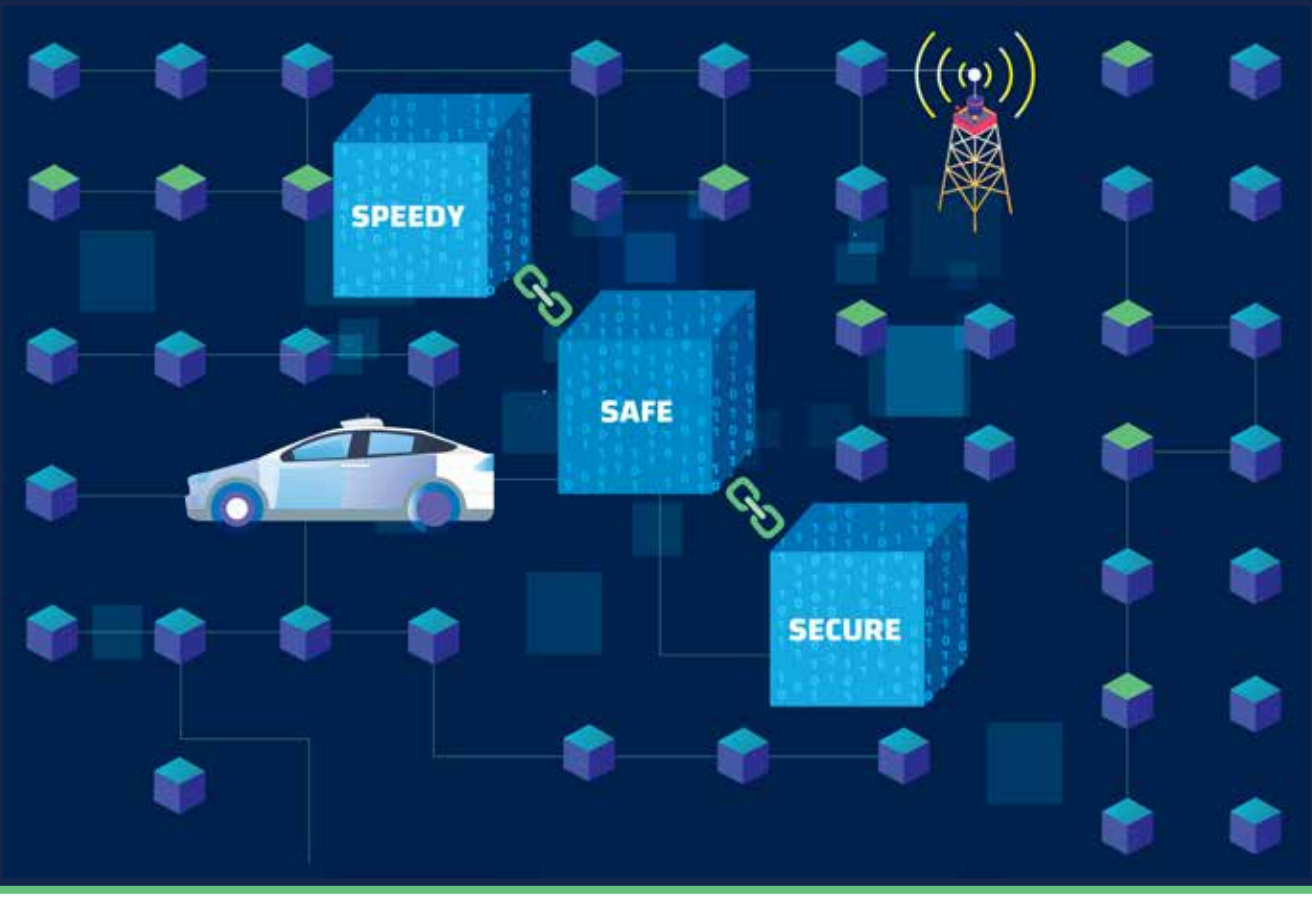
Dr. Naveed Ul Hassan
Ali Hussain Khan

Ali Hussain Khan, under supervision of Dr. Naveed Ul Hassan from the Department of Electrical Engineering, deems 6G infrastructure as the future of secure and ubiquitous commnication – of course, not without blockchain.

According to this study, the vision for 6G is driven by futuristic applications like Human Bond Communication (HBC), Multi-sensory Extended Reality Applications (XR), Wearable Technology Based Futuristic Applications (WTech), Large-scale Connected Autonomous Systems (LS-CAS), and greater support for several vertical domains. These applications have very stringent requirements of data rate, latency and reliability. The nature of data collected by several 6G applications will be increasingly sensitive and critical. The successful adoption of 6G applications by the users would therefore require strict data security guarantees. The stringent network performance requirements of these applications will require support of technologies like Reconfigurable Intelligent Surfaces (RIS), TeraHertz (THz) communication, Artificial Intelligence (AI) and small cell networks. To enable an efficient combination of these technologies for the provision of resources to achieve the performance requirements, collaboration and coordination in a transparent and trustless environment is needed. These technologies also require dense network deployments which will lead to more infrastructure and complicated network deployment. Network decentralisation will be needed to simplify the network deployment. In light of this, 6G requirements can be divided into performance-related and security-related requirements.

Blockchain will provide desired transparency and trustless-ness in the decentralised network. It will also provide strict security requirements of future communication systems because of its in-built security features. Blockchain is a distributed ledger technology where cryptography and hash functions are used to form a chain of data blocks, created when an event occurs and verified in a decentralised way using consensus algorithms.

Automation on blockchain is managed through smart contracts which are computer programmes stored on the blockchain to define the contractual obligations and enable the automatic transfer of assets between peers when the required conditions



are met. Blockchain, initially only used in cryptocurrencies is now being used in other application domains like smart grid, connected vehicles, and Internet of Things.

To achieve the targets related to performance requirements, 6G networks are expected to be extremely dense 3D integrated communication systems. The previously underutilised vertical dimension (height and depth) would also become increasingly congested with the deployments of high altitude platforms (HAPs), low-altitude drones, unmanned aerial vehicles, mega-constellations of low earth orbit satellites, and communication ships and submarines. This would make infrastructure and asset management a challenging task. Additionally, the ownership models along with the use of spectrum, computing power and data storage would also become much more complex in order to fulfil the performance-related needs of 6G applications. AI assisted and trained models would become increasingly common in 6G to solve challenging resource optimisation problems for throughput maximisation, latency minimisation, and energy efficiency maximisation. AI models would also generate and communicate critical signals for several vertical domain applications. Management and security of hard-trained AI models would also become complex in 6G systems.

One of the most prominent features of blockchain is the creation of a trustless network where multiple non-trusting parties can interact with each other without any intermediaries.

Confidence in the blockchain security features enables decentralised entities in the network to make automated transactions on the network with the help of smart contracts. Consensus algorithms and protocols further allow multiple distributed nodes on blockchain to achieve the same global view of the transactions taking place on the entire network. Integration of blockchain in 6G would therefore provide elegant solutions for resource and AI model parameter management.

With respect to security-related requirements, integration of blockchain in 6G would not only help but also control these targets. Through the appropriate selection of network, consensus, and automation management algorithms, blockchain can provide the desired levels of data integrity, non-repudiation and auditability.

Blockchain allows asymmetric Public Key Infrastructure (PKI) based cryptography and the inclusion of privacy preservation frameworks for greater data privacy and confidentiality. Blockchain accepts new

blocks only after verification through a consensus mechanism among multiple peer-to-peer (P2P) nodes. Every block is linked to its parent block (previous block in the chain) by a cryptographic hash function. This allows auditability and makes it possible to verify data all the way back to the genesis block. Data integrity in any block can be easily verified simply by checking the hash-trees.

Moreover, as the blockchain size increases, data tampering becomes even more difficult because of the linkage between all the chained blocks. Due to these properties, blockchain is different and superior in many ways to traditional security solutions, and a good candidate for security-related requirements in 6G applications.

Commenting on his work, Ali Hussain Khan says:

"We will demonstrate that combining blockchain and 4G or blockchain and 5G cannot achieve the same level of synergy that we can obtain with blockchain and 6G. Our scenario consists of vehicles, drones and RSUs to incorporate all three dimensions in the system. We consider a data-sharing scenario between vehicles. The data within is considered valid after achieving consensus among the mining nodes after which the data-sharing record is uploaded to the blockchain."

Khan also mentioned that his team derived the time required for one complete cycle of data-sharing and consensus by deriving relevant expressions based on data sizes and data rates. MATLAB was the primary tool used for all the simulations in this work. They also derived the response of a reputation calculation algorithm based on a pre-defined behaviour and calculated the time required for malicious miner detection based on that. His team had observed that for all practical purposes, 6G performed better than both 5G and 4G. These simulation results are very promising and suggest the use of more secure blockchain implementations in 6G are possible as both complement each other.

Dr. Naveed Ul Hassan received his B.E. degree in avionics engineering from the College of Aeronautical Engineering (CAE), Risalpur, Pakistan, in 2002 and his M.S. and Ph.D. degrees in electrical engineering, with specialization in digital and wireless communications, from the Ecole Superieure d'Electricite (Supelec), Gif-sur-Yvette, France, in 2006 and 2010, respectively. In 2011, he joined as an Assistant Professor at the Department of Electrical Engineering, Lahore University of Management Sciences (LUMS), and serves as the Director of AdCom Lab at SBASSE (https://adcom.lums.edu.pk/)

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To read the complete paper, visit this link:
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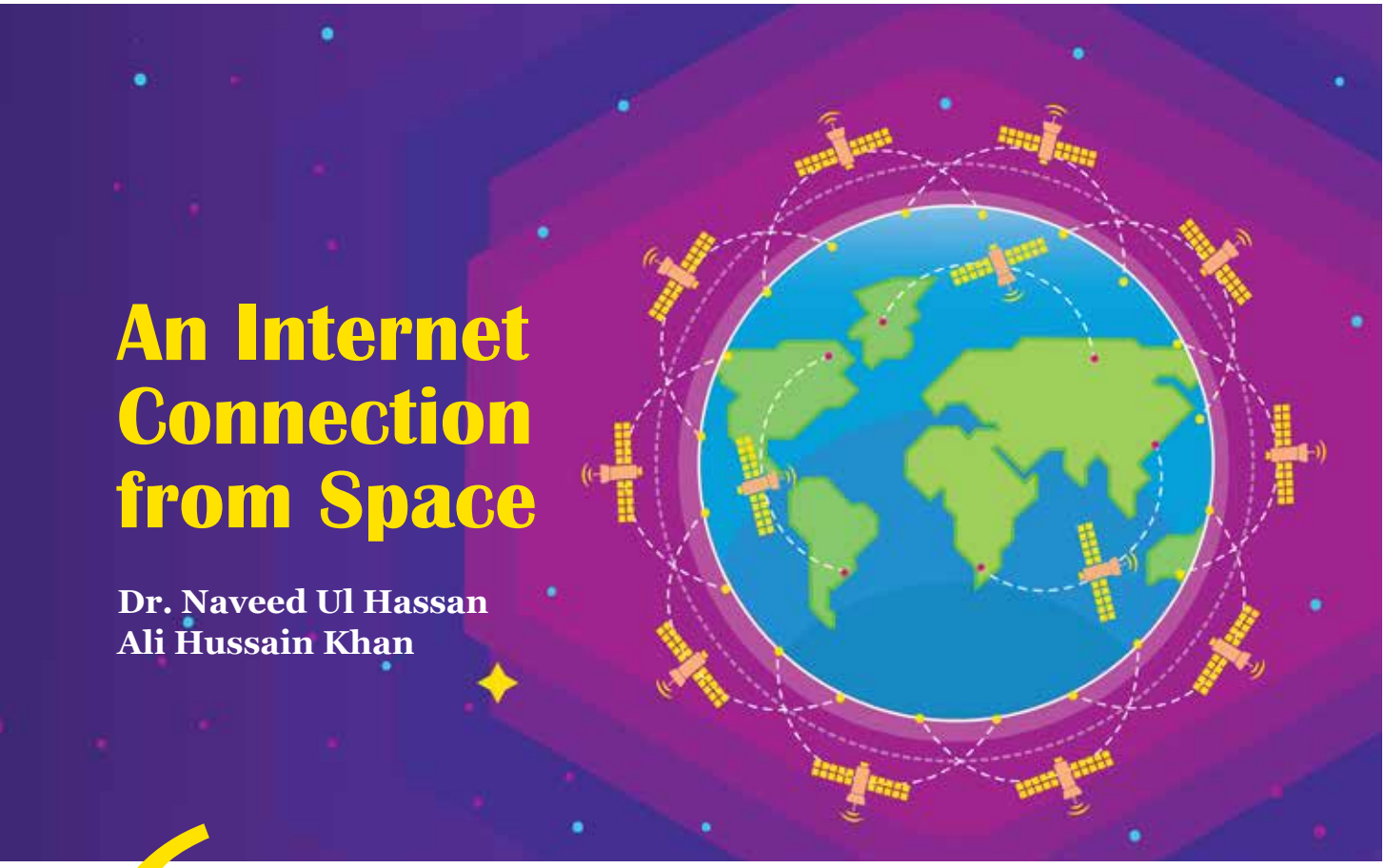


An Internet Connection from Space

Dr. Naveed Ul Hassan
Ali Hussain Khan

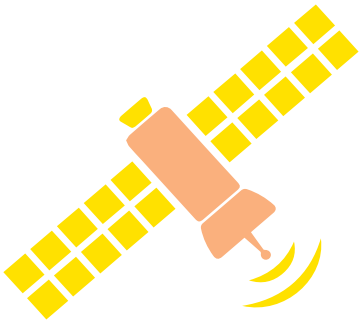
Communication has been at the heart of our survival. We itch to be heard, and to be understood. In modern times, the need to communicate has seen a reincarnation in that it is not only still part of our biological construct but also our civic and technological design altogether.

Add the fact that we can beam electronic signals through waves of energy and that the Earth is round, making it impossible for a beam of precious signals that inherently move in a straight line, to follow the curves path of our world's contours. We needed something better – we needed satellites!

During this research, Dr. Naveed ul Hassan and his co-authors worked out the energy efficiency of a satellite network coupled with ground infrastructure and compared it with the energy efficiencies of Traditional Terrestrial Heterogeneous (TTH) and Long Term Evolution (LTE) networks (in other words – older technology!). For an increasing cell density, it was shown that the satellite-terrestrial network performs better in terms of energy efficiency as compared to the TTH and LTE networks. These results are promising and show that satellite networks can complement terrestrial networks for providing communication resources to the users.

Communication satellites have been in service for a long time. They are used to provide communication services to far off and difficult to reach places. Conventional satellites have been large-sized, expensive, and very difficult to deploy. They are also very far away, which introduces significant lag. With the recent uprise of the Internet of Things (IoT) and wireless networks, the service requirements have changed. High data rates with low latency are required, and the current ground-based infrastructure is already overloaded. This has given rise to the development of Low Earth Orbit (LEO) satellites, which have a lot less lag and better bandwidth availability. These satellites are deployed as Dense Small Satellite Networks (DSSN), across the globe, covering a large fraction of our planet at any given time.

These satellite networks have many advantages in telecommunications. Their most crucial benefit is extending coverage to areas that are otherwise difficult to cover with land infrastructure. They also provide low-latency transmission as compared to satellites in higher orbits. There is an exponential increase in the number of connected devices. Satellites can be deployed alongside ground infrastructure to support a massive number of devices. Satellite networks can provide the data rate and bandwidth requirements in areas where there is a sudden increase in network traffic and the ground infrastructure becomes loaded. Satellite networks also complement GPS systems to provide accurate locations for location-based services and can be used to cache data for reducing latency.



LEO satellites do not have a stationary footprint on the ground. Therefore, to use them in telecommunications, the satellite network infrastructure needs to be carefully planned. Satellites could form a constellation with identical satellites or clusters with non-identical satellites performing different functions. The orbital pattern of the satellites could be set as polar, rosette or hybrid. The inter-satellite communication could be based on radio frequency links, optical wireless communication links or visible light communication links. The satellite to ground contact could be either direct, could utilise a space or ground relay, or could be hybrid to utilise both types of relays.

Some technologies will aid the adoption of satellite networks in communications. Owing to the changing distances and positions between satellites, they should be fitted with intelligent, steerable, and high gain antennas. Multiple access techniques should be utilised for satellite networks where there should be provision to reuse frequency resources. Satellite networks are solar-powered, and their energy consumption characteristics are predictable because of known trajectories. Solar power optimisation can be used to provide the required energy.

To cater flexibility and advancement in network design and operation, satellite systems should be upgradeable to cater for new functionalities to be added remotely without changing the expensive hardware. Satellite network deployment should be optimised for resources such as capacity, power, latency and quality.

Dr. Naveed Ul Hassan received his BE degree in avionics engineering from the College of Aeronautical Engineering (CAE), Risalpur, Pakistan, in 2002 and his MS and Ph.D. degrees in electrical engineering, with specialisation in digital and wireless communications, from the Ecole Superieure d'Electricite (Supelec), Gif-sur-Yvette, France, in 2006 and 2010, respectively. In 2011, he joined the Department of Electrical Engineering, SBASSE as an Assistant Professor and also serves as a Director at the school's AdCom Lab. (https://adcom.lums.edu.pk/)

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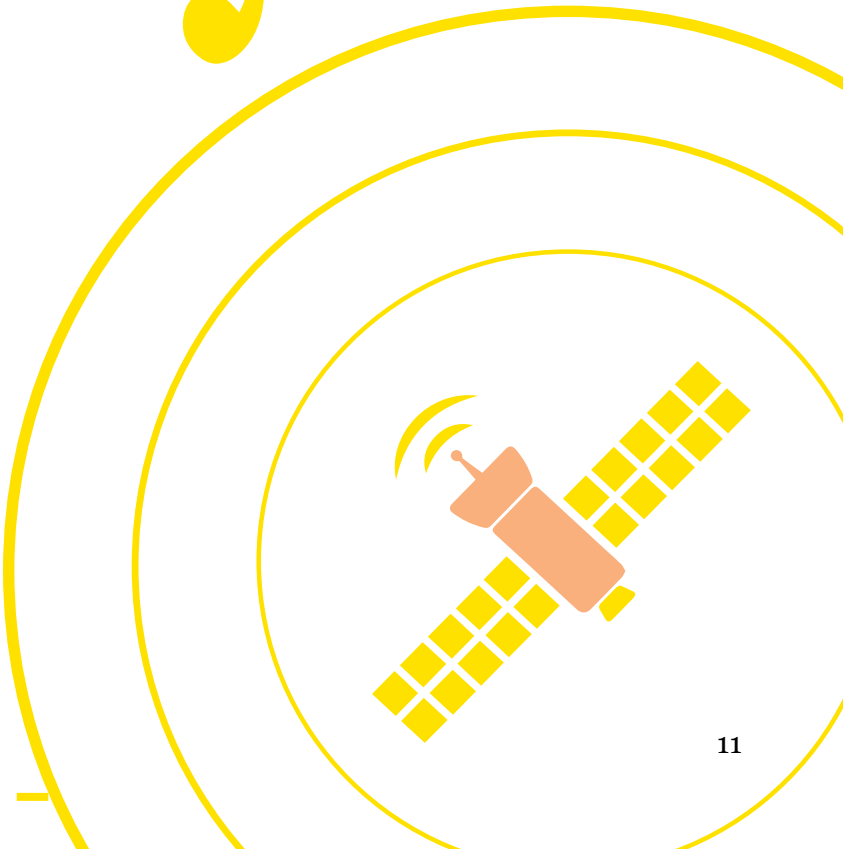
Reference:

N. U. Hassan, C. Huang, C. Yuen, A. Ahmad and Y. Zhang, "Dense Small Satellite Networks for Modern Terrestrial Communication Systems: Benefits, Infrastructure, and Technologies," in *IEEE Wireless Communications,* vol. 27, no. 5, pp. 96-103, October 2020, doi: 10.1109/MWC.001.1900394.



RESEARCH SPOTLIGHT

The Quantum Revolution

Much faster,

much safer,

much better:

this is the future of technology promised by the quantum revolution.

At the intersection of optics, materials science, physics and chemistry, the quantum revolution at SBASSE is focused on shaping the future of communication systems, computation, biosensors and photovoltaic technologies. The work highlighted in this video production is led by Dr. Ata Ulhaq and Dr. Ammar Khan from the Department of Physics, SBASSE.

The quantum revolution team is dedicated to the fundamental research for the development of third generation perovskite solar cells, single photon quantum light emitters and fabrication of devices out of two-dimensional semiconducting materials. They design and build optical systems which integrate lasers, optics, microscopy and spectroscopy into a highly specialised optical set-up. Some of these experiments use laser light to initialise and control qubits; a fundamental unit of quantum computing, with the promise of completely revolutionising computer technology, giving us unbreakable encryption protocols for security applications and incredible computing speeds that hold invaluable potential for the future of research in Pakistan and across the world.

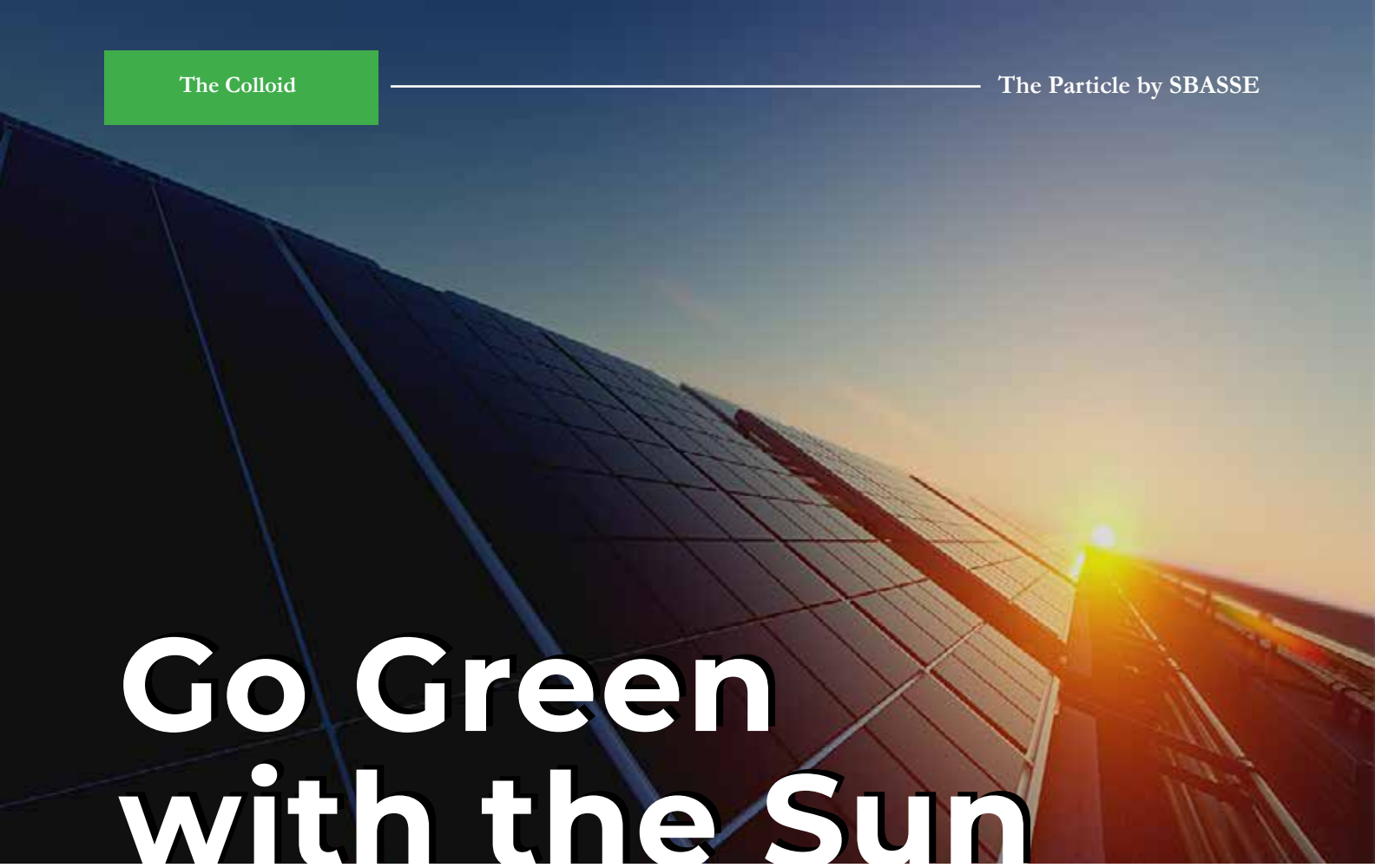
Targeting Disease

In the great melodrama of life on Earth, diseases have played the role of an effective antagonist.

Researchers at SBASSE are busy with developing new ways to fight disease through the fusion of cutting-edge technology, drug discovery and vaccine development. The work highlighted in this video is led by Dr. Rahman Shah Zaib Saleem and Dr. Shahzad ul Hussan.

Treatment of cancer, a disease that is one of the leading contributors to mortality, is often complicated by the development of multidrug resistance in the patient. The Drug Discovery Labs at SBASSE aims to develop drugs of the future that can target specific cellular pathways critical for the development and progression of cancer and at the same time help overcome multidrug resistance.

The focus of the Biochemistry and Structural Biology Research Group, led by Dr. Shahzad ul Hussan is to discover potential antiviral drugs, create knowledge that can guide to develop successful vaccines and understand the details of viral infections at an atomic-level to help in devising better strategies to combat them. For achieving these goals, research teams at SBASSE are working on four different, globally and locally prevalent viruses including HIV, Hepatitis C virus (HCV), dengue virus and SARS-CoV-2.



