

## **CURRICULUM VITAE**

Name: Rajan Sankaranarayanan

Date and Place of Birth: 28<sup>th</sup> May 1968, Papanasam Project  
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### **Education:**

1990-1996	Ph.D. from Molecular Biophysics Unit, Indian Institute of Science, Bangalore.
1988-1990	M. Sc. in Physics from Madurai Kamaraj University.
1985-1988	B. Sc. in Physics from Madurai Kamaraj University.

### **Research Experience:**

March 2002 – present	Senior to Outstanding Scientist and Group Leader, Structural Biology Laboratory, CSIR-CCMB, Hyderabad.
October 1996 – February 2002	Postdoctoral research with Prof. Dino Moras, Laboratoire de Biologie Structurale, IGBMC, Strasbourg, France.
April 1996 – September 1996	Postdoctoral research with Prof. M. Vijayan, Molecular Biophysics Unit, Indian Institute of Science, Bangalore.

August 1990 – March 1996      Doctoral research with Prof. M. Vijayan,  
Molecular Biophysics Unit, Indian Institute of  
Science, Bangalore.

### **Honours and awards:**

- 2020 **Infosys Prize** in Life Sciences category awarded by the Infosys Science Foundation.
- 2020 Member of the **Board of Reviewing Editors (BRE)** of the journal **Elife**.
- 2018 **GD Birla Award** for Scientific Research for the year 2017.
- 2018 **Sun Pharma Research Award** for 2016 in Medical Sciences under Basic Sciences Category.
- 2017 **Dr. M. R. Das Memorial lecture** awarded by INSA, New Delhi.
- 2015 Awarded the **G. N. Ramachandran Gold Medal** for Excellence in Biological Sciences and Technology by CSIR, India.
- 2015 Awarded the **JC Bose National Fellowship** from Science and Engineering Research Board (SERB), India.
- 2014 Delivered the 3rd **G. N. Ramachandran Award Lecture** at the IUPAB-International Biophysics Congress (IBC)-2014 in Brisbane, Australia.
- 2014 Editorial board member of **Frontiers in Molecular Biosciences**, a Swiss, Gold open-access academic publisher in partnership with Nature Publishing Group.
- 2014 Editorial board member of **Current Opinion in Structural Biology**, an Elsevier publication.
- 2013 Appointed as the **Associate Editor** of the **Journal of Structural Biology**, an Elsevier publication.
- 2013 **Editorial Advisory Panel member for Biochemical Journal**, Portland Press Limited.
- 2013 Elected as a **Fellow of Indian National Science Academy**, New Delhi, India.
- 2012 Elected as a **Fellow of Andhra Pradesh Academy of Sciences**, Hyderabad, India.
- 2011 Awarded the **Shanti Swarup Bhatnagar Prize** in Biological Sciences.

- 2010 Elected as a **Fellow of National Academy of Sciences**, Allahabad, India.
- 2010 Elected as a **Fellow of Indian Academy of Sciences**, Bangalore, India.
- 2009 Appointed as the **Co-Editor of *Acta Crystallographica***, an International Union of Crystallography publication.
- 2009 Awarded the **BM Birla Science Prize** for 2008 in Biological Sciences.
- 2009 Received the **National Bioscience Award** for the year 2008 from the Department of Biotechnology, India.
- 2008 Received the **Endeavour Executive Award** from the Department of Education, Science and Training (DEST), Australia.
- 2007 Editorial board member of the **Journal of Structural Biology**, an Elsevier publication.
- 2007 Awarded the **Swarnajayanti Fellowship** for the year 2005-06 from the Department of Science and Technology, India.
- 2004 Elected as a member of **Guha Research Conference**.
- 2003 Received an **International Senior Research Fellowship (ISRF)** award in Biomedical Science for five years from The Wellcome Trust, UK.
- 1996 '**Shamrao Kaikini Gold medal and award**' for the best thesis from Indian Institute of Science, Bangalore.
- 1990 '**Gold medal**' from Madura College, Madurai for M.Sc. in Physics branch.

## Publications

\*Corresponding author(s). If not indicated, the last author is the corresponding author.

