SAMPARK

TIFR ALUMNI NEWSLETTER

July 2018

Volume 1/2

TAA requests its members to update their email ID by sending a mail to alumni@tifr.res.in or tifraa@gmail.com

TAA PUBLIC LECTURES 2018

TAA NATIONAL SCIENCE DAY PUBLIC LECTURE was held on 28th Feb

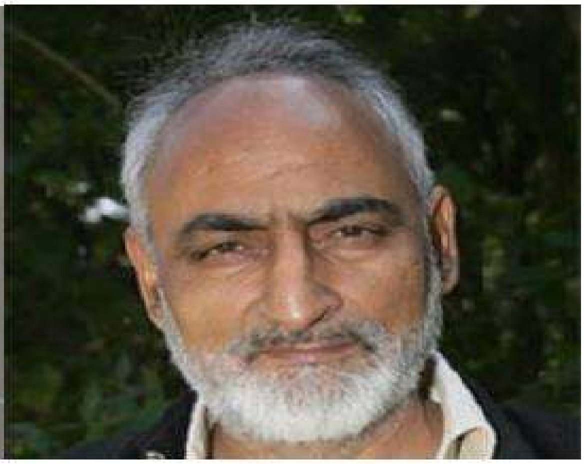
BY PROF. RAKESH MISHRA, CSIR-CCMB, HYDERABAD.

TATA INSTITUTE OF FUNDAMENTAL RESEARCH
Alumni Association

National Science Day Public Lecture

Lessons of time keeping from fly

Prof. Rakesh K. Mishra
CSIR-CCMB, Hyderabad



One of the essential and spectacular displays of life on earth is *time keeping*. From practicing the 24 hr rhythm to determining the average life-span, living beings stick to their timing. The work of Jeffrey C. Hall, Michael Rosbash and Michael W. Young that explains the molecular mechanism of this time keeping process using fruit-fly as the model system. Their findings explain how plants, animals and humans adapt their biological rhythm so that it is synchronized with the Earth's revolutions. This work was recognized by the 2017 Nobel Prize in Physiology or Medicine. This story also demonstrates that simple and convenient model system like fruit-fly can be used to investigate the general principles and mechanisms of life processes. Such systems can therefore, help us understand human diseases and potential remedies.

Wednesday, February 28, 2018 at 5.15 p.m.
Homi Bhabha Auditorium
Tata Institute of Fundamental Research
Colaba, Mumbai 400005

Dr. Mishra received his Ph.D. in Organic Chemistry in 1986 from University of Allahabad and started his career in biology by studying DNA structure at Molecular Biophysics Unit of the Indian Institute of Science, Bangalore, and, subsequently, effect of such structures on the regulatory functions at the Centre for Cellular and Molecular Biology, Hyderabad. He explored small antisense DNA approach to control of protozoan parasites at the University of Bordeaux, France, and use of such tools to understand the mechanism of RNA processing in frog eggs at Saint Louis University, Missouri, USA. He has also held a position at the University of Geneva, Switzerland. He is currently the Director of CCMB.

He is a Fellow of the Indian Academy of Sciences, the National Academy of Sciences, the Indian National Science Academy. Dr Mishra is currently a J C Bose National Fellow of the Department of Science and Technology.

Lecture is open to all

For details: 22782473, 22782500, mail: alumni@tifr.res.in, pro@tifr.res.in.
Non-TIFR members are requested to bring a valid photo ID

INTERVIEWS

An interview with Prof. Rakesh K. Mishra

[“There is no formula to overcome such challenges or any challenge for that matter. The approach that works is – to have trust in yourself, to focus on the problem, have faith in your conviction and dedication to put your best.”]

TAA: Thank you for giving us an opportunity to talk to you for the TAA newsletter. To start with, it would be nice if you could tell us how you got interested in Epigenetics after doing your Phd in Organic Chemistry.