Go Green with the Sun

Researchers at SBASSE envision to empower the lives of more than 56 million Pakistanis

by providing them with access to cheap electricity. Dr. Hassan Abbas Khan and Dr. Ammar Ahmed Khan, along with their team of researchers and technicians have been busy developing the next generation of solar cell technology, called perovskites, that offer not only a simpler, cheaper manufacturing process but a substantially cheaper alternate to their current silicon-based technology counterpart.

To test out this technology, SBASSE's Department of Electrical Engineering has initiated pilot deployments in parts of Sindh with the help of an industry partner. We look forward to inviting further investors and partners to collaborate with our team and invest in their research to develop this promising new technology that has great potential in additional developing regions like Bangladesh, India and sub-Saharan Africa, empowering the lives of up to 1 billion people!

Written by **Roshaan Bukhari**

برق رفتار!

پاکستان کی شاہراہوں پر برقی گاڑیوں کے چارجنگ اسٹیشنز کی تیاری

پاکستان میں ایک منظر اکثر دیکھا جاتا ہے کہ کسی ویران سڑک پہ دو تین لوگ گاڑی کو دھکا لگا کے پٹرول سٹیشن تک لے جا رہے ہوتے ہیں۔ عمومی طور پہ ایسا پٹرول اسٹیشن کے دور ہونے کی وجہ سے ہوتا ہے۔ تاہم غور طلب بات یہ ہے کہ بظاہر بے ضرر نظر آنے والا یہ منظر کسی بھی ناخوشگوار واقعہ کا پیش خیمہ بن سکتا ہے۔ برقی توانائی کے حالیہ افراط سے وطنِ عزیز میں جہاں بجلی سے چلنے والی گاڑیوں کی آمد کی بازگشت ہے، وہیں یہ تشویش بھی پائی جاتی ہے کہ ان گاڑیوں کے چارجنگ اسٹیشن کہاں لگائے جائیں گے؟

لمز میں ڈاکٹر نوید ارشد اور انکی ٹیم نے اس تشویش کو بروقت زیرِ غور لانے کے بعد اپنی ٹیم کو ٹریفک انتظامیہ کے مختلف دفاتر میں بھیجا تاکہ وہاں سے ٹریفک کے بہاؤ سمیت دیگر متعلقہ اعداد و شمار اکٹھے کیے جا سکیں۔ تمام اعداد و شمار کا تجزیہ، اور موٹر وے کا سروے کرنے کے بعد لمز کی ٹیم نے کُل ۸۵ مقامات کا تعین کیا جو ہر لحاظ سے چارجنگ اسٹیشن کے لیے موزوں ثابت ہو سکیں گے۔ اعداد و شمار کے مطابق آغاز میں ان میں سے پندرہ کو ترجیحی بنیاد پر قائم کیا جانا چاہیے۔ تحقیق کے مطابق اگر ان پندرہ مقامات پہ دس تیز رفتار چارجر لگائے جائیں تو وہ پاکستان کے بڑے شہروں تک رسائی کی بنیادی ضرورت کو پورا کر سکیں گے۔

لاہور - اسلام آباد موٹروے (ایم - 2) پر گاڑیوں کے حالیہ بہاؤ، سالانہ اضافے کی شرح اور نقل و حرکت کو مدِ نظر رکھتے ہوئے پانچ مقامات پہ چارجنگ اسٹیشن بنانے کی تجویز دی گئی ہے جس سے لاہور تا اسلام آباد جانے والی برقی گاڑیوں کی چارجنگ ضروریات کو کماحقہ پورا کیا جا سکے گا۔ یہاں یہ امر بھی قابلِ ذکر ہے کہ دن بھر گاڑیوں کے بدلتے ہوئے بہاؤ کے پیشِ نظر یہ تجویز دی گئی ہے کہ جن اوقات میں چارجنگ کی طلب بہت کم ہو تب ایک محرک چارجنگ سٹیشن مطلوبہ مقام تک بھیجا بھی جا سکتا ہے۔

ان چارجنگ اسٹیشنز کا قیام تاجر برادری کے لیے توجہ کا مرکز بن سکتا ہے جیسا کہ پٹرول اسٹیشنز کے قریب ہوٹل، دکانات اور دیگر تجارتی مراکز کو فروغ ملتا ہے۔ یہ بھی تجویز کیا گیا ہے کہ یہ تمام کاروبار اپنے منافع کا ایک طے شدہ حصہ چارجنگ سٹیشن کو دیں جس سے چارجنگ سٹیشن کے مجموعی منافع میں اضافہ ہو گا جو اسے ملک میں مزید پھیلاؤ کا موقع دے گا تاکہ زیادہ سے زیادہ صارفین کو کم فاصلے اور کم نرخ پہ چارجنگ کی سہولت میسر ہو۔

مکمل تحقیقی مقالہ:

N Arshad, HOA Khan, M M Arslan, and M A Javed. Developing Electric Vehicle Charging Infrastructure Across Highways and Motorways of Pakistan. LUMS Energy Institute. June 2021.

https://lei.lums.edu.pk/index.php/2021/06/04/developing-electric-vehicle-charging-infrastructure-across-highways-and-motorways-of-pakistan-report-release/

مصنف:
محمد احتشام مبارک

روشنی، کوانٹم فزکس کے آئینے میں

یہ امر ایک مسلم حقیقت ہے کہ ارتقائے زندگی کا اہم ترین جزو ہونے کے ساتھ ساتھ روشنی بقائے حیات کے لیے بھی لازم ہے۔ سائنس کی ترقی اور کائنات کے پوشیدہ رازوں کو جاننے میں روشنی کا کلیدی کردار رہا ہے۔ اربوں کہکشاؤں کی وسعتوں میں پھیلے کھربوں ستاروں کے احوال اور ان میں رونما ہوئی حشر سامانیوں کی داستانیں سناتی یہ روشنی اپنی ساخت میں ایک سحر انگیز کارگزار ہے۔ روشنی کی موج یا ذرّاتی ساخت سے متعلق تجربات و مشاہدات نے لگ بھگ تین سو برس وقت کے نامور سائنسدانوں کو انگشت بدندان رکھا۔

بیسویں صدی میں کوانٹم میکانیات کی دریافت سے جہاں سائنس کی ترقی کے نئے دور کا آغاز ہوا وہیں روشنی اور اس سے جڑے نظریات بھی اس ارتقائی عمل سے محفوظ نہ رہے اور نتیجتاً کلاسیکی اور کوانٹم روشنی میں تفارت کی صورت واضح ہوئی۔ یہ بات یہاں قابلِ ذکر ہے کہ روشنی کلاسیکی ہو یا کوانٹم، اس کے بنیادی ذرّے، یا توانائی کے پیکٹ، کو فوٹان ہی کہا جائے گا۔

کوانٹم میکانیات سے جُڑے انہی اسرار کی کھوج میں لمز یونیورسٹی کے سائنس اور انجینئرنگ سکول کے ڈین ڈاکٹر صبیح انور، ڈاکٹر علی اکبر اور طالبِ علم فیضان الٰہی نے کلاسیکی بصریات کے ایک مشہور رجحان کو کوانٹم روشنی سے جانچنے کا تجربہ کیا۔ کوانٹم روشنی کی افزائش ایک نان لینیئر کرسٹل سے کی گئی، جس میں فاٹون بقائے توانائی کو ملحوظ خاطر رکھتے ہوئے ایک خاص توانائی کا فوٹان دو کم توانائی والے فوٹانز میں تبدیل ہوتا ہے۔ ان میں سے ایک فوٹان کو مزید ایک ہمہ رخ کرسٹل اور مقناطیسی میدان کی موجودگی میں سے گزارا گیا اور روشنی کے تقطیبی خواص میں ہونے والی تبدیلی کا تجزیہ کیا گیا۔ اس تبدیلی کو گردشِ فاراڈے کہا جاتا ہے۔

یہ سائنسی کاوش اس لحاظ سے منفرد ہے کہ اس تجربے سے حاصل ہونے والے نتائج کو خالصتاً کوانٹم میکانکی اصولوں سے پرکھا گیا اور ایک سنگل فوٹان کی گردشِ فاراڈے کی پیمائش کی گئی۔ کلاسیکی اور کوانٹم میکانیات کا حسین امتزاج ثابت ہونے والا یہ تجربہ طبیعات کی تین مختلف شاخوں یعنی کلاسیکی بصریات، کنڈینسڈ مادہ اور کوانٹم انفارمیشن کا خوبصورت ملاپ بھی ہے۔

اردو کے نامور شاعر، ن م راشد نے کہا تھا:

"تمنا کی وسعت کی کس کو خبر ہے جہاں زاد"

مگر یوں لگتا ہے جیسے تمنا کی بھی وہی وسعت ہے جو روشنی کو میسر ہے۔

اس تحقیقی مقالہ کی مکمل تفصیلات:

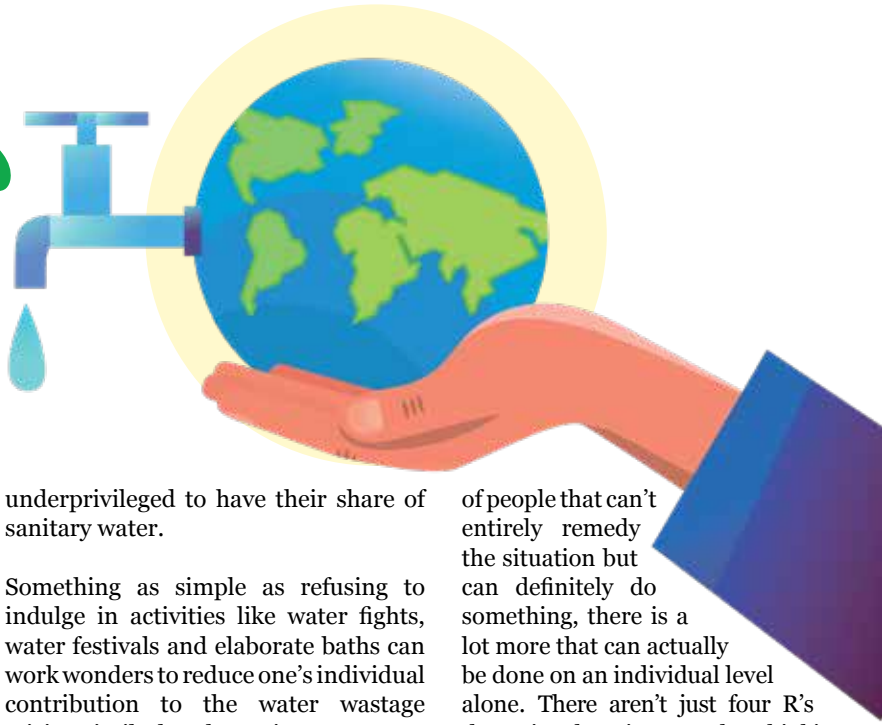
Ali Akbar, Faizan-e-Ilahi, Muhammad Sabieh Anwar,
Quantum process tomography of a magneto-optic transformation,
Physics Letters A,
Volume 406,
2021,
127467,
ISSN 0375-9601,
https://doi.org/10.1016/j.physleta.2021.127467.

Everyone has a Role to Play in Fighting Climate Change

Sustainable, Affordable and Scalable Water and Sanitation Solutions

Sarah Shamim is a second-year Alevel student at Nixor College, Karachi.

Climate Change Wlimate Change kuch nahee hota!



Hundreds of Pakistanis continue to obviate the strain of social responsibility. In a realm not too separate from the reality where said people push the narrative that climate change does not exist, exist the deaths of about 2,000 people in Pakistan's 2015 heatwave. This is something that occurred precisely due to the changing climate, according to Asif Shuja of the Pakistan Environmental Protection Agency.

Water bodies getting clogged by poly-ethene and permeated by oxo-plastic has rendered the Indus river responsible for being the second-largest contributor of plastic to oceans. The crisis of water pollution in Pakistan alone has numerous facets and nuances to it, with little to none of them talked about. If a nation does not take ownership and accept accountability for the problems that face it, how can it possibly resolve said problems?

While it is true that legislative and industrial-logistical changes are absolutely vital if we aim to change the statistics for the better, there is always room for more individual effort to be made to improve the situation if you look at the micros. As simplistic as it sounds, the four R's — Refuse, Reduce, Reuse, Recycle — really work. It is vital for the more privileged classes to reduce their water consumption for the underprivileged to have their share of sanitary water.

Something as simple as refusing to indulge in activities like water fights, water festivals and elaborate baths can work wonders to reduce one's individual contribution to the water wastage crisis. Similarly, showering consumes a lot more water than bathing using your good old, conventional *baalti* does. Albeit uncomfortable and not as luxurious, the *baalti*, so quintessential and inherently desi in its own glory, does actually help one conserve water. Reusing is also easy and does not require money. The same water can be used in the kitchen to boil multiple vegetables, for example. Water left over after sterilising something by boiling it can be used to water your *Aloe Vera ka gamla*. That's recycling for a *desi* household!

Besides those being excellent, scalable, sustainable and simple little things that can be incorporated into the daily lives of people that can't entirely remedy the situation but can definitely do something, there is a lot more that can actually be done on an individual level alone. There aren't just four R's that exist, there is so much rethinking, reimagining and realising left to be done. There is a charcuterie board of R's sprawled before us to pick and choose from to do our part in helping avert the climate crisis.

In her article 'Unpacking Motherhood During the Anthropocene', Sarah Elahi writes, "You start out learning about global warming and the greenhouse effect in school, nobody talks about it outside of school, and one day, you grow up, leaving behind awareness of environmental degradation like a discarded binder in a locker." I feel like most Pakistani kids share this specific rhetoric in school where the earth is considered to be this abstract entity and

climate change is sad and all, but we're never made to realise that it has and will have serious implications on us and our lives. I didn't talk about climate change with my parents until I was 16 and that too only when I brought it up and was met with partial eye-rolls and partial remarks like *"Beta iska kia kersaktay hain"*. In middle school, I was told to paint "Save the Earth" in bright green and blue, on fresh single-use and non-biodegradable paper with paints containing non-biodegradable acrylic polymers.

I want things to change.

The biggest change that will pave the way for remedying the water crisis or any other facet of the general climate crisis, is discourse. I want these topics to be spoken about in Urdu, realistically, repeatedly, casually, over and over and over again when your *khala* comes over, when your *maamu* comes over, heck, even when your *phuphi* comes over. I want uncles to freak out about it like they freak out about inflation, while sipping mint lemonade instead of smoking *suttas*. I want these words of discourse to be over cups of chai not made from teabags because they contribute to extra single-use plastic waste. I want these words to be exchanged during water balloon fights between cousins, but over shared *ghar ka chaat-masala*-laden french fries eaten out of molasses plates instead of paper ones.

Discourse leads to action and with the internet being a thunderstorm-like democratising force, especially for the *desi Twitterati* and with climate marches ensuing in most of our major cities, there is so much that a common person can do to get the attention for the policy-makers to listen and act. When the policy-makers will listen and act, government-endorsed, scalable and sustainable laws and bills will pass which could potentially change the water crisis statistics for the better. Writers, photographers, artists, and creators can create art for the awareness of the water crisis. There is a dire need for climate journalism in Pakistan and personally, as an aspiring journalist myself, I have already worked with an NGO — Climate Tracker — to promote climate journalism in areas like South Asia. People will not realise the gravity of the situation until the privileged responsibly use their privilege.

The Climate March in Karachi was truly something else. I held my poster — made of a repurposed *aatay-ka*-paper-bag — high, but my hopes higher. Soon enough I was invited by someone who works with the minister of my local constituency, PS-111, to help them draft a bill to resolve issues such as the plastic crisis and replantation. The government ended up listening after one march. It is everyone's shared responsibility to push for what will actually make a difference, which is, action taken by the government.

"You be careful!', said my Qatar Trip Cheperone, and I could feel her nails dig a little bit into the skin of my arm as she helped me climb up what I would classify as a very mild hill in the Oxygen Park there. What astounded me more than the hills was the fact that all the water flushed out of toilets from the Qatar fund dorms was used to irrigate the park. Scalable, sustainable solutions that industrialists, civil engineers, and policymakers can introduce are countless. What if buildings were designed to ensure that less water is wasted. Now one would question, why would an engineer put in all the noble work to ensure a building is water-efficient, and the answer to that is: the LEED Certification. An organisation in the USA gives out certifications for "green" architecture, which is what the building in Qatar also had. The shiny LEED plaque is becoming a huge asset, almost a requirement for one to be considered a good architect. My city only has one such building, the HBL building at Teen Talwar. Sustainable architecture could be a government-endorsed scheme that comes about.

Additionally, barriers could possibly be placed on the water consumption of the rich and elite so that the more disadvantaged social classes can get their share of sanitary water. To counter the sanitation issue, Government-funded purification campaigns could be enacted that somehow incorporate Reverse Osmosis somehow without the heaps of water waste it comes with, converting hard water to sanitary water.

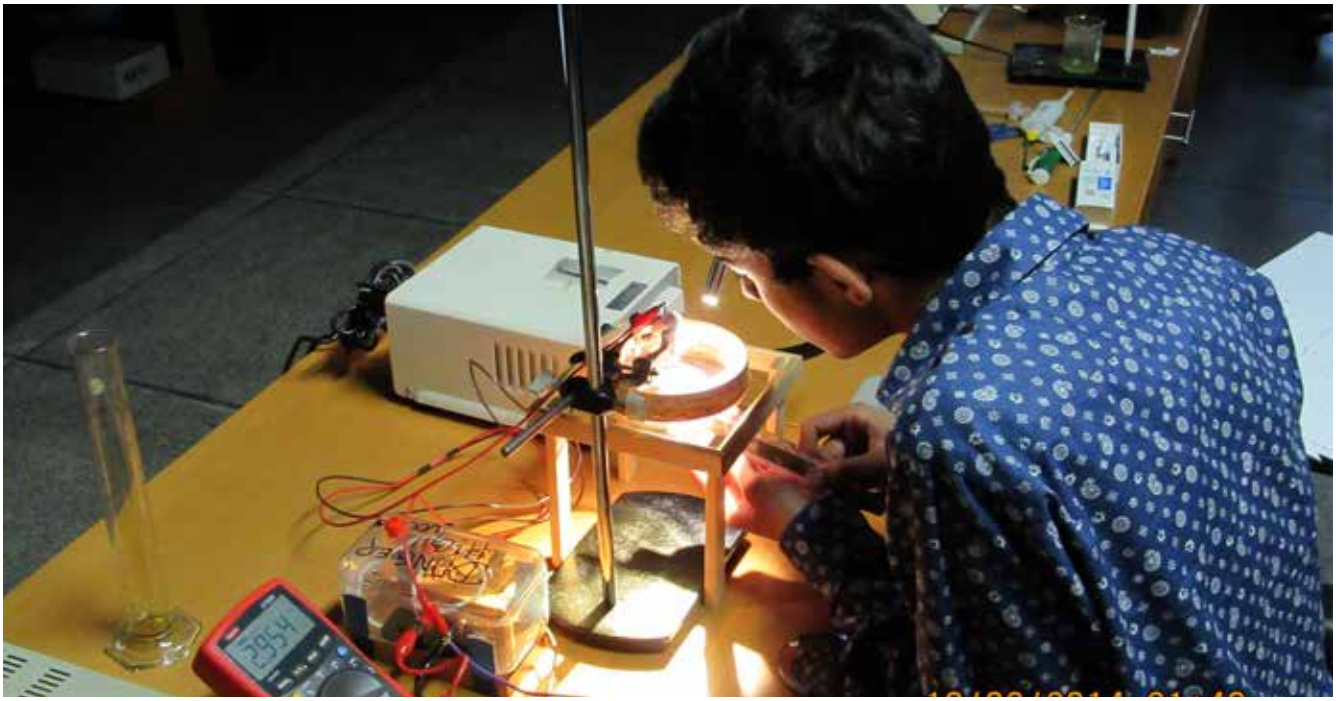
It is to be noted that Pakistan has one of the most wasteful irrigation systems globally. If the government funds an upgrade to that, we get more water and better harvests, truly a win-win situation.

In his article, Hasan Abbas elaborated upon Dam Equivalents; essentially dams that take away the down-sides that come with them. This is evidently another win-win situation. This solution even seems viable in foresight because of the public and media attention that the dam fund scheme drew to itself, and truly all politics and intersections aside, shines a ray of optimism.

But as I have said before, all of these changes can transcend the realm of theory to enter into the reality that we live only if there is the discourse.

If people will care about it, people will talk about it. And if people will talk about it, people will march for it. And if people march for it the government will consider solving the dilemma. That is how everyone truly has a role to play in fighting climate change.

Author is the winner of the World Water Day 2020 Essay Competition organised by the LUMS Centre for Water Informatics & Technology.




21/12/2016

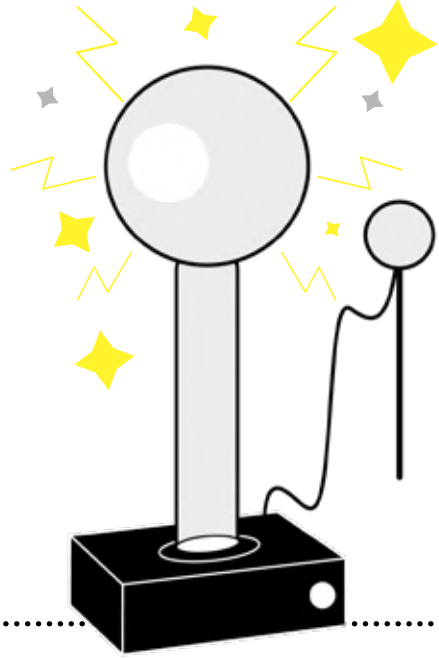
ہے کہ وہ نائٹروجن کی حرارتِ مخصوصہ معلوم کریں۔ اب ظاہر ہے اس تجربے کی مدد سے گراف اور اس کی وضع قطع کا فہم بھی سیکھا جاتا ہے، حراریات (thermal physics) اور برقیات (electricity) کا باہمی تعلق بھی نمایاں ہوتا ہے اور توانائی کے استقرار (conservation) کا عملی مظہر بھی کھلی آنکھوں نظر آتا ہے۔ اس تجربے میں استعمال ہونے والے سب آلات فزلیب ہی کی پیداوار ہیں۔ برقی ترازو سے لے کے فزلاگر تک، جو مقادیر (quantities) کو کمپیوٹر میں منتقل کرتا ہے، عمر حسن اور اس کے ساتھیوں نے تخلیق کیے ہیں۔

ایک اور تجربے میں لوہے کی ایک لمبی افقی پٹی کی سطح پر باریک سوراخ بنائے گئے ہیں۔ اِس پٹی کا اندرونی حصّہ خالی ہے اور اِسے ایک ہوا کے پمپ (Pump) سے منسلک کیا گیا ہے۔ ہوا تیز رفتاری سے ان باریک سوراخوں سے خارج ہوتی ہے اور پٹی کے متوازی ایک تہ بنا دیتی ہے۔ اس تہ پہ گیٹیاں بہت معمولی مزاحمت سے فراٹے بھرتی ہوئے گزرتی ہیں۔ ان کی رفتار اور اسراع معلوم کرنے کے لیے بصری کواڑ (photogate) فزلاگر سے منسلک کیے گئے ہیں۔ اب ان گیٹیوں پہ معلوم اوزان کے ذریعے معلوم قوت لگائی جاتی ہے اور ان کا اسراع معلوم کر کے نیوٹن کے المشہور $F=ma$ قانون کی تطبیق تلاش کی جاتی ہے۔

اِسی طرح کے تقریباً سو کے قریب تجربے اس وقت فزلیب کی زینت ہیں۔ میرے لیے فزلیب میں آنا ایک مشاہدہ گاہ اور عجائب گھر کی سیر سے کم نہیں۔ کہیں گیند آپس میں ٹکرانے کی دھماد ھم ہے، تو کہیں مائعات کے بخارات کی صفیری آوازیں۔ کہیں پنڈولم درویشانہ گھوم رہے ہیں تو کہیں کوئی مصروف طالبِ علم دُنیا ومافیہا سے بے خبر پانی کے اٹکے ہوئے قطروں کے ٹپ ٹپ گرنے کا انتظار کر رہا ہے۔ اس کے لیے وقت جیسے رُک سا گیا ہے،

