INDIAN SOCIETY FOR CHRONOBIOLOGY

SAMAY

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OFFICE BEARERS

INSIDE...

FOR JAN 2024 ISSUE, SEND YOUR ENTRIES TO

DR. AAKANSHA SHARMA
EDITOR, SAMAY- INSC
INSCDU@GMAIL.COM

From Presidents Desk

Dear Colleagues,

I greet you and your family during the new academic session and sincerely wish you the best of health, joy, happiness and incremental progress during the rest of the 2023. I am sure that year 2023 has been able to revert you to the best of your normal schedules.

The past months of 2023 has been very inspiring for the Chronobiology community in India. We have had several excellent meetings, and many of us were so interactive. The InSC had its Biennial meeting and conference in Aizawl, Mizoram that Dr. Amit Trivedi hosted in the best way possible in early March 2023. The new executive took over the charge on 01 April 2023, and several good decisions were taken by the InSC community in its General Body meeting.

We have successfully conducted the first InSC School in Chronobiology 2023 in NEHU, Shillong, with Prof. A. S. Dixit as the host and convener of the activity. The activity was well planned and had excellent faculty both from abroad and India. The next school is being proposed to be hosted by Prof. Sheeba Vasu at the JNCSR, probably in February 2024. You should be able to have details about it when it is formally announced. It has also been accepted that the International conference of the InSC will be held in Hyderabad in the latter half of 2024 with Dr. Sandipan Roy as convener, and another International workshop/ symposium in Raipur during February/ March 2025 with Prof. Arti Parganiha as the convener.

I have some more good news to share since the last ‘Samay’ went out in January 2023. Dr. Aakansha Sharma and Dr. Abhilash Laxmanan have received coveted INSA medal 2022, awarded this year. With Dr. Nikhil Lokesh awarded in previous years, we have three INSA medallists as current member of the Society. The InSC community feels proud of them, and also wishes them best in their endeavours. The InSC community also congratulates Dr. Sheeba Vasu for her promotion to the full professorship at the JNCASR.

I look forward to hearing from you about activities that you are current involved in, or you are planning to do in the next six months. The InSC will support you in all possible ways in conducting an activity that comes under its mandate.

Very best wishes to all of you.
Vinod Kumar
President, InSC

Editor's Note

Mid-year greetings to all our readers!

The 2nd half of the year has begun! As the time is going by, we hope that this year is treating you well and we wish that your future endeavors culminate into favorable outcomes.

Along with the member of the editorial team of SAMAY, I am happy to bring you this issue of our bi-annual newsletter. We are pleased to inform our readers that the research efforts of young Chronobiologists are being identified across the country. Three of our young society members, Dr. Aakansha Sharma (2022), Dr. Abhilash Laxmanan (2022) and Dr. Nikhil Lokesh (2019) were awarded the "INSA medal for young scientist" by the Indian National Science Academy, New Delhi, India. In this issue we have included articles from these three awardees where they discussed their research journey that led them to the INSA medal. In our "Spotlight event" section, we have covered the "InSC School in Chronobiology" that was held in North Eastern Hill University, Shillong very recently in May, 2023. We have also included a section on "Chronobiology in News" and "Upcoming events" to keep you up-to-date.

The credit for successful publication of this newsletter goes to all the members and researchers who contributed to the present issue and helped us fulfill the deadline. We extend our thanks and appreciation to all the contributors for their prompt replies to our requests.

As always, drop us a line (inscdu@gmail.com) with your suggestions on topics you'd like to see us cover or things that you like or do not like about what we are doing. We look forward for your feedback and suggestions.

Warm Regards
Sangeeta Rani
Editor-in-chief, SAMAY
Indian Society for Chronobiology

Indian National Science Academy (INSA) recognizes young chronobiologists

Congratulations

Abhilash Lakshman

Aakansha Sharma

Nikhil Lokesh

We are proud of you

One question, ten years, and a Ph.D. later...

Abhilash Lakshman (labhilash@gc.cuny.edu)
The Advanced Science Research Center, The City University of New York; The Graduate Center at the City University of New York.