SPEAKER: Organic Chemistry always deals with compounds that are coming from living systems and I was particularly interested in proteins, DNA and RNA on how they function, how DNA makes RNA and RNA translates into proteins. One of the things which made me curious about biological system was that all organisms will develop from a single cell which is called “zygote”. When millions and trillions cells are formed and they organize into different tissues, they still have identical genetic material but completely different shape, size, property. This essentially is also Epigenetics where the same genetic information is expressed as different biological outputs. Recent advance in technology have made it possible to ask precise questions in this area and that is what makes it more interesting at present as there are ways of solving them.

TAA: Can you tell us about your childhood and early education.

SPEAKER: I was born and brought up in a small village in Uttar Pradesh and we had very simple, traditional education system where class will be held under a tree and if it rains, we go home. We were taught in the beginning only two subjects, language (Hindi) and Mathematics and once in a while History, Geography and Agriculture. When I reflect back, it looks simple but effective, it provide tools to think and it gives us freedom to think.

TAA: What and who inspired you to reach to the current position, Director CCMB?

SPEAKER: Frankly speaking I did not plan to reach at this position. I always kept focusing and doing what I thought was best and possible for me to do at that particular time. I think this is logical, if you keep doing alright and you are interested in the system, you will eventually end up at some kind of administrative responsibility.

TAA: What challenges did you face and how did you overcome those challenges during your journey so far?

SPEAKER: One of the advantages of doing science is that you do what you find interesting but at the same time you have to make others feel it is important because you need support and funding and place to pursue your interest. To me, challenging thing is when I realized after sometime that things are not changing in right directions. That is what makes me restless and uncomfortable and that is the challenge. There is no formula to overcome such challenges or any challenge for that matter. The approach that works is – to have trust in yourself, to focus on the problem, have faith in your conviction and dedication to put your best. The rest is really neither in your control nor something worthwhile worrying about.

TAA: Any memorable incident/anecdote?

SPEAKER: One memorable "incident" which is rather personal that comes to my mind is that took place during Drosophila Conference in Chicago almost 20 years back. I was standing in front of my poster about my work on bithorax complex of Drosophila which is the genetic locus that determines the body axis formation in the fly. Suddenly, I realize that one person of short stature with glasses come with very childlike curiosity, goes through the poster, asking me many questions/clarifications. Only during the conversation I realized that it was **Ed Lewis**, the man who discovered the biology of Drosophila complex and deciphered the genetic basis of body axis formation in animals - the work for which he was already awarded the Nobel Prize. The simplicity, the unassuming and childlike curiosity for science even after such a success – was a lifetime experience for me. His words "I like this work" while leaving my poster, still remain fresh in my memory.

TAA: What do you think about a career and future opportunities available in molecular biology for today's students?

SPEAKER: Current time is actually the time of biology where both industry and healthcare area depend heavily on molecular biology approaches and methodologies. Biotechnology sector and healthcare sector which is already the biggest economic sector in the world, is ever expanding and students of molecular biology have great opportunity not only in finding job but also making difference and discovering new technologies and products.

TAA: How do you envisage CCMB as being one of the role models for other CSIR organizations for promoting science and technology in the country?

SPEAKER: CCMB has already positioned itself as one of the premier institutions of biology in this country. As per its mandate, CCMB has focused on addressing the basic questions in biology and pursuing it using the most sophisticated and cutting edge technologies. As a consequence, CCMB has not only made major contributions to the understanding of biology, training quality human resources but also given technologies of immense societal impact to the country. This is really a role model for this country where while doing quality science, we keep our eyes open for potential applications of the science and technology for the human needs.

For example, CCMB while studying how decision of male or female embryos is made in snakes, stumbled upon DNA probe that led to the development of DNA Fingerprinting technology which has made revolutionary changes in the way paternity disputes or crime incidents are investigated in this country. Using the basic understanding of DNA variations and using DNA technologies in breeding programmes, CCMB has given technologies of Wildlife Forensics by which a trace of tissue can be used to identify the animal source and on the other hand provided disease resistance variety of one of the most popular rice that is now grown in 8 states of our country. This has given tremendous benefit to the society. While doing this, CCMB has created highly trained human resource and close to 150 PhD students that have passed out from CCMB, are in leadership position in the country in major public and private organizations. This shows that a small laboratory like CCMB can create quality science and give impact making technology to the society by having the work culture that respects ethics, human dignity and openness.