لے سانس بھی آہستہ کہ نازک ہے بہت کام
آفاق کی اِس کارگہِ شیشہ گری کا

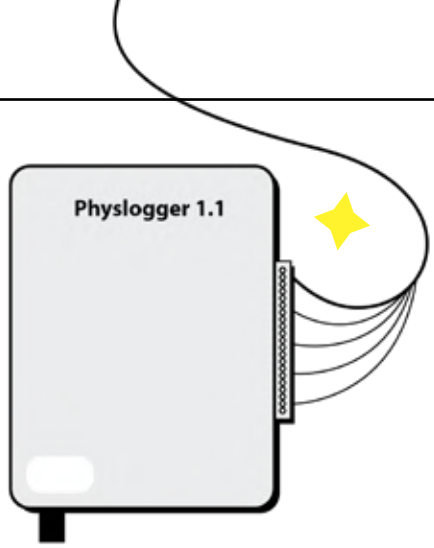
فزلیب میں ہر طرح کے تشنگانِ علم کے لیے سامانِ حیرت ہے۔ ریاضی کے دلدادہ مقناطیسی پنڈولم سے کھیل سکتے ہیں۔ ڈیٹا کے شائقین تصویروں کی جانچ پڑتال کر سکتے ہیں۔ ہاتھ سے کام کو پسند کرنے والے مہندسین کے لیے لکڑی کے ٹکڑوں کو جوڑ کر متوازن پُل بنانے کی آزمائش کے دوران تفریح کے ساتھ ساتھ سائنسی حکمت حاصل کرنے کے مواقع بھی ہیں۔ نُوریات کے شایقین کے لیے گوشۂ اِبنِ سہل سات آٹھ دلچسپ نوری تجربوں (optical experiments) کا میدان ہے۔ بہت سے تجربات کیمرے اور سمارٹ فون کی مدد سے بھی کیے جاتے ہیں۔ کئی نوبل انعام یافتہ تجربوں کی جدید اور معاصر صورت بھی فزلیب میں دکھائی دے گی جیسے ۱۹۱۰ء کا پیرِن (Perrin) کا تجربہ ایک جدید خوردبین کی مدد سے نئے روپ میں جلوہ گر ہے۔ اِس تجربے میں پولی سٹائرین کے مائکرو دانے (polystyrene microspheres) پانی کی ایک باریک سی تہ میں خوردبین کے نیچے دیکھے جاتے ہیں اور ہمارے تیار کردہ سوفٹ وئیر (Phystrack) کے ذریعے ان کے مقامات کو وقت کے دھارے پہ متعین کیا جاتا ہے جس سے بے ربط (random) اعمال کی فزکس سمجھنے میں بے حد آسانی ہو جاتی ہے اور ایک تاریخی اہمیت کے حامل تجربے کو بھی از سرِ نو زندہ کر لیا جاتا ہے۔



فزلیب کی تیاری میرے لیے چشم کُشا اور ذہن کُشا تھی۔ مجھے جو تھوڑی سی فزکس آتی ہے، اس کا بڑا سہرا انھی تجربات کی تیاری کے سر ہے۔ اس تجربہ گاہ کا تعلیمی نصاب کسی نظریاتی نصابِ تدریسی (theoretical coursework) کا مرہونِ منت نہیں۔ میں اس قبیل کے پروفیسروں سے تعلق رکھتا ہوں، جس کے مطابق تجرباتی سائنس خود نظریات کو تشکیل دینے میں اہم کردار ادا کر سکتی ہے۔ اِسی طرح فزلیب کی کوکھ سے جنم لینے والی تنظیم قوسین سائنٹیفک کم خرچ پہ سائنسی آلات بنانے کے رستے پہ گامزن ہے۔ اُمید ہے کہ آلات اور خیالات کا یہ ادل بدل، فزکس کی دُنیا میں، ہمارے نوجوانوں کے ذہنوں کو کھول کے اُنھیں فطرت کے اسلوب کو سمجھنے اور بالآخر تسخیر کرنے کے لیے ایک خود اعتمادی عطا کرے گا۔ ہماری تجربہ گاہ اِسی جذبے کی سرشاری میں قائم ہوئی اور یہی جذبہ اِسے آگے بڑھنے پہ مجبور کرتا ہے۔

معراج بن جاتا ہے۔ یہ خود ساختہ تجربے ایک تو نہایت سستے ہوتے ہیں، دوسرا، اُن کو بنانے کے سفر میں فزکس کے نت نئے پہلو اُجاگر ہوتے ہیں اور کتابوں میں بند نظریے جیتے جاگتے، رنگ برنگ صورتوں میں تجسیم پاکر ذہن کے دریچوں کو وَا اور سمجھ کے افقوں کو زیر کرتے نظر آتے ہیں۔ گویا حَسن کوزہ گر کے بنائے ہوئے مٹی کے پیالے بولنا شروع کر دیتے ہیں! اپنی مدد آپ سے بنے ہوئے۔

تجربے شاگردوں میں سائنسی اور طبیعی شعور اُجاگر کرنے میں، برآمدشدہ، زرق برق اور چمکتے دمکتے مگر غلافوں میں بند تجربات کی نسبت بہت زیادہ مُفید ہوتے ہیں۔ گویا فزکس کی تجربہ گاہ اِس خود پروری کے نتیجے میں ایک مستعد کارخانہ بن جاتی ہے، اور ساکت وجامد نوادرات کا شیش محل نہیں بنی رہتی۔ اِن آلات کے خراب ہونے کا ڈر بھی جاتا رہتا ہے کہ آخر آپ نے یہ آلات خود بنائے ہیں، انہیں مرمت کرنا بھی تو آپ کے بس میں ہوگا۔ خرابیوں کا سُراغ لگانا بھی نہایت آسان ہوجاتا ہے۔

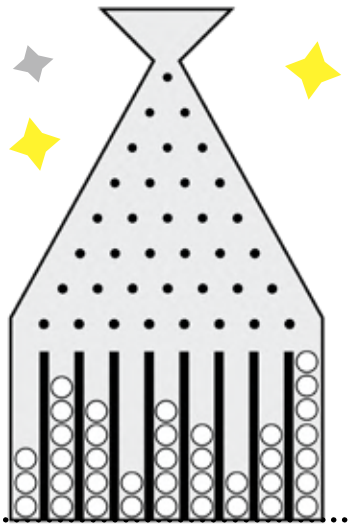


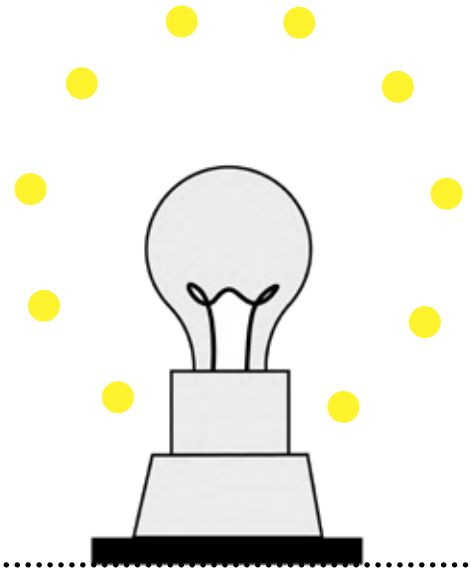
بقولِ غالب :

اور بازار سے لے آئے، اگر ٹوٹ گیا
ساغرِ جم سے میرا جامِ سفال اچھا ہے

ایسی توانا تجربہ گاہ تخلیق کی جاتی ہے، تعمیر نہیں۔ میں نے یہی جذباتی تحریک اپنے کام میں استعمال کی۔ چنانچہ سب سے پہلے میں نے ایک خرادمشین خریدی، وہ بھی کباڑیے سے۔ فزلیب بنانے میں تکنیکی ماہرین کو، جن میں حافظ رضوان، محمد یوسف اور خادم محمود سرِفہرست ہیں، اپنی انجمن میں شامل کیا اور ان کی مدد سے فزکس کے اصولوں پہ مبنی تجربات کا سانچہ ذہن میں بٹھایا، آلات کے ڈیزائن کو آگے بڑھایا، تجربوں سے حاصل ہونے والی متوقع مقداروں کا بیش آمدگی سُراغ لگایا اور پھر اپنی نئی تعمیر کردہ کارگاہ میں نئے نئے آلات بنائے۔ بہت سے تجربوں کو کمپیوٹر کے ساتھ جوڑا تاکہ تجرباتی مقداروں کو سہولت کے ساتھ اور وافر مقدار میں حاصل کیا جاسکے اور پھر مقداری تجزیے (data analysis) سے کام لیتے ہوئے قیاس اور استنباط، پیش گوئی اور استخراج کی منزلیں، جو سائنسی رویے کا حصہ ہیں، بروئے کار لایا جاسکے اور نتیجتاً فزکس درسی کتابوں کی قید سے نکل کے عمل کی جولانگاہ میں داخل ہوسکے اور ہمارے ہزاروں طلبہ وطالبات فزکس کی حیرت انگیزیوں کی خوشہ چینی کر سکیں۔

الحمدُللہ، اب فزلیب مُلک میں تجرباتی فزکس کی عملی تربیت کے لیے ایک مثالی آماج گاہ بن چکی ہے۔ ہمارے پاس بنیادی سے لے کر عالی درجوں کے تجربات تیار ہیں۔ یہ تجربے ہر لحظہ بدلتے بھی رہتے ہیں اور فزکس کی تمام شاخوں کا احاطہ کیے ہوئے ہیں۔ چند مثالوں سے ان تجربات کی نوعیت واضح کی جاسکتی ہے۔ ابتدائی تجربہ گاہ میں ایک تجربہ مائع نائٹروجن کی حرارتِ مخصوصہ (specific heat) ناپنے سے تعلق رکھتا ہے۔ ایک چھوٹے سے کپ میں مائع نائٹروجن اُنڈیلی جاتی ہے۔ یہ کپ ایک برقی ترازو (electronic balance) پہ دھرا ہے۔ نائٹروجن کی تبخیر (evaporation) سے وزن رفتہ رفتہ کم ہوجاتا ہے۔ وقت اور وزن کا ڈیٹا کمپیوٹر پہ منتقل ہوتا ہے اور طلبہ اِسے ایک متحرک گراف (graph) میں دیکھتے ہیں۔ اس عمل کے دوران نائٹروجن میں ایک مزاحم (resistor) میں سے مخصوص وقت کے لیے برقی رَو (current) گزاری جاتی ہے جس سے مزاحم گرم ہوتا ہے اور تبخیر کا عمل تیز ہوجاتا ہے۔ کچھ دیر بعد برقی رو روک دی جاتی ہے اور تبخیر کی قدرتی رفتار ایک بار پھر بحال ہوجاتی ہے۔ تبخیر کی قدرتی اور برقی رفتار کے موازنے سے طلبہ کو دعوت دی جاتی





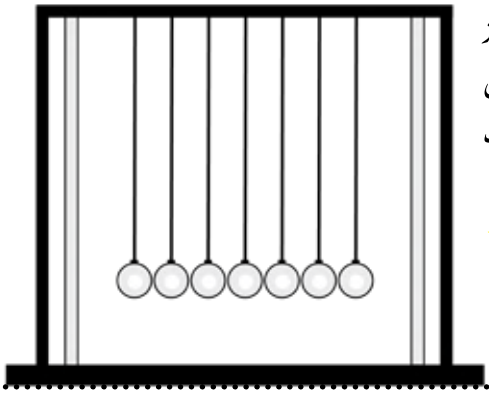
فزکس ہاتھوں میں

ڈاکٹر محمد صبیح انور پروفیسر فزکس

جب میں نے ۲۰۰۷ء میں امریکہ سے واپس آنے کے بعد سکول برائے سائنس اور انجینئرنگ، لمز میں بطور اُستاد اور محقق قدم رکھا، تو میرے سامنے ایک خالی کمرہ تھا۔ ایک سال بعد طلبہ کی پہلی جماعت نے داخل ہونا تھا اور میرے ذمے یہ احساس تھا کہ اِن طلبہ کے لیے مُجھے فزکس کی ایک شاندار اور فکر انگیز تجربہ گاہ بنانی ہے۔ چنانچہ میں نے اپنے چھوٹے سے کمرے کو تجربہ گاہ بنالیا۔ وائس چانسلر ڈاکٹر ظہور احمد اور بعدازاں ڈاکٹر احمد دُرانی سے خصوصی رقم کی دستیابی کا وعدہ لیا اور کام میں جُت گیا۔

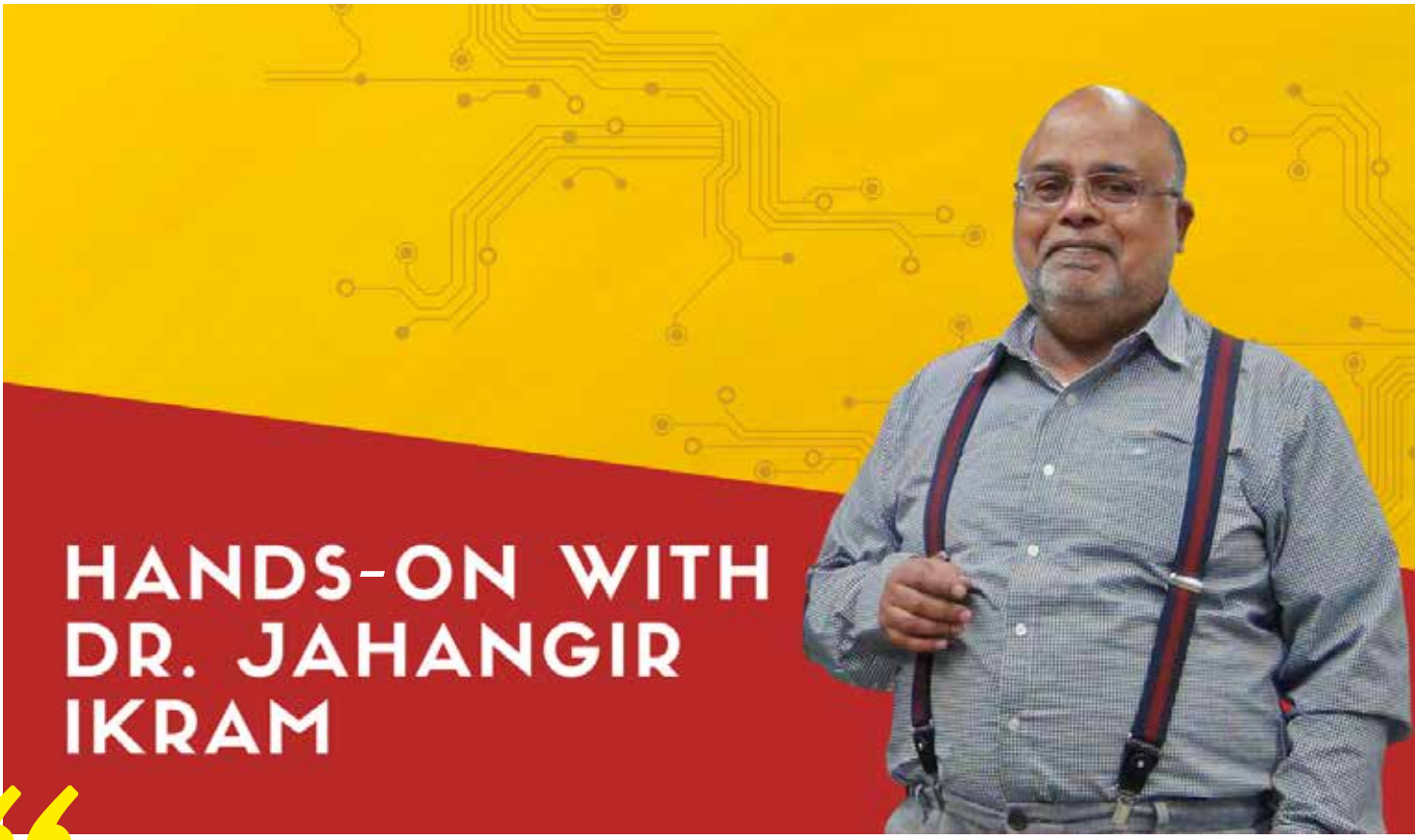
آنجہانی صہیب شمیم سے آکسفورڈ ہی سے دوستی تھی۔ اُن کے ساتھ مل کے نئے تجربوں کی تخلیق کا بیڑا اُٹھایا۔ عمر حسن، رابعہ ودود، علی حسن، عظیم اقبال، کنیز آمنہ اور اسماء خالد کے ساتھ مل کے نئے افکار کی تلاش کے بعد نیا سامان خود ہاتھوں سے بنایا اور ۲۰۰۸ء میں ڈیڑھ سو کے لگ بھگ ہشیار بچوں کے سامنے ایک نیم تیارشدہ کمرے میں پہلی مرتبہ فزکس کی ابتدائی تجربہ گاہ پیش کی اور اطمینان کی کبھی نہ ختم ہونے والی دولت حاصل کی۔ ڈاکٹر عمر حسن اب رٹگرز یونیورسٹی میں اور ڈاکٹر اسماء خالد ملبورن یونیورسٹی میں تحقیق اور تدریس کی جدید رفعتوں کو طے کرکے ہم سب کو حیران کررہے ہیں۔

سائنس اور فزکس کی تعلیم تجربوں کے بغیر بانجھ ہوتی ہے۔ تجربوں کی اپنی ایک الگ دنیا ہوتی ہے جو خالص نظریّے کی دُنیا سے مختلف ہوتی ہے۔ ایک ماہر تجربہ کار ایک متحمل اور بُردبار شخصیت کا مالک ہوتا ہے جو عرق ریزی سے حرارت پیما کے سیمابی وجود کو ٹکٹکی باندھ کے دیکھتا ہے، دُوربین کے عدسے سے کسی دُور افتادہ ستارے کے جھرمٹ کو پہروں تکتا رہتا ہے اور نہایت ایمانداری سے اپنے تمام مشاہدات کو دفترِ قرطاس پہ قلمبند کرتا چلا جاتا ہے۔ وولٹ پیما کی سوئی کی ہلکی سی جُنبش اس کے چہرے پہ مسکراہٹ بکھیر دیتی ہے۔ موٹر کی گراریوں کی آواز اُسے بے چین کردیتی ہے اور لیزر شعاعیں جب پردے پہ ایک خوش رنگ نقش بکھیرتی ہیں، تو اس کی سانس تیز چلنے لگتی ہے۔ مشاہدہ کار نہایت عاجزی سے اپنی کائنات اور اپنے تجربات



کے آئینے میں اپنی بے مائگی کو بھی سنوارتا رہتا ہے۔ تجرباتی سائنس دان جب اپنے تجربوں سے حاصل ہونے والی مقداروں کو تحریر کرتا ہے تو نہایت ایمانداری سے مقداری بے یقینی (Uncertainty) کو بھی لکھتا ہے، تجربوں کی فکری حُدود کی نشاندہی کرتا ہے اور اِس طرح اپنی عاجزی کا برملا اقرار کرتا ہے۔ پچھلے چودہ پندرہ سالوں میں میری ہمیشہ یہی کوشش رہی ہے کہ لمز میں فزکس کی تجربہ گاہ، جِسے ہم فزلیب (Physlab) کہتے ہیں، اِسی طور شاگردوں کی ذہن سازی اور شخصیت کی صنّاعی کرسکے۔ چنانچہ میرے نزدیک فزلیب بنانے کا عمل شخصیتوں کو سنوارنے کے عمل کے مترادف ہے۔

آپ جانتے ہوں گے کہ ہمارے مُلک میں عام طور پر یہ سمجھا جاتا ہے کہ جب تک ہم مہنگے داموں بیرونِ ملک سے بہترین آلات منگوا کے اپنی درسگاہوں کی زینت نہیں بنائیں گے، ہم سائنسی تحقیق کے سمندر کی موجزنی نہیں کرپائیں گے۔ یہ تاثُر صرف ایک حد تک درست ہے۔ تدریسی نقطۂ نگاہ سے بننے والی تجربہ گاہوں میں یہ اصول پوری طرح لاگو نہیں ہوتا۔ بلکہ اِس میدان میں تو "آپ کاج، مہاکاج" کے مصداق خود ہاتھ سے اپنے آلات بنانا اور پھر اِن آلات کو حُسنِ ترتیب کے ساتھ جوڑ کے ایک بڑا تجربہ بناڈالنا ہی عملی فزکس کی



HANDS-ON WITH DR. JAHANGIR IKRAM

I shall do something for my students, no matter what

declares Dr. Muhammad Jahangir Ikram, while reminiscing about the development of portable kits for electrical engineering students at SBASSE. Over the past two decades at LUMS, Dr. Ikram has had the good fortune of teaching about four thousand computer science and electrical engineering students! This immersion into the teaching endeavour shapes his personality.

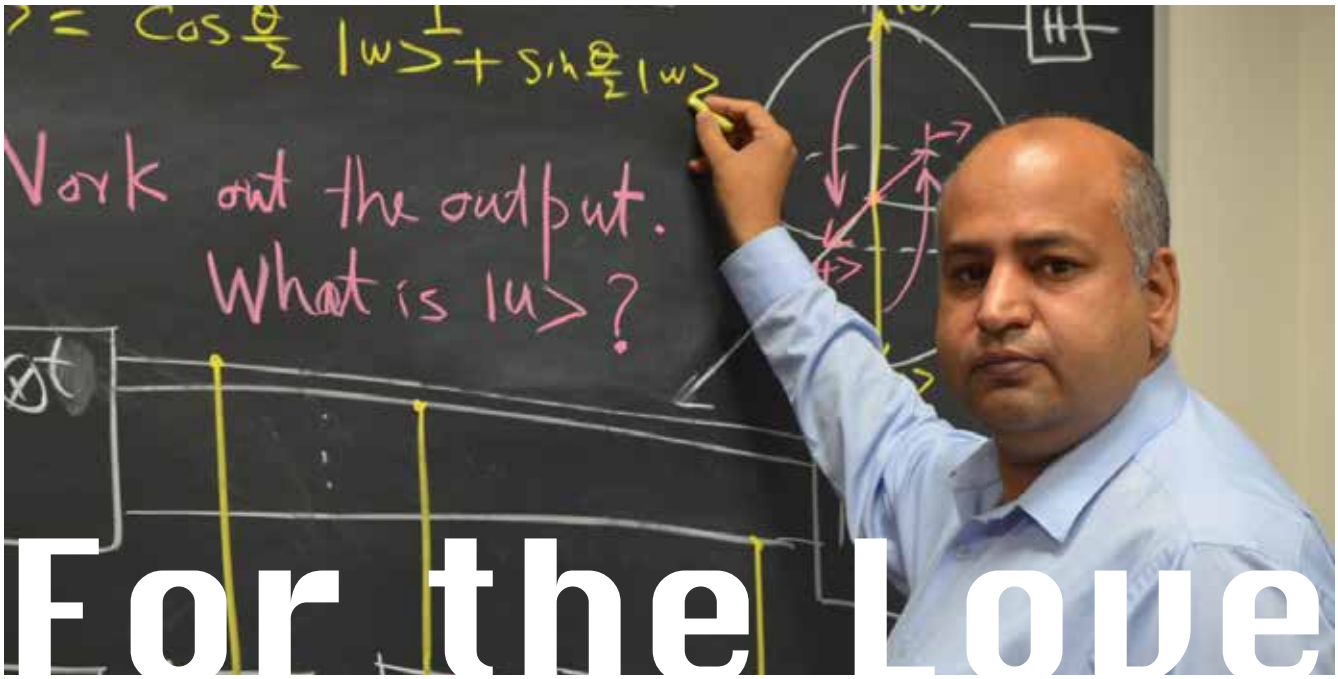
Popular among his students for his engaging pedagogical strategies, Dr. Ikram's approach to teaching pivots on the most important agenda of 'hands-on learning'. The coveted digital-analog training system, a precipitate of Dr. Ikram's knowledge and passion for electronics, is an intricate piece of machinery designed to help his students experiment with state monitors, input/output connectors, function generators and a surfeit of logic switches. The device is a treat for his students, allowing them to obtain a concrete feel for how electronic components work together and get familiar with experimentation. It has been 12 years since the first iteration of this trainer kit came to light and the system is still in use today!

Recalling his olden days of teaching at the School, Dr. Ikram vividly remembers one of his undergraduate students taking up to seven courses from him. "It was also very common for my students to have studied four courses from me," he warmly recalled, while sitting comfortably near the granite facade of SBASSE. His office shelves are populated with awards gathered over the years, one of which reads 'Award for Excellence in Teaching', bestowed upon him after being selected from a group of 15 odd world-class teachers. But according to Dr. Ikram, his biggest award in life are his students who excel in all walks of life and in electronic design in particular.

In the summer of 2020, Dr. Ikram and his team created portable kits for electrical engineering students. These kits were the result of arduous work by his team throughout the gruelling summer heat. The kits were successfully developed and deployed later that year. "I like students to have practical experience. I do not like [relying only on] simulations." – and indeed he has lived these words throughout his years in academia.

Dr. Muhammad Jahangir Ikram is Associate Professor at SBASSE and teaches both computer science and electrical engineering at the School.

Written by **The Particle Team**



For the Love of Learning

The sight of disinterested students, lack of class participation and sporadic yawns here and there will make for a bad day for any passionate teacher out there. We live in an era where any kind of information is accessible within seconds – without needing a guide or an instructor. On top of that, tectonic forces like social media have reduced attention spans to mere minutes. Thus, it can be expected that a student sitting in a classroom will find it easy to switch over to distractions unless the class session is engaging and awash in active learning.

Two years ago, after seeing dwindling class participation and students who seemed bored of the daily drill of a classroom, Dr. Muhammad Faryad (Chair, Physics Department, SBASSE) began experimenting with active learning techniques in his class. "I used class activities in almost every class that were merely small thought-provoking questions/problems based on that very lecture (not on previous lectures).", he said. Students would submit their activities to LMS right away and an in-class discussion on the answers and solutions would ensue. The activities were graded and student participation was usually above 90%! According to Dr. Faryad, this resulted in reduced homeworks (without sacrificing learning) as well as a thorough assessment.

Dr. Faryad's students have developed a liking for these activities. In a short survey after one of his activities, a student wrote:

> "This was one of the smoothest online learning experiences in the past two semesters. The way the course was organized made life very easy and reduced so much unnecessary stress."

Taking part in the same survey another student commented, "Most of the students find it very difficult to attend live sessions, but this policy resulted in greater motivation and at the same time did not put pressure or mental stress on students."

