

CURRICULUM VITAE

V. Ramakrishnan

Nationality U.S. & U.K. (b. India)

Address MRC Laboratory of Molecular Biology
Francis Crick Avenue
Cambridge Biomedical Research Campus
Cambridge, CB2 0QH
United Kingdom

Tel: +44 1223 267078

E-mail: ramak@mrc-lmb.cam.ac.uk

Education

1971	B.Sc.	Baroda University, India	Physics
1976	Ph.D.	Ohio University	Physics
1976-78	Graduate student	University of California, San Diego	Biology

Positions held

1978-82 Postdoctoral Fellow, Department of Chemistry, Yale University.

1983-95 Biology Department, Brookhaven National Laboratory: Assistant Biophysicist, 1983-85; Associate Biophysicist, 1985-88; Biophysicist, 1988-90; Biophysicist with tenure, 1990-94; Senior Biophysicist with tenure, 1994-95.

1995-99 Professor, Biochemistry Department, University of Utah. Member, Graduate Programs in Molecular Biology and Biological Chemistry

1999- MRC Laboratory of Molecular Biology, Cambridge, England.
Group Leader, 1999- ; Joint Head, Structural Studies Division, 2005-15;
Deputy Director, 2013-16.

2008- Fellow, Trinity College, Cambridge.

2015- President, The Royal Society, London.

Research Interests:

Current interest: Structure and function of ribosomes. Action of antibiotics on ribosomes.

Past interests: Chromatin structure. X-ray crystallography, especially the use of anomalous scattering and MAD. Neutron scattering.

Other Professional Activities:

Editorial Board of Cell (2001-2015) and PNAS (2008-2015)
Member, Scientific Advisory Committee of EMBL (2002-2006, 2013-2015)
Member, Scientific Advisory Committee of IMP, Vienna (2008-2011)
Member, Scientific Advisory Board of Rib-X Pharmaceuticals (2004-2011)

Awards and Honors:

Guggenheim Fellowship, 1991-92
Member of EMBO (elected 2002)
Fellow of the Royal Society (elected 2003)
Member, National Academy of Sciences, USA (elected 2004)
Louis Jeantet Prize for Medicine, 2007
Datta Medal and Lecture, FEBS annual meeting, Vienna (2007)
Heatley Medal, British Biochemical Society, 2008
Foreign Member, Indian National Science Academy (elected 2008)
Fellow, Trinity College, Cambridge (elected 2008)
Rolf-Sammet professorship, University of Frankfurt (2009)
Nobel Prize in Chemistry (shared with Tom Steitz and Ada Yonath) (2009)
Sir Hans Krebs Medal and lecture, FEBS annual meeting, Seville (2012)
Jimenez Díaz Prize & Lecture, Madrid 2014
President of the Royal Society (2015-)

Selected named lectures include:

Stetten Lecture, NIH, 2000
Dorcas Cummings Lecture, 60th Cold Spring Harbor Symposium on “The Ribosome,” 2001
Alkis Seraphim Lecture, Cambridge University, 2001
Joseph Black Lecture, Glasgow University, 2001
Randall Lecture, Kings College, 2001
Dahlem Lecture, Max Planck Institute, Berlin, 2001
Zurich Chemical Society Lecture, 2001
G.N. Ramachandran Memorial Lecture, India, 2002
Weissbach Lecture, Rockefeller University, 2002
EMBL Distinguished Visitor Lecture, 2002
Max Perutz Memorial Lecture, British Crystallography Association, York, 2003
Skirball Symposium, *Molecular Machines*, New York, 2003
EMBO Lecture, Symposium on Recognition, Heidelberg, 2003
Linné Lecture, Uppsala University, 2004
BSA Distinguished Lecture, Brookhaven National Laboratory, 2004
Kathleen Kendrick Memorial Lecture, Ohio State University, 2005
Marker Lectures, Pennsylvania State University, 2008
Simpson Lecture, SUNY Stony Brook, 2008
Dintzis Lecture, Johns Hopkins University, 2009
Mendel Lecture, Brno, Czech Republic, 2009
Rolf-Sammet Lectures, Frankfurt, 2009
John M. Buchanan Lecture, MIT, 2009