Upon being awarded the INSA Young Scientist Medal 2022, Prof. Vinod Kumar asked me to write an article for Samay, summarizing my research for which this recognition was given to me. But I did not want to write just another article summarising my research; so, I thought I will write a little bit about how I got into this area of research and what led me to write my thesis on circadian clock evolution, organization, and entrainment.

The first time I encountered chronobiology was during a talk by Prof. Vijay Kumar Sharma (VKS) when he talked about how socio-sexual interactions in the fruit-fly affects timekeeping. Fascinated by the idea of animals keeping time, I wrote to him asking if I could spend some time in his lab and learn more about circadian rhythms. He wrote back right away, inviting me to come. So, I planned a trip to the Jawaharlal Nehru Center for Advanced Scientific Research (JNCASR) in Bangalore during the December of 2010. Thus began my journey in Drosophila chronobiology.

VKS had told me to contact Koustubh Vaze, a Ph.D. student at that time, with whom I was to work. Koustubh was working with these flies that we call 'early' and 'late' populations. Fruit-flies are holometabolous insects, i.e., they undergo complete metamorphosis during development, and transition from larvae to adults through a pupal stage. The emergence of adults from pupae, a phenomenon referred to as eclosion, occurs predominantly during the early hours of the day (just after lights-ON in a light/dark or LD cycle; Figure 1). VKS's lab had initiated populations of flies that were subjected to strictly defined, 'allowed' windows of eclosion (Figure 1). The 'early' populations are maintained by collecting flies (selecting) from culture vials in a four-hour window around dawn. The 'late' populations, on the other hand, are maintained by collecting flies in a four-window around dusk (Figure 1). At each generation, such selection is performed on several consequent cycles to avoid any differences in development time that could lead to differences in daily timing. As a direct response to such selection pressures, the 'early' and 'late' flies expectedly evolved divergent timings of the eclosion rhythm (Figures 2-3). During the course of my discussions with Koustubh about these populations, one thing I quickly learnt was the widely theorized and demonstrated 'rule' that circadian clocks that run faster under constant conditions also tend to have earlier phases under entrainment, and

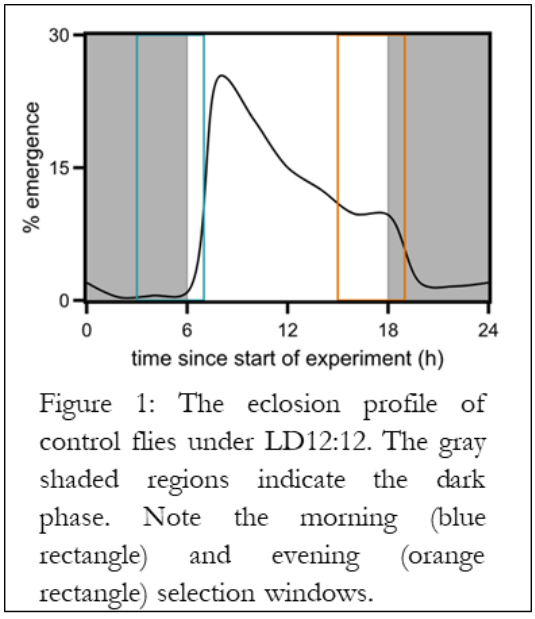

Figure 1: The eclosion profile of control flies under LD12:12. The gray shaded regions indicate the dark phase. Note the morning (blue rectangle) and evening (orange rectangle) selection windows.