Addressing fellow peers, Dr. Faryad recommends practice of active learning techniques, without worrying for completion of syllabus. He has expressed satisfaction in the way students have reacted to his techniques and continues to adapt his strategies to make sure a sustainable active learning program can continue to thrive, one that is tailored to the changing needs of his students.

Written by **The Particle Team**

کیا آپ کسی ایسے کیمیائی مادے کو جانتے ہیں جو گھریلو ٹوٹکوں سے لے کر سائنسی تجربہ گاہ تک میں استعمال ہوتا ہو؟ قدرت کے اِس کارآمد کیمیائی نگینے کو سکسینک ایسڈ کے نام سے جانا جاتا ہے۔ یہ ایک ایسا سفید قلمی نامیاتی تیزاب ہے جسے اکثر اشیائے خوردونوش کی تیاری اور دواسازی میں بھی استعمال کیا جاتا ہے۔ صنعتی سطح تو پر سکسینک ایسڈ کو کیمیائی طور طریقوں سے بنایا ہی جا رہا ہے مگر پیداوار کا یہ روایتی طریقہ مہنگے خام مال اور ماحول دشمن نتائج کی وجہ سے زیادہ کارگزار نہیں۔ کیا ہی اچھا ہو کہ اِس اہم کیمیائی مرکب کی پیداوار کا ذمہ حیاتیاتی طرزِ عمل کو سونپ دیا جائے! شعبۂ کیمیا اور کیمیائی انجنئیرنگ کے ڈاکٹر روفس ڈِکسن کی تحقیق اسی مرکزی خیال کو عملی جامہ پہنانے کی ایک بامعنی کوشش ہے۔

ڈاکٹر ڈِکسن کا تحقیقی مقالہ حال ہی میں ایک نامور سائنسی جریدے Energy and Environment Science میں شائع ہوا ہے۔ اِن کی تحقیق میں سکسینک ایسڈ کو سستے، موثر اور ماحول دوست طریقوں سے بنانے کی تجویز دی گئی۔ دراصل ڈاکٹر ڈِکسن کی تحقیق ۵ اہم سوالات کے جواب تلاش کرتی ہے:

۱۔ سکسینک ایسڈ کی پیداوار میں کون سا خام مال استعمال ہونا چاہیے؟

۲۔ پیداوار کو مزید سستا کرنے کے لیے کون کون سی فنیات و صنعتیاتی ترکیبیں استعمال کی جا سکتی ہیں؟

۳۔ پیداوار سے جڑے معاشی اور ماحولیاتی اثرات کیا ہوں گے؟

۴۔ اس پورے عمل کو سرمایہ کار کے لیے معاشی طور پر پُرکشش کرنے میں کونسے عناصر اہمیت کے حامل ہیں؟

۵۔ سکسینک ایسڈ کی پیداوار میں کون سے معاشی مسائل قابلِ نظر ہیں؟

ان سوالات کو سلجھانے کے لیے ایک ایسی سیمولیشن تیار کی گئی ہے جس میں صرف ایسے خاکوں پر نظر ثانی کی گئی جو معاشی طور پر استحکام فراہم کر سکیں۔ "مونٹی کارلو" قسم کی سیمولیشن کے ذریعے ہر ممکن حل کے جوکھم کا تخمینہ بھی لگایا گیا۔ ایک پیچیدہ ریاضیاتی ماڈل کے ذریعے ۸۵ ہزار سے زائد متغیر عناصر اور ۳۵ ہزار سے زائد پابندیاں لگائی گئیں، گویا سکسینک ایسڈ کی حیاتیاتی طرزِ عمل کے ذریعے پیداوار کو مختلف زاویوں سے مستحکم اور قابلِ عمل بنانے کی کوشش کی گئی۔ معلوم ہوا کہ سکسینک ایسڈ کو بڑے پیمانے پر بنانے کے لیے گلیسرول سے اخذ کردہ طریقہ سب سے موثر ہے، جس کی سالانہ لاگت ۱۳.۵ کروڑ ڈالر ہوگی۔

کسی بھی سرمایہ کار کے لیے نقصان سے بچاؤ اُس کی پہلی ترجیح ہوتی ہے۔ چنانچہ اِس پوری کاوِش کو صنعتی اعتبار سے کارآمد بنانا ڈاکٹر ڈِکسن کی بھی اوّلین ترجیح رہی ہے تاکہ سکسینک ایسڈ کی بڑے پیمانے پر تیاری کو حقیقی جامہ پہنایا جا سکے اور اِس اہم کیمیائی مرکب کی ماحول دوست اور معاش دوست پیداوار کو یقینی بنایا جا سکے۔ ہم ڈاکٹر ڈِکسن کی اِس قابلِ ستائش کوشش پر اِن کو مبارک باد پیش کرتے ہیں اور اُمید کرتے ہیں کہ ان کو مستقبل میں بھی ایسی کامیابیاں ملتی رہیں۔

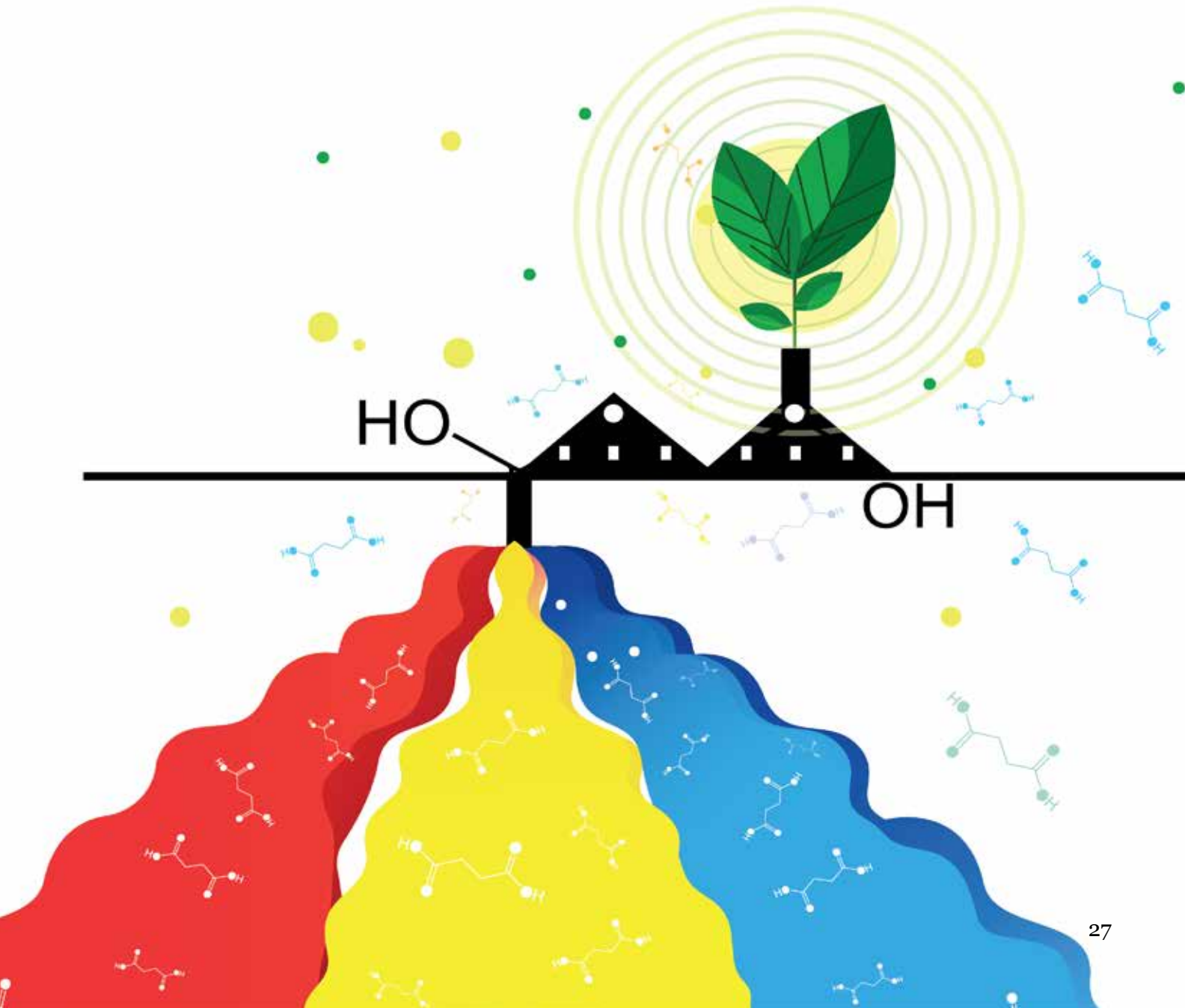
حوالہ:

Dickson, Rofice, et al. 'Sustainable Bio-Succinic Acid Production: Superstructure Optimization, Techno-Economic, and Lifecycle Assessment'. Energy & Environmental Science, Apr. 2021 DOI:10.1039/D0EE03545A

مصنف:
روشان بخاری

حَسبِ ضرورت سکسینک ایسڈ

ڈاکٹر روفس ڈِکسن کا نسخہ



A High Honour

Nazish Naeem, a BS student from The Department of Electrical Engineering at SBASSE, has been offered a fully-funded PhD position at MIT!

The Department of Electrical Engineering continues to celebrate its students' excellent academic placements in top international universities across the globe. We are thrilled to announce that Nazish Naeem, a BS student from The Department of Electrical Engineering at SBASSE, has been offered a fully-funded PhD position at MIT for Fall 2021 admissions. She will join Signal Kinetics Group at MIT Media Lab, where she hopes to contribute to "inventing, building, and deploying wireless sensor technologies to address complex problems in society, industry, and ecology."

Nazish found herself fascinated by the field of Signal Processing and developed her research portfolio in this area. She plans to continue her higher studies in the same field. The entire SBASSE community wishes her the best of luck in her future studies and research.

Written by **The Particle Team**

Expressing her gratitude to the department while emphasising its role in her achievements, Nazish recalled that being a first-generation college student, she had always believed in the power of education. She mentioned that soon after starting her career as a student of electrical engineering at SBASSE, the opportunities provided by her teachers in the School broadened her horizon and paved the way for a better understanding of concepts

A Prestigious Recognition

For his outstanding and vibrant contributions to Computer Networks between 2011 and 2020, Dr. Zafar Ayyub Qazi has recognised as the AI 2000 Most Influential Scholar (Honourable Mention).

He ranks 17 in the list that includes researchers from Stanford, MIT, UC Berkeley, CMU, Google and Microsoft Research.

Sifting through more than 133 million expert profiles and over 270 million publications from across the globe, Tsinghua University's AMiner software generates a list that covers 20 sub-fields of computer science and recognises top-cited research scholars who have made outstanding technical contributions with lasting impact. Moreover, the inclusion of computer scientists in this list is recognised and celebrated by universities and technology companies due to its prestige.

The list recognises the top 100 computer scientists in a given sub-field based on the most citations in the top venues in that area from 2011-2020. For computer networks, they considered publications in the leading research venues like ACM SIGCOMM and ACM MobiCom. We want to extend our congratulations to Dr. Zafar Qazi on behalf of the entire SBASSE community and wish him well in all his future research.

More information on the AI 2000 listing:

https://www.aminer.org/ai2000

Written by **The Particle Team**

Among Giants!

Dr. Khaled Letaief elected to the US National Academy of Engineering

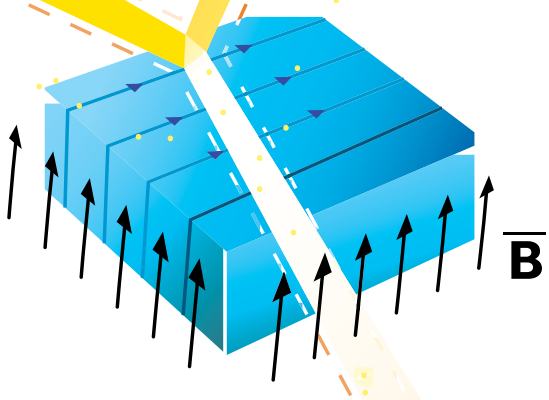
Dr. Khaled Letaief joins the US National Academy of Engineering (NAE) – one of the highest professional distinctions awarded to an engineer!

Written by **The Particle Team**

Membership of the NAE recognises those with pioneering contributions in the advancement of the field not only in research literature but, as per NAE fine text, "developing and implementing new and innovative approaches to engineering education." Dr. Letaief's membership to NAE is the culmination of a year-long peruse, sifting through thousands of well-qualified professionals for the most deserving of this accolade.

Dr. Letaief is a member of the SBASSE Advisory Board, sharing valuable insight for educational efforts made in the developing world. These insights are firmly rooted in the ground realities of a developing society. He is also the New Bright Professor of Engineering at the Hong Kong University of Science and Technology (HKUST). He is a world-renowned figure in wireless communications and networks research, with more than 620 journal papers, exceeding 35,000 citations!

برقی مقناطیسیت میں دو جہتی ٹوپولوجیکل مادے کی روشنی سے شناسائی



لَمز کی فزلیب میں بطور پی ایچ ڈی طالبِ علم خدمات انجام دیتے ہوے، مزمل شاہ نے اپنے تحقیقی مقالے میں دو جہتی ٹوپولوجیکل مادے پر روشنی گرنے سے نت نئے بدلتے زاویوں کی تحقیق پیش کی۔ امید ہے کہ ایسی جانچ پڑتال سے بائیوسینسرز کے ارتقا میں جدت لائی جا سکے گی اور مقناطیسی قوت ناپنے والے آلات کو بھی مزید بہتر بنایا جا سکے گا۔

مزمل شاہ صاحب نے اپنی تحقیق میں اِن غیر معمولی مٹیریلز کا استعمال کیا جن کا ڈھانچہ تین پرتوں پر مشتمل ہوتا ہے۔ اس میں پہلی اور تیسری پرت، جس کو دو جہتی سطح تصور کیا جاتا ہے، نہایت باریک ہوتی صرف ۵ تا ۱۰ نینومیٹرز موٹی اور برقی اصالت کی خوبی رکھتی ہیں، جبکہ درمیانی تہہ غیر موصل ہوتی ہے۔ مزمل شاہ کی سیمولیشن میں اوپر اور نیچے والی دو جہتی سطح پر روشنی گرائی جاتی ہے جس کے انعکاس میں اہم معلومات چھپی ہوتی ہیں۔ مگر اس سیمولیشن میں مزمل صاحب نے ایک اور متغیر عنصر کا اضافہ کیا: یعنی مقناطیسی قوت۔ اس اضافی جز سے پیدا ہونے والی توانائی کو زیمین انرجی کہا جاتا ہے۔ پہلی اور تیسری پرتوں پر گرتی ہوئی روشنی مقناطیسی میدان میں اپنی تقطیب میں ردوبدل کرتی ہے۔ یہ گھومنے کا عمل دو طرح سے بیان کیا جاتا ہے۔ جب مادے پر روشنی گر کر واپس پلٹ جائے تو اس کو گردشِ کر، جبکہ یہی عمل اگر اس طرح واقع ہو کہ روشنی مادے میں سے آر پار گزر جائے، تو اس کو گردشِ فاراڈے کہتے ہیں۔

مزمل شاہ نے دریافت کیا کہ ۵ ٹیسلا کے مقناطیسی میدان میں حیرت کن حد تک بڑی گردشِ کر دیکھی گئی۔ جبکہ اس طرح کے تجربات میں عمومی طور پر دوسرے مادوں میں گردش محض ۵ یا ۶ ڈگری تک ہوتی ہے۔ اس سیمولیشن میں یہ بڑھ کر ۱۵ ڈگری تک ناپی گئی! امید ہے کہ یہ کھوج طبیعیات کے معروف مضمون کوانٹم تھیوری کے مزید کرشمات کو انسانی عقل و فہم کے قریب لانے میں مدد دے گی۔

یہ تحقیقی مقالہ ڈاکٹر صبیح انور، ڈاکٹر علی اکبر اور ڈاکٹر محمد ساجد کے تعاون سے مکمل کیا گیا۔

Doubling Down on Awards!

Winner of the inaugural Syed Babar Ali Research Awards, Dr. Abdul Rehman Aslam from the Department of Electrical Engineering at SBASSE has been selected for the IEEE Circuits and Systems Society Pre-Doctoral Award!

The purpose of the annual IEEE Circuits and Systems Society (CASS) Awards is to illuminate the accomplishments of its members and celebrate their dedication and contributions in the field. CASS offers grants to recognise its young members enrolled in a PhD programme in an area related to the Society's Field of Interest. The Society has top-tier membership scientists from across the globe and organises numerous conferences every year. Winning an award from the CASS is a high honour granted to the best research institutions and the best researchers.

In honour of this recognition, the CASS granted USD 2,500 to Dr. Abdul Rehman Aslam to aid his ongoing research efforts. Dr. Rehman credits this achievement to the support and mentorship of his PhD advisor, Dr. Awais bin Altaf. Dr. Rehman's work on developing wearable technology to sense early symptoms of ASD (Autism Spectral Disorder) by monitoring the brain activity of affected children had won him the SBARA award last year. We congratulate Dr. Abdul Rehman Aslam on this laudable achievement and wish him success in his future research.

Written by **The Particle Team**

Distinguished Teaching Award

Dr. Adeel Pasha, Department of Electrical Engineering, SBASSE

Written by **The Particle Team**

Dr. Adeel Pasha has played a pivotal role in modernising course contents in the area of embedded systems. In addition to preparing and delivering high-quality lecture content, Dr. Pasha's passion for teaching is most demonstrated by his untiring efforts towards enriching his students' learning experience with hands-on lab exercises and excellent mentorship. He is often seen sweating over lab equipment and ironing out all steps for the lab content. Faced with a fast-changing field, Dr. Pasha is known to continuously adapt his course content to ensure his students' cutting-edge training. His outstanding commitment is duly recognised by his students as well as his peers.

Dr. Pasha is also an exceptional researcher, working in digital system design, embedded computing, and hardware architectures for artificial intelligence. Besides outstanding teaching and research, he has rendered invaluable services for the department. Receiving a Distinguished Teaching Award or Outstanding Service Award is one of the highest recognitions for faculty at any academic department.

Outstanding Service Award

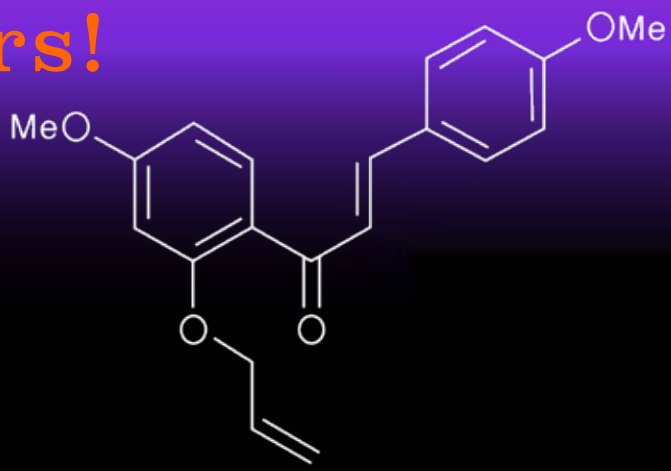
Dr. Wasif Tanveer Khan, Department of Electrical Engineering, SBASSE

Dr. Wasif Khan has been recognised as an exemplary faculty member to help establish departmental connections with the industry and leading initiatives for societal impact. Along with other colleagues, his untiring efforts have opened the door for EE students to gain opportunities for internships and different types of industrial exposure. Dr. Wasif works directly with several local and international industries for his research.

Dr. Khan collaborated with the National Incubation Center (NIC) to establish a Makers Lab at LUMS with industrial funding. The Makers Lab has opened its doors to faculty, students, and industry professionals nationwide for prototyping products and learning industrial skills. His efforts have also helped create a technology development fund at LUMS for the electronics industry to support entrepreneurial activities by our faculty and students. He is also the patron of the IEEE student chapter at LUMS, which organises electronics and computing-related activities. Dr. Khan is also a distinguished researcher in the area of RF and Microwave systems. Receiving a Distinguished Teaching Award or Outstanding Service Award is one of the highest recognitions for faculty at any academic department.

Chalcone 4

Taking Leukemia to The Cleaners!



Our body works like a country – we have cells that carry out particular functions with some contributing to defense (white blood cells).

One may think the greater the white blood cell count, safer the body. However, you may have heard of the moniker "excess of everything is bad". It stands true with white blood cells too. Sometimes white blood cells are created in a much larger number, but they don't seem to work right. Something goes awry in the production line and quantity takes over quality, abundance takes over function and blood cancer, called leukemia, begins its onset.

Leukemia relapse is observed in some patients, sometimes with deadly consequences, when a certain enzyme in these cancer cells is triggered. This 'funny bone' of cancer cells is the FLT3 enzyme. Ugly name for an ugly character! However, we can always trust nature to have all the elements of a well-balanced script. This is where the combined efforts of Haleema Sadia Malik and her team, including Dr. Amir Faisal and Dr. Rahman Saleem make a plot entry. The team figured out a way to 'inject this enzyme with poison' so that it stops working. They have discovered an enzyme inhibitor that targets specifically the FLT3 and even stops the process of reproduction within cancer cells that house this troublemaker of an enzyme. The inhibitor of ugly we're referring to is Chalcone 4. Chalcone 4 - it has a nice ring to it, doesn't it? Well, Haleema's team will agree!

Researching on a family of Chalcones, Haleema and her team have learned that different types offer different blows to FLT3 with Chalcone 4 being a direct inhibitor of FLT3 – exactly what was needed.

The research paper was published in the American Chemical Society's *Journal of Natural Products*.

Reference: Haleema Sadia Malik, Aishah Bilal, Rahim Ullah, Maheen Iqbal, Sardraz Khan, Ishtiaq Ahmed, Karsten Krohn, Rahman Shah Zaib Saleem, Hidayat Hussain, and Amir Faisal
Journal of Natural Products
DOI: 10.1021/acs.jnatprod.0c00699

Written by **The Particle Team**

Designing Reprogrammable Chemicals and Materials!

MOF (Metal Organic Framework) is the name of the game here. This unique group of compounds, that look like tiny spheres trapped inside a cube-shaped frame, exhibit the extraordinary ability to be reprogrammed and therefore be reused once a chemical reaction is over. Dr. Basit Yameen, Associate Professor at the Department of Chemistry and Chemical Engineering at SBASSE, along with his team of researchers herald the age of chemicals and materials that are programmable according to the wishes of the chemist!

Co-led by Dr. Basit, a team of researchers spanning three different continents (Europe, Asia and Australia) was able to pull off the extraordinary feat of developing a simple route to reprogram the chemical nature of MOF materials. One of ways to flip the switch of reprogram-ability was found to be through thermally triggered reversible Diels–Alder (DA) and hetero-Diels-Alder (HDA) reactions through the trifecta of Zirconium, Zinc and Aluminium derived MOFs. In addition, the thiol-maleimide Michael addition reaction was also demonstrated as a post-synthetic modification (PSM) for the fabrication of chemically diverse MOFs.

This exciting piece of work is part of Dr. Basit's research efforts focused on developing facile strategies for chemical reprogramming of a diverse range of materials. Considering the ever-evolving challenges associated with sustainable and reliable access to functional materials and their fossil fuel origin, the discovery of such strategies will enable the practical realisation of Circular Economy model. The members of Dr. Basit's research group Dr. Sana Nayab (Postdoctoral research fellow) and Ms. Iqra Azeem (PhD student) played a leading role in this study.

The study was published in the leading American Chemical Society (ACS) Journal Inorganic Chemistry.

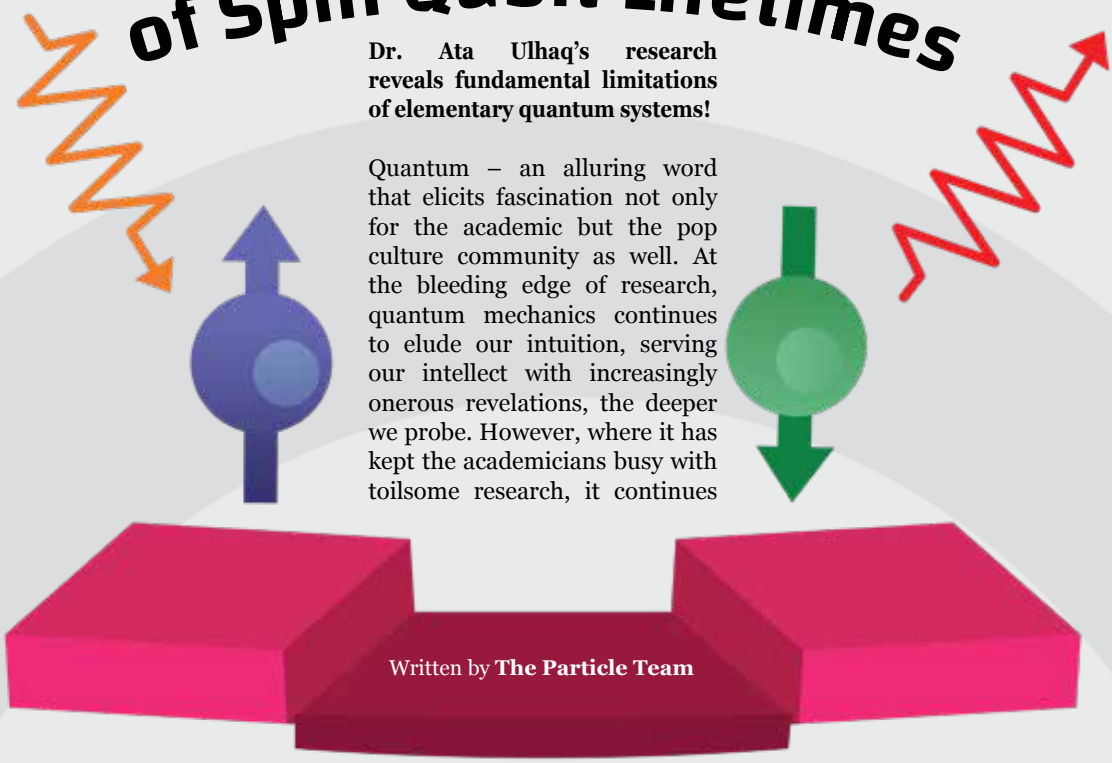
Reference: Reversible Diels–Alder and Michael Addition Reactions Enable the Facile Postsynthetic Modification of Metal–Organic Frameworks.
Sana Nayab, Vanessa Trouillet, Hartmut Gliemann, Peter G. Weidler, Iqra Azeem, Saadia R. Tariq, Anja S. Goldmann, Christopher Barner-Kowollik, and Basit Yameen. Inorganic Chemistry 2021 60 (7), 4397-4409

DOI: 10.1021/acs.inorgchem.0c02492

Written by **The Particle Team**

Probing Limits of Spin Qubit Lifetimes

Dr. Ata Ulhaq's research reveals fundamental limitations of elementary quantum systems!

