

Sheeba Vasu

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Research Interests

My laboratory studies neuronal circuits that regulate rhythmic behaviours such as locomotor activity, sleep, adult-emergence, feeding and egg-laying in drosophilid flies. Genetic amenability of *Drosophila melanogaster* enables the manipulation of neuronal circuits in a spatio-temporal fashion. The neuronal network that modulates sleep/wake cycles by integrating circadian (daily) clocks and homeostatic control mechanisms is of interest to us. We also examine the role of temperature sensitive ion channels and the neuronal circuits involved in modulating daily rhythms. We use the circadian neuronal circuit in fruitflies as a model to study progression of neurodegenerative Huntington's disease. We are also interested in studying the interaction between central and peripheral circadian oscillators that may control feeding and metabolic rhythms. We also use a comparative approach to study neuronal circuits by examining the behavioural and underlying neuronal networks modulating circadian rhythms of five closely related species of Drosophilids collected locally.

Post-doctoral training

Associate Specialist, Dept. of Physiology and Biophysics, University of California, Irvine. (Mar 2007-Sept 2008)

Post doctoral fellow, Dept. of Biology, New York University, New York. (Jul 2003-Feb 2007)

Post doctoral fellow, Dept. of Neurobiology, University of Massachusetts, Worcester. (Jan 2002 -Jul 2003)

Research Publications

1. Iyengar, Aishwariya; Kulkarni, Rutvij; **Vasu, Sheeba**. Under warm ambient conditions, *Drosophila melanogaster* suppresses nighttime activity via the neuropeptide PDF. **Genes Brain Behavior**, *in press*
2. Ghosh A, **Sheeba V**. VANESSA—Shiny Apps for Accelerated Time-series Analysis and Visualization of *Drosophila* Circadian Rhythm and Sleep Data. **Journal of Biological Rhythms**, *in press* <https://doi.org/10.1177/07487304221077662>
3. Lone SR, Potdar S, Venkataraman A, Sharma N, Kulkarni R, Rao S, Mishra S, **Sheeba V**, Sharma VK. Mechanosensory Stimulation via *Nanchung* Expressing Neurons Can Induce Daytime Sleep in *Drosophila*. *J Neurosci*. 2021 Nov 10;41(45):9403-9418. doi: 10.1523/JNEUROSCI.0400-21.2021. Epub 2021 Oct 11. PMID: 34635540; PMCID: PMC8580144.
4. Ramakrishnan A, **Sheeba V**. Gap junction protein Innexin2 modulates the period of free-running rhythms in *Drosophila melanogaster*. *iScience*. 2021. PMID: 34522854