Linacre Lecture, Cambridge, 2010
50th Anniversary Distinguished Lecture, UCSD, 2011
Ruth & Eddie Hughes Lecture, Caltech, 2011
Anfinsen Lecture, Weizmann Institute, 2011
Sackler Lectures, Cambridge & London, 2011
Skirball Symposium, *Beyond the Central Dogma*, New York University, 2011
Maclyn McCarty Lecture, Annual Helen Hayes Whitney Fellows Meeting, 2011
Martha Ludwig Lecture, University of Michigan, 2011
Dorothy Hodgkin Lecture, Oxford, 2012
Wright Colloquium, Geneva, 2013
Sadler Lecture, University of Colorado, Denver, 2014
Tetelman Lecture, Yale, 2014
Chandler Medal Lecture, Columbia University, 2015
Baddiley Lecture, Newcastle University, 2016
Chatt Lecture, John Innes Centre, Norwich, 2016
G.N Ramachandran Plenary Lecture, International Congress of Biophysics, Edinburgh 2017
Erasmus Darwin Lecture, Lichfield, 2017

PUBLICATIONS

N. Desai, A. Brown, A. Amunts, V. Ramakrishnan (2017) The structure of the yeast mitochondrial ribosome. *Science* **355**, 528-531.

N. R. James, A. Brown, Y. Gordiyenko, V. Ramakrishnan (2016) Translational termination without a stop codon. *Science* **354**, 1437-1440.

Hussain, T., Llácer, J. L., Wimberly, B. T., Kieft, J. S., and Ramakrishnan, V. (2016). Large-Scale Movements of IF3 and tRNA during Bacterial Translation Initiation. *Cell* **167**, 133-144.e13.

Brown, A., Fernández, I. S., Gordiyenko, Y., and Ramakrishnan, V. (2016). Ribosome-dependent activation of stringent control. *Nature* **534**, 277-280.

Murray, J., Savva, C. G., Shin, B. S., Dever, T. E., Ramakrishnan, V., and Fernández, I. S. (2016). Structural characterization of ribosome recruitment and translocation by type IV IRES. *Elife* **5**

Brown, A., Shao, S., Murray, J., Hegde, R. S., and Ramakrishnan, V. (2015). Structural basis for stop codon recognition in eukaryotes. *Nature* **524**, 493-496.

Llácer, J. L., Hussain, T., Marler, L., Aitken, C. E., Thakur, A., Lorsch, J. R., Hinnebusch, A. G., and Ramakrishnan, V. (2015). Conformational Differences between Open and Closed States of the Eukaryotic Translation Initiation Complex. *Mol Cell* **59**, 399-412.

Amunts, A., Brown, A., Toots, J., Scheres, S. H., and Ramakrishnan, V. (2015). The structure of the human mitochondrial ribosome. *Science* **348**, 95-98.

- Amunts, A., Fiedorczuk, K., Truong, T. T., Chandler, J., Peter Greenberg, E., and Ramakrishnan, V. (2015). Bactobolin A Binds to a Site on the 70S Ribosome Distinct from Previously Seen Antibiotics. *Journal of Molecular Biology* **427**, 753-755.
- Ramakrishnan, V. (2014). The ribosome emerges from a black box. *Cell* **159**, 979-984.
- Amunts, A., Brown, A., Bai, X. C., Llacer, J. L., Hussain, T., Emsley, P., Long, F., Murshudov, G., Scheres, S. H., and Ramakrishnan, V. (2014). Structure of the yeast mitochondrial large ribosomal subunit. *Science* **343**, 1485-1489.
- Brown, A., Amunts, A., Bai, X. C., Sugimoto, Y., Edwards, P. C., Murshudov, G., Scheres, S. H., and Ramakrishnan, V. (2014). Structure of the large ribosomal subunit from human mitochondria. *Science* **346**, 718-722.
- Hussain, T., Llacer, J. L., Fernandez, I. S., Munos, A., Martin-Marcos, P., Savva, C. G., Lorsch, J. R., Hinnebusch, A. G., and Ramakrishnan, V. (2014). Structural changes enable start codon recognition by the eukaryotic translational initiation complex. *Cell* **159**, 597-607.
- Fernandez, I. S., Bai, X. C., Murshudov, G., Scheres, S. H., and Ramakrishnan, V. (2014). Initiation of translation by cricket paralysis virus IRES requires its translocation in the ribosome. *Cell* **157**, 823-831.
- Ban, N., Beckmann, R., Cate, J. H., Dinman, J. D., Dragon, F., Ellis, S. R., Lafontaine, D. L., Lindahl, L., Liljas, A., Lipton, J. M., McAlear, M. A., Moore, P. B., Noller, H. F., Ortega, J., Panse, V. G., Ramakrishnan, V., Spahn, C. M., Steitz, T. A., Tchorzewski, M., Tollervey, D., Warren, A. J., Williamson, J. R., Wilson, D., Yonath, A., and Yusupov, M. (2014). A new system for naming ribosomal proteins. *Curr Opin Struct Biol* **24C**, 165-169.
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- Fernandez, I. S., Ng, C. L., Kelley, A. C., Wu, G., Yu, Y. T., and Ramakrishnan, V. (2013). Unusual base pairing during the decoding of a stop codon by the ribosome. *Nature* **500**, 107-110.
- Fernandez, I. S., Bai, X. C., Hussain, T., Kelley, A. C., Lorsch, J. R., Ramakrishnan, V., and Scheres, S. H. (2013). Molecular architecture of a eukaryotic translational initiation complex. *Science* **342**, 1240585.
- Voorhees, R. M., and Ramakrishnan, V. (2013). Structural basis of the translational elongation cycle. *Annu Rev Biochem* **82**, 203-236.
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Tourigny, D. S., Fernandez, I. S., Kelley, A. C., and Ramakrishnan, V. (2013a). Elongation factor G bound to the ribosome in an intermediate state of translocation. *Science* **340**, 1235490.