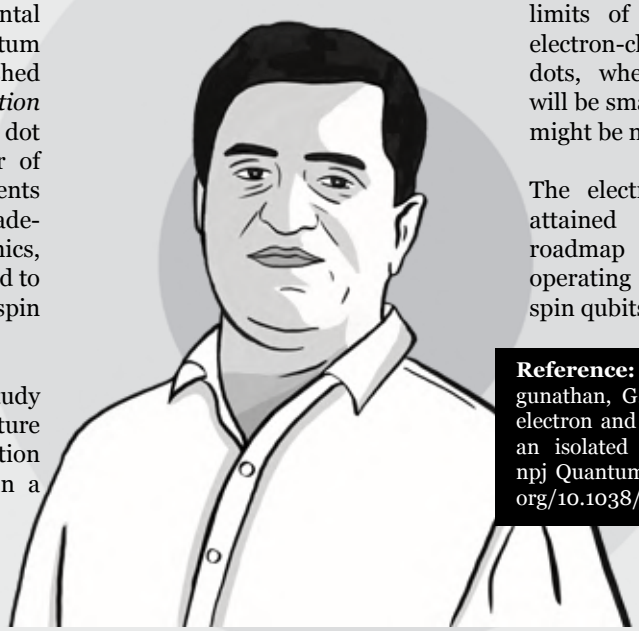


Written by **The Particle Team**

Quantum – an alluring word that elicits fascination not only for the academic but the pop culture community as well. At the bleeding edge of research, quantum mechanics continues to elude our intuition, serving our intellect with increasingly onerous revelations, the deeper we probe. However, where it has kept the academicians busy with toilsome research, it continues to hold promise for great technological advancements also. Our understanding of any physical discipline is incomplete without also understanding its basic, fundamental limits.

Dr. Ata Ulhaq, Assistant Professor of Physics, has co-authored a paper revealing insights into the fundamental limitations of elementary quantum systems. This paper has been published in Nature's *npj Quantum Information journal*. By setting up a quantum dot (a man-made electron transporter of nanoscale proportions), experiments reveal fundamental limits and trade-offs of quantum dot spin dynamics, while reduced tunnelling can be used to achieve longer lifetimes of electron spin qubits, exceeding one second.

Experiments presented in this study establish a comprehensive picture of electron–nuclear spin relaxation in self-assembled quantum dots in a wide range of practically accessible conditions. Current experiments require a magnetic field intensity greater than 0.15T to initialise the spins. In these experiments, electron spin relaxation is fundamentally limited by phonon coupling in. However, nuclear spin relaxation studied in Dr. Ata's work is specific to III-V quantum dots and is governed by noncollinear hyperfine interaction. The techniques employed in this study can also be applied to establish the less explored fundamental limits of nuclear spin dynamics in electron-charged strain-free quantum dots, where noncollinear interaction will be small, but nuclear spin diffusion might be more prominent.



The electron-nuclear spin relaxation attained in this work provides a roadmap for design of the optimal operating conditions in quantum dot spin qubits.

Reference: Gillard, G., Griffiths, I.M., Ragunathan, G. et al. Fundamental limits of electron and nuclear spin qubit lifetimes in an isolated self-assembled quantum dot. npj Quantum Inf 7, 43 (2021). https://doi.org/10.1038/s41534-021-00378-2

PERCEPTRON

Breakthrough in in-silico biology

We are living, breathing chemical conglomerates who've carefully gathered knowledge over the course of centuries, to piece together clues in solving one of the greatest mysteries of our existence – the origin of life on Earth.

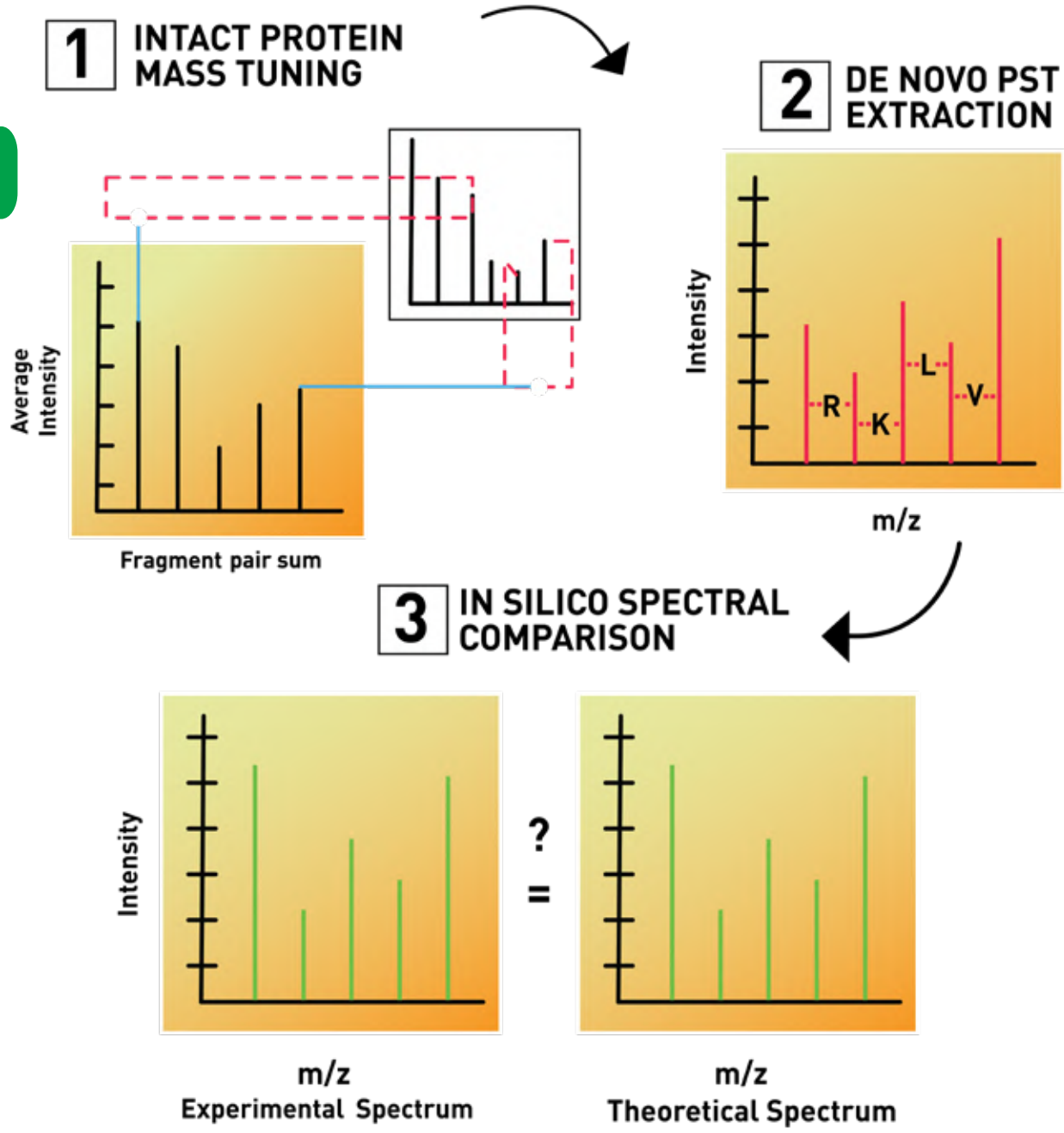
Written by **The Particle Team**

An understanding of proteins has been a low hanging fruit of this endeavour. Decades of meticulous research on these magical molecules have revealed that much of life's rich tapestry rests upon their complex and delicate structures. Therefore, tools and mechanisms that can zoom in on the structure of proteins and reveal the identification, are of incredible importance to scientists working on the frontier of life sciences research.

Dr. Safee Ullah Chaudhry, and his team of researchers, have developed a breakthrough tool, called PERCEPTRON, for highly efficient proteoform identification from top-down proetomics (TDP) spectral data. Their work has been published in the journal Nucleic Acids Research (NAR); a paramount achievement requiring nothing less than an outstanding team of researchers.

PERCEPTRON, a web-based platform that outperforms all other similar tools by up to 135% in terms of reported proteins numbers and is ten times more efficient in terms of runtime. In a technological masterstroke, Dr. Safee Ullah and his team have designed PERCEPTRON's search pipeline to bring together algorithms for six different perimeters; (1) intact protein mass tuning, (2) de novo sequence tags-based filtering, (3) characterization of terminal as well as post-translational modifications, (4) identification of truncated proteoforms, (5) in silico spectral comparison, and (6) weight-based candidate protein scoring. To meet PERCEPTRON's heavy demand of powerful and robust technology, GPU units by NVIDIA were used, along with Microsoft ASP.NET and ANGULAR Frameworks.

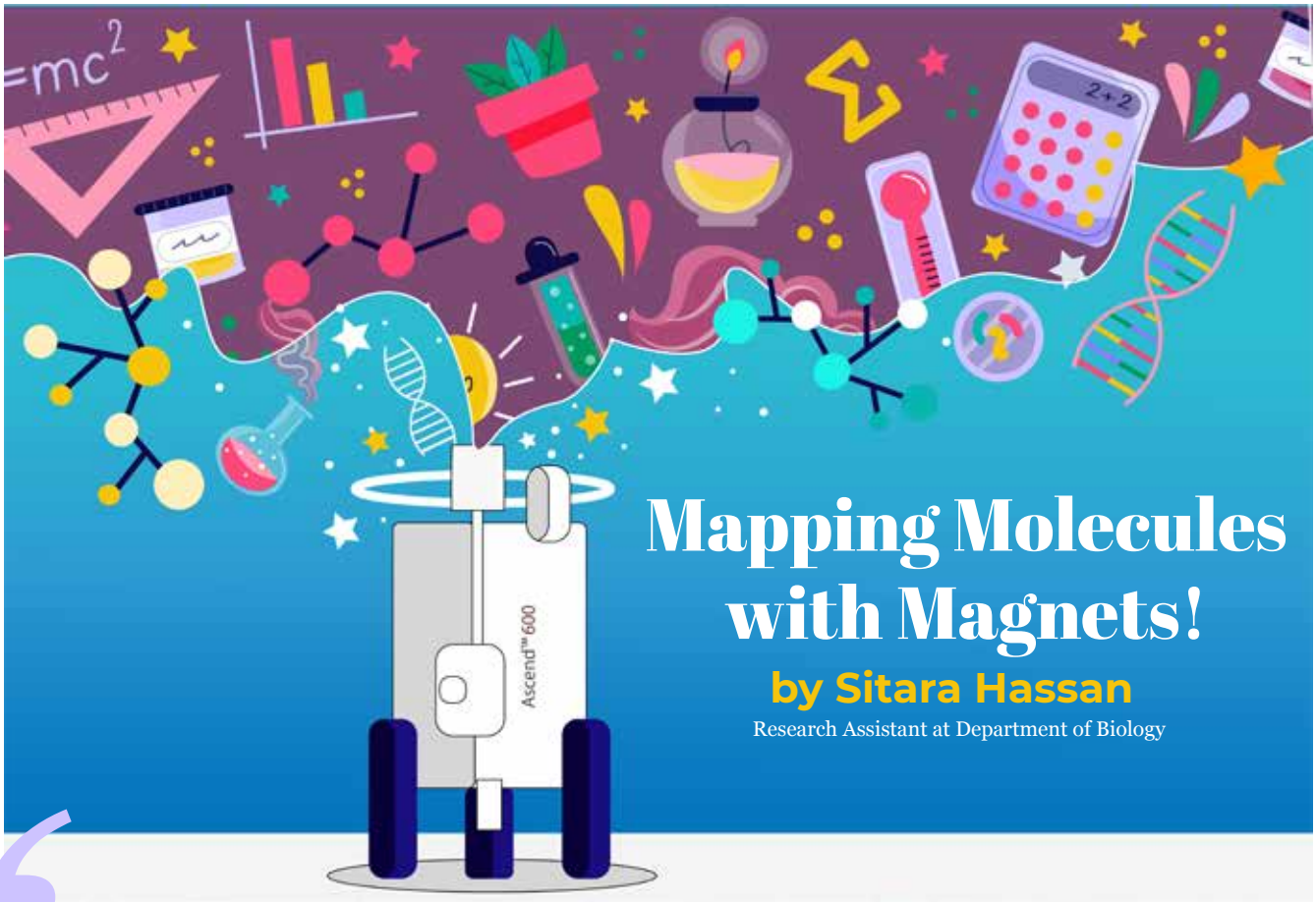
PERCEPTRON aims to fill the voids in conventional protein identification software for TDP data, and make the process easier, more efficient and reliable. We congratulate Dr. Safee Ullah Chaudhry and his team for championing this multi-year effort through in-house resources at SBASSE, and pioneering Computational Biology and Bioinformatics research at the School.



Reference:
Muhammad Farhan Khalid, Kanzal Iman, Amna Ghafoor, Mujtaba Saboor, Ahsan Ali, Urwa Muaz, Abdul Rehman Basharat, Taha Tahir, Muhammad Abubakar, Momina Amer Akhter, Waqar Nabi, Wim Vanderbauwhede, Fayyaz Ahmad, Bilal Wajid, Safee Ullah Chaudhary, PERCEPTRON: an open-source GPU-accelerated proteoform identification pipeline for top-down proteomics, Nucleic Acids Research, 2021;, gkab368, https://doi.org/10.1093/nar/gkab368

More information on PERCEPTRON:
https://perceptron.lums.edu.pk/index.html#/home

The NMR Training Internship Programme



Mapping Molecules with Magnets!

by Sitara Hassan

Research Assistant at Department of Biology

If you ever have had the chance to visit the SBASSE basement,

you may have glanced upon what looks like a spaceship standing proudly with an air of futuristic appeal. This is actually the Nuclear Magnetic Resonance (NMR) Spectrometer, a fundamental piece of technology that is pioneering research and development across a multitude of disciplines.

The NMR Spectrometer Lab at LUMS is a state-of-the-art facility, being the first of its kind in the region, and boasts a miraculous machine capable of probing nuclear spins to determine molecular architecture (imagine an atomic ballet, choreographed by the forces of magnetism!). It has not only enabled the instant identification of the structural characteristics of compounds, but has also shed light on the vast network of interactions involved at an atomic level. For instance, the discovery of a therapeutic drug extracted from cloves against Dengue virus by students at the Department of Chemistry and Chemical Engineering, or the anti-viral activities of a protein engineered at the Department of Biology last year, is but a small demonstration of the promising potential of employing NMR studies.

Recently, two undergraduate SBASSE students received the proverbial Golden Ticket to gaining a hands-on experience through a ten-week long NMR Training Internship Programme organised by the Department of Biology. Muhammad Azhan (BS Chemistry) and Wahaj Ayub (BS Physics) participated in learning the intricate technicalities of the NMR instrumentation. From sample preparation to data visualization, the apprenticeship was a whirlwind of activities and rigorous training, fostering a proactive involvement by the interns.

The internship was a great way to delve deeper into exploring the specifics of the spectrometer and its associated equipment, ultimately bringing out a practical perspective to theoretical knowledge. During the duration of the training, the students learnt about safety precautions for proper handling of the machine,

operated sophisticated software (such as TopSpin), and ran various NMR techniques (If Heteronuclear Single Quantum Coherence, (HSQC) or Correlation Spectroscopy (COSY) has you scratching your head in confusion, fear not. Such methods simply help to reveal the arrangement of interacting particles - sort of like a Google Map of their location!) The two apprentices also expertly calibrated parameters predicted and interpreted spectral data.

For Wahaj, the internship was an exciting prospect of seeing a topic in a Physics course that he had merely read in passing, come to life before his very eyes! When contacted for a short interview, he also shared how he felt intimidated the first time he saw the gigantic NMR machine - expensive and extremely fragile- but gradually came to appreciate the technology when it would seamlessly react to the input commands. Learning, he exclaims, is especially nice when it is outside of the classroom environment and pressure. Rising to the task of becoming proficient at something new, he is hopeful that similar opportunities would be available for students in the future He was, however, constantly afraid of breaking one thing or the other! He also highlighted how the biggest challenge for him was navigating through the internship in times of the COVID-19 lockdown, and he is sorry that part of it was left incomplete as they had to cut it short. Wahaj is utterly grateful to Dr. Muhammad Adil Raees (NMR Facility Manager) and wishes to thank him again for the kind help throughout the apprenticeship!

Answering the question of how he first came to pursue Chemistry, Muhammad Azhan explained that the concept of 'Learning Without Borders' at LUMS, whereby freshmen partake in various SBASSE core courses before declaring their major, lent him exposure to diverse disciplines. Taking a CHEM 101 class by Dr. Habib-ur-Rehman was the turning point in taking up this field in order to unravel the 'mystery of matter' and contribute to solving threats of global warming, energy crisis, pollution and resource scarcity. In his correspondence, he also mentioned that he has been enthralled by the likes of Dr. Muhammad Abdus Salam, Dr. Irshad Hussain and Dr. Basit Yameen for building scientific curiosity and igniting his interest. He found the internship programme to be tremendously unique and rewarding, and one that cultivated critical thinking along with inquisitiveness. It also equipped him with the technical expertise that proved immensely valuable in his quest to pursue higher education. He is honored to be part of this enlightening experience!

When asked if there was anything that could be done to improve the internship, both Wahaj and Azhan believe that the development of a manual/handout to incorporate all the learning material would help make the initiation process easier for the interns.

After getting in touch with Dr. Muhammad Adil Raees, the NMR Facility Manager, he gave an account of how his research involves the isolation of natural products from medicinal plants and their structural characterization using both NMR and mass spectroscopic techniques. He further described how a three-month long internship at the NMR facility at the University of Karachi sparked his interest for the first time, and that even after ten years of working with this marvellous machine, each day is replete with the surprise of uncovering the veiled through the eye of the NMR.

When questioned about the favorite aspect of his work, he conveyed that it was supervising and supporting the operation of the NMR laboratory as well as aiding students to run experiments with the spectrometer. While working with NMR is technically demanding of expertise, experience and knowledge for proper upkeep, he proudly exclaimed that they have successfully maintained this facility ever since its induction and strive to continue doing so. In the very near future, he wishes for students and researchers from other institutes to also have the opportunity to inculcate this instrument in their work in order to not only improve the education standards of Pakistan, but to also establish quality research in areas of structural biology, drug discovery, vaccine development, metabolomics and synthetic chemistry.
In an interview with Dr. Syed Shahzad-ul-Hussan, an Associate Professor at the Department of Biology and part of the NMR core team, he expressed that he had had a great time supervising the keen interns during their training. He explained that he initially came across the NMR spectroscopy during his MPhil and later during his PhD in Bio-organic Chemistry at the University of Luebeck, Germany, where his advisor encouraged his interest in discovering answers on the atomic level. He fondly remembers how deeply engrossed he was in trying to solve the structure of a protein during his Postdoc, that his supervisor would come in the evening to say "Go home now!" because 15-16 hours would have passed without Dr. Shahzad noticing! And this is exactly what he loves about his work- discovering the structural basis of a biological process because it gives a real picture. Using the NMR has been such an exceptional experience that it has become an integral part of his career! His research centres around drug discovery against viruses and comprehending the cross talk between viruses and the human immune system to subsequently obtain the necessary information for designing vaccines. He elucidated that NMR spectroscopy is crucial for this in several ways- to identify new molecules from nature as potential antiviral agents, to determine the structure of such compounds, to study the atomic level interactions between the drug and its viral target and then to further optimise their efficacy, and besides this, the structural and dynamic studies of protein and glycans can also aid in answering important biological questions of molecular recognition.

So, the next time you come across the NMR spectrometer, I hope you find it to be a glorious example of human ingenuity and innovation- with each piece of data bringing clarity to the jigsaw puzzle of scientific questions and conundrums- and that this remarkable contraption inspires you to join the NMR bandwagon!

Peril in the Plant Room

by Sitara Hassan

Carl Sagan Write for Science internship

Much like an Agatha Christie novel, mystery shrouded the Department of Biology a few months ago when the incubator in the Plant Growth Rooms refused to maintain its temperature to the set 18 ˚C and 25 ˚C. Fearing a fire hazard when the temperature shot up to 56 ˚C, help was sought from the company that had fitted the incubators in the first place.

Installed by Force Engineering, the four series of walk-in incubators, barred by heavy steel doors, come equipped with controls for temperature, humidity and light settings to mimic the conditions necessary for optimum growth and proper circadian rhythms (an internal biological clock tuned to light and dark cycles). While two incubators are reserved for the tiny Drosophila (pronounced Droh-so-filaa) flies buzzing around in their cylindrical food vials, the other two are filled with plant seedlings in plastic pots on racks with fluorescent lighting. These are, of course, the Plant Growth Rooms that harbor various genetic experiments attempting to understand and characterize plant response to an assortment of stress factors.

Though the Plant Growth Rooms were established several years ago by the pioneering work on plant molecular biology led by Dr. Ahmed Jawaad Afzal, they have just now been continued for use by the newest addition to the Department of Biology - Dr. Khurram Bashir. Unfortunately, it was soon observed that only one outdoor unit was functioning (and that too, barely) while three others had lost utility altogether. Though the indoor units were working, they were unable to maintain the correct levels of temperature and humidity. Further investigation only then revealed the depth of the damage- Extensive fungal contamination on the indoor units, burst pipes and loss of gases had contributed to the malfunction.

When Force Engineering was contacted for the maintenances, the Department of Biology learnt that the company had been disbanded and, thus, had stopped all their services. With great technical expertise needed for this repair job, hope seemed to be a thinning silver line of a very dark cloud.

Would a fix be found in time?

Then a light bulb went off, and it was decided to procure the same external source that was used for the upkeep of fridges/freezers/cold rooms to restore the walk-in incubators. Bismillah Engineering was therefore put to the task of having the incubators up and running, which they miraculously did in no time!

Not only were all four outdoor units now operational but extensive servicing of all components, thorough cleaning of the indoor units, refilling of the gases, and installation of new parts was also provided by them. Additionally, all the tube lights were also replaced with efficient LED lights on the racks and halogen lamps on the ceiling.

Needless to say, the engineers saved a massive expense with their know-how and facilitated in getting the study and research on plants back on track!

Harder, Better, Faster, Stronger

The rise of super bacteria

by Mohammad Taha Zakir

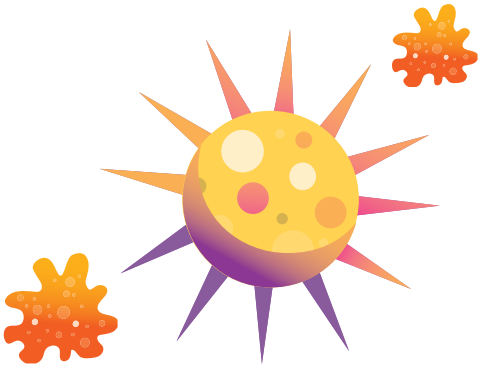
What does not kill you makes you stronger.

While not generally touted as absolute truth, the above idiom correctly sums up trends in antimicrobial resistance amongst pathogens. Like the dreaded final boss in a video game, if you do not correctly eliminate these pathogenic bacteria, they evolve into stronger, smarter versions of themselves and come right back with a vengeance. These versions, commonly known as "super bacteria," have developed mechanisms that prove resistant against common anti-biotics. Antimicrobial resistance (AMR) is currently described by the WHO as one of the top global public health threats facing humanity. This problem is exceptionally prevalent in Pakistan, where misuse of antimicrobials has resulted in increasing AMR trends amongst common pathogens. However, through the combined efforts of Dr. Nida Javaid, Dr. Safee Ullah Chaudhary and Dr. Shaper Mirza from the Department of Biology, we can start our quest in fighting back against these pathogens and defeat them once and for all.

However, every heroic journey starts with an origin story. For this tale, our researchers described how they found their passion for Biology that began a decades-long journey that culminated in the publication of a ground-breaking research study. Dr. Nida Javaid, one of the researchers for this study, tells us how curious she found illnesses to be as a child. Inquisitive from the start, she wondered how something so microscopic that it is invisible could profoundly impact our lives. Thus began her fascination with these invisible yet powerful agents leading her to choose microbiology and epidemiology as her field of interest. Equipped with a world-class education, a creative mind and a steadfast determination, our heroes understood the gravity of the threat AMR posed to Pakistan and quickly endeavoured to find a solution to this problem.