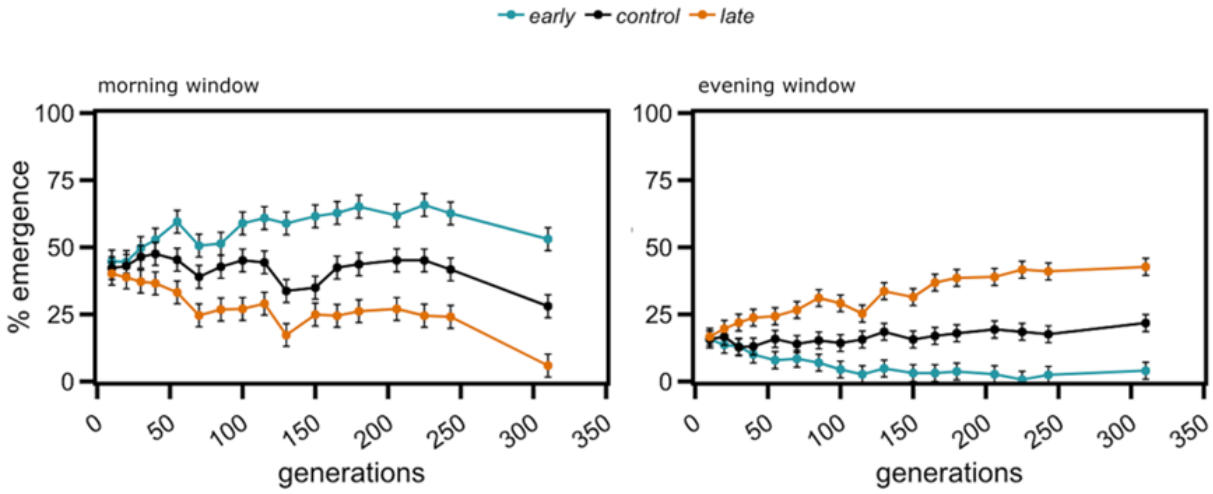

Figure 2: Response to selection in the morning and evening windows over ~300 generations.

vice versa. conditions also tend to have earlier phases under entrainment, and vice versa. For example, "morning" people have faster running circadian clocks when they are removed from a light/dak cycle than people identifying as "evening" people. As expected from this framework the free-running period of the eclosion rhythm of 'early' flies, was indeed shorter than the free-running period of the 'late' flies. However, at the time, there was a mysterious result with these populations. While the free-running period of the locomotor activity rhythm (another significant output of the circadian clock) was also shorter in the 'early' flies compared to the 'late' flies, their phases under entrainment were identical. Koustubh had, I think half-jokingly, asked me how this was possible. This question intrigued me and fuelled my journey towards understanding the principles of entrainment and circadian organization in these populations, and my Ph.D.

My first undergraduate project was to work with Koustubh and ask what happens to the divergence in timing of eclosion between these two populations when they are reared in outdoor/semi-natural conditions; we found that the divergence between the 'early' and 'late' flies was drastically enhanced (Vaze et al., 2012a). The only other conceivably strong time-cue in such conditions (apart from light) is temperature, thereby indicating that some degree of temperature sensitivity of the clock must have evolved in these populations. Extremely interested in these populations, I came to JNCASR the subsequent summer in 2011 with a

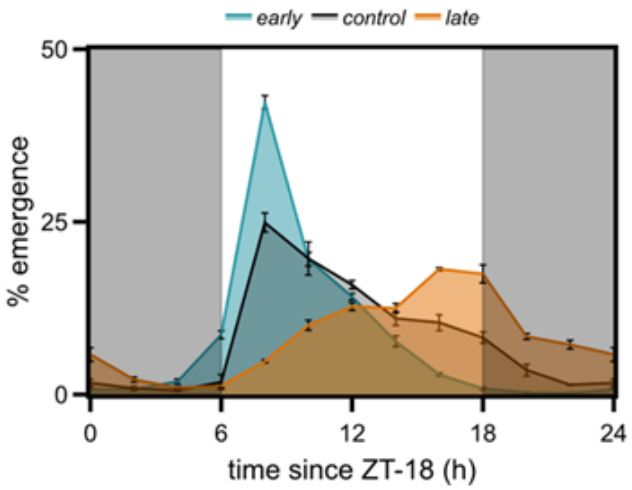

Figure 3: Evolved eclosion waveforms under LD12:12. Gray shaded regions are the dark phase.

summer research fellowship from the Indian Academy of Sciences, to work with Koustubh on light sensitivity in these populations. From the light sensitivity experiments we found that the 'early' flies required light for long durations at dusk and the 'late' flies required long durations during dawn to establish phases of the eclosion rhythm that they had evolved as a consequence of the selection pressure (Vaze et al., 2012b). You may see a pattern here, of my obsession with these flies; before I started my graduate training, I had already found a fascinating field of biology with mysterious questions that needed to be answered. Therefore, interested in understanding the design principles underlying circadian oscillators, I joined the Integrated Ph.D. program at the Evolutionary and Organismal Biology Unit at JNCASR in 2012. After various lab rotations I joined VKS and Prof. Sheeba Vasu to pursue this question further.