Tourigny, D. S., Fernandez, I. S., Kelley, A. C., Vakiti, R. R., Chattopadhyay, A. K., Dorich, S., Hanessian, S., and Ramakrishnan, V. (2013b). Crystal structure of a bioactive pactamycin analog bound to the 30S ribosomal subunit. *J Mol Biol* **425**, 3907-3910.

Agirrezabala, X., Fernandez, I. S., Kelley, A. C., Carton, D. G., Ramakrishnan, V., and Valle, M. (2013). The ribosome triggers the stringent response by RelA via a highly distorted tRNA. *EMBO Rep* **14**, 811-816.

Matt, T., Ng, C. L., Lang, K., Sha, S. H., Akbergenov, R., Shcherbakov, D., Meyer, M., Duscha, S., Xie, J., Dubbaka, S. R., Perez-Fernandez, D., Vasella, A., Ramakrishnan, V., Schacht, J., and Bottger, E. C. (2012). Dissociation of antibacterial activity and aminoglycoside ototoxicity in the 4-monosubstituted 2-deoxystreptamine apramycin. *Proc Natl Acad Sci U S A* **109**, 10984-10989.

Neubauer, C., Gillet, R., Kelley, A. C., and Ramakrishnan, V. (2012). Decoding in the absence of a codon by tmRNA and SmpB in the ribosome. *Science* **335**, 1366-1369.

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Ramakrishnan, V. (2011). Molecular biology. The eukaryotic ribosome. *Science* **331**, 681-682.

Schmeing T.M., Voorhees R.M., Kelley A.C., and Ramakrishnan V. (2011). How mutations in tRNA distant from the anticodon affect the fidelity of decoding. *Nat Struct Mol Biol.* **18**, 432-436.

Voorhees, R. M., Schmeing, T. M., Kelley, A. C., and Ramakrishnan, V. (2010). The mechanism for activation of GTP hydrolysis on the ribosome. *Science* **330**, 835-838.

Ng, C. L., Lang, K., Meenan, N. A., Sharma, A., Kelley, A. C., Kleantous, C., and Ramakrishnan, V. (2010). Structural basis for 16S ribosomal RNA cleavage by the cytotoxic domain of colicin E3. *Nat Struct Mol Biol* **17**, 1241-1246.

Ramakrishnan, V. (2010). Unraveling the Structure of the Ribosome (Nobel Lecture). *Angew Chem Int Ed Engl* **49**, 4355-4380.

Jin, H., Kelley, A. C., Loakes, D., and Ramakrishnan, V. (2010). Structure of the 70S ribosome bound to release factor 2 and a substrate analog provides insights into catalysis of peptide release. *Proc Natl Acad Sci U S A* **107**, 8593-8598.

Neubauer, C., Gao, Y. G., Andersen, K. R., Dunham, C. M., Kelley, A. C., Hentschel, J., Gerdes, K.,

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Schmeing, T. M., and Ramakrishnan, V. (2009). What recent ribosome structures have revealed about the mechanism of translation. *Nature* **461**, 1234-1242.

Schmeing, T. M., Voorhees, R. M., Kelley, A. C., Gao, Y. G., Murphy, F. V. 4th., Weir, J. R., and Ramakrishnan, V. (2009). The crystal structure of the ribosome bound to EF-Tu and aminoacyl-tRNA. *Science* **326**, 688-694.