TAA: What are your comments and message for young students who are on the threshold of deciding their scientific careers on todays' inter-disciplinary nature of science?

SPEAKER: The field of science is never saturated. The more we learn, more is there to be learned and discovered. With the development of technologies, computational approaches and revolution in information technology, it is like never before, an opportunity for a student of science to address questions which was not even thinkable 15-20 years back. In order to make an impact, however, a student must get the basics of a discipline whether it is Physics or Chemistry or Mathematics or Engineering and then bring this knowledge of basic science in addressing the question of biology. This strategy provides a unique opportunity and perspective and, therefore, great possibilities.

TAA: **Learning's and insights from your overall experience that will be useful to the youngsters.**

SPEAKER: In any domain of life, there will always be success and failure however small or big. We should take the success not to be satisfied but to be inspired that we can do and take resilience and strength from failure to do it better because we can do it. Every young person is full of potential, all that is required is self belief that we can succeed and to make things interesting and effective, a youngster should choose what is most attractive however challenging it maybe and not which is necessarily convenient.

TAA: Professor Mishra, it was a pleasure to be in conversation with you. Thank you very much.

Photographs of the National Science day Lecture held on Feb, 28th 2018 at TIFR.

NOBEL PRIZE IN PHYSIOLOGY (2017)
Discovering the rhythm of clocks within cells”

Subhojit Sen
UM-DAE Center for Excellence in Basic Science, Mumbai

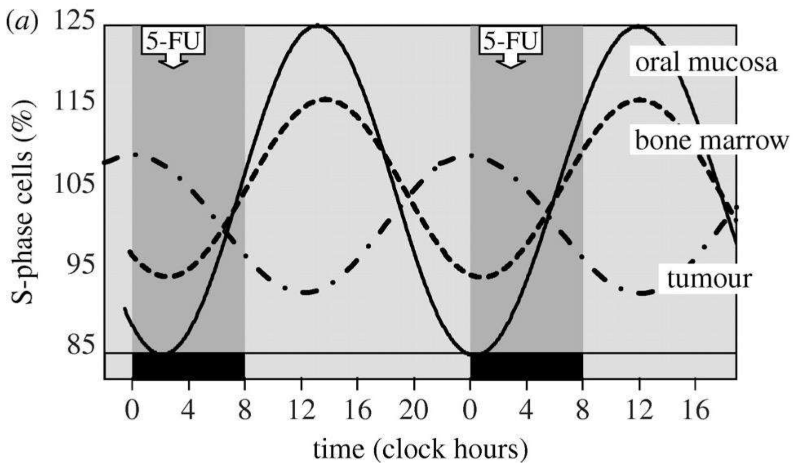
__Dr. Subhojit Sen__ is currently a Ramalingaswami Fellow at UM-DAE Centre for Excellence in Basic Sciences, Mumbai University, Kalina Campus Mumbai. He did his BSc from Mumbai University and MSc from MS University, Baroda. Subsequently he did his Phd from Tata Institute of Fundamental Research, Mumbai in 2002. He was a Visiting Fellow at National Cancer Institute, National Institutes of Health (NIH) Bethesda, USA. Thereafter, he was a research fellow at the Johns Hopkins Medical Inst., JHU, Baltimore USA (with Prof. Stephen Baylin). His expertise lies in molecular biology, epigenetics, genetics, biochemistry & Genomics. His group focusses on Epigenetics of Behaviour and Diseases using human and algal model systems.

Waking up on a bright sunny morning after a good night’s sleep, gives you that unmistakable feeling of rejuvenation and enthusiasm. Although we take this daily encounter for granted, there is an entire machinery working around the clock, within cells, to keep up this biological rhythm. Indeed, when our sleep cycles are disturbed, either due to erratic work schedules or changes in time zones (due to travel), feelings of uneasiness and disrupted mood comes to being, affecting our performance efficiency. In severe clinical cases, this even leads to anxiety disorders or depression. How does our body maintain this biological rhythm? Is it an active mechanism, or just a passive output of lack of sleep? If that is the case, why does it take us time to adjust to drastically new time zones, in spite of a regular sleep cycle?