I started examining differences in temperature sensitivity and light sensitivity of these populations in parallel. I eventually found that the clocks of 'late' populations driving the eclosion rhythm were exquisitely sensitive to temperature cues (Abhilash et al., 2019). I eventually also found that the entrainment of locomotor activity rhythms to LD cycles in these populations are largely driven by integrating light information over long durations (parametric entrainment), which is one reason why despite having different clock speeds, they had identical phases of entrainment (Abhilash and Sharma, 2020). Having found enhanced sensitivity of the eclosion rhythm in 'late' populations, I asked if there were differences in entrained locomotor activity rhythms of these populations under cycling temperature conditions. To my excitement, I found that the locomotor activity rhythm of the 'late' flies were also more sensitive to temperature cues. Moreover, the 'late' flies had a delayed peak of activity, as would be expected from the 'rule' I outlined above – slower running clocks under constant conditions must have delayed phases under entrainment (Abhilash et al., 2020a). It is important to note that this 'rule' is only a direct prediction of one model of entrainment, the non-parametric model. To summarize, our 'early' and 'late' flies, that differ in clock speeds, only differed in their phase of entrainment under temperature cycles and not under LD cycles, consistent with the idea that entrainment to light and temperature happen via different modes.

Interestingly, the delay in the activity of 'late' flies was only observable in the evening peak of activity, not the entire waveform (Abhilash et al., 2020a). Typically, the locomotor activity rhythm of flies is described within the framework of an M-E (morning-evening) oscillator system, wherein the M-oscillator drives the timing of activity contiguous with dawn, and the E-oscillator drives the timing of activity contiguous with dusk. The M and E-oscillators are thought to be bi-directionally coupled to each other, are both light sensitive, but in opposite ways, and temperature compensated. If both the M- and E-oscillators are temperature compensated, then this delayed evening peak in 'late' flies remains inexplicable.

I digress here for a little bit to describe a different model of circadian organization that was originally proposed to describe eclosion rhythms, i.e., the A-B oscillator model. This proposed that there is a core master oscillator (A-oscillator). This oscillator is temperature compensated and light sensitive. The A-oscillator was thought to drive a

peripheral oscillator (B-oscillator). The B-oscillator was identified to be light insensitive and its period temperature sensitive. It was also argued that the phase of the overt behavior was directly driven by the phase of the B-oscillator. My results seemed to suggest that there must be some degree of overlap between the E-oscillator and the B-oscillator, at least in the context of the locomotor activity rhythm, and that selection on timing of eclosion rhythms has resulted in co-evolution of the temperature sensitive B-oscillator of the system that drives several different overt behaviors. I subsequently used artificial 12-h days and showed that the E-oscillator, that also appears to be temperature sensitive, was dominant in the network in our 'late' populations (Abhilash et al., 2020b).

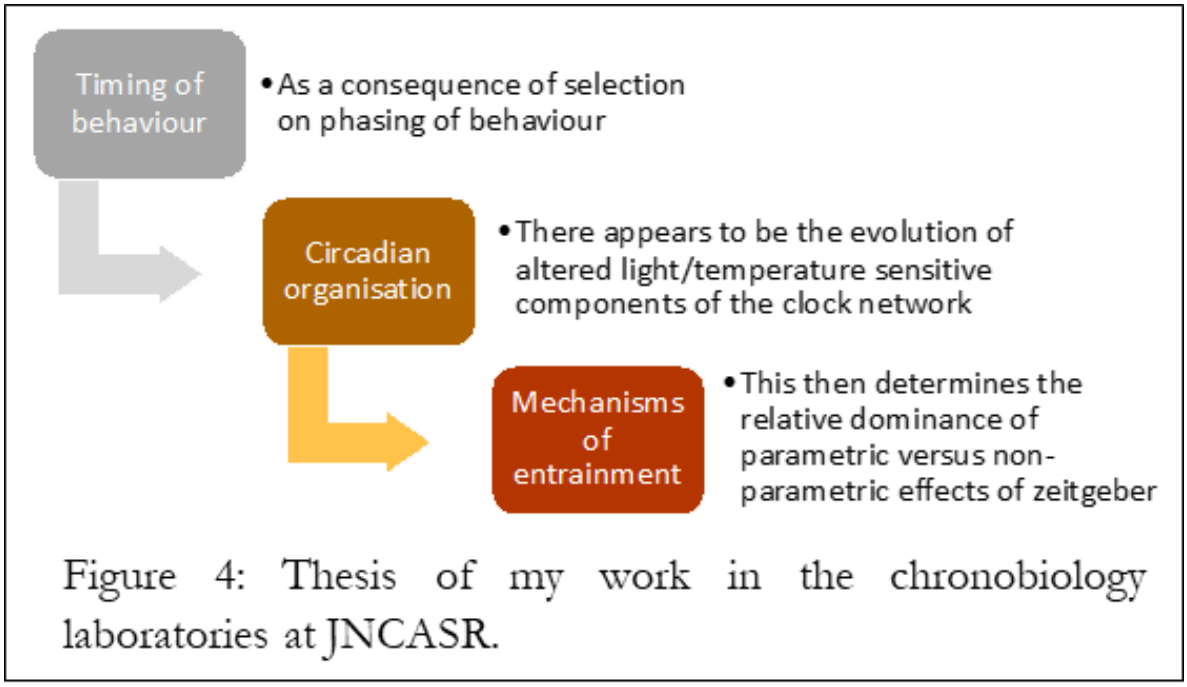

Figure 4: Thesis of my work in the chronobiology laboratories at JNCASR.

The final thesis of the work I did over the last decade or so really speaks to the fundamental overlap in the models of circadian organization, and their inter-relationships with timing of behavior and mechanisms of entrainment (Figure 4) – all of which started with one fundamental question. However, although we understand that selection in the wild on timing of behavior can have predictable changes in the organizational principles that impinge upon how the clock entrains, these ideas are fairly abstract (Figure 4). Neither do we entirely understand the anatomical and physiological bases of the B-oscillator for various fly rhythms, nor do we understand the mechanistic basis of parametric entrainment. To pursue some of these questions, I joined Prof. Orie Shafer at the City University of New York for my postdoctoral research, where I continue to chip away at these problems, which I know will keep me busy for the foreseeable future.

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Journey for survival: Decoding the mechanisms of bird migrations

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Here is my journey from my MSc class on Chronobiology to the INSA hall. My first introduction to the field was during my master's programme when I opted for Chronobiology as a special paper. During the course, Prof. Vinod Kumar introduced our class to the concepts of daily and seasonal rhythms. This was the first time when I got interested in learning about the rhythms in biological systems. My interest in the field of seasonality further got a direction during the 2nd SERB School in Avian Biology which was held at Gurukul Kangari Vishwavidyalaya, Haridwar. There I got a chance to interact with many great scientists working in the field of avian research. In a talk by Prof. Franz Bairlein, he introduced how the genetic components of migration are influenced by a number of environmental factors such as changes in annual photoperiod (light period), temperature, food availability, risks of predations, etc. influence migratory activity in birds. I was fascinated that how a small bird undertakes such tedious journeys and what role does the environment has to play in the planning of these trips. During my PhD research work, under the able guidance of Prof. Vinod Kumar at University of Delhi, I tried to address my curiosities regarding the regulation of seasonal migrations in birds.

Every year, billions of latitudinal migratory birds undertake two long distance migratory journeys between their breeding and wintering ground. During spring (in response to long photoperiods) they prepare and start from their overwintering grounds to reach their breeding grounds. They spend around 3-4 months on their breeding sites during which they breed and raise their young ones. Again, in the beginning of autumn when daylength starts to reduce, they prepare and fly back to their wintering grounds to escape the harsh winter conditions of their breeding areas. So as to successfully complete these events that are a part of the bird's annual cycle, they undergo drastic changes in its behavior and physiology. For example, the passerines prefer to migrate only during night and hence during the migratory period, they undergo a switch from being day active to predominantly night active. Not only this, just prior to the migration, they exhibit hyperphagia, accumulate a large amount of fat and also undergo muscle hypertrophy. Photoperiod (=day length) is the major cue that drives these changes. In fact, different seasonal states can be faithfully reproduced in the controlled laboratory condition by exposing these birds to season-appropriate photoperiods such as if the migratory birds are kept under 10 h of light per day, they exhibit a winter like phenotype and when the photoperiod is extended up to 13 h of light per day, they start to show spring migratory phenotype.

During my PhD, I worked with two such latitudinal migratory finches, the blackheaded and redheaded buntings (*Emberiza sp.*). I worked on understanding the molecular basis of induction of different seasonal states in response to changes environmental cues (i.e., the photoperiod). To characterize each seasonal state, we employed global approaches such as study of transcriptome and proteome under different seasonal states in different target tissues. From our findings, we demonstrated that the birds exhibit seasonal plasticity in neural as well as metabolic centers that are important for them to support their non-migratory and migratory states at different times of the year. Interestingly, the birds could differentiate between short and long-day photoperiods from the first long day itself. This was also evident in their transcriptome from hypothalamus and blood after exposure to a single long day. One of our major contributions to the avian migration literature was the comparison of two migratory events (spring vs. autumn migration) to understand if there are any difference between the two events that appear to be similar to each other. We demonstrated that birds prepare differently for the two journeys as in spring they sprint in order to reach their breeding ground as early as possible, while in autumn they can go at a slow pace. This would require them to take longer and faster flight bouts during spring. As a preparation for that, the birds accumulate more fat reserves, show increased free fatty acids in circulation and an enhanced fatty acid transport machinery in the flight muscles. Similarly, there are change in the regulatory center, the hypothalamus as well.

My overall research effort has been rewarding, and contributed to the understanding of physiology of migration, which indeed is a challenging research area in biology of animals. We now have some understanding of the regulation of different seasonal states in migratory birds. To our satisfaction, present research generated many interesting questions for future research in the field. Presently, I am pursuing some of these questions at Department of Zoology, University of Lucknow and I am looking forward to unravelling more details on this natural marvel that avian migration is.

Circadian Cartographer – mapping circadian clocks

Nikhil Lokesh (nikhil@wustl.edu)
Research Associate, Erik Herzog Laboratory, Washington University in St. Louis, USA

I am a circadian biologist with a background in engineering interested in understanding how order emerges in biological systems, specifically focusing on synchronization in circadian clocks. I obtained my Bachelor of Engineering from BMS College of Engineering, Bangalore before embarking upon the Ph.D. research with Prof. Vijay Kumar Sharma (demised) and Prof. Sheeba Vasu at the Jawaharlal Nehru Centre for Advanced Scientific Research (JNCASR), Bangalore.

As an early doctoral student, I attended the 2010 Chronobiology School in Delhi where I won the best student and best participant awards. This school holds special value to me as it was one of my earliest experiences of discussing with and learning from some of the world-renowned experts in Chronobiology and played a crucial role in reinforcing my fascination for how organisms track time. Chronotypes refer to the individual variations in sleep patterns. These patterns determine whether we are "morning larks," who feel most alert and productive in the early morning, or "night owls," who thrive during late-night hours. Fascinated by the intricacies of chronotypes, I combined experimental evolution in Drosophila melanogaster with theoretical chronobiology to understand how circadian clocks in morning and evening chronotypes entrain or synchronize to day-night cycles. Through this work, I uncovered several previously unrecognized aspects of circadian clocks that distinguish between chronotypes. Notably, I demonstrated that circadian clocks share pathways to sense light and temperature in the environment, and distinct differences in sensing the two cues strongly dictate chronotypes. Furthermore, by investigating the expression of circadian clock genes and neuropeptides, I revealed that these differences arise from altered molecular clock network and functional coupling of the underlying neural circuitry. Till date, I co-mentor graduate students and continue to collaborate with Prof. Sheeba Vasu at JNCASR, Bangalore on whole-genome sequencing studies to explore the genetic architecture of morning and evening chronotypes. Additionally, I am engaged in research examining the evolutionary dynamics and advantages of circadian clocks in Drosophila populations with divergent evolutionary histories. My doctoral research was recognized with the CNR Rao Medal for Best Doctoral Thesis in Biological Sciences. My research work in India resulted in 10 research publications across reputed journals in chronobiology, evolutionary biology, and genetics. In recognition of my contributions, I was awarded the prestigious Indian National Science Academy (INSA) Medal for Young Scientists in 2019—considered the highest recognition for young scientists in India.

After my PhD, I received the renowned Humboldt Fellowship for Postdoctoral

Researchers to pursue research at Achim Kramer's laboratory in Charité – Universitätsmedizin Berlin, Germany. During this period, I delved into the role of stochasticity and biological regulation in driving heterogeneity in circadian clocks. Extending my expertise in experimental evolution to human and plant cell populations, coupled with high-throughput gene expression and genome sequencing studies, I unveiled that heterogeneity in circadian cells is predominantly driven by stochastic methylation of about 3 clock genes that likely enable them to function as period regulators. This work has also shed light on non-heritable factors contributing to circadian periods, which could explain heritability differences observed in human populations. I was later awarded with the McDonnell Postdoctoral Fellowship to work with Erik Herzog at Washington University in Saint Louis where I collaborate with mathematicians and engineers and integrate experimental neuroscience with machine learning, network science, and synchronization engineering to understand the functional and organizational principles of circadian clocks in mammals. My current research interests include employing machine learning to reveal and study novel circadian behaviors, deciphering the network topology and functional connectivity of the Suprachiasmatic Nucleus, and unravelling how circadian clocks facilitate seasonal adaptations. I am also actively involved in teaching various courses in chronobiology, python programming for neuroscientists, research ethics, and problem-solving methods in biology. I also contribute to mentoring programs at Washington University designed to guide and support international graduate students in their transition to becoming postdocs in the USA.

Spotlight event: InSC School in Chronobiology

The InSC School in Chronobiology 20223 was held at Department of Zoology, North Easter Hill University, Shillong from 20th to 28th May 2023 with Prof. A.S. Dixit as the Convenor.

The **faculty** invited was chosen on the basis of course content of the school ranging from basics of Chronobiology to the application of biological rhythms in human health.


Vinod Kumar


Anand S. Dixit


Mewa Singh


Roelof A. Hut


Hugh D. Piggins


Takashi Yoshimura


Sheeba Vasu


Russell G. Foster


Shaon Chakrabarti


Sougata Roy


Amit K. Trivedi


Gaurav Majumdar

The team of **mentors and session-in-charges** were decided in such a manner that there were two senior faculty member and a number of young teachers from different Universities were also trained in Chronobiology.


Sangeeta Rani


S. K. Bhardwaj


Amit K. Trivedi


Gaurav Majumdar


Namram S. Singh


Aakansha Sharma

The **students** were selected from all over India. The selection was made on the basis of biodata of the candidate, their current research interest and write-up explaining their aptitude for research in Chronobiology.


Heba Jamal


Nehareeka Dan


Ashwani Kumar


Nisha Rana


Ashvitha B


Aabha Pal


Shreyayukta


Rebecca


Lalsiamkima


Priyesh Singh


Anjoom Nikhat


Mayank Kumar


Debashish


Bidisha Kataki


Susha SS


Surajit Dawn


Shilpi Borah


Aloke K. Singh


Ashutosh Ranjan


Anshuman Naik


Payal Patra


Aastha Saini


Arshad K


Mansi Rathi

- The event received wonderful feedbacks from students and faculty.
- All the faculty members participated very actively and enthusiastically, and stayed at the venue for entire duration of the school.
- Formal and informal interaction with faculties and mentors were organized for students.
- It was an activity encompassing the overall development of participants' scientific attitude.
- The participants learnt different techniques used in Chronobiological research Training of young teachers as mentors was also an important achievement of the school.

Awards at InSC School in Chronobiology

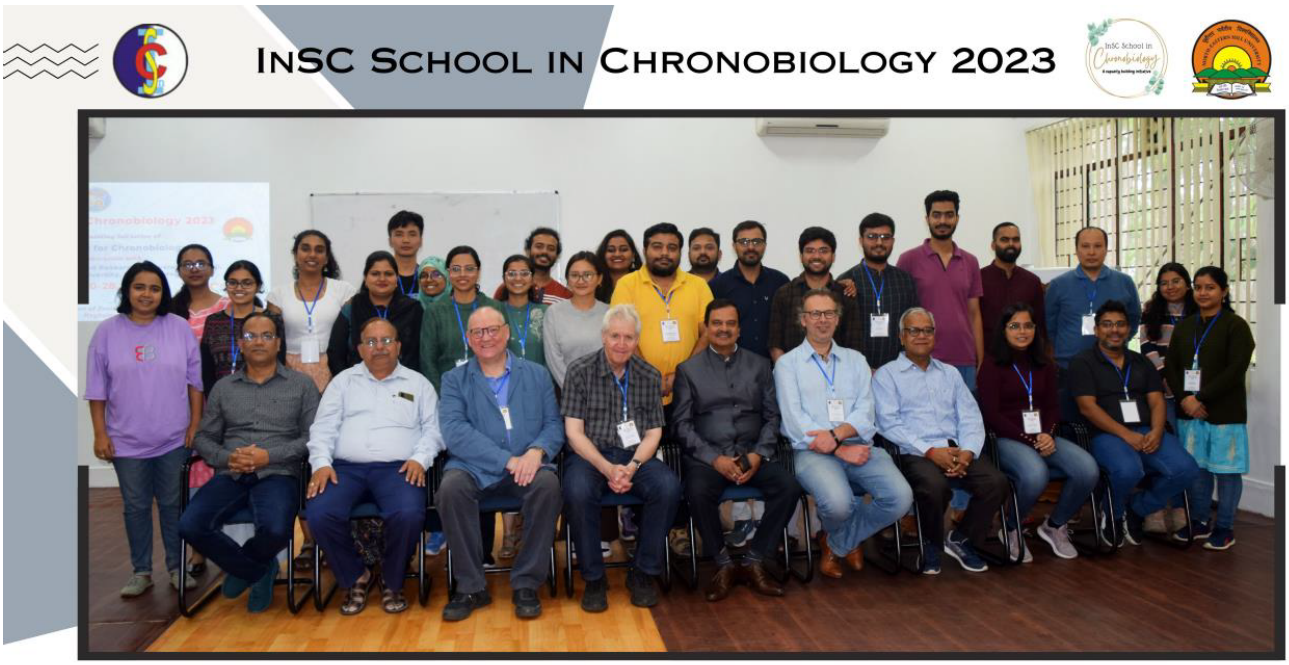
Best Student award: Ms. Shreyayukta
Highest Scorer award (in assessment tests): Mr. Priyesh Singh

Best group (in lab presentation): Brain Follett Group (Ms. Nehareeka Dan, Mr. Mayank Kumar, Ms. Payal Patra, Mr. Priyesh Singh)

In picture: from left: Prof. Anand S. Dixit, Shreyayukta, Prof. Rusell G. Foster, Prof. Vinod Kumar and Prof. Sanjay Bhardwaj

In picture: from left: Mayank Kumar, Payal Patra, Nehareeka Dan and Priyesh Singh

The group picture: InSC School in Chronobiology



CHRONOBIOLOGY IN NEWS

Chronobiology
Timing is Everything®

Circadian Rhythm: New Research Reveals How the Body Clock is Regulated and What Causes Misalignment

April, 2023

Read the full article here:
https://www.chronobiology.com/circadian-rhythm-new-research-reveals-how-the-body-clock-is-regulated-and-what-causes-misalignment/

Migraine and Cluster Headache: The Role of the Circadian Rhythm

April, 2023

Read the full article here:
https://www.chronobiology.com/migraine-and-cluster-headache-the-role-of-the-circadian-rhythm/

THE CONVERSATION
Academic rigour, journalistic flair

Does it matter what time I go to bed

March, 2023

Read the full article here:
https://theconversation.com/does-it-matter-what-time-i-go-to-bed-198146

UPCOMING EVENTS

2024 Annual Meeting of Society for Research on Biological Rhythms

May 18-22, 2024

San Juan, Puerto Rico

For more, visit: http://srbr.org

Society for Research on Biological Rhythms

International Symposium on Avian Endocrinology- 2024

March 17-22, 2024

Meerut, UP, India

For more, email: isaeindia24@gmail.com

Share your feedbacks

inscdu@gmail.com
biorhythmccsu@gmail.com

Become a life member of Indian Society for Chronobiology

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