### Research Articles

1. Patil, G. S., Kinatukara, P., Mondal, S., Shambavi, S., Patel, K. D., Pramanik, S., Dubey, N., Narasimhan, S., Madduri, M. K., Pal, B., Gokhale, R. S. and Sankaranarayanan, R. (2021) A universal pocket in fatty acyl-AMP ligases ensure redirection of fatty acid pool away from coenzyme A-based activation. *Elife* **10**.7554/elife.70067.
2. Mazeed, M., Singh, R., Kumar, P., Roy, A., Raman, B., Kruparani, S. P. and Sankaranarayanan, R. (2021) Recruitment of archaeal DTD is a key event toward the emergence of Land plants. *Science Advances* **7**, eabe8890, 1-16.
3. Kinatukara, P., Subramanian, P. S., Patil, G. S., Shambavi, S., Singh, S., Mhetre A., Madduri, M. K., Soundararajan, A., Patel, K. D., Shekar, P. C., Kamat, S. S., Kumar, S.\* and Sankaranarayanan, R.\* (2020) Peri-natal growth retardation rate and fat mass accumulation in mice lacking Dip2A is dependent on the dietary composition *Transgenic Res.* **29**, 553-562.
4. Kuncha, S. K., Venkadasamy, V. L., Amudhan, G., Dahate, P., Kola, S. R., Pottabathini, S., Kruparani, S. P., Shekar, P. C. and Sankaranarayanan, R. (2020) Genomic innovation of ATD alleviates mistranslation associated with multicellularity in Animalia. *Elife* doi: **10.7554/eLife.58118**.
5. Krishnan, B., Srivatsava, S. S., Sankeshi, V., Garg, R., Srivatsava, S., Sankaranarayanan, R.\* and Sharma, Y.\* (2019)  $\beta\gamma$ -Crystallination endows a novel bacterial glycoside hydrolase 64 with  $\text{Ca}^{2+}$ -dependent activity modulation. *J. Bacteriology* **201**, e00392-19.
6. Srivastava, S. S., Raman, R., Kiran, U., Garg, R., Chadalawada, S., Pawar, A. D., Sankaranarayanan, R.\* and Sharma, Y.\* (2018) Interface interactions between  $\beta\gamma$ -crystallin domain and Ig-like domain render  $\text{Ca}^{2+}$  binding site inoperative in Abundant Perithecial Protein of *Neurospora Crassa*. *Mol Microbiol.* **110**, 955-972.
7. Kuncha, S. K., Suma, K., Pawar, K. I., Gogoi, J., Routh, S. B., Pottabathini, S., Kruparani, S. P. and Sankaranarayanan, R. (2018) A discriminator-based DTD surveillance ensures faithful glycine delivery for protein biosynthesis in bacteria. *Elife* **8**, e38232, 1-15.
8. Kuncha, S. K., Mazeed, M., Singh, R., Kattula, B., Routh, S. B. and Sankaranarayanan, R. (2018) A chiral selectivity paralog of DTD for proofreading tRNA mischarging in Animalia. *Nature Commun.* **9**:511, 1-13.
9. Tayi, L., Kumar, S., Nathawat, R., Haque, A. S., Maku, R. V., Patel, H. K., Sankaranarayanan, R.\* and Sonti, R. V.\* (2017) A mutation in an exoglucanase of *Xanthomonas oryzae* pv. *oryzae* that confers an endo mode of activity affects bacterial virulence but not the induction of immune responses in rice. *Mol. Plant. Pathol.* **19**, 1364-1376.
10. Pawar, K. I., Suma, K., Seenivasan, A., Kuncha, S. K., Routh, S. B., Kruparani, S. P. and Sankaranarayanan, R. (2017) Role of D-aminoacyl-tRNA deacylase beyond chiral proofreading as a cellular defense against glycine mischarging by AlaRS. *Elife* **6**,

- e24001, 1-19 (Covered by *Spotlight article in TIBS* vol 42:9, September, 2017).
11. Srivastava, S. S., Jamkhindikar, A. A., Raman, R., Jobby, M. K., Chandalawada, S., Sankaranarayanan, R.\* and Sharma, Y.\* (2017) A Transition Metal-Binding, Trimeric  $\beta\gamma$ -Crystallin from Methane-Producing Thermophilic Archaea, *Methanosaeta thermophila*. *Biochemistry* **56**, 1299-1310.
  12. Routh, S. B., Pawar, K. I., Ahmad, S., Singh, S., Suma, K., Kumar, M., Kuncha, S. K., Yadav, K., Kruparani, S. P. and Sankaranarayanan, R. (2016) Elongation factor Tu prevents misediting of Gly-tRNA(Gly) caused by the design behind the chiral proofreading site of D-aminoacyl-tRNA deacylase. *PLOS Biol.* **14(5)** e1002465, 1-22.
  13. Priyadarshan, K., Patel, K. D., Haque, A. S., Singh, R., Gokhale, R. S. and Sankaranarayanan, R. (2016) Structural insights into the regulation of NADPH binding to reductase domains of nonribosomal peptide synthetases: A concerted loop movement model. *J. Struct. Biol.* **194**, 368-374.
  14. Srivastava, S., Chaudhary, S., Thukral, L., Shi, C., Gupta, R. D., Gupta, R., Priyadarshan, K., Vats, A., Haque, A. S., Sankaranarayanan, R., Natarajan, V. T., Sharma, R., Aldrich, C. C. and Gokhale, R. S. (2015) Unsaturated Lipid Assimilation by Mycobacteria Requires Auxiliary cis-trans Enoyl CoA Isomerase. *Chemistry & Biology* **22**, 1577-1587.
  15. Ahmad, S., Muthukumar, S., Kuncha, S. K., Routh, S. B., Yerabham, A. S. K., Hussain, T., Kamarthapu, V., Kruparani, S. P. and Sankaranarayanan, R. (2015) Specificity and catalysis hardwired at the RNA-protein interface in a translational proofreading enzyme. *Nature Commun.* **6**:7552.
  16. Gupta, M. K, Nathawat, R., Sinha, D., Haque, A. S., Sankaranarayanan, R. and Sonti, R. V. (2015) Mutations in the predicted active site of *Xanthomonas oryzae* pv. *oryzae* XopQ differentially affect virulence, suppression of host innate immunity and induction of HR in a non-host plant. *Mol. Plant Microbe Interact.* **28**, 195-206.
  17. Haque, A. S., Patel, K. D., Deshmukh, M. V., Chhabra, A., Gokhale, R. S. and Sankaranarayanan, R. (2014) Delineating the reaction mechanism of reductase domains of Nonribosomal Peptide Synthetases from mycobacteria. *J. Struct. Biol.* **187**, 207-214.
  18. Ahmad, S., Routh, S. B., Kamarthapu, V., Chalissery, J., Muthukumar, S., Hussain, T., Kruparani, S. P., Deshmukh, M. V. and Sankaranarayanan, R. (2013) Mechanism of chiral proofreading during translation of the genetic code. *Elife* **2**, e01519, 1-18. (#Highlighted as *Science Editor's Choice* article: 'Chirality Check' *Science* Vol. 343, p119; 10<sup>th</sup> January, 2014)
  19. Ahmad, S., Sravankumar, A. S., Kruparani, S. P. and Sankaranarayanan, R. (2012) Cloning, expression, purification, crystallization and preliminary X-ray crystallographic analyses of threonyl-tRNA synthetase editing domain from *Aeropyrum pernix*. *Acta Cryst.* **F68**, 1390-1393.
  20. Rajanikanth, V., Srivastava, S. S., Singh, A. K., Rajyalakshmi, M., Chandra, K., Aravind, P., Sankaranarayanan, R.\* and Sharma, Y.\* (2012) Aggregation prone near-native intermediate formation during unfolding of a structurally similar nonlenticular  $\beta\gamma$ -crystallin domain. *Biochemistry* **51**, 8502-8513.
  21. Kumar, S., Haque, A. S., Jha, G., Sonti, R. V. and Sankaranarayanan, R. (2012) Crystallization and preliminary crystallographic studies of CbsA, a secretory