Early in the 18th century, Jean Jacques d'Ortous de Mairan started asking these pertinent questions using the simple mimosa plant. His observation, that the opening and closing of mimosa leaves followed a typical day-night rhythm in spite of keeping the plant in the dark, revealed for the first time, an internal clock that runs independent of exposure to sunlight. Fundamental to the regulation of networks, interest in this oscillating biological mechanism over the next two hundred years, gave rise to the idea of waves of signals used by living organisms in order to keep time. Of course, it is not the physical nature of time, but the biological readout of oscillating rhythms that aligns well with a day and night cycle (circa – around, dies – day), which is now popularly known as circadian rhythms in living organisms.

In the modern era of biology, genetic studies in model organisms played a catalytic role in defining the exact information in DNA (genes), controlling seemingly abstract processes such as 'time-keeping'. Using DNA mutants of the fruit-fly *Drosophila melanogaster*, Seymour Benzer and his research pedigree showed that genetic aberrations indeed altered biological rhythm, and therefore time, as perceived by these flies. Named as period mutants, these flies were not only affected in daily functions such as locomotion, larval heartbeat, and wing vibration, but also unexpectedly in courtship song rhythms and neural circuitry. These experiments very elegantly posed circadian rhythms in a central role in multicellular organisms, ranging from flies to worms to mice to humans. Not surprisingly, a minimal set of these genes are also present in some of our evolutionarily primitive cousins, the unicellular eukaryotes (yeast and algae), making the mechanism fundamentally important in how it controls cell division as well as behaviour. In fact, modelling these oscillatory gene-circuits has shown how they create a complex set of regulatory outputs, which seems to be self-buffered, and can dictate the time of cell division in synchrony with light and dark cycles (Fig 1). Cancer cells, where these genetic factors get decoupled, would show altered oscillations, implying a strong correlation between circadian systems and disease (Fig 1a).

In order to uncover the molecular underpinnings of this elegant biological phenomenon, using a combination of genetics and molecular biology, **Jeffrey Hall** and **Michael Rosbash** at Brandeis University, and **Michael Young** at the Rockefeller University studied the *period* mutants developed by Benzer and colleagues. In 1984, using the power of Drosophila genetics they identified and isolated the *period* gene, effectively writing in stone, a genetic basis for 'time keeping'. Hall and Rosbash went on further to demonstrate how the gene product, PER protein, peaked through the night and was degraded at dawn, leading to an oscillation of protein levels over a 24-hour cycle, in synchrony with the circadian cycle (Fig 1b). The key to the problem was to understand how the cells generate and sustain these protein oscillations. Hall and Rosbash hypothesized that PER shut down its own gene expression creating a feedback inhibitory loop, which could eventually explain the oscillatory nature of gene expression, because as soon as the protein levels would go down, the gene would express again. However, the accumulated PER was produced in the cytoplasm, and needed to travel into the nucleus to effect shut down, where the period gene resided. By using suppressor/enhancer genetic screens



(b)