Gao, Y. G., Selmer, M., Dunham, C. M., Weixlbaumer, A., Kelley, A. C., and Ramakrishnan, V. (2009). The structure of the ribosome with elongation factor G trapped in the posttranslocational state. *Science* **326**, 694-699.

Schuetz, J. C., Murphy, F. V. t., Kelley, A. C., Weir, J. R., Giesebrecht, J., Connell, S. R., Loerke, J., Mielke, T., Zhang, W., Penczek, P. A., Ramakrishnan, V., and Spahn, C. M. (2009). GTPase activation of elongation factor EF-Tu by the ribosome during decoding. *Embo J* **28**, 755-765.

Voorhees, R. M., Weixlbaumer, A., Loakes, D., Kelley, A. C., and Ramakrishnan, V. (2009). Insights into substrate stabilization from snapshots of the peptidyl transferase center of the intact 70S ribosome. *Nat Struct Mol Biol* **16**, 528-533.

Weixlbaumer, A., Jin, H., Neubauer, C., Voorhees, R.M., Petry, S., Kelley, A.C., and Ramakrishnan, V. (2008). Insights into translational termination from the structure of RF2 bound to the ribosome. *Science* **322**, 953-956.

Ramakrishnan, V. (2008). What we have learned from ribosome structures. (The Heatley Medal Lecture). *Biochem Soc Trans* **36**, 567-74.

Weixlbaumer A, Petry S, Dunham CM, Selmer M, Kelley AC, Ramakrishnan V (2007). Crystal structure of the ribosome recycling factor bound to the ribosome. *Nat. Struct. Mol. Biol.* **14**, 733-737.

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Dunham, C. M., Selmer, M., Phelps, S. S., Kelley, A. C., Suzuki, T., Joseph, S., and Ramakrishnan, V. (2007). Structures of tRNAs with an expanded anticodon loop in the decoding center of the 30S ribosomal subunit. *RNA* **13**, 817-823.

Selmer, M., Dunham, C.M., Murphy, F.V. IV, Weixlbaumer, A., Petry, S., Kelley, A.C., Weir, J.R. and

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- Brodersen, D. E., Clemons W. M. Jr., Carter, A. P., Wimberly, B. T., and Ramakrishnan, V. (2002). Crystal structure of the 30S ribosomal subunit from *Thermus thermophilus*. Proteins of the 30S subunit and their interactions with 16S RNA. *J. Mol. Biol.* **316**, 723 - 766.
- Brodersen, D.E., Carter, A.P., Clemons, W.M. Jr., Morgan-Warren, R. J., Murphy F.V. IV, Ogle, J. M., Tarry, M. J., Wimberly, B.T. and Ramakrishnan, V. (2001). Atomic structures of the 30S subunit and its complexes with ligands and antibiotics. *Cold Spring Harbor Symp. Quant. Biol.* **66**, 17-32.
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Brodersen, D.E., Clemons, W.M., Jr., Carter, A.P., Morgan-Warren, R.J., Wimberly, B.T. and Ramakrishnan, V. (2000). The structural basis for the action of the antibiotics tetracycline, pactamycin and hygromycin B on the 30S ribosomal subunit. *Cell* **103**, 1143-1154 (2000).

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Shu, F., Ramakrishnan, V. & Schoenborn, B. P. (2000). Enhanced visibility of hydrogen atoms by neutron crystallography on fully deuterated myoglobin. *Proc Natl Acad Sci U S A* **97**(8), 3872-3877.

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White, S.W., Clemons, W.M., Davies, C., Ramakrishnan, V. and Wimberly, B.T. (2000). Structure of bacterial ribosomal proteins: High resolution probes of the architecture and mechanism of the ribosome. In *The Ribosome. Structure, Function, Antibiotics and Cellular Interactions* (Garrett, R.A., Douthwaite, S.R., Liljas, A., Matheson, A.T., Moore, P.B. and Noller H.F., eds), ASM Press, Washington D.C.

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Wimberly, B.T., Guymon, R., McCutcheon, J.P., White, S.W. and Ramakrishnan, V. (1999). A detailed view of a ribosomal active site: the structure of the L11-RNA complex. *Cell* **97**, 491-502.

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of the Conserved Subdomain of Human Protein SRP54M at 2.1 Å Resolution: Evidence for the Mechanism of Signal Peptide Binding. *J. Mol. Biol.* **292**, 697-705.

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special case of multiple isomorphous replacement. *Meth. Enzymol.* **276**, 538-557.

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