- exoglucanase from *Xanthomonas oryzae* pv. *oryzae*. *Acta Cryst.* **F68**, 1191-1194.
22. Chhabra, A., Haque, A. S., Pal, R. K., Goyal, A., Rai, R., Joshi, S., Panjikar, S., Pasha, S., Sankaranarayanan, R.\* and Gokhale, R. S.\* (2012) Nonprocessive [2+2]<sup>e</sup> off-loading reductase domains from mycobacterial nonribosomal peptide synthetases. *Proc. Natl. Acad. Sci. (USA)* **109**, 5681-5686.
  23. Goyal, A., Verma, P. Anandhakrishnan, M., Gokhale, R. S.\* and Sankaranarayanan R.\* (2012) Molecular basis of the functional divergence of fatty acyl-AMP ligase biosynthetic enzymes of *Mycobacterium tuberculosis*. *J. Mol. Biol.* **416**, 221-238.
  24. Mishra, A., Suman, A. K., Srivastava, S. S., Sankaranarayanan, R.\* and Sharma, Y.\* (2012) Decoding the molecular design principles underlying Ca(2+) binding to  $\beta\gamma$ -crystallin motifs. *J. Mol. Biol.* **415**, 75-91.
  25. Puri, V., Goyal, A., Sankaranarayanan, R., Enright, A. J. and Vaidya, T. (2011) Evolutionary and functional insights into Leishmania META1: evidence for lateral gene transfer and a role for META1 in secretion. *BMC Evol. Biol.* **11**, 334.
  26. Kamal, M. Z., Ahmad, S., Molugu, T. R., Vijayalakshmi, A., Deshmukh, M. V., Sankaranarayanan, R. and Rao, N. M. (2011) In vitro evolved and non-aggregating and thermostable lipase: Structural and thermodynamic investigation. *J. Mol. Biol.* **413**, 726-741.
  27. Chennupati, V., Datta, D., Rao, M. R., Boddapati, N., Kayasani, M., Sankaranarayanan, R., Mishra, M., Seth P, Mani, C. and Mahalingam, S. (2011) Signals and Pathways Regulating Nucleolar Retention of Novel Putative Nucleolar GTPase NGP-1(GNL-2). *Biochemistry* **50**, 4521-4536.
  28. Hussain, T., Kamarthapu, V., Kruparani, S. P., Deshmukh, M. V. and Sankaranarayanan, R. (2010) Mechanistic insights into cognate substrate discrimination during proofreading in translation. *Proc. Natl. Acad. Sci. (USA)* **107**, 22117-22121. (#Covered by an accompanying *Commentary* article in the same PNAS issue titled 'Proofreading in translation: Dynamics of the double-sieve model' p21949-50)
  29. Matharu, N. K., Hussain, T., Sankaranarayanan, R. and Mishra, R. K. (2010) Vertebrate homologue of Drosophila GAGA factor. *J. Mol. Biol.* **400**, 434-447.
  30. Dubey, V. P., Pal, B., Srikantan, S., Pottabathini, S., De, P. K. and Sankaranarayanan, R. (2010) Cloning, overexpression, purification, crystallization and preliminary X-ray analysis of a female-specific lipocalin (FLP) expressed in the lacrimal glands of Syrian hamsters. *Acta Cryst* **F66**, 509-512.
  31. Aravind, P., Mishra, A., Suman, S. K., Jobby, M. K., Sankaranarayanan, R.\* and Sharma, Y.\* (2009) betagamma-Crystallin superfamily contains a universal motif for binding calcium. *Biochemistry* **48**, 12180-12190.
  32. Aparna, G., Chatterjee, A., Sonti, R. V. and Sankaranarayanan, R. (2009) A cell wall degrading esterase of *Xanthomonas oryzae* requires a unique substrate recognition module for pathogenesis on rice. *Plant Cell* **21**, 1860-1873.
  33. Roy, S., Aravind, P., Madhurantakam, C., Ghosh, A. K., Sankaranarayanan, R.\* and Das, A. K.\* (2009) Crystal structure of a fungal protease inhibitor from *Antheraea mylitta*. *J. Struct. Biol.* **166**, 79-87.
  34. Arora, P., Goyal, A., Natarajan, V. T., Rajakumara, E., Verma, P., Gupta, R., Yousuf, M., Trivedi, O. A., Mohanty, D., Tyagi, A., Sankaranarayanan, R.\* and Gokhale, R. S.\* (2009) Mechanistic and functional insights into fatty acid activation in