5. Ghosh A, Dansana S, Sharma P, **Sheeba V**. Evidence for co-evolution of masking and circadian phase in *Drosophila melanogaster*. **J Biol Rhythms**. 2021, 36 (3)254-270.
6. Abhilash L, Kalliyil A, **Sheeba V**. Responses of activity rhythms to temperature cues evolve in *Drosophila* populations selected for divergent timing of eclosion. **J Exp Biol**. 2020, 223 (11),
7. Abhilash L, Ramakrishnan A, Priya S, **Sheeba V**. Waveform Plasticity under Entrainment to 12-h T-cycles in *Drosophila melanogaster*: Behavior, Neuronal Network, and Evolution. **J Biol Rhythms**. 2020, 35 (2), 145-157
8. Abhilash L, **Sheeba V**. RhythmicAlly: your R and Shiny-based open-source ally for the analysis of biological rhythms **J Biol Rhythms**. 2020, 34 (5), 551-561
9. Sasmal R, Das Saha N, Schueder F, Joshi D, **Sheeba V**, Jungmann R, Agasti SS. Dynamic host-guest interaction enables autonomous single molecule blinking and super-resolution imaging. **Chem Commun (Camb)**. 2019, 55(96):14430-14433.doi: 10.1039/c9cc07153a.
10. Abhilash L, Ghosh A, **Sheeba V**. Selection for Timing of Eclosion Results in Co-evolution of Temperature Responsiveness in *Drosophila melanogaster*. **J Biol Rhythms**. 2019, 13. doi: 10.1177/0748730419877315.
11. Varma V, Krishna S, Srivastava M, Sharma VK, **Sheeba V**. Accuracy of fruit-fly eclosion rhythms evolves by strengthening circadian gating rather than developmental fine-tuning. **Biol Open**. 2019 Aug 27;8(8). pii: bio042176. doi:10.1242/bio.042176
12. Srivastava M, Varma V, Abhilash L, Sharma VK, **Sheeba V**. Circadian Clock Properties and their Relationships as a function of free-running period in *Drosophila melanogaster*. **J Biol Rhythms**. 2019 doi.10.1177/0748730419837767.
13. Srivastava M, James A, Varma V, Sharma VK, **Sheeba V**. Environmental cycles regulate development time via circadian clock mediated gating of adult emergence. **BMC Dev Biol**. 2018 doi:10.1186/s12861-018-0180-6.
14. Potdar S, **Sheeba V**. Wakefulness is promoted during day time by PDFR signalling to dopaminergic neurons in *Drosophila melanogaster*. **eNeuro** 2018 doi: <https://doi.org/10.1523/ENEURO.0348-18.2018>.
15. Potdar S, Daniel DK, Thomas FA, Lall S, **Sheeba V**. Sleep deprivation negatively impacts reproductive output in *Drosophila melanogaster*. **J Exp Biol**. 2018 Mar 26;221(Pt 6). pii: jeb174771. doi: 10.1242/jeb.174771. PubMed PMID: 29361608.
16. Prakash P, Nambiar A, **Sheeba V**. Oscillating PDF in termini of circadian pacemaker neurons and synchronous molecular clocks in downstream neurons are not sufficient for sustenance of activity rhythms in constant darkness. **PLoS One**. 2017 12(5): e0175073. doi:10.1371/journal.pone.0175073.
17. Das A, **Sheeba V**. Temperature Input for Rhythmic Behaviours in Flies: The Role of Temperature-Sensitive Ion Channels. In, **Biological Timekeeping: Clocks, Rhythms and Behaviour**. (Ed) Kumar V, 2017. DOI 10.1007/978-81-322-3688-7_19
18. Das A, Holmes TC, **Sheeba V**. dTRPA1 in non-circadian neurons modulates temperature-dependent rhythmic activity in *Drosophila melanogaster*. **J Biol Rhythms**. 2016 Jun;31(3):272-88. doi: 10.1177/0748730415627037.
19. Gogna N, Singh VJ, **Sheeba V**, Dorai K. NMR-based investigation of the *Drosophila melanogaster* metabolome under the influence of daily cycles of light and temperature. **Molecular Biosystems**. 2015 Dec;11(12):3305-15. doi: 10.1039/c5mb00386e.
20. Das A, Holmes TC, **Sheeba V**. dTRPA1 modulates afternoon peak of activity of fruit flies *Drosophila melanogaster*. **PLoS One**. 2015 Jul 30;10(7):e0134213. doi: 10.1371/journal.pone.0134213.