"Know your enemy." Arguably, the greatest military strategist in world history, Sun Tzu understands the

importance of insight. To guarantee victory in any battle, one must have a thorough understanding of their opponent; otherwise, they will surely bite the dust. Therefore, the first step to combating rising AMR trends was to analyze the different types of soldiers in the bacterial army, their strengths, weaknesses, and attack strategies. From a scientific perspective, this means identifying the most common pathogens that cause deadly diseases, understanding their evolution to resist certain types of anti-biotics, their geographic distribution across Pakistan and what gender or age-group demographic are most susceptible to infection.



Along with their teams, the above-mentioned researchers have been working on a comprehensive analysis of long-term AMR trends in Pakistan and have published a paper identifying these trends from 2011 to 2015. Conducting a ground-breaking study on such a massive scale poses several formidable challenges, but our researchers are faced these difficulties head-on and dispatched them with ease. Dr. Nida describes how organizing such a vast dataset for this study, from so many sources, was a monumental task. They needed information on the site of isolation, demographics, and antimicrobial susceptibility profile of each isolate against over 15 antimicrobials. That's more than 3000 separate profiles for each pathogen they encountered. Even Sun Tzu himself would have blanched at such an onslaught of information.

However, our researchers remained resolute and enjoyed the process of diligently visualizing this data. Dr. Nida fondly remembers how satisfying it was learning to utilize Circos plotting software and ultimately transforming the data into a single figure for each pathogen. After the data had been compiled, visualized and analyzed, the researchers began to draw conclusions from the results and buried under layers of increasing AMR trends for many a pathogen, they discovered something quite interesting.

The findings report a rise in antimicrobial resistance in several pathogens isolated from blood and cerebrospinal fluid cultures, such as the Acinetobacter species, which demonstrated the highest resistance rates to all antimicrobials.

This, then, could be considered the Lieutenant General of the Bacterial Army, a potent threat that must be defeated, or we would suffer dire consequences. Almost all other pathogens also showcased increasing AMR trends following their leader and showcasing the might of their army. Interestingly, decreasing resistance trends were observed for Staphylococcus aureus against common antibiotics, unlike its other aggressive pathogen comrades. To that end, we would like to nominate S. aureus for Pathogen of the Month for being so well mannered. Truly a shining example for other microbes to follow.

These findings were compiled into a research paper nearly half a decade in the making. Through this arduous journey, the researcher's preservation paid immense dividends, as Dr. Nida described her elation when this paper got accepted for publication. This data will be invaluable in planning a stellar counterattack against these pathogens. The paper highlights several actions we can take to stop the growing threat of AMR in its tracks. The public must be aware of the dangers of antibiotic misuse to resolve the problem at its source before it's too late. The battle lines have been drawn.

As one researcher described it, AMR is a major public health challenge. The antibiotic production pipeline is drying out, and microbes are becoming increasingly resistant by the day. By 2050, every minute, a person would die due to antimicrobial-resistant infections. Considering how the COVID-19 pandemic crippled the world and its economies, it is paramount that policymakers should prioritize antimicrobial stewardship to counter the rising trends of AMR.

References:
Trends in antimicrobial resistance amongst pathogens isolated from blood and cerebrospinal fluid cultures in Pakistan (2011-2015): A retrospective cross-sectional study DOI: 10.1371/journal.pone.0250226
Nida Javaid, Qamar Sultana, Karam Rasool, Sumanth Gandra, Fayyaz Ahmad, Safee Ullah Chaudhary, Shaper Mirza

https://journals.plos.org/plosone article?id=10.1371/journal.pone.0250226

clean and green reign supreme

BIOMASS VALORIZATION AT SBASSE

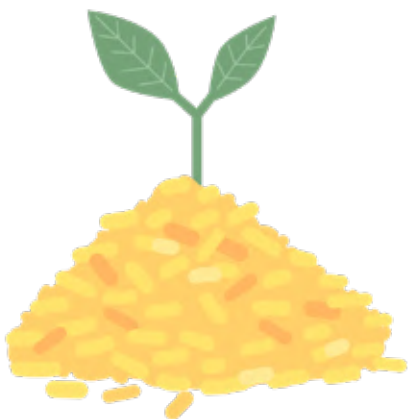
Written by The Particle Team

Green always wins. Biofuel does indeed offer a lot of value over its fossilized counterpart.

Due to the renewable nature of biomass, such fuels are infinitely sustainable, unlike fossil fuels. Furthermore, the by-products of biofuels are generally safer, non-toxic, and non-polluting as well. Therefore, it is a genuine pleasure to announce the recent successes of the chemistry department in biomass conversion, led by Dr. Muhammad Zaheer from the Department of Chemistry and Chemical Engineering, at SBASSE.

Being at the forefront of biomass research does have its perks. The Department of Chemistry and Chemical Engineering received spades of funding from the HEC for two research projects focusing on converting biomass into fuels and chemicals. While it may appear like wizardry, we would argue it is even grander in its scale. Our esteemed researchers used crop residue and waste to produce valuable chemicals through catalysis. Utilizing waste in such an effective manner can be a real boon for our weary economy.

It does not end there either. Effective utilization of biomass opens realms of possibilities for their chemicals and by-products. For instance, the Department of Chemistry and Chemical Engineering has developed a novel catalyst that does not require any external oxidant to convert the lignin (organic substance usually found in wood) content of biomass into bio-oil. Thus, as a side product, this reaction produces pulp which can further be used for papermaking. Surely that is it, right? Nope. Biomass is the gift that keeps on giving. In collaboration with Dr. Ali Rauf, also from the Department of Chemistry and Chemical Engineering, the researchers at SBASSE have decided to utilize this pulp to produce



bioethanol or even hydrogen, both excellent fuels for various processes.

In the right hands, biomass has turned out to be an absolute treasure-trove. There are always plans for future projects, scientists tinkering away and day night to unlock all the secrets of bio-mass valorization and unleash its untapped potential. Currently, they are working on a project to simultaneously convert crop residues and plastic waste into liquid fuels, which is under review for grants from HEC-CPEC and other sources. It seems nothing less than alchemy except it is environmentally friendly too.

The Department of Chemistry and Chemical Engineering is making great strides in biomass research. A team of the brightest minds in Pakistan is working together to achieve sustainable, pollution-free fuels and chemicals for Pakistan, adding much-needed economic value to our country. With partnerships at world-class institutions such as the DALIAN Institute of Chemical Physics; the sky's the limit.

Threading a needle can be a tedious task.

Imagine engineering a thread that would automatically align itself as it nears a needle and threads itself – everything would be right again! This work focuses on engineering threads that encourage self-assembled gels to form that may have important and diverse applications.

A team of researchers including Dr. Ammar A. Khan along with research teams of Dr. Ata ul Haq and Dr. Habib ur Rehman have studied ways of crafting tiny fibers made up of columns of disc-shaped crystals, called Discotic Liquid Crystals (DLCs). Discotic liquid crystals are key to this study and can be imagined as a stack of coins where the length of and order within each stack determines the physical characteristics of the resultant gel that has optoelectronic properties, which means engineers will have the capability to befriend light and electricity through this material to our benefit. This can bear applications in sensors, displays and photovoltaic surfaces with better reliability and efficiency.

Say H-A-T. The study involves four different DLCs, that have been named HAT4, HAT5, HAT6 and HAT7, where HAT stands for Hexakis Alkyloxy Triphenylene. Out of these, HAT7 has been found to create the most thermally stable gel. Additionally, a special type of solar cell was created to test the photovoltaic properties of the gel. A strong dependency was revealed between solar cell performance and gel structure of HAT7. Another important set of components for this experimental study were alkyl chains. Think of alkyl chains as extensions to molecules. They can be added or removed to make molecules shorter or longer. Different lengths of alkyl chains in a gelator medium resulted in different length and thickness of fibers.

We congratulate Dr. Ammar A. Khan and the teams of Dr. Ata ul Haq and Dr. Habib ur Rehman for this work getting published in the journal Liquid Crystals.

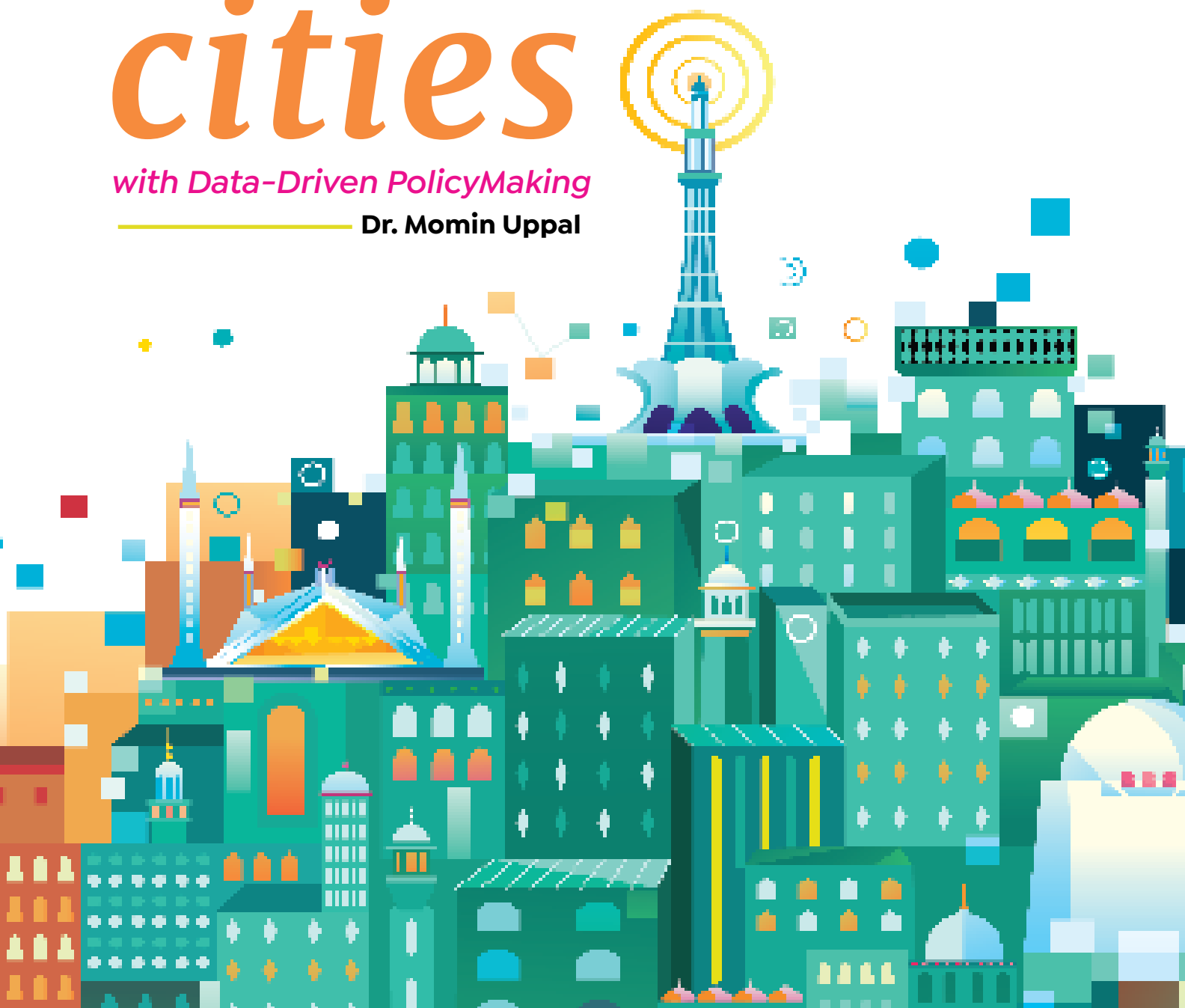
Written by The Particle Team

Reference:
Qurat Ul Ain, Sehrish Iqbal, Shahzad Akhtar Ali, Murtaza Saleem, Habib Ur Rehman, Ata ulHaq & Ammar A. Khan (2020) Engineering fibre morphology in self-assembled physical gels of a prototypical discotic liquid crystal, Liquid Crystals, https://doi.org/10.1080/02678292.2020.1825840

Saving our cities

with Data-Driven PolicyMaking

Dr. Momin Uppal



***Dr. Momin Uppal** and his team have secured a grant of Rs. 210 million for a project that strives to infuse sustainability to our cities, using technological innovations and data driven policy making.*

The project comes as a response to HEC's Grand Challenge Fund (GCF) call for proposal, which seeks to promote research excellence in strategic sectors of the economy by supporting large, multisectoral/ multidimensional research projects. Dr. Momin's project was one of five funded under the GCF, out of more than 700 applications from across Pakistan.

Seen from above, the urban sprawl of Pakistan's major cities looks like the work of an opportunistic contagion; it is chaotic, unplanned and stems a family of problems that we are all aware of and are frequently affected by its messy spin-offs. An ever-increasing strain on cities' infrastructure, environment, and public services are just a few of the most pressing issues. While Pakistan has seen data collection initiatives in the past, they have so far failed to box in these problems because of a lack of investment in technological advancements. Dr. Momin Uppal is the Principal Investigator of a project where the goal is to enable the use of technological innovations in data gathering, data analytics, and data-driven decision making for addressing problems that have plagued small and large cities of Pakistan.

To achieve this broad objective, the activities within the three-year project duration will focus on six separate, albeit intertwined vertical dimensions of an urban system. These so-called verticals span Pakistan's pressing urban problems of sprawl, environment and health, and mobility.

In particular, the six verticals are:

(1) Mapping and analysis of sprawl in major cities of Pakistan.
(2) Smart solid waste management through remote monitoring solutions.
(3) Analysis of urban mobility patterns.
(4) Tracking and countering air pollution,
(5) Tracking spatial prevalence of disease as well as analyzing vaccine coverage.
(6) Developing sustainable urban logistics solution.

Each one of the six verticals will be guided by intricately linked horizontal themes that have been designed so as to enable transdisciplinary activities as well as to ensure maximum engagement with relevant stakeholders. The horizontals include Data collection, Data analytics, Development of software toolsets, Capacity building, and Data-driven decision making and policy design. Not only will the project utilize publicly available data as well as data-sets obtained from partners, it will also focus on developing customized data-collection solutions such as a crowd-sourced network of vehicle-mounted sensors and smart device-driven data capture for urban mobility informatics, a ground-based air quality sensing network etc.

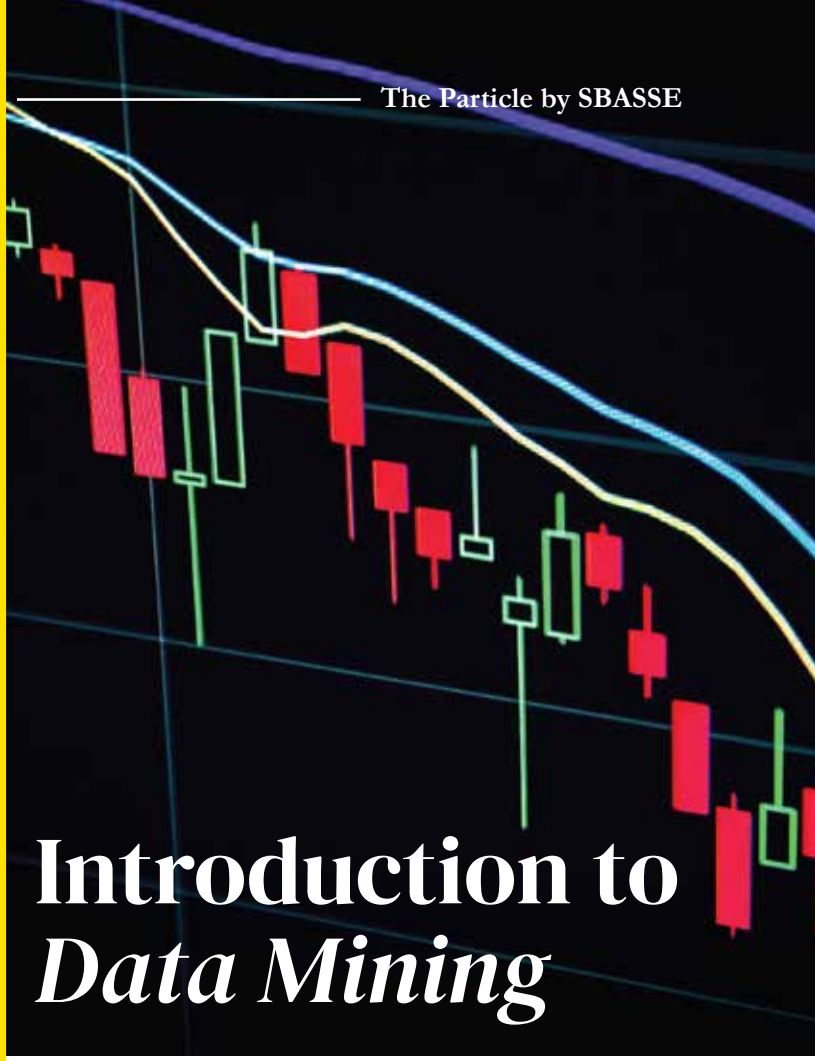
The project consists of a truly multidisciplinary team of national and international scientists. It has experts in engineering, information processing, machine learning, bio-informatics, and computer science (the technologists), as well as in urban economics, evidence-based policy design, urban policy, and public health. We wish all the best to Dr. Momin Uppal and his team in pursuing all the primary objectives of this mega project.

Written by **Roshaan Bukhari**

This summer semester brings a bouquet of riveting engaging courses, tied together by our faculty's forte and strewed with the vigor of scientific insight and pedagogical cadence. Take a look through some of the offerings of this past summer...

For more information and detail of every course offered, visit this webpage:

https://sbasse.lums.edu.pk/course-advertisements



Introduction to *Data Mining*

A comprehensive introduction to the data mining process.

By Dr. Asim Karim

Data mining is popularly applied in the industry and it is an active area of academic research.

This course will provide a comprehensive introduction to the data mining process; build theoretical and conceptual foundations of key data mining tasks such as itemset mining and clustering; discuss analysis and implementation of algorithms; and introduce major sub-areas such as outlier and time series analysis. Emphasis will be placed on the design and application of efficient and scalable algorithms.

The students will get hands-on experience through the implementation of algorithms and use of software in the assignments.

This course is taught by Dr. Asim Karim, Professor of Computer Science, SBASSE.

Machine Learning

A thorough introduction to the theoretical foundations and practical applications of ML.

By Dr. Zubair Khalid.

Machine learning (ML) studies the development of algorithms that learn from the data and improve their performance through experience. ML refers to a set of methods that help computers to learn, optimise and adapt on their own.

This course provides a thorough introduction to the theoretical foundations and practical applications of ML. Students will learn fundamental algorithms in supervised learning and unsupervised learning. They will not only learn how to use ML methods and algorithms but will understand the underlying theory building on mathematical foundations. While reviewing the several problems and algorithms to carry out classification, regression, clustering, dimensionality reduction, we will focus on the core fundamentals which unify all the algorithms.

This course is offered by Dr. Zubair Khalid, Assistant Professor in the Department of Electrical Engineering, SBASSE.

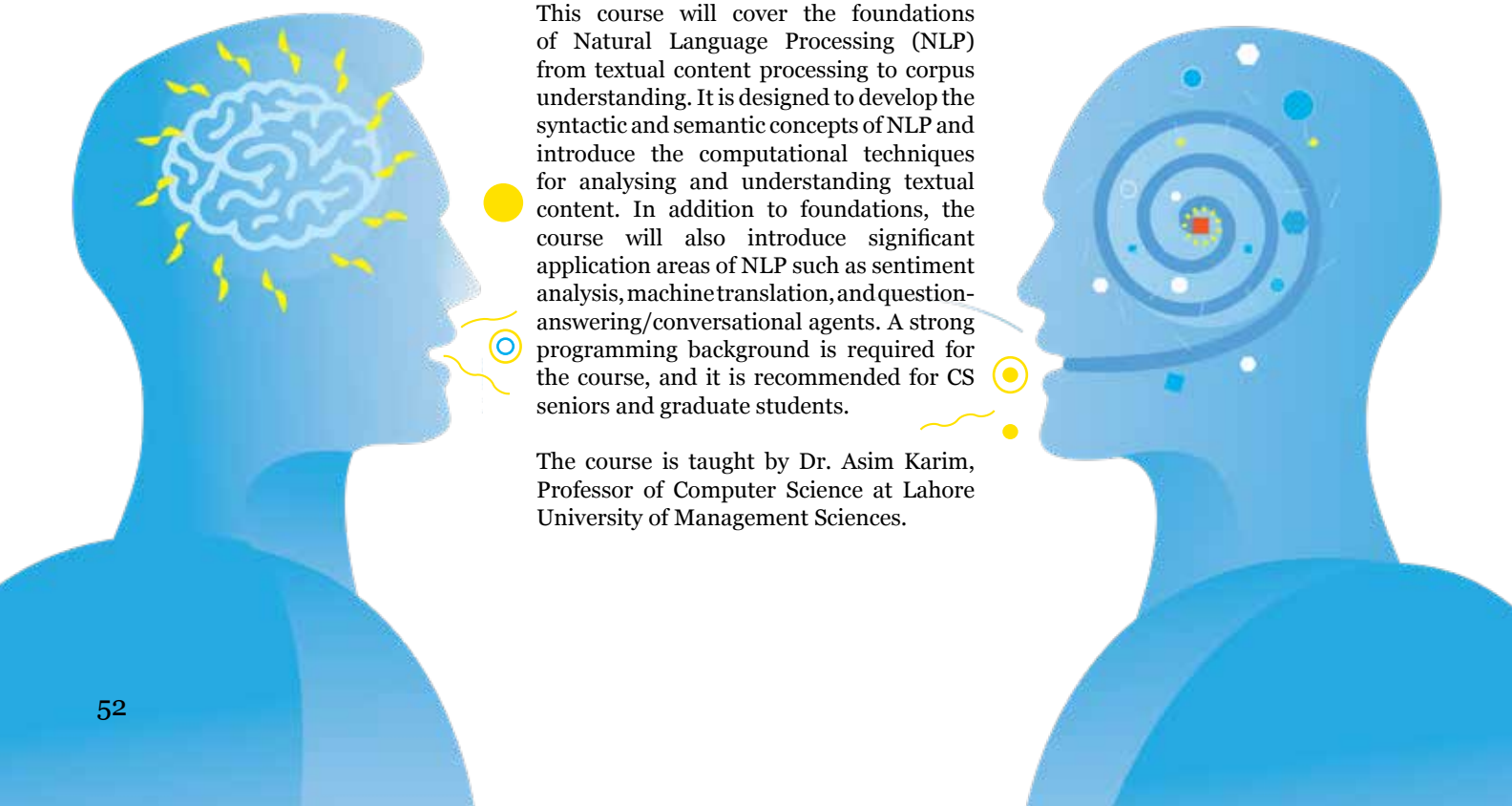
Natural Language Processing

Foundations of Natural Language Processing (NLP) from textual content processing to corpus understanding.

Can we converse with a computer as naturally as we do with each other? If you're interested in Natural Language Processing, check out this course by Dr. Asim Karim.

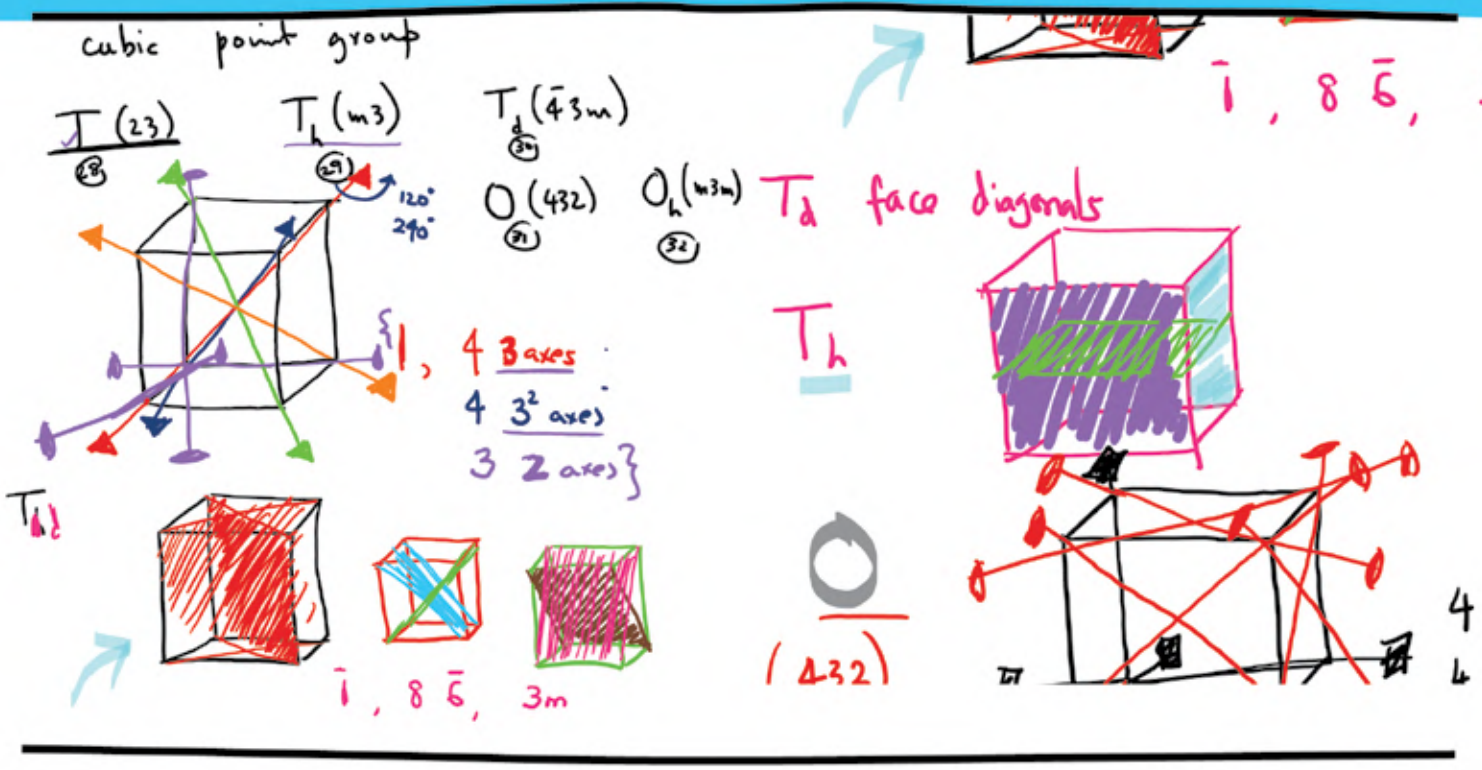
This course will cover the foundations of Natural Language Processing (NLP) from textual content processing to corpus understanding. It is designed to develop the syntactic and semantic concepts of NLP and introduce the computational techniques for analysing and understanding textual content. In addition to foundations, the course will also introduce significant application areas of NLP such as sentiment analysis, machine translation, and question-answering/conversational agents. A strong programming background is required for the course, and it is recommended for CS seniors and graduate students.