- Mycobacterium tuberculosis*. *Nature Chem. Biol.* **5**, 166-173.
35. Aravind, P., Suman, S. K., Mishra, A., Sharma, Y.\* and Sankaranarayanan, R.\* (2009) Three-Dimensional domain swapping in Nitrollin, a single-domain  $\beta\gamma$ -Crystallin from *Nitrosospora multiformis*, controls protein conformation and stability but not dimerization. *J. Mol. Biol.* **385**, 163-177.
  36. Aravind, P., Mishra, A., Suman, S. K., Sharma, Y.\* and Sankaranarayanan, R.\* (2008) Betagamma-crystallins: A universal calcium-binding superfamily. *Protein Science*, 17, suppl 1, pg.173.
  37. Ahmad, S., Kamal, M. Z., Sankaranarayanan, R.\* and Rao, N. M.\* (2008) Thermostable *Bacillus subtilis* lipases: in vitro evolution and structural insight. *J. Mol. Biol.* **381**, 324-340.
  38. Aravind, P., Wistow, G., Sharma, Y.\* and Sankaranarayanan, R.\* (2008) Exploring the limits of sequence and structure in a variant betagamma-crystallin domain of the protein absent in melanoma-1 (AIM1). *J. Mol. Biol.* **381**, 509-518.
  39. Goyal, A., Saxena, P., Rahman, A., Singh, P., Kasbekar, D., Gokhale, R. S.\* and Sankaranarayanan, R.\* (2008) Structural insights into biosynthesis of resorcinolic lipids by a type III polyketide synthase in *Neurospora crassa*. *J. Struct. Biol.* **162**, 411-421.
  40. Satapathy, A. K., Pavankumar, T. L., Bhattacharjya, S., Sankaranarayanan, R. and Ray, M. K. (2008) ATPase activity of RecD is essential for growth of the Antarctic *Pseudomonas syringae* Lz4W at low temperature *FEBS J.* **27**, 1835-1851.
  41. Rajakumara, E., Acharya, P., Ahmad, S., Sankaranarayanan, R.\* and Rao, N. M.\* (2008) Structural basis for the remarkable stability of *Bacillus subtilis* lipase at low pH. *Biochim. Biophys. Acta* **1784**, 302-311.
  42. Aparna, G., Chatterjee, A., Jha, G., Sonti, R. V. and Sankaranarayanan, R. (2007) Crystallization and preliminary crystallographic studies of LipA, a secretory lipase/esterase from *Xanthomonas oryzae* pv. *oryzae*. *Acta Cryst.* **F63**, 708-710.
  43. Rao, M. R., Kumari, G., Balasundaram, D., Sankaranarayanan, R. and Mahalingam, S. (2006) A Novel Lysine-rich Domain and GTP Binding Motifs Regulate the Nucleolar Retention of Human Guanine Nucleotide Binding Protein, GNL3L. *J. Mol. Biol.* **364**, 637-654.
  44. Hussain, T., Kruparani, S. P., Pal, B., Dock-Bregeon, A-C., Dwivedi, S., Shekar, M. R., Sureshbabu, K. and Sankaranarayanan, R. (2006) Posttransfer editing mechanism of a D-aminoacyl-tRNA deacylase-like domain in threonyl-tRNA synthetase from archaea. *EMBO J.* **25**, 4152-4162.
  45. Roy, S., Aravind, P., Madhurantakam, C., Ghosh, A. K., Sankaranarayanan, R.\* and Das, A. K.\* (2006) Crystallization and preliminary X-ray diffraction analysis of a protease inhibitor from the haemolymph of the Indian tsar silkworm *Antheraea mylitta*. *Acta Cryst.* **F62**, 669-671.
  46. Goyal, A., Yousuf, M., Rajakumara, E., Arora, P., Gokhale, R. S. and Sankaranarayanan, R. (2006) Crystallization and preliminary X-ray crystallographic studies of the N-terminal domain of FadD28, a fatty acyl AMP ligase from *Mycobacterium tuberculosis*. *Acta Cryst.* **F62**, 350-352.
  47. Aravind, P., Rajini, B., Sharma, Y. and Sankaranarayanan, R. (2006) Crystallization and preliminary X-ray crystallographic investigations on a  $\beta\gamma$ -Crystallin domain of Absent In Melanoma 1 (AIM1), a protein from *Homo sapiens*. *Acta Cryst.* **F62**, 282-

