BIOPHYSICAL SCIENCES INCLUDING CHEMISTRY

Biophysics Division

Biophysics Division

Permanent members of the Division:

Scientific		Technical		Adm/Auxiliary	
D Dasgupta	Sr. Prof.	T.K.Roy	SO	B. Das	Superintendent
P K Sengupta	Sr. Prof.	S. Bhattacharyya	SO	S.C.Digar	Helper
D Bhattachrayya	Prof.	A.Chakrabarty	SA		
A K Pal	Prof.	A.Pal	SA		
K Sengupta	Asst. Prof.	N.C..Das	Tech.		
R. Bhattacharya	Sr. Scientist				
P.Roy	Engg. SG				

Ph.D students & Post Doctoral Fellows (2007 onwards)
Madhumita Chakraborty, Sudipta Pal, Parijat Majumdar, Shibojyoti Lahiri, Sukanya Halder, Swati Panigrahi, Sanchita Mukherjee, Biswapathik Pahari, Manas Mondal, Saptaparni, Ghosh, Shreyasi Dutta, Amrita Banerjee

Ashim Roy, Subhra Shankha Roy

Ph.D Degrees awarded 2007 onwards

P. Grihanjali Devi, Anwesha Banerjee, Suman Kalyan Pradhan, Shayantani Mukherjee, Dipankar Bhattacharya, Sumanta Basu, Amitabha Sengupta,

Resources & Major Instruments:

1. Fluorescence Spectrometer
2. UV-Vis spectrophotometer
3. Preparative Ultracentrifuge
4. Akta- FPLC System
5. Isothermal Titration Calorimeter
6. Differential Scanning Calorimeter
7. Dynamic Light Scattering Spectrometer
8. High Performance Thin Layer Chromatography
9. High Performance Computing Server

Research Activities:

The research activities in Biophysics Division spans both experimental and *in silico* biology. The specific areas are as follows: Chemical and Structural Biology, Biomolecular Spectroscopy, Structural Bioinformatics and Computational Chemistry and Microbiology. Some of the research activities have collaborative components. Till May, 2010, there have been activities also in Genomics and Proteomics. Two faculty members, Profs. Subrata Banerjee and Abhijit Chakrabarty, have since joined the newly created Structural Genomics Division. Their publications have been listed under Structural Genomics Division. A new faculty member, Dr. Kaushik Sengupta, has joined the Division as Assistant Professor in June, 2010. The three publications (30-32) contain his research output as a post-doctoral fellow in USA.

Important Results

Chemical and Structural Biology:

Small molecules from natural and synthetic sources have long been employed as human medicine. In the last three years chemical biology of two classes of small molecules with therapeutic potential have been studied. The first type includes DNA binding molecules which function at the chromatin level modulating DNA templated phenomena and inhibition of (core) histone modification enzymes. The studies on the second class of molecules have been aimed to explore alternate intracellular targets for generic drug(s). In this class anticancer antibiotics, mithramycin and chromomycin, have been shown to possess potential for chelation therapy arising from their bivalent metal ion binding potential. The antibiotic(s) inhibit the activity of metalloenzymes like alcohol dehydrogenase, alkaline phsphatase, beta metallolactamase and superoxide dismutase.

In the area of structural biology two problems are being addressed. Sanguinarine and ellipicin are two putative anticancer agents. They bind to human telomere sequence forming quadruplex DNA. Telomeric sequences are short stretches of guanine (G)-rich DNA that occur at the termini of chromosomes and play an important role in chromosome duplication and are attractive targets for anticancer drugs. The structural modulation induced by these agents upon the quadruplex structure and the associated energetics are being investigated. The results show that sanguinarine (SGR) exhibits two distinct interactions with human telomere d[$(TTAGGG)_4$] (H24) in presence of K+. Up to about 1:2 molar ratio of H24:SGR, two molecules of SGR bind H24. Above this molar ratio, SGR induces a conformational transition in H24 from the K+- form to the Na+- form. The demonstration of drug-induced conformational transition in a G-quadruplex formed by a human telomeric sequence would provide new insights into interaction of the drugs with quadruplex DNA structure.

Biomolecular Spectroscopy :