21. Prabhakaran PM, **Sheeba V**. Temperature sensitivity of circadian clocks is conserved across *Drosophila* species *melanogaster*, *malerkotliana* and *ananassae*. **Chronobiol Int.** **2014** Nov;31(9):1008-162:
22. Prabhakaran PM, **Sheeba V**. Simulating natural light and temperature cycles in the laboratory reveals differential effects on activity/rest rhythm of four *Drosophilids*. **J Comp Physiol A Neuroethol Sens Neural Behav Physiol.** **2014** Oct;200(10):849-62.
23. Prabhakaran PM, De J, **Sheeba V**. Natural conditions override differences in emergence rhythm among closely related *drosophilids*. **PLoS One.** **2013** Dec 11;8(12):e83048.
24. Prabhakaran PM, **Sheeba V**. Insights into differential activity patterns of *drosophilids* under semi-natural conditions. **J Exp Biol.** **2013** Dec 15;216(Pt 24):4691-702.
25. Potdar S, **Sheeba V**. Lessons from sleeping flies: insights from *Drosophila melanogaster* on the neuronal circuitry and importance of sleep. **J Neurogenet.** **2013** Jun;27(1-2):23-42. doi: 10.3109/01677063.2013.791692.
26. De J, Varma V, Saha S, **Sheeba V***, Sharma VK. Significance of activity peaks in fruit flies, *Drosophila melanogaster*, under seminatural conditions. **Proc Natl Acad Sci U S A.** **2013** May 28;110(22):8984-9. (* Co-corresponding author)
27. Prabhakaran PM, **Sheeba V**. Sympatric *Drosophilid* species *melanogaster* and *ananassae* differ in temporal patterns of activity. **J Biol Rhythms.** **2012** Oct;27(5):365-76.
28. Potdar S, **Sheeba V**. Large ventral lateral neurons determine the phase of evening activity peak across photoperiods in *Drosophila melanogaster*. **J Biol Rhythms.** **2012** Aug;27(4):267-79.
29. **Sheeba V**. The *Drosophila melanogaster* circadian pacemaker circuit. **J Genet.** **2008** Dec;87(5):485-93. Review. PubMed PMID: 19147937.
30. **Sheeba V**, Fogle KJ, Holmes TC. Persistence of morning anticipation behavior and high amplitude morning startle response following functional loss of small ventral lateral neurons in *Drosophila*. **PLoS One.** **2010** Jul 16;5(7):e11628. doi: 10.1371/journal.pone.0011628.
31. **Sheeba V**, Fogle KJ, Kaneko M, Rashid S, Chou YT, Sharma VK, Holmes TC. Large ventral lateral neurons modulate arousal and sleep in *Drosophila*. **Curr Biol.** **2008** Oct 28;18(20):1537-45. doi: 10.1016/j.cub.2008.08.033. Epub 2008 Sep 4. PubMed PMID: 18771923; PubMed Central PMCID: PMC2597195.
32. Ayaz D, Leyssen M, Koch M, Yan J, Srahna M, **Sheeba V**, Fogle KJ, Holmes TC, Hassan BA. Axonal injury and regeneration in the adult brain of *Drosophila*. **J Neurosci.** **2008** Jun 4;28(23):6010-21. doi: 10.1523/JNEUROSCI.0101-08.2008.
33. **Sheeba V**, Sharma VK, Gu H, Chou YT, O'Dowd DK, Holmes TC. Pigment dispersing factor-dependent and -independent circadian locomotor behavioral rhythms. **J Neurosci.** **2008** Jan 2;28(1):217-27. doi: 10.1523/JNEUROSCI.4087-07.2008.
34. **Sheeba V**, Gu H, Sharma VK, O'Dowd DK, Holmes TC. Circadian- and light-dependent regulation of resting membrane potential and spontaneous action potential firing of *Drosophila* circadian pacemaker neurons. *J Neurophysiol.* **2008** Feb;99(2):976-88. Epub 2007 Dec 12. PubMed PMID: 18077664; PubMed Central PMCID: PMC2692874.
35. **Sheeba V**, Kaneko M, Sharma VK, Holmes TC. The *Drosophila* circadian pacemaker circuit: Pas De Deux or Tarantella? *Crit Rev Biochem Mol Biol.* **2008** Jan-Feb;43(1):37-61. doi: 10.1080/10409230701829128 . Review.
36. Nitabach MN, Wu Y, **Sheeba V**, Lemon WC, Strumbos J, Zelensky PK, White BH, Holmes TC. Electrical hyperexcitation of lateral ventral pacemaker neurons desynchronizes downstream circadian oscillators in the fly circadian circuit and induces multiple behavioral periods. *J Neurosci.* **2006** Jan 11;26(2):479-89.
37. Holmes TC, **Sheeba V**. Circadian pathway: the other shoe drops. *Curr Biol.* **2005** Dec 20;15(24):R987-9. Review. PubMed PMID: 16360675.