48. Sachdev, M., Sankaranarayanan, R., Reddanna, P., Thangaraj, K. and Singh, L. (2005) Major histocompatibility complex class I polymorphism in Asiatic lions. *Tissue Antigens* **66**, 9-18.
49. Dwivedi, S., Kruparani, S. P. and Sankaranarayanan, R. (2005) A D-amino acid editing module coupled to the translational apparatus in archaea. *Nature Struct. Mol. Biol.* **12**, 556-557.
50. Madhurantakam, C., Rajakumara, E., Mazumdar, P. A., Saha, B., Mitra, D., Wiker, H. G., Sankaranarayanan, R.\* and Das, A. K.\* (2005) Crystal structure of low molecular weight protein tyrosine phosphatase (MPtpA) from *Mycobacterium tuberculosis* at 1.9 Å resolution. *J. Bacteriol.* **187**, 2175-2181.
51. Dwivedi, S., Kruparani, S. P. and Sankaranarayanan, R. (2004) Cloning, expression, purification, crystallization and preliminary X-ray crystallographic investigations on a unique editing domain from Archaeobacteria. *Acta Cryst. D60*, 1662-1664.
52. Acharya, P., Rajakumara, E., Sankaranarayanan, R.\* and Rao, N. M.\* (2004) Structural basis for selection and enhanced thermostability of laboratory evolved *Bacillus subtilis* lipase. *J. Mol. Biol.* **341**, 1271-1281.
53. Sankaranarayanan, R.\*, Saxena, P., Marathe, U., Gokhale, R. S.\*, Shanmugam, V. M. and Rukmini, R. (2004) A novel tunnel in mycobacterial type III polyketide synthase reveals the structural basis for generating diverse metabolites. *Nature Struct. Mol. Biol.* **11**, 894-900.
54. Rukmini, R., Shanmugam, V. M., Saxena, P., Gokhale, R. S. and Sankaranarayanan, R. (2004) Crystallization and preliminary X-ray crystallographic investigations of an unusual type III polyketide synthase PKS18 from *Mycobacterium tuberculosis*. *Acta Cryst. D60*, 749-751.
55. Rajakumara, E., Acharya, P., Ahmad, S., Shanmugam, V. M., Rao, N. M.\* and Sankaranarayanan, R.\* (2004) Crystallization and preliminary X-ray crystallographic investigations on several thermostable forms of a *Bacillus subtilis* lipase. *Acta Cryst. D60*, 160-162.
56. Chatterjee, S., Sankaranarayanan, R. and Sonti, R. V. (2003) PhyA, a secreted protein of *Xanthomonas oryzae* pv. *oryzae*, is required for optimum virulence and growth on phytic acid as a sole phosphate source. *Molecular Plant-Microbe Interactions* **16**, 973-982.
57. Torres-Larios, A., Sankaranarayanan, R., Rees, B., Dock-Bregeon, A-C. and Moras, D. (2003) Conformational movements and cooperativity upon amino acid, ATP and tRNA binding in threonyl-tRNA synthetase. *J. Mol. Biol.* **331**, 201-211.
58. Caillet, J., Nogueira, T., Masquida, B., Winter, F., Graffe, M., Dock-Bregeon, A-C., Torres-Larios, A., Sankaranarayanan, R., Westhof, E., Ehresmann, B., Ehresmann, C., Romby, P. and Springer, M. (2003) The modular structure of *Escherichia coli* threonyl-tRNA synthetase as both an enzyme and a regulator of gene expression. *Mol. Microbiol.* **47**, 961-974.
59. Torres-Larios, A., Dock-Bregeon, A-C., Romby, P., Rees, B., Sankaranarayanan, R., Caillet, J., Springer, M., Ehresmann, C., Ehresmann, B. and Moras, D. (2002)