The Biomolecular Spectroscopy laboratory focuses on biophysical and relevant biomedical applications. During 2007-2010, the research in this laboratory was directed toward exploring target binding and nanoencapsulation of some natural product based drugs. We have pioneered novel uses of the exquisitely sensitive 'two color' intrinsic fluorescence of therapeutically important plant flavonoids (which are effective against free radical mediated and other diseases, including atherosclerosis, ischemia, cancers, diabetes, viral diseases etc) to explore their interactions with macromolecular targets , and with model as well as natural membranes. The encapsulation of these compounds (which have poor solubility in water, which restricts their bioavailability) in cyclodextrin based 'nanovehicles' for drug deliverywas explored. Using the novel fluorescence based approach, target binding sites of the flavonoids together with binding constants/ partition coefficients were successfully determined . Binding of flavonoids were found to have significant protective (antioxidant and antihemolytic) effects in RBC membranes, which crucially depend on their locations (inferred from fluorescence studies) in the membrane matrix. Several flavonoids were found to bind normal human hemoglobin with different affinities, and prevent hemoglobin glycosylation (which is a major complication of diabetes mellitus). Steady state and time resolved fluorescence studies were performed to explore the qualitative as well as quantitative aspects of hemoglobin-flavonoid and serum albumin-flavonoid interactions. As part of the research on developing efficient drug delivery strategies, fluorescence, along with other related spectroscopic techniques (electronic absorption and circular dichroism) , as well as theoretical (molecular docking) studies were employed to understand the encapsulation of various therapeutically important flavonoids and serotonin (a monoamine neurotransmitter); such studies revealed the superiority of some of the chemically modified derivatives of beta cyclodextyrin as a drug carrier, compared to natural beta cyclodextrin.

Structural Bioinformatics and Computational Chemistry:

In order to understand base sequence dependent DNA structural rigidity quantum chemical potential energy surface of DNA base pair stacking by varying different relative orientation parameters between successive base pairs are being explored using Density Functional Theory. We are also characterizing potential energy surface of DNA and RNA in torsion angle hyperspace. We have adopted a special technique of molecular

dynamics to simulate polymeric DNA double helices and showed its applicability to emulate the true polymeric nature of DNA, in terms of regularity of structural parameters. This technique would be utilized to understand effect of base sequence, temperature and ligand in DNA structure and flexibility. Different types of base pairs have been found to be extremely important in structure, stability and function of most RNA molecules. We are analyzing origin of such structural variability of RNA base pairs by quantum chemical calculations and molecular dynamics simulation studies.

Microbiology :

In continuation of the previous work on the effect of turmeric extracts in bacterial system, which revealed both genotoxic as well as radio-protective properties, attempts were made to look into the conditions under which the expression of these two altogether different
properties take place in a bacterial system subsequent to a radiation exposure. It was found that these two properties were selectively expressed into the bacterial system depending on the nature and extent of DNA damage inflicted in the system. Studies on the effect of four other spices in a bacterial system are also being undertaken.

The studies on the environmental impact on Rhizobium sp. cells revealed that different fertilisers and pesticides have detrimental effect on growth and ultra structure of Rhizobium sp. cells. in liquid culture medium.

Publications(2007-July, 2010)

2010

1. Identification of a novel inhibitor of coactivator-associated arginine methyltransferase 1 (CARM1)-mediated methylation of histone H3 Arg-17: B.R. Selvi , K. Batta , A.H. Kishore , K. Mantelingu , R.A. Varier , K. Balasubramanyam , S.K. Pradhan , D. Dasgupta , S . Sriram , S. Agrawal and T.K. Kundu, **J Biol Chem. 285(10)**, (2010) 7143-52.

2. Mechanism of interaction of small transcription inhibitors with DNA in the context of chromatin and telomere: S.Ghosh, P. Majumder, S.K. Pradhan and D. Dasgupta, **Biochimica et Biophysica Acta** (Gene Regulatory Mechanism), July, 2010

3. Encapsulation of serotonin in beta-cyclodextrin nanocavities: Fluorescence spectroscopic and molecular modeling studies : S. Chaudhuri, S . Chakraborty and P.K. Sengupta, **J. Molecular Structure 975**, (2010) 160-165.

4. Binding of the bioflavonoid robinetin with model membranes and hemoglobin: Inhibition of lipid peroxidation and protein glycosylation: S .Chaudhuri, B.P.Pahari, B. Sengupta and P.K. Sengupta,. **J. Photochem. Photobiol. B**: Biology, (2010) 9812-19.

5. Interactions of therapeutically active plant flavonols with biological targets: Insights from fluorescence spectroscopic studies (Invited article): P.K. Sengupta and S. Chaudhuri, **J. Indian Chem. Soc. 87**, (2010) 213-220.

6. Why Pyridine Containing Pyrido[2,3-d]pyrimidin-7-ones Selectively Inhibit CDK4 Than CDK2: Insights From Molecular Dynamics Simulation: N. M. Mascarenhas, D. Bhattacharyya and N. Ghoshal, **J. Molec. Graphics Modelling 28**,(2010) 695-706.

7. On the Role of cis Hoogsteen:Sugar Edge Family of Base Pairs in Platforms and Triplets -- Quantum Chemical Insights into RNA Structural Biology: P. Sharma, J. Sponer, J. S. Sponer, D. Bhattacharyya and A. Mitra, **J. Phys. Chem. B 114**, (2010) 3307-3320.

8. Structure and Dynamics of Double Helical DNA in Torsion Angle Hyperspace: A Molecular Mechanics Approach: A. Borkar, I. Ghosh and D. Bhattacharyya, **J. Biomol. Struct. Dynam. 27