The course is taught by Dr. Asim Karim, Professor of Computer Science at Lahore University of Management Sciences.



Condensed Matter Physics

An Online Course - *Spring 2021*



Learn about the high-paced field of condensed matter physics with

Dr. Sabieh Anwar

This course will introduce students to the structure of the solid phase of matter and how the properties can be derived from a quantum understanding of electrons, phonons and their interactions, modulated by the periodic arrangement of atoms. Emphasis will be made on the band structure and methods to determine the same. There will be special focus, towards the end, on the burgeoning field of low-dimensional materials as well as the ubiquitous semiconductors.

After the course, the students will be familiar with the basics of condensed matter physics, enabling them to take more advanced courses focusing on unique materials properties in the electronic, optical, magnetic, thermal, and acosutic regimes as well as specialised courses on mesoscopic physics and devices.

Introduction to Sustainable Energy

Dr. Muhammad Shoaib

The use of energy has been central to the functioning and development of human society. Over the past centuries, humanity learned how to harness the energy contained within fossil fuels. This provided the power that drove the industrial revolution, bringing unparalleled increases in affluence and productivity.

However, there is a growing realisation that the world's energy systems need to be radically changed to supply our energy needs sustainably on a long-term basis. This course will provide an overview of some of the problems associated with conventional energy sources and their 21st century solutions by discussion on energy with science, economics, and environmental aspects. The science portion of the course will cover conventional energy sources, renewable energy sources, their extraction / generation, distribution, and storage. The economical context of energy will focus on lifecycle analysis and feasibility assessment methods.

The course will also cover the environmental impacts of energy production and utilisation. The concepts of sustainability will be introduced as a unifying theme for considering our energy future.

Introduction to Forensic Science

Dr. Muhammad Zaheer

Join clues and figure out the entire story – join Dr. Muhammad Zaheer as he takes you on a thrilling journey to make forensic science clear and comprehensible. The course introduces various aspects of the forensic laboratory and the forensic sciences used in collecting, preserving, and analysing physical evidence from the crime scene.

R Programming

Dr. Aziz Mithani

Conducted by Dr. Aziz Mithani, this hands-on course aims to teach students how to program in R and use it for effective data analysis.

Starting from basis including installation and software configuration, this course will teach the students generic programming concepts which are typically used in a high-level statistical language. Specific topics include basic programming in R, reading/ write data from text files, functions, and using R packages. Practical examples from biology will be used to demonstrate the use of R for data analysis.

Introduction to Food Science

Dr. Muhammad Saeed

Break away from the world of myths surrounding food and nutrition with Dr. Muhammad Saeed's course.

Understand the nature of food, what makes it go bad and both domestic and commercial aspects of production, preparation, cooking, handling and consumption of food.

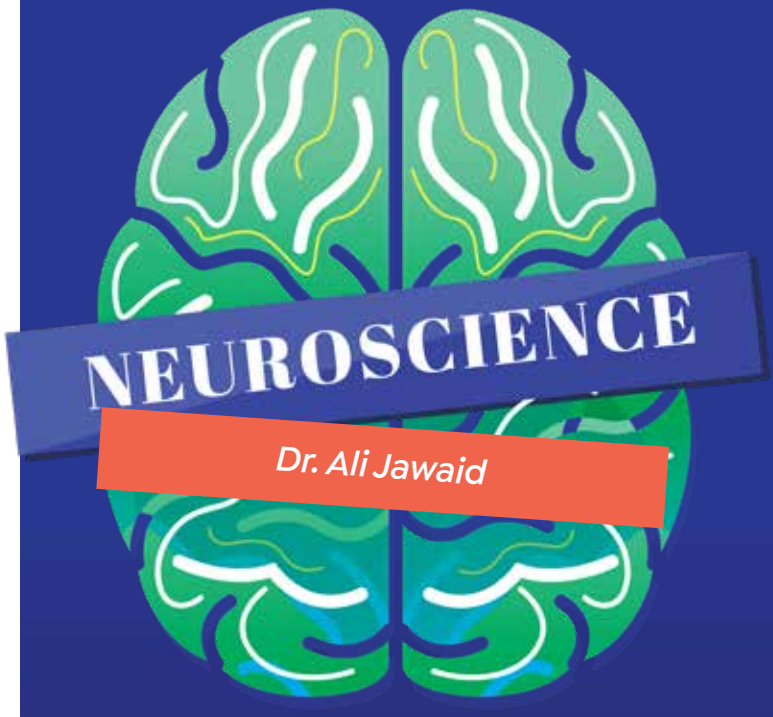
Quantum Computing

Dr. Muhammad Faryad

This course will be your first introduction and hands-on interaction with quantum computers and will be conducted by Dr. Muhammad Faryad.

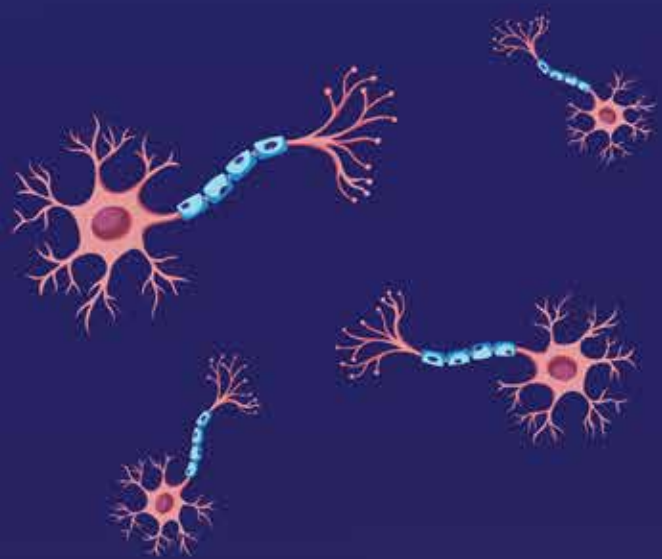
It is specifically designed for broader group of students to introduce quantum computer programming without requiring any previous knowledge of quantum physics. We will study algorithms to solve practical problems like searching a database, factoring prime numbers, optimisation, etc. and demonstrate the quantum advantage over currently used classical computers.

This course will also cover all the syllabus of recently announced IBM's certification exam for quantum developers.



Dr. Ali Jawaid is passionate about equiping his students with a *'neuroscience toolbox'* which not only contains a strong theoretical basis for different process related to human central nervous system, but also how to develop, study, and solve a neuroscience-based scientific question after gaining knowledge about the molecular mechanisms involved.

Join his course to get a glimpse of what makes our fascinating brain function the way it does.



Carl Sagan

WRITE FOR SCIENCE INTERNSHIP

The Science Communication Cell at SBASSE initiated the Carl Sagan Write for Science Internship programme. The programme has two primary goals; to establish a culture of ardent science journalism in the school and to develop and prune science writing skills in our students.

The internship was open for all students (BS, MS and PhD) and staff, to merge their creative writing skills with scientific fervor and create awe-inspiring science stories. During the 8-week voyage, the interns learned ins and outs of science communication, copyediting, techniques to capture the attention of your reader and explore various methods to create content that is well-balanced, coherent and engaging. Not only were they encouraged to create content that inks their imagination but also captures the imagination and emotional attention of reader; stories that attempt to create a connection between both the reader and the writer. The program also presented an opportunity to work closely with the Science Communication Office's in-house artisan, Mr. Hazem Asif, who guided the interns to create stunning artwork based on the authors' articles. The best work was featured on the SBASSE website, digital platforms and some even made it to The Particle!

This programme enrolls a maximum of 3 interns. After successfully completing the internship, each intern was awarded a certificate of completion, along with an honorarium of PKR 15,000.

The first cohort of the internship has just graduated. We will announce the next internship session on our social media and the website. Stay tuned!

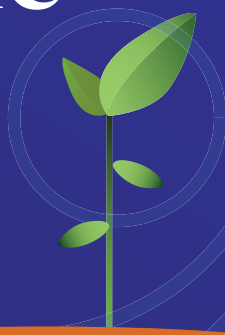
Carl Sagan Write for Science Internship 2021

Taha Zakir (BS Computer Science)
Ahtesham Mubarak (MS Electrical Engineering)
Sitara Hassan (Research Associate Biology)

Link: https://sbasse.lums.edu.pk/Carl-Sagan-Internship

Workshop

Delivering a Sustainable Energy Transition for Pakistan



A three-day workshop, 'Delivering a Sustainable Energy Transition for Pakistan', was co-organised by the University of Glasgow (Dr. Mark Symes) and LUMS (Dr. Salman Arshad) from June 8 to 10, 2021.

It was supported by Researchers Links Climate Challenge Workshop Grant and funded by the British Council to bring together early-career researchers from the UK and Pakistan and industry and government stakeholders to share research expertise and develop collaborations to enable sustainable energy transition in Pakistan.

On the first day of the workshop, prominent energy experts from both countries discussed socio-economic, technical, financial, and policy issues. On the second day, participants attended three separate discussion groups - each moderated by a Pakistani and a UK mentor - covering renewable energy sources, storage and distribution, and energy policy and economics. The participants concluded their discussion on the last day, by teaming up, and finalising research themes. They will now submit research proposals based on the finalised projects, and each project will be seed-funded after a peer review.

It was a unique event where 40 young researchers selected from leading Pakistani and UK universities were given a chance to brainstorm on energy issues in a highly interdisciplinary environment. Experts shared their knowledge and highlighted critical problems of the sector, while mentors helped participants team up according to their research interests and strengths. The workshop has opened new avenues of collaboration between the UK and Pakistani researchers and will help provide innovative solutions to national energy challenges.

Eligible candidates should have obtained their PhD no earlier than 2010. Participants must also have a research or academic position (a permanent post, research contract, or fellowship etc.) at a recognised research institution either in the UK or Pakistan.

Written by **The Particle Team**

Link to workshop website:
http://www.chem.gla.ac.uk/staff/msymes/ClimateChallenge2021/

LUMS is Hosting the

CIMPA School on Algebraic and Combinatorial Methods in Geometry *March 1st till 11th, 2022*

Is nature whispering its secrets in mathematics? Does math truly have an unreasonable effectiveness in describing natural sciences? A product of a kilogram of grey matter inside our heads, mathematics offers an incredible mélange of diverse and complex ideas that enjoy their own existence as island universes within a larger mathematical framework. Wouldn't it be a wonderful idea to build bridges between some of these island universes? This is exactly what the CIMPA School is all about; to link various disciplines of mathematics which all apply algebraic and combinatorial methods in geometry.

The central topic of the school is the mutual interaction of algebra, combinatorics and geometry. Objects of research in algebraic geometry are affine as well as projective varieties and their associated invariants which can be studied using methods from algebra and combinatorics. Toric and tropical varieties are instances where such kind of approaches were and still are very successful. In discrete geometry cones, graphs, hyperplane arrangements and matroids are examples of research subjects which naturally play prominent roles in algebra and discrete mathematics.

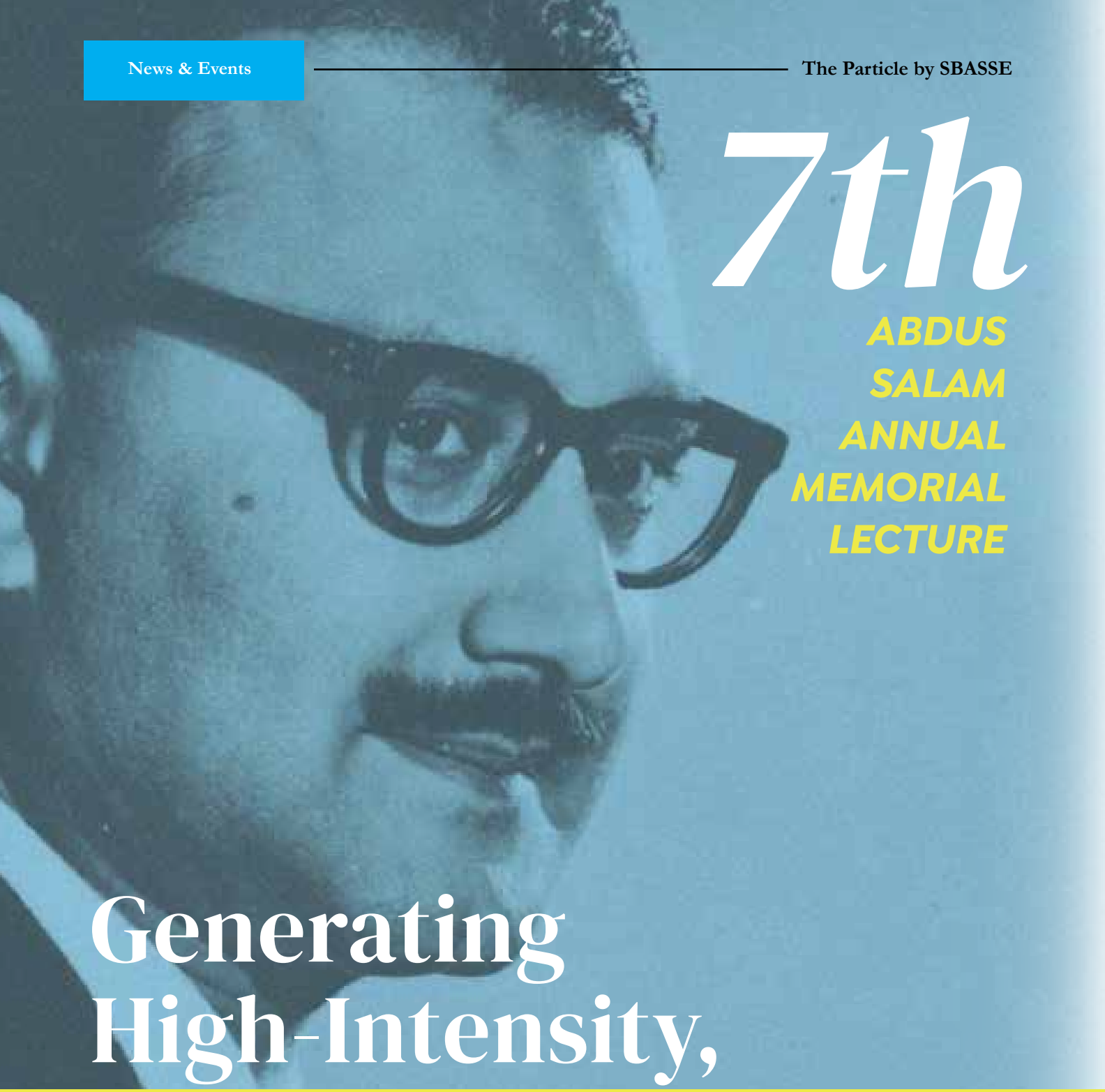
The Centre International de Mathématiques Pures et Appliquées (CIMPA), founded in France in 1978, is a nonprofit organisation that promotes research in Mathematics in developing countries. To date, CIMPA has organized its School in more than 60 countries: from Brazil to China, across multiple continents, engaging hundreds of thousands of students and scholars alike. This year, LUMS is the honored host of the CIMPA School and looks forward to your active participation.

This 10-day mathematical affair is now taking registrations so be sure to apply and share it in your circles!

Registration for local participants from Pakistan:
https://docs.google.com/forms/d/e/1FAIpQLSdgB5lYKQkVhZospclpZlaDn5FGdxOoMpLH3s7oVIjcZoEHnA/viewform

Registration for International participants:
https://applications.cimpa.info/login

Written by **The Particle Team**



7th ABDUS SALAM ANNUAL MEMORIAL LECTURE

Generating High-Intensity, Ultrashort Optical Pulses

The seventh Abdus Salam Memorial Lecture was delivered by Nobel Laureate in Physics (2018), Prof. Donna Strickland on April 9, 2021. Her popular talk was titled *"Generating high-intensity, ultra-short optical pulses"*.

This Nobel Prize-Winning work describes one of the fastest lasers ever built that can also carry immense amounts of energy capable of shaping human corneas, cutting metals, or knocking off electrons from an atom. The pulses can be as short as the billionth of the billionth of a second. The development of lasers capable of emanating brilliant bursts of energy constituted Prof. Strickland's work spread over many years.

Energizing light beyond the luminance of a candle not only cleared the way for explorers on land, sea and air, but also for the explorers inside the laboratory. It began an era of optics, slewing passion-laden explorers towards studying spectacular phenomena like spectroscopy. Fast forward to the 1980s, a similar leap was in the making. Scaffolded by hard work and a drive to create a high intensity optical laser, Dr. Donna Strickland successfully invented the 'chirped pulse amplification' technique, ushering in a new era of research in optics that led to a new understanding of laser-matter interactions, development of new machining techniques that are now used in laser eye, surgery and micromachining techniques used in the production of glass used in smartphones.

Donna Strickland is a professor in the Department of Physics and Astronomy at the University of Waterloo and is one of the recipients of the Nobel Prize in Physics 2018 for developing chirped pulse amplification with Gérard Mourou, her PhD supervisor at the time. They published this Nobel-winning research in 1985 when Strickland was a PhD student at the University of Rochester.

Dr. Strickland earned a B.Eng. from McMaster University and a PhD in optics from the University of Rochester. Strickland was a research associate at the National Research Council Canada, a physicist at Lawrence Livermore National Laboratory and a member of technical staff at Princeton University. In 1997, she joined the University of Waterloo, where her ultrafast laser group developed high-intensity laser systems for nonlinear optics investigations. Strickland served as the president of the Optical Society (OSA) in 2013 and is a fellow of OSA, SPIE, the Royal Society of Canada and the Royal Society. She is an honorary fellow of the Canadian Academy of Engineering and the Institute of Physics and an international member of the US National Academy of Science. Strickland was named a Companion of the Order of Canada.

The LUMS Syed Babar Ali School of Science and Engineering initiated the Abdus Salam Memorial Lecture Series, on January 29, 2015. Since then, a series of lectures, geared towards a non-specialist audience, is organized every year to a pay tribute to the legacy of one of Pakistan's most distinguished scientists, exhibiting our School's unwavering commitment to highlighting and celebrating the advancing frontiers of scientific knowledge, and physics and mathematics in particular.

Here is a compilation of the lectures held so far:

https://sbasse.lums.edu.pk/abdus-salam-memorial-lecture-series

Written by **The Particle Team**

Speaker

Dr. Donna Strickland

Nobel Laureate, Physics 2018

A Generous Donation

SBASSE is thrilled to announce that it has received a donation of USD 2 million from the CEO and co-founder of Careem, Mr Mudassir Sheikha, to set up the "Sekha Scholarship" for the undergraduate students at our School. The scholarship will warrant 100% merit-based fee waivers to ten students that need financial assistance.

Syed Babar Ali thanked Mr Sheikha for his expression of confidence in SBASSE's capacity to create impact. "This is the type of support that takes us in the right direction", commented Shahid Hussain, Rector, LUMS. "The Sekha Merit Scholarships goes a long way to support students in the Sciences to pursue academic excellence and change lives", said Dr. Arshad Ahmad, Vice-Chancellor, LUMS. Showing his appreciation for the donation, Dr. Sabieh Anwar, Dean, SBASSE, said that it would allow the top undergraduates to receive an inspiring education that empowers them to become agents of change.

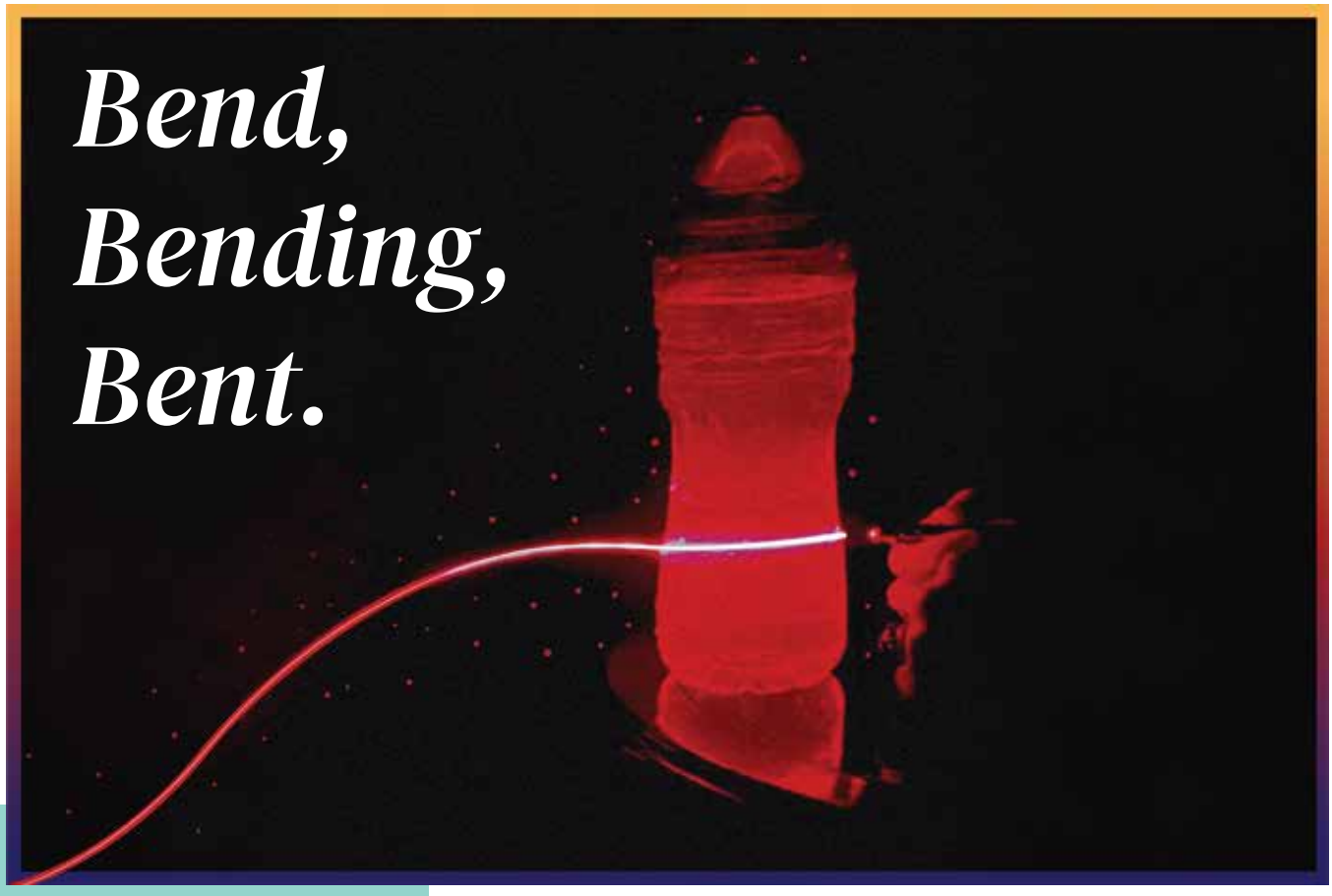
John Conway Spirited
Mathematics Seminar Series

As the timeless title of the physicist Eugene Wigner's article suggests, *"The Unreasonable Effectiveness of Mathematics in the Natural Sciences"*, it is prudent to think that mathematics is the language in which the Universe whispers its quietest secrets. The Department of Mathematics has organised a series of online seminars to disseminate mathematical knowledge, which is open for anyone to attend!

These sessions commemorate the memory of John Conway, a highly passionate mathematician who recently passed away. In his career, John Conway made significant contributions to mathematics in the fields of group theory, number theory, algebra and geometric topology. Some of the other fields his work had a huge impact on included theoretical physics, combinatorial game theory and geometry. Mr. Conway had won numerous, highly honourable prizes in his field, including the Berwick Prize (1971), Polya Prize (1987), Nemmers Prize (1998) and the Leroy P. Steele (2000).

Link to past and upcoming seminars:
https://sites.google.com/view/conway-spirited-math-seminars/home

Bend, Bending, Bent.