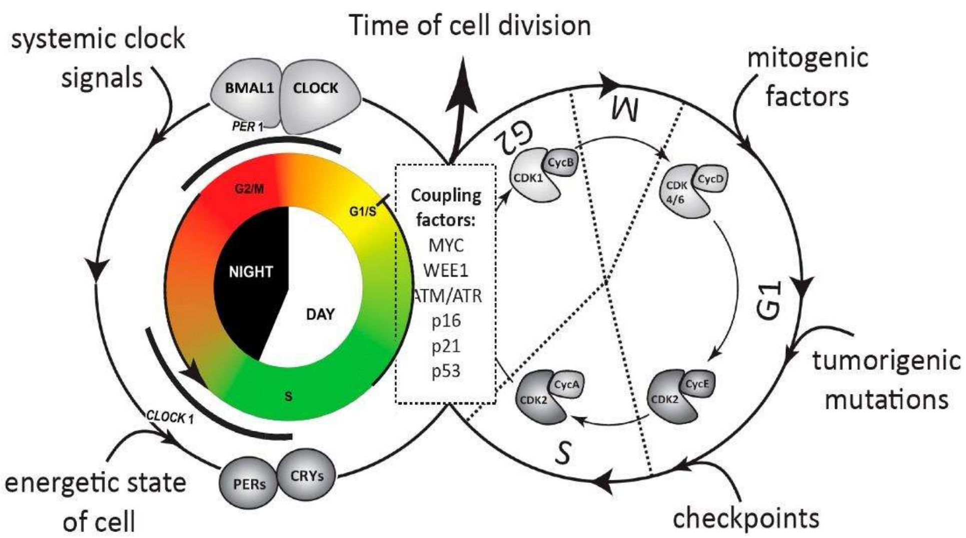


Figure 1: This figure has been adapted from Int. J. Mol. Sci. ***2017*** *(doi:10.3390/ijms18040873). The graphical representation on top (1a) depicts the oscillatory nature of cell division in response circadian cycles while 1b shows the network of circadian genes and its interaction with the cell cycle. The various inputs that interject with circadian biology (e.g. tumorigenic mutations and systemic clock signals) and a host of coupling factors are listed, which interact with the clock mechanism to time cell division.*

of the *period* mutants, Young uncovered the TIM protein (*timeless*) which bound PER and eventually DBT (*doubletime*), an interaction that helped translocate it into the nucleus in a timely 24 hr cycle, to effect shut down. These approaches eventually uncovered a whole host of circadian genes that displayed interacting feedback and feed-forward loops to maintain the oscillatory nature of the output, a biological rhythm that seemed to run independent of the cosmic clock.

In subsequent research Hall, Rosbash and Young also demonstrated that although the circadian clock did maintain this rhythm for multiple cycles, it needed light cues at specific durations to maintain the synchrony of the oscillations, thereby explaining how jet lag could possibly occur and suggestively rectified. These discoveries became fundamental in identifying the molecular mechanism of the circadian clock, and how it manifests both at the cellular as well as hormonal level in complex multicellular organisms such as humans, to help co-ordinate the ballet of biology that seemingly runs uninterruptedly. Understanding how this can be disrupted, helped us understand its control over hormonal cycles and effects on neural physiology. Today, circadian clocks have become a prime target/tool to evaluate and analyse how we can treat many manic depressive or chronic disorders, which might manifest due to genetic aberrations or a simple lack of regular sleep cycles.

The Nobel Prize of 2017 is not only relevant but timely, as we are slowly leaving the idea of cosmic time behind each day. With electricity and artificial light permeating every aspect of our daily lives and with the advent of the personal computer (smartphone) that we even carry to bed, how will the extended exposure to light affect our neural being? Will longer exposure to light affect our circadian cycles and thereby our ability to function effectively? Is the spread of new age disorders like Schizophrenia, Alzheimer's or even Cancer, related to these patterns going awry? Although waves of technological revolution in the last hundred years have pushed mankind to the next precipice, it is yet only, a blip in evolutionary time (thousands to millions of years). Our genes and biology have not had the luxury to be evolutionarily trained in order to adapt to the fast changing environment. Understanding these fundamental processes that drive us, will spare us from the wrath of evolutionary selection, where many might be left behind. Proof of the pudding, lies in how melatonin can be used to reset jet lag, or the analysis of cell division in tumour versus normal cells, where disruptive circadian rhythms can be identified and targeted for rectification (Fig 1a). Thus understanding circadian biology, has not only uncovered a fundamental principle of how our cells perceive time, but also from a scientific curiosity standpoint, enabled questions that were not possible to address before. Going forward into the futuristic era, i.e. space travel and exposure to elements that are completely new to human physiology, will be key areas of research where our current understanding of circadian biology will prove invaluable.