- Structural basis of translational control by *Escherichia coli* threonyl tRNA synthetase. *Nature Struct. Biol.* **9**, 343-347.
60. Sankaranarayanan, R. and Moras, D. (2001) Solution to the double discrimination problem by the class II threonyl-tRNA synthetase. *Med Chem Res.* **10**, 516-523.
  61. Dock-Bregeon, A-C., Sankaranarayanan, R., Romby, P., Caillet, J., Springer, M., Rees, B., Francklyn, C. S., Ehresmann, C. and Moras, D. (2000) Transfer RNA-mediated editing in threonyl-tRNA synthetase: The class II solution to the double discrimination problem. *Cell* **103**, 877-884.
  62. Sankaranarayanan, R., Dock-Bregeon, A-C., Rees, B., Bovee, M., Caillet, J., Romby, P., Francklyn, C. S. and Moras, D. (2000) Zinc ion mediated amino acid discrimination by threonyl-tRNA synthetase. *Nature Struct. Biol.* **7**, 461-465.
  63. Sankaranarayanan, R., Dock-Bregeon, A-C., Rees, B., Bovee, M., Caillet, J., Romby, P., Francklyn, C. S. and Moras, D. (2000) Zinc ion mediated amino acid recognition by threonyl-tRNA synthetase. *Acta Cryst.* **A56**, S-93.
  64. Arnez, J. G., Sankaranarayanan, R., Dock-Bregeon, A-C., Francklyn, C. S. and Moras, D. (2000) Aminoacylation at the atomic level in class IIa aminoacyl-tRNA synthetases. *J. Biomol. Struct. Dyn.* **1**, 23-27.
  65. Sankaranarayanan, R., Dock-Bregeon, A-C., Romby, P., Caillet, J., Springer, M., Rees, B., Ehresmann, C., Ehresmann, B. and Moras, D. (1999) The structure of threonyl-tRNA synthetase-tRNA<sup>Thr</sup> complex enlightens its repressor activity and reveals an essential zinc ion in the active site. *Cell* **97**, 371-381.
  66. Prabu, M.M., Sankaranarayanan, R., Puri, K.D., Sharma, V., Surolia, A., Vijayan, M. and Suguna, K. (1998) Carbohydrate specificity and quaternary association in basic winged bean lectin: X-ray analysis of the lectin at 2.5 Å resolution. *J. Mol. Biol.* **276**, 787-796.
  67. Suresh, S., Rani, P. G., Pratap, J. V., Sankaranarayanan, R., Surolia, A. and Vijayan M. (1997) Homology between jacalin and artocarpin from jackfruit (*Artocarpus integrifolia*) seeds. Partial sequence and preliminary crystallographic studies of artocarpin. *Acta Cryst.* **D53**, 469-471.
  68. Sankaranarayanan, R., Sekar, K., Banerjee, R., Sharma, V., Surolia, A. and Vijayan, M. (1996) A novel mode of carbohydrate recognition in jacalin, a *Moraceae* plant lectin with a  $\beta$ -prism fold. *Nature Struct. Biol.* **3**, 596-603.
  69. Vijayan, M.\*, Sekar, K., Banerjee, R., Mahanta, S.K., Surolia, A. and Sankaranarayanan, R. (1996) A three-fold symmetric  $\beta$ -prism fold without internal sequence homology in the structure of the two-chain lectin, Jacalin. *Acta Cryst.* **A52**, C-147.
  70. Sankaranarayanan, R., Puri, K. D., Ganesh, V., Banerjee, R., Surolia, A. and Vijayan, M. (1993) Crystallization and preliminary X-ray studies of the basic lectin from winged bean (*Psophocarpus tetragonolobus*). *J. Mol. Biol.* **229**, 558-560.

## Reviews, News and Views articles and book sections

1. Kuncha, S. K., Kruparani, S. P. and Sankaranarayanan, R. (2019) Chiral checkpoints

during protein biosynthesis *J. Biol. Chem.* **294**, 16535-16548.

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3. Priyadarshan, K. and Sankaranarayanan, R. (2018) Fatty acyl-AMP ligases as mechanistic variants of ANL superfamily and molecular determinants dictating substrate specificities. *Journal of the Indian Institute of Science* **98**, 261-272.
4. Routh, S. B. and Sankaranarayanan, R. (2017) Editing and proofreading in translation. Reference Module in Life Sciences. <http://dx.doi.org/10.1016/B978-0-12-809633-8.06374-3>.
5. Routh, S. B. and Sankaranarayanan, R. (2017) Mechanistic insights into catalytic RNA-protein complexes involved in translation of the genetic code. *Adv. Protein Chem. Struct. Biol.* **109**, 309-353.
6. Priyadarshan, K., Haque, A. S., Rukmini, R. and Sankaranarayanan, R. (2014) Structural remodeling creates diversity in lipid repertoire of *Mycobacterium tuberculosis*. *Journal of the Indian Institute of Science* **94**, 139-148.
7. Routh, S. B., Ahmad, S. and Sankaranarayanan, R. (2013) D-amino acids: Occurrence, stereochemistry and exclusion from translational machinery. Biomolecular Forms and Functions - A celebration of 50 years of the Ramachandran Map. Edited by: Manju Bansal and N. Srinivasan. IISc Press - WSPC Publication, pp. 247-263.
8. Arora, A., Chandra, N. R., Das, A., Gopal, B., Mande, S. C.\*, Prakash, B., Ramachandran, R., Sankaranarayanan, R., Sekar, K., Suguna, K., Tyagi, A. K. and Vijayan, M. (2011) Structural biology of *Mycobacterium tuberculosis* proteins: The Indian efforts. *Tuberculosis* **91**, 456-468.
9. Mohanty, D., Sankaranarayanan, R. & Gokhale, R. S. (2011) Fatty acyl-AMP ligases and polyketide synthases are unique enzymes of lipid biosynthetic machinery in *Mycobacterium tuberculosis*. *Tuberculosis* **91**, 448-455.
10. Gokhale, R. S., Sankaranarayanan, R. and Mohanty, D. (2007) Versatility of polyketide synthases in generating metabolic diversity. *Current Opin. Struct. Biol.* **17**, 736-743.
11. Sankaranarayanan, R. (2006) A type III PKS makes the DIfference. *Nature Chem. Biol.* **2**, 451-452 (**Invited NEWS and VIEWS article**).
12. Sankaranarayanan, R. and Moras, D. (2001) The fidelity of the translation of the genetic code. *Acta Biochimica Polonica* **48**, 323-335.