Trapped inside a thin column of flowing water, a beam of crimson light appears to bend effortlessly, taking the path of water, as onlookers watch in fascination.

We see light submitting to the laws of optics and water to the wishes of gravity – all combine to create a demonstration that has earned first position in the International Day of Light photography competition.

Ali Raza Mirza, who serves as the President of the SPIE Student Chapter at LUMS, has won the competition with this simple yet arresting demonstration.

This competition was organized by the SPIE Student Chapter ITU and the OSA (Optical Society). The competition hosted two categories of submissions: photography and posters - with LUMS securing winning positions in both! The poster competition was aced by Mr. Shehzad Akhtar Ali, senior member of the SPIE Student Chapter LUMS.

We congratulate both winners and wish them continued success in all future endeavors.

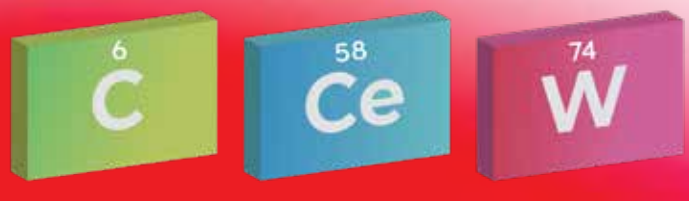
Written by **The Particle Team**

To read more on the SPIE, visit this link:
https://spie.org/about-spie/about-the-society

To learn more about SPIE's chapter in LUMS, visit this link:

https://spie.org/membership/student-services/student-chapters/student-chapter?chapter_id=2008809

CHEMISTRY AND CHEMICAL ENGINEERING WEBINARS



CCEW-1: Soft, Skin-Interfaced Microfluidic Systems for Capture and In Situ Biomarker Analysis of Sweat

Recent advances in materials science, mechanical engineering and manufacturing techniques established the foundations for high performance classes of microfluidic lab-on-a-chip technologies. These chips had physical properties that matched those of human skin. The resulting devices can integrate with the surface of the skin in a water-tight yet physically imperceptible fashion to provide continuous, clinical-quality biochemical information on physiological status via the captured, storage and in situ analysis of sweat.

This talk summarizes the key ideas and presents specific recent examples in skin-interfaced microfluidic technologies designed for applications in sports performance, worker safety and nutritional monitoring.

About the speaker

Since September 2016, John A. Rogers is a Louis Simpson and Kimberly Querrey Professor of Materials Science and Engineering, Biomedical Engineering and Neurological Surgery (and by courtesy Electrical and Computer Engineering, Mechanical Engineering, and Chemistry). He received a Ph.D. in Physical Chemistry and S.M in Physics and Chemistry from Massachusetts Institute of Technology (MIT). Before that, Rogers obtained BA and BS degrees in Chemistry and Physics from the University of Texas, Austin.

From 2003-2016, Professor Rogers held a Swanlund Chair—the highest chaired position at the university—at the University of Illinois at Urbana Campaign. His primary appointment was in the Department of Materials Science and Engineering, and joint appointment in the Department of Chemistry, Bioengineering, Mechanical Science and Engineering and Electrical and Computer Engineering.

Professor Rogers' research seeks to understand and exploit interesting characteristics of 'soft' materials, such as polymers, liquid crystals, and biological tissues as well as hybrid combinations of them with unusual classes of micro/nanomaterials, in the form of ribbons, wires, membranes, tubes or related. The aim is to control and induce novel electronic and photonic responses in these materials; and also develop new 'soft lithographic' and biomimetic approaches for patterning them and guiding their growth. Current research focuses on soft materials for conformal electronics, nanophotonic structures, microfluidic devices, and microelectromechanical systems, all lately with an emphasis on bio-inspired and bio-integrated technologies. These efforts are highly multidisciplinary, and combine expertise from nearly every traditional field of technical study.

Professor Rogers has invented over 80 patents and patent applications, more than 50 of which are licensed or in active use by large companies and startups. Professor Rogers has named several distinguished lectureships and awards to his credit.

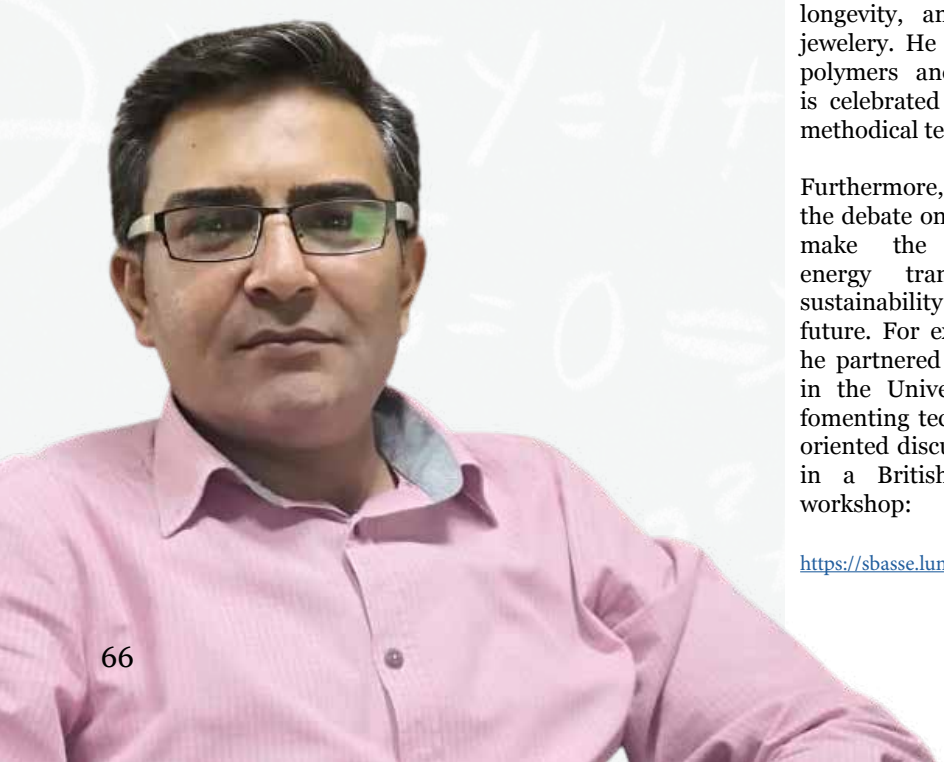
Written by **The Particle Team**

Promotions & Tenure!

Dr. Amer Rasheed has been promoted to Associate Professor and granted tenure at the Department of Mathematics.

Dr. Amer works in the area of mathematical modeling, finite element methods, differential equations and their applications to a diverse range of problems particularly in fluidics. He has published important work in these disciplines, continues to supervise graduate students and is a highly-respected teacher. He has also been working as the Director of the Centre for Advanced Studies in Mathematics (CASM) for many years.

We congratulate Dr. Amer Rasheed for the recognition of his work.



Dr. Salman Noshear Arshad has been granted tenure and promoted to Associate Professor.

A faculty member in chemistry and chemical engineering, Dr. Salman's work focuses on leveraging nanostructures, particularly fibers, for higher performance in energy storage, photocatalysis and environmental remediation. These nanomaterials are heterostructures with novel designs and enhanced functionality. Over the years he has led a focused investigative stream on materials engineering in our School and has recently published important results in *ChemistrySelect, RSC Advances ChemChatChem and Synthetic Metals*.

Dr. Salman has played an important role in facilitating usage of shared experimental research facilities common to all users in the School (https://centrallab.lums.edu.pk/). He has also partnered with the industry in various projects. A recent example is his ambition to improve the wear resistance, longevity, and splendor of ornamental materials and jewelery. He teaches physical chemistry, polymers and nanotechnology and is celebrated as a motivated and methodical teacher.

Furthermore, Dr. Salman leads the debate on helping Pakistan make the much needed energy transition, towards sustainability and greener future. For example, recently, he partnered with researchers in the University of Glasgow fomenting technical and policy-oriented discussions on this topic, in a British Council sponsored workshop:

https://sbasse.lums.edu.pk/node/8605

Dr. Shafay Shamail has been made Professor and granted tenure in the Department of Computer Science at SBASSE.

Dr. Shafay is a pioneer of software engineering in the country and has shaped this discipline. This celebratory news is a befitting acknowledgment of his all round contributions.

In the almost two decades of association with LUMS, Dr. Shafay has helped set up the Department and the School, as well as the Office of Research. His main research interests lie in the areas of software quality, e-commerce, service computing, autonomic systems, governance, and IT for development. By graduating the School's first PhD student, in a way, he initiated our graduate programme as well. Dr. Shafay has taught a wide set of diverse courses including the popular CS 100 course, initiating large numbers of students into the art of programming and computational thinking.

Importantly, Dr. Shafay has played an important role in the development of the software industry and its liaison with the academia. He serves on national accreditation and curriculum revision committees and is member of various Boards of Studies, and contributes to important policy level decisions at various forums.

Dr. Shafay Shamail completed his BSc Electrical Engineering from UET Lahore, MSc Electronics from University of Wales, UK and Ph.D. degree in Electrical Engineering from University of Bath U.K.

Ascending to a new role in the Syed Babar Ali School of Science and Engineering, is ***Dr. Adam Zaman*** – the new Chair of the Department of Physics. *Congratulations!*

Dr. Adam Zaman's research interests lie in what are considered the backbone of quantum computers – open quantum systems. He is an avid teacher and is known for his ability to fuse passion and rigor in the classroom. Resorting to computational digressions to bring home complex ideas in mechanics, condensed matter physics, atomic-laser physics and quantum mechanics, he is popular and highly respected among many students. He has played an important role in maintaining the high quality of teaching and pedagogy that the Physics Department strives for.

He picks up the mantle from Dr. Muhammad Faryad who has illustriously chaired the Department with his soft and forward-looking demeanor and made standout contributions in teaching excellence, research excellence and has led the Department from the front. The migration to the online realm and the many challenges it brought, brought out the best from Dr. Faryad's skills in pedagogy and communion with our students. He has helped us rethink about labs, introduced active learning modalities, engineered new courses in quantum engineering, and has helped his colleagues in building and conducting new experiments in the laboratory. Many things that happen in the Physics department are now unique in Pakistan.

We extend our heartiest congratulations to Dr. Adam Zaman and wish him the best of success in this newfound role.

Dr. Adeel Pasha has been promoted to the ranks of Associate Professor and granted tenure.

Dr. Adeel Pasha's work revolves around implementation of novel computer architectures on VLSI systems, including efficient deployment of machine learning algorithms. This is a beautiful merging together of algorithm and hardware. The hardware design also follows a highly technical algorithm. Such systems are at the lower edge of miniaturised devices and foray into the realm of post-Moore electronic architectures. It is important that these systems remain reconfigurable, parallelisable, draw minimal power and are robust and fault tolerant.

His work focuses on these very aspects. Besides, Dr. Pasha has considered several notable applications for these devices, e.g., in smart energy grids and internet-of-things (IoT) technologies. Therefore, the research output straddles from architecture to applications, from concept to devices - truly outstanding.

His research in embedded systems, very-large-scale-integration (VLSI) systems and low-power architectures, has been termed as "revolutionary" and "ground-breaking". With eighteen journal publications (including about four submitted articles) in the world's top most journals associated with the ACM and IEEE and two book chapters, notably one published in the Lecture Notes for Computer Science series, Dr. Pasha work is inspiring.

Dr. Pasha's striking characteristic is his ability to teach both theory and laboratory courses, especially computer architectures, embedded systems and digital systems design. He has excelled in teaching too and was recipient of the Department's Distinguished Teacher Award. At the moment, he is also leading the Department of Electrical Engineering's efforts in industrial liaison and partnerships.

Written by **The Particle Team**

Histone Variant H2A.Z

– Inscribing Our Identity

Story

When do you tightly coil a long piece of wire or rope? We're guessing when you'd be travelling or packing things up because you either want to have your place look neat and tidy or because you just want to save up on space. Well, our body is smart, and it does the same too – only it does it with our DNA. Yes, our DNA is a really long molecule that would stretch out to be about 2 meters in length but is wrapped up around small proteins called histones, that can fit this entire length in a space just 10 microns across!

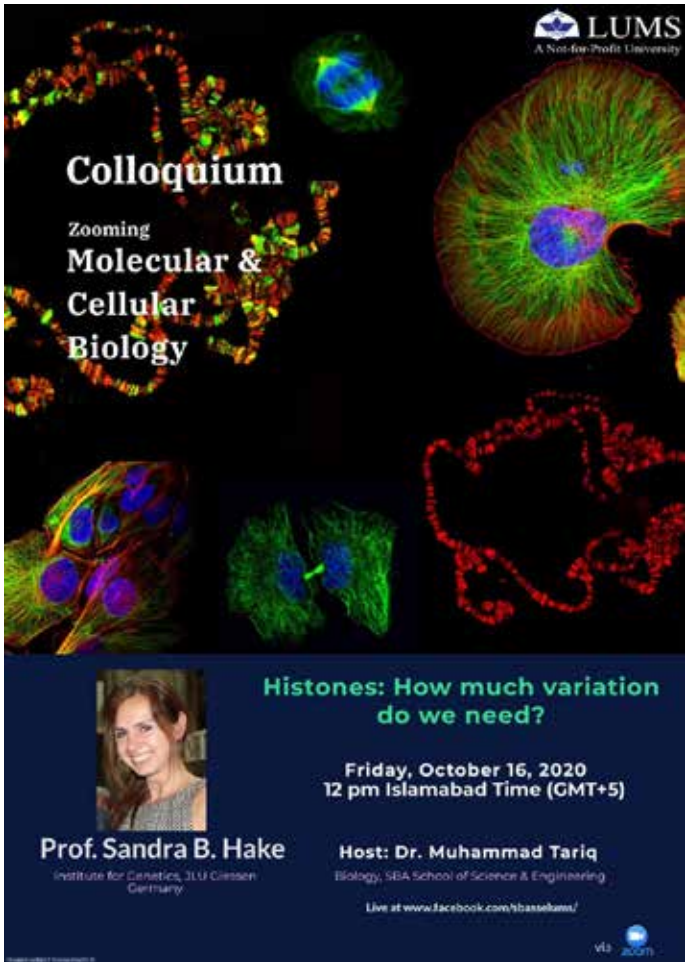
This story involves three main characters:

H2A.Z – the target
M1HR – the modifier
PWWP2A – the binder

Dr. Sandra and her team of researchers have identified that a process of acetylation/deacetylation determines the histone function and the molecule PWWP2A is a key player in this scenario because it acts as an adapter to help bind the M1HR with the H2A.Z.

However, a dramatic story is not complete without a dramatic show of preference, partiality and bias. It turns out that PWWP2A has a preference to bind to M1HR over M2HR (shattered dreams at a molecular level?!) – but this mechanism is not fully understood. We think some things are just complicated!

Dr. Sandra B. Hake, a postdoc fellow at Rockefeller University, USA., was invited to a Zoom webinar organised by the Department of Biology, SBASSE LUMS where she talked about a particular histone called H2A.Z (fancy name!) that appears to control extremely important biological functions at the micro level (DNA repair, mitosis, gene expression, and much more!) but the mechanism of this crucial control stood elusive and puzzling. In her talk, she described the wonderful world of key molecules that regulate these processes where it seemed these chemical commodities have become alive and aware!



Written by **The Particle Team**

Dr. Sandra's research paper can be found here: https://www.nature.com/articles/s41467-018-06665-5

Reference: Link, S., Spitzer, R.M.M., Sana, M. et al. PWWP2A binds distinct chromatin moieties and interacts with an MTA1-specific core NuRD complex. Nat Commun 9, 4300 (2018). https://doi.org/10.1038/s41467-018-06665-5

ABOVE & BEYOND

Recognised as one of the world's best scientists, LUMS alumnus, Dr. Haris Aziz (BSc Class of 2003) and Scientia Associate Professor at the University of New South Wales, has recently been honoured by the Association for the Advancement of Artificial Intelligence (AAAI) for his contribution to Game Theory and Artificial Intelligence (AI). We reached out to Dr. Aziz for a candid interview, which he very kindly agreed to. We hope you enjoy his captivating journey and insight into his latest recognition.

Science Communication Cell (SCC): Please tell us about your place of birth and your initial schooling. How do you credit your schooling in where you are today?

Dr. Haris Aziz (HA): I was born in Lahore. I had my schooling at Beaconhouse Public School (Defence Campus) and Aitchison College of which I have fond memories of a kaleidoscope of activities covering academics, sports and friendships. Obviously, the total schooling experience played a major role in shaping my development in those formative years for which I'm thankful to my teachers and mentors.

SCC: During childhood, was there anything (an event or experience) that inspired and sparked your interest in science?

HA: Throughout school and university, I was inclined towards mathematical subjects for at least two reasons. Firstly, I had a natural aptitude for mathematics, so opting for such courses made less demands on my academic time and allowed me to indulge in my other passion i.e., sports, which led to many a wonderful evening full of intense physical activity, competition and camaraderie.

Secondly, I had a growing appreciation of logical reasoning and mathematical proofs. Many people have a misconception and lack of appreciation for mathematics because, at school, mathematics is often equated with arithmetic which tends to be mechanical. Here, I would like to quote two of my favourite researchers David Gale and Lloyd Shapley, who wrote in an influential paper (that pioneered market design) that any argument which is carried out with sufficient precision is mathematical.

SCC: How do you remember your time at LUMS? Any fond memories or valuable experiences you'd like to share?

HA: I had a great time at LUMS. I enjoyed the liberal arts programme with its varied subjects. It was also a time to make lasting friendships some of which formed when I played football and tennis for LUMS against other universities. The highlight of the year used to be our long bus ride to GIKI. I also have fond memories of working for two years as an instructor and mentor of National Outreach Programme applicants.

In terms of developing mathematical maturity, lessons from Professors Ismet Beg, Wasiq Hussain, and Sarmad Abbasi were helpful. I especially want to honour the memory of the late Prof. Zaeem Jafri (may Almighty bless his

soul), who took a personal interest in the welfare of students. I was deeply touched when he gave me a hand-written letter for my application to Oxford.

SCC: We understand that an ambitious and fulfilling path in life is never without its share of difficulties and rough patches. How do you recall such moments in your journey, and what life lessons have they delivered to you?

HA: I am hugely grateful that I have been blessed in my opportunities. Obviously, striving for higher degrees can have some challenges for overseas students. In particular, I recall doing various part-time on-campus jobs to supplement my income during my PhD. Also, at the time when there was peer pressure to opt for a more lucrative corporate life, I persevered in pursuing my intellectual interests and personal passions. I strongly believe that one's life should be meaningful and well directed, where effort should be made to find time for the priorities to keep it balanced.

SCC: You have been listed among the world's top 2% scientists in a study led by Stanford University researchers. Is there a specific set of skills that you think a researcher needs to hone, to achieve such level of success in their field?

HA: I strongly feel that the most important attribute for a researcher is to have an inquisitive and open mind. Asking good questions is as important as problem-solving. Researchers who have a critical mindset are able to build theoretical frameworks and pursue an independent research agenda. Another aspect that I feel is very useful is to have the ability to identify connections and synergies between apparently disparate research disciplines.

Finally, one piece of advice which I have followed is that being the smartest person in a room may not always be possible but being the most well-read person is always achievable. In research, good awareness of previous ideas can be really helpful to see how to utilize them for novel insights.

SCC: How do you think developing countries like Pakistan can benefit from investing in research for Decision Science and AI? Do you think it can be a potent tool in guiding policy, especially in the economy and healthcare sectors?

HA: Decision sciences and AI are key components of a shared economy. Many upcoming markets are inherently online and hence easier to scale up. Examples of Amazon, Airbnb, and Uber are in front of us. Decision sciences and AI do not just affect the economy and health sector but just about every other sector as well. With overpopulation and stress on our infrastructure, it is even more important for a developing country to plan smartly and use the constrained resources in the most beneficial and effective manner. Unlike certain other engineering fields, decisions sciences and AI programs do not necessarily require huge infrastructure. So, investment in these fields provides excellent value for public money. Computer science, in general, is an outward-facing field that interacts with most disciplines.

SCC: Under the tutelage of AI, technology is poised to become even smarter. Some think the future is surely utopic, while others link advancements in AI with a dystopian future. What are your thoughts on this?

HA: The future is probably somewhere in the middle. For an in-depth discussion on this topic directed toward laypeople, I would recommend popular science books written by Toby Walsh, who is one of my mentors. In general, it is important to keep the perspective that technological advances should be geared toward improving quality of life and aiding decision making. They should not replace human values and expression. As a researcher working within the area, I am aware of the potential pitfalls of designing AI systems that overlook important concerns such as privacy, security, and fairness.

SCC: What message would you like to leave for students, faculty, and researchers at LUMS?

HA: Students who have a strong mathematical background and who are passionate about similar research topics are welcome to reach out to me to discuss research opportunities.

On a final note, we, as members of the LUMS community, have been associated with a great institution. It is up to us to continue on this trajectory to greater horizons ahead.

Interview by **Roshaan Bukhari**

“Gravity bends light?

Imagines Einstein being in an elevator's upward acceleration,
holding a torch that horizontally shines a light,
in conflict with the established Newtonian formulation,
ponders what path would observe his sight,
concludes Albert that light would bend,
and proposes the general relativity,
equivalence equates acceleration to a gravitational field,
deflected indeed is light by gravity,
sun hides behind the moon in nineteen nineteen,
bringing Eddington to Brazil with his telescope,
he measures the stars on a photo-screen
as they shift closer to the sun fulfilling Einstein's hope.”

Haadi Masuood
BS Physics – SBASSE 2022

THE HIGHEST FLIGHT

The moon and the stars, the light of the night
Ruling the darkness, give the courage to fight

The colossal mountains and their magnificent sight
Mastering the majesty, motivate to touch the height

The depth of the ocean, silent though agite
Conquering the emptiness, encourages to fill the void inside

The seeds and the grass, the gigantic trees upright
Endeavoring the storm, depicts victory lies beyond fright

Wondering the most wonderful, I found that I should write
It's you and your power, lets take the highest flight

Novaira Rizwan - *Ms Biology*

Belief

In my wild thoughts, thinking about the world where
Breaths are worthless, damage is hard to repair

Echoed in their stories of savage atrocities
Feelings difficult to grasp, Injuries hard to repair

Identities trapped in the game of maleficence
Values shattered, realities ready to scare

Then I Caught the conscious trying to smother the fire
But again lost in paradigm where the fear of next is near

Relating things to the falling stars in the dark sky
Worried about the consequence, I sat in despair

Only the heart was relaxed and firmed by the belief
Allah does not burden a soul beyond that it can bear

Novaira Rizwan - *Ms Biology*

سِلسلہ

پوچھا جو ایک شب، تارے نے چاند سے
دیکھے جو دیر تک، کیا واسطہ ہے اُسے
سوچا اور ہنس دیا، چندا بھی ٹوٹ کر
بلواؤں گا میں کیا، انسان سے اِسے
ہیں کچھ تو اِن میں ناداں، گلیوں میں گھومتے
بُڑھیا کو تاکتے، حیرت زدہ کھڑے
کوئی مارا محبت کا، تَرسے دیدار کو
دیکھے ہے جو ہمیں، مجنوں کی آنکھ سے
کچھ اِن میں بیکراں، کہ رہتے ہیں ڈھونڈتے
چہرے وہ خواب سے، قبروں میں جا بسے
یہ تھا وہ سلسلہ، جو بچپن سے سنگ چلے
جوانی کی دھوپ یوں، ظُلمت میں آڈھلے

نعمان بیگ

ضیائی تالیف

یہ چار سُو بکھرے سبزہ و گُل
ذہن و نظر کی تراوت
یہ معطر مُشکبار فضائیں
بادِ نسیم کو عطر بنائیں
مضمحل ذہنوں کو بہلائیں
سوچنے کی جستجو دیں
فکرِ فرداں کو آبرو دیں
مہر و ماں چرخ بھی یہ جانتا ہے
کہ یہ پتہ شجر بھی بڑا معتبر ہے
قدرت نے عطا کی ہے اسکو خودداری
نہیں ہے یہ محتاج کسی کا
اسی زعم میں جیا ہے
اسی زعم میں رہا ہے
کہ اسباب اپنی زندگی کے
خود کو خود ہی میسر کر رہا ہے
جو جی رہا ہے خودی کے مارے
جو مر کر بھی اَمر ہو رہا ہے
یہ شجر سایہ دار
یہ برگ بے مثال
خودی اور بندگی کا درس دے رہا ہے

——— ثروت آفتاب، والدہ محمد جنید

Collaboration for

Science Diplomacy

Calling researchers!

The Science Communication Cell at SBASSE is collaborating with the Ministry of Foreign Affairs to help launch the ministry's first science diplomacy issue, helping our local research gain global outreach.

If you would like your research work to be featured in the aforementioned issue, please send it here:
theparticle@lums.edu.pk

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Built between 1643 and 1644 AD, this astrolabe was crafted in Lahore by one of the most popular astrolabe makers of their time, Muhammad Muqim Lahori, descendant of the famous astrolabe maker Allahdad Lahori, during the mughal era. It displays 15 scales of the following types: Altitude; Declination; Prayer lines; Sine/Cosine; Cotangent; Shadow square; Lunar Mansions; Zodiacal signs; Terms; Faces; Triplicities. The back is inscribed with a maker's signature marked as:

صنعت اَضعف العباد محمد مقيم ابن عيسى ابن الهداد اسطرلابي همايوني لاهوري

(Work of the weakest of servants Qāim Muḥammad ibn Īsā ibn Allāhdād, the imperial (humāyūnī) astrolabist of Lahore)