In Memorium- *Prof. Cadatur Badrinathan (1930-2018)*

It was with much sadness that friends, colleagues and admirers of Cadatur Badrinathan, known to all as Badri, received the news of his passing away on 11 April 2018 in Navi Mumbai. Badri, who was born in Salem,Tamil Nadu, on 20 September 1930, did his Masters in Physics from the University of Rajasthan in Jaipur before joining Tata Institute of Fundamental Research on 23 November 1955. His early work was with Dr. E. Kondiah and was based largely around the 1 MV Cockroft- Walton cascade generator accelerator at the Institute. It was during this time that Badri completed his doctoral degree that involved extensive experimental studies of transfer reactions using deuterons and 14 MeV neutrons. He also utilized neutrons that were made available from the Apsara and Cirus reactors at BARC. His level of enthusiasm and his acumen for high-quality experimental work was evident right from the beginning of his research career. Within a very short time of joining TIFR, he was producing well-noticed papers, with colleagues like K V K Iyengar and N Lingappa, on various topics, like the interaction with fluorine of fast neutrons arising from D (d, n), Be (d, n) and T (d, n) reactions using deuterons accelerated in the cascade generator and on the width of excited states of isotopes of tin by studying nuclear resonance scattering of de-excitation gamma rays. Badri's skills as a topnotch experimenter were exemplified in the large number and variety of instruments that he developed, including the building of many of the early detector systems that were used by him and other colleagues at TIFR and, subsequently, at BARC and further afield.

In the period from the mid to late 1960s Badri spent two fruitful years at the University of California at Davis and a year at the Max-Planck Institute for Nuclear Physics at Heidelberg. Not only was this time well spent in updating and further sharpening his skills in stae-of-the-art experimental techniques, he also contributed to cutting-edge basic research in nuclear physics, with studies that included what were amongst the earliest experiments on neutron-proton bremsstrahlung at 208 MeV–pioneering work that appeared in Physical Review Letters in 1968. Upon his return to TIFR, Badri played a leading role in the 1970s in attempts to build, in house, a tandem van de Graaff accelerator and, along with colleagues, he succeeded in constructing a pellet-chain charging system and was able to demonstrate its ability to generated high voltages. Such a charging system lies at the heart of contemporary Pelletron accelerators.

In the 1980s Badri shifted his interests towards the emerging field of experimental atomic and molecular physics. He developed low-energy ion sources and various types of mass spectrometers for experiments conducted at low energies – over the range 1 eV to 5 keV – and helped incorporate them into a new generation of lab-made instruments designed to explore, in adiabatic fashion, the dynamics of electron-molecule and ion-molecule collisions, especially those that had relevance to processes and situations in plasma physics, atmospheric and ionospheric sciences, and in astrophysics. It was one such apparatus that he helped develop - a crossed atomic beam-ion beam apparatus that resulted in what was the first atomic physics paper, in 1980, to emerge from experiments conducted with the newly set up Pelletron accelerator at TIFR (the second paper published from the Pelletron). Here, ultra-slow, multiply charged recoil ions were shown to be produced in high energy collisions of hydrogenic and helium-like fluorine ions from the Pelletron accelerator with neutral rare-gas atomic beams at impact energies in the range 60–99 MeV. The highly charged rare gas ions, like Xe10+, possessed only a few eV of kinetic energy, and were to prove to be useful precursors for future ion molecule experiments conducted at low enough energies to permit studies to be made of how electronic charge clouds on projectile ions and target molecules interacted with each other, and adjusted to each other's "presence" in the course of the collision. Badri became a vigourous participant in the new instrumentation-intensive, low-energy atomic and molecular sciences programme that was being developed in TIFR from the early 1980s. His contributions to the design, fabrication and use of many novel forms of ion sources, molecular beams, ultrahigh vacuum systems, mass spectrometers and computerized data handing systems laid a firm foundation for a very successful and globally visible programme that continued well beyond his retirement from TIFR in 1990.

Over and above his formal work at TIFR, Badri was also an accomplished and internationally renowned photographer. He was amongst the first photographers in India to be honoured with membership of the Royal Society of Photography for the expertise that he developed in the ancient photographic technique of developing prints using natural sunlight. Badri was one of the few photographers to make use of carbon printing which is based on the fact that gelatin, upon sensitization to light by a dichromate, becomes hard and is made insoluble in water when exposed to the ultraviolet components of sunlight. He printed on dichromate-sensitized sheets of gelatin-coatedcarbon tissue which, upon developing in warm water, dissolved the unhardened gelatin, leaving a relief image that is thickest where it received the strongest exposure. The finished print resulting from such a process is usually of outstanding visual quality and proven archival permanence. Badri published detailed information, including relevant formulae, for all to freely utilize in a seminal article entitled "The Direct Carbon or Fresson Process" in the May/June 1978 issue of the Royal Photographic Society Journal; it continues to draw attention to this day.