13. Sankaranarayanan, R. and Moras, D. (1999) Modular organization of aminoacyl-tRNA synthetases. Perspectives in structural biology Ed. Vijayan, M., Yathindra, N. and Kolaskar, A. S. Universities Press (India) Limited, pp 128-138.

## Presentations

Invited speaker at the 12<sup>th</sup> International symposium '**AARS-2019**' held at Hangzhou, China during 5-9, November 2019.

Plenary speaker at the **27<sup>th</sup> international tRNA conference** held at Strasbourg, France from 23 – 27 September, 2018.

Delivered **Sir J. C. Bose Memorial Lecture** at NIPGR, New Delhi on the Foundation day on 30<sup>th</sup> November, 2017.

Delivered **Prof. MR Das Memorial Lecture of INSA** at Banaras Hindu University on 13, November, 2017.

Chaired a session and delivered an invited talk at the **IUBMB focussed meeting on AARS-2017** held at Clearwater, Florida, USA from 29 October to 2 November, 2017.

Delivered **Prof. A. K. Lala Memorial Lecture** at IIT, Bombay on 13<sup>th</sup> September, 2017.

Invited speaker at the **5<sup>th</sup> Asia Pacific Protein Association (APPA) conference** held at Bansaen, Thailand during 11-14, July, 2017.

Invited speaker at the **international tRNA meeting** held at Jeju, South Korea during 4-8, September, 2016.

Invited speaker at **MCB-75** to celebrate the 75 years of MCBL department of IISc, Bangalore during 11-14, December, 2015.

Chair and invited speaker at the **Asian Crystallographic Association meeting (AsCA-2015)** held at Science City, Kolkata during 5-8, December, 2015.

Invited speaker at the **FAOBMB meeting** held at BITS Hyderabad Campus, Hyderabad from 27-30, November, 2015.

Invited speaker at the '**Institute of Protein Research, Osaka and Australian National University, Canberra**' joint symposium held at Canberra during 14-16 November, 2015.

Invited speaker at the **aaRS-2015 meeting** held at Barcelona, Spain from 18-22nd October, 2015.

Invited speaker at the 10th **International Symposium on Bio-Organic Chemistry** (ISBOC-10), under the aegis of IUPAC, held at IISER, Pune from 11-15 January, 2015.

Invited to deliver the **GN Ramachandran Award Lecture** at the IUPAB-International Biophysics Congress held at Brisbane, Australia during 3 - 7 August, 2014.

Invited **Platinum Jubilee Award Lecture** at the 100th Indian Science Congress held at Kolkata from 3rd to 7th January, 2013.

Invited as a Session Organizer for the **Indo-American Kavli Frontiers of Science Symposium** organized by National Academy of Sciences, USA at Beckman Centre, Irvine from 17<sup>th</sup> to 20<sup>th</sup> April, 2011.

Invited speaker at the '**Asian Biophysics Association**' meeting held at India Habitat Center, New Delhi from 30<sup>th</sup> January to 2<sup>nd</sup> February, 2011.

Invited session chair on 'Combining methods/new tools in structural biology' at the **Asian Crystallography Association (AsCA-2010) meeting** held at Busan, South Korea from 31<sup>st</sup> October to 4<sup>th</sup> November, 2010.

Presented an invited talk entitled 'Evolution of virulence properties using old folds in pathogenic bacteria' at the **International conference on Microbial Biotechnology (MICROCON-2009)** held at Panjab University, Chandigarh from 3<sup>rd</sup> to 4<sup>th</sup> March, 2009.

Invited session chair on 'Protein-Nucleic acid interactions' at the **International Union of Crystallography (IUCr) congress and general assembly** held at Osaka, Japan from 23<sup>rd</sup> to 31<sup>st</sup> of August 2008.

Presented an invited lecture entitled 'Structure-function analysis of enzymes involved in the complex lipid cell wall synthesis of Mycobacterium tuberculosis' at the joint **4<sup>th</sup> AOHUPO (Asia Oceania Human Proteome Organization) and 2<sup>nd</sup> PRICPS (Pacific Rim International Conference on Protein Science)** held at Cairns Convention Centre, Australia from 22<sup>nd</sup> to 26<sup>th</sup> June, 2008.

Presented an invited lecture entitled 'Rational design for enantioselectivity: A lesson from nature' at the 6<sup>th</sup> Temasek Life Sciences symposium on Biotechnology: Innovative applications from basic research held at **Temasek Life Sciences Laboratory, Singapore** from 24-25<sup>th</sup> January, 2008.

Presented a **plenary lecture** entitled 'Structural basis for proofreading during translation of the genetic code' in the **76<sup>th</sup> SBC (Society of Biological Chemists, India) meeting** held at Sri Venkateshwara University, Tirupati from 25<sup>th</sup>-27<sup>th</sup> November, 2007.

Presented an invited talk entitled 'Inverting enantioselectivity in modules responsible for enforcing a high fidelity during translation' at the **EMBL, Hamburg, Germany** on 14<sup>th</sup> September, 2007.

Invited popular lecture on 'Physics of Living Matter' on the **Indian Academy of Sciences** sponsored lecture programme from 19<sup>th</sup> to 20<sup>th</sup> July 2007 organized by Aurora Degree and PG College, Hyderabad to Graduate and Post graduate students.

Invited as a session chair and to present a talk on 'Macromolecular Machines' at the **Indo-American Frontiers of Science Symposium** at University of California, Irvine from 18<sup>th</sup> to 20<sup>th</sup> January, 2007.

Invited talk entitled 'Inverting enantioselectivity in modules responsible for enforcing a high fidelity during translation of the genetic code' at the **RNA group, Ohio State University**, Columbus, USA on the 10<sup>th</sup> October, 2006.

Presented an invited talk entitled 'A single residue enantioselectivity switch in a domain enforcing homochirality during translation of the genetic code' in the **International Symposium on Recent Trends in Macromolecular Structure and Function (ISRTMSF)** held at Guindy Campus, University of Madras, Chennai from 18<sup>th</sup> to 20<sup>th</sup> January, 2006.

Invited as a Session Chair and also to present a talk in the '**21<sup>st</sup> International tRNA meeting**' held between 2-7, December 2005 at the Indian Institute of Science, Bangalore.

Presented an invited talk entitled 'Structure-function studies on enzymes involved in the complex lipid cell wall biosynthesis of *Mycobacterium tuberculosis*' in the **Symposium on 'Tuberculosis Research – An Indian perspective'** organized by Astra Zeneca at Bangalore on the 20<sup>th</sup> October, 2005.

Presented an invited talk entitled 'A novel substrate binding tunnel reveals the structural basis for generating diverse metabolites by a type III polyketide synthase from *Mycobacterium tuberculosis*' at **IGBMC, Strasbourg, France** on 22<sup>nd</sup> September, 2004.

Presented an invited talk entitled 'A novel tunnel in mycobacterial PKS18 reveals the structural basis for generating diverse metabolites' in the **International Conference on 'Structural Biology at Crossroads: From Biological molecules to Biological Systems'** held at **EMBL, Hamburg, Germany** from 15<sup>th</sup> to 18<sup>th</sup> of September, 2004.

Presented an invited talk entitled 'Exploring the Structural basis of enhanced thermostability in *Bacillus subtilis* lipase' in the **International Symposium on Recent**

**Trends in Macromolecular Structure and Function (ISRTMSF)** held at Guindy Campus, University of Madras, Chennai from 19<sup>th</sup> to 23<sup>rd</sup> January, 2004.

Presented an invited talk entitled ‘Structural basis of how threonyl-tRNA synthetase acts as a translational repressor and solves a crucial double discrimination problem for a faithful translation of the genetic code’ in the **Institute of Molecular and Cell Biology (IMCB)**, Singapore on the 7<sup>th</sup> July, 2003.

Presented an invited talk entitled ‘How Threonyl-tRNA Synthetase Solves a Crucial Double Discrimination Problem to Ensure a High Fidelity During Translation of The Genetic Code?’ in the **School of Biological Sciences, Nanyang Technological University (NTU)**, Singapore on the 5<sup>th</sup> July, 2003.

Presented a talk entitled ‘Unexpected conformational movements upon substrate binding by the class II threonyl-tRNA synthetase’ in the 4th tRNA Synthetase meeting on "**tRNA Synthetases in Biology, Medicine, and Evolution**" held at the Asilomar Conference Center, Monterey, California, U. S. A. January 13<sup>th</sup> -18<sup>th</sup>, 2002.

Presented a talk entitled ‘Solution to the double discrimination problem by the class II threonyl-tRNA synthetase’ in the international symposium on **Current Trends in Drug Discovery Research** (CTDDR-2001) organized by the Central Drug Research Institute, Lucknow, India, 11<sup>th</sup> – 15<sup>th</sup> February, 2001.

Presented a talk entitled ‘The fidelity in the translation of the genetic code’ in a meeting on the **Molecular architecture of evolution** organized by the Polish Academy of Sciences in The Institute of Bio-organic chemistry, Poznan, Poland, 29<sup>th</sup> – 31<sup>st</sup> October, 2000.

Presented a talk entitled ‘Zinc ion mediated amino acid recognition by threonyl-tRNA synthetase’ in **European Crystallographic Meeting (ECM-19)**, Nancy, France, 25<sup>th</sup> – 31<sup>st</sup> August, 2000.

Presented a talk entitled ‘Crystal structure of threonyl-tRNA synthetase-tRNA<sup>Thr</sup> complex from *E. coli*’ in the Fifth IUPAC international symposium on **Bio-organic chemistry ISBOC-5** held at National chemical laboratory, Pune, 30<sup>th</sup> Jan – 4<sup>th</sup> Feb, 2000.

Presented a talk entitled ‘Structure of *E. Coli* Threonyl-tRNA synthetase’ in the 12<sup>th</sup> Regio meeting on **X-ray crystallography of Biomacromolecules**, Strasbourg, France 30<sup>th</sup> Sept – 2<sup>nd</sup> October, 1998.

Presented a talk entitled ‘Structural studies on Lectins’ in the **Asian Regional Seminar on Crystallography in Molecular Biology**, University of Madras, Madras, 9<sup>th</sup> –14<sup>th</sup> December, 1993.