38. Nitabach MN, **Sheeba V**, Vera DA, Blau J, Holmes TC. Membrane electrical excitability is necessary for the free-running larval *Drosophila* circadian clock. *J Neurobiol.* 2005 Jan;62(1):1-13. PubMed PMID: 15389695.
39. **Sheeba, V.**, Chandrashekar, M. K., Joshi, A. and V. K. Sharma. Locomotor activity rhythm in *Drosophila melanogaster* after 600 generations in an aperiodic environment. *Naturwissenschaften* 89: 512-514. 2002.
40. **Sheeba, V.**, Chandrashekar, M. K., Joshi, A. and V. K. Sharma. Developmental plasticity of the locomotor activity rhythm of *Drosophila melanogaster*. *Journal of Insect Physiology* 48: 25-32. 2002.
41. **Sheeba, V.**, Nihal, M., Mathew, S. J., Swamy, N. M., Bandhopadhyay, L., Chandrashekar, M. K., Joshi, A. and V. K. Sharma. Does the difference in the timing of eclosion of the fruit fly *Drosophila melanogaster* reflect differences in the circadian organization? *Chronobiology International* 18: 601-612. 2001.
42. **Sheeba, V.**, Chandrashekar, M. K., Joshi, A. and V. K. Sharma. Persistence of oviposition rhythm in individuals of *Drosophila melanogaster* reared in an aperiodic environment for several hundred generations. *Journal of Experimental Zoology* 290: 541-549. 2001.
43. **Sheeba, V.**, Chandrashekar, M. K., Joshi, A. and V. K. Sharma. A case for multiple oscillators controlling different rhythms in *Drosophila melanogaster*. *Journal of Insect Physiology* 47: 1217-1225. 2001.
44. Prasad, N. G., Shakarad, M., Gohil, V. M., **Sheeba, V.**, Rajamani, M. and A. Joshi. Evolution of reduced pre-adult viability and larval growth rate in laboratory populations of *Drosophila melanogaster* selected for shorter development time. *Genetical Research* 76: 249-259. 2000.
45. **Sheeba, V.**, Sharma, V. K., Shubha, K., Chandrashekar, M. K. and A. Joshi. The effect of different light regimes on adult lifespan in *Drosophila melanogaster* is partly mediated through reproductive output. *Journal of Biological Rhythms* 15: 380-392. 2000.
46. **Sheeba, V.**, M. Rajamani and A. Joshi. Bimodal distribution of oviposition preference for a novel food medium in *Drosophila melanogaster*. *Current Science* 77: 1197-1200. 1999.
47. **Sheeba, V.**, Sharma, V. K., Chandrashekar, M. K. and A. Joshi. Effect of different light regimes on pre-adult fitness in *Drosophila melanogaster* populations reared in constant light for over six hundred generations. *Biological Rhythms Research* 30: 424-433. 1999.
48. **Sheeba, V.**, Sharma, V. K., Chandrashekar, M. K. and A. Joshi. Persistence of *Drosophila* eclosion rhythm after 600 generations in an aperiodic environment. *Naturwissenschaften* 86: 448-449. 1999. (reviewed in *The New Scientist* 25th August 2000 issue)
49. **Sheeba, V.** and A. Joshi. A test of simple models of population growth using data from very small populations of *Drosophila melanogaster*. *Current Science* 75: 1406-1410. 1998.
50. **Sheeba, V.**, Madhyastha, N. A. A. and A. Joshi. Oviposition preference for novel *versus* normal food resources in laboratory populations of *Drosophila melanogaster*. *Journal of Biosciences* 23: 93-100. 1998.

Professional Awards/Recognition

- Awarded postdoctoral fellowship from Japanese Society for the Promotion of Science (JSPS), Japan in 2000 (*declined*).
- Best Ph D thesis Award of 2002 from Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India.
- Grants received: Charles E Culpeper Foundation (Rockefeller Brothers Fund) – Biomedical Pilot Initiative 2003.
- Research Excellence Trainee Travel Award 2006, Society for Research on Biological Rhythms (SRBR).

- Chosen for Hot Topic Presentation and Travel Award 2007, Gordon Research Conference (GRC) in Chronobiology.
- Awarded the DST Ramanujan Fellowship 2009-2013.

Professional Responsibilities in International and National Forum

- Member, Education Committee Society for Research on Biological Rhythms (since 2020)
- Member, Program Committee Society for Research on Biological Rhythms 2022
- Vice President, Executive Committee, Indian Society for Chronobiology since 2021.

International and National Conferences / Workshop Organised

- SERC-SERB School in Chronobiology 2010 and 2013 – Co-organiser of 2 week-long school taught by teachers from India, Europe and USA
- International Conference on Chronobiology – Time in the living world – 2021 July 15-17th with scientists from USA, Europe, Australia and India conducted in virtual mode due to the pandemic. Sponsored by the IUSSTF – Indo-US Science and Technology Forum.

Current teaching responsibilities at JNCASR:

Code	Course Title	Credits	Semester	Remarks
JNS201	Introduction to Neuroanatomy	2:0	August – December	Co-instructors NK Subedhar ; J Chelliah
JNS202	Introduction to Neurobiology	3:0	August – December	Co-instructor J Chelliah
JE304	Advanced Neurogenetics	3:0	January - April	-
Lab1	Int PhD Biology	4 credits	August – December	Co-instructors
Lab2	Laboratory course	4 credits	January - April	G Ramesh & James Chelliah

Courses Taught Previously at JNCASR and IISc:

Code	Course Title	Credits	Semester
JE205	Introductory Course in Neurogenetics	2:0	August – December 2009-2015
JE207	Laboratory Course in Neurogenetics	2:0	August – December 2009-2012 January – April 2011-2014
JE304	Advanced Neurogenetics	3:0	January - April 2011; 2012; 2014;2015
NS201	Introduction to Neuroscience. Centre for Neuroscience, IISc	2:0	August – December 2009

Other Teaching Responsibilities

- Summers in the POBE programme at JNCASR – 1 week each for the years 2009-till date

- Faculty at the SERC/SERB School in Chronobiology – 2008-2015 (2- 5 lectures and labs).
- Faculty at the SERC/SERB School in Neuroscience – 2014 (2 lectures in 1 school).
- Faculty at the SERC/SERB School in Insect Biology – 2015, 2016,2017 (2 lectures and labs in 1 school).
- EUCLOCK: EU-Sponsored School in Chronobiology – 2010
- Academy sponsored refresher course in Animal Behaviour – 2010
- Member of the Society for Research in Biological Rhythms (SRBR) Education Committee – since 2020.
- Member of the Society for Research in Biological Rhythms Program Committee 2021-22

Academic / Research Mentorship

I have mentored the following students since my joining at JNCASR.

MS thesis submitted

- **Sheetal Potdar** **2012**
- **Joydeep De** **2013**
- **Payel Ganguly** **2015**
- **Pritha Kundu** **2017**
- **Rutvij Kulkarni** **2019**
- **Ankit Sharma** **2019**
- **Saheli Roy** **2019**

PhD:

<u>Name of the student</u>	<u>Degree Awarded</u>
1. Priya M. Prabhakaran	2014
2. Antara Das	2015
3. Sheetal Potdar	2017
4. Vishwanath Varma	2017 (In Charge-supervisor)
5. Manishi Srivastava	2019 (In Charge supervisor)
6. Abhilash Lakshman	2020
7. Aishwarya Ramakrishnan	2021
8. <i>Arijit Ghosh</i>	<i>2022 (thesis submitted)</i>

International Meetings invited to:

2010	EUCLOCK School in Chronobiology, Bangalore	Insect Clocks
2012	International Congress in Chronobiology, Delhi	Invited lecture Sympatric <i>Drosophilid</i> species <i>melanogaster</i> and <i>ananassae</i> occupy different temporal niches
2014	Society for Research on Biological rhythms (SRBR)	Invited lecture dTRPA1 for temperature entrainment: Lab <i>versus</i> nature
2017	Chinese Society for Biological Rhythms	Invited lecture

2017	Asia Pacific Drosophila Neurobiology Conference	Invited Lecture
2018	Society for Research on Biological rhythms (SRBR)	Invited lecture
2019	5 th world Congress on Chronobiology	Invited Lecture

Other academic responsibilities

Examiner/editor/reviewer

Served as Ad-hoc reviewer for the following funding agencies:

- National Science Foundation (NSF) USA
- Department of Biotechnology (DBT), India
- Czech Science Foundation, Czech Republic
- Israel Research Foundation (ISF)

Served as Ad-hoc reviewer for the following journals:

- Current Biology; Frontiers in Neurology; Journal of Neurogenetics; BMC Genomics; PloS One; Journal of Biological Rhythms; Journal of Genetics; Science Reports; Nature Communications.

Review Editor Editorial Board of the 'Insect Neurobiology' Section of Frontiers in Insect Science.

Served as Thesis Examiner for PhD theses at IISc, NCBS, NIMHANS

Served as Thesis Committee Member at NCBS, NIMHANS