Badri was known to all as dynamic, knowledgeable and extremely cheerful. Over and above the wisdom in physics and photography that he readily shared with colleagues and friends, in the course of long periods during experimental runs, he would regale colleagues with tales of travels he had undertaken on little-used railway lines, visiting obscure railway stations, and of long hikes in the hills around Mumbai, and further afield.

Badri was, most certainly, a fun person to be with. He will surely be greatly missed by his wife, Kamla, two sons, a daughter, and six grandchildren, and also by all who knew him.

Written by
Prof. Deepak Mathur
With contributions from Profs Amit Roy, P N Tandon, H C Jain and Vandana Nanal

TAA mourns the sad demise of the following TIFR Alumni

Prof. K Sivaprasad (-2018)

Prof. Sivaparasad passed away on May 15, 2018 in the USA. He was a member of High energy cosmic ray group at TIFR and worked extensively for the air shower array project at Kolar Gold Fields (KGF). On closure of KGF project he worked for the GRAPES experiment at CRL, Ooty. He had worked at Uni Adelaide Australia & Uni Maryland at College park, USA during his sabbatical.

Prof. E.C.G. Sudarshan (1931-2018)

Prof. Sudarshan had spent three years (1952 – 55) working in Homi Bhabha's cosmic ray group at TIFR, before moving to the University of Rochester in the USA, where he did his Ph.D. Though he was a professor at the University of Texas, he remained an Honorary Fellow of TIFR till his last day. He has been credited with numerous contributions to the field of theoretical Physics including optical coherence, Sudarshan-Glauber representation, V-A theory, Tachyons, Quantum Zeno effect, open quantum system to name a few.

TIFR ARCHIVES

Through photos from the TIFR Archives, we have been trying to present the TIFR history: the important events and academic visits which took place in TIFR and which have remained an integral part of the fond memories of this institute! In the previous issues we have focused on the period from the 1945-1955 i.e. primarily on the founding of the institute and the immediate years thereafter. In this issue, we present pictures from the period 1960-1965.

1: Miss Yamini Krishnamurthy performing at a cultural programme held in TIFR for Mathematics Colloquium, 1960

2: Group photograph of the participants: Summer School in Theoretical Physics organised by TIFR at Bangalore. In the photograph Prof. Menon, Prof. R.H. Dalitz, Dr. Bhabha, Prof. M. Gell-Mann and others.(Left to Right), 1961

3: Eighth International Conference on 'Cosmic Rays' in Jaipur, Dr. Bhabha and Dr. V. A. Sarabhai, 1963

4: Ustad Alla Rakha on tabla and Pandit Ravishankar on sitar performing in a cultural programme at Jaipur Conference. Eighth International Conference on 'Cosmic Rays' in Jaipur, 1963

5: Dr. Bhabha explaining the working of the machine to Prime Minister Lal Bhadur Shastri. 1965

Awards and Honors (Others)

Prof. Anish Ghosh

Elected as a "Fellow" of the Indian Academy of Sciences, Bangalore, from 01/01/2018

Prof. Sudipta Maiti

Elected as a "Fellow" of the Indian Academy of Sciences, Bangalore, from 01/01/2018

Prof. Krishna Kumar Mishra, HBCSE

Awarded the "Homi Jehangir Bhabha Gold Prize" of the "Maharashtra Rajya Hindi Sahitya Academy" for the year 2016-17 under the category "Scientific-Technical", by the Government of Maharashtra

Prof. Pankaj S. Joshi

Felicitated by the Society for Cancer Research and Communication (SCRAC), for his contributions to Science and Technology

Prof. Kalobaran Maiti

Awarded the P.K. Iyengar Memorial Award for Excellence in Experimental Physics - 2016

TAA Executive Committee 2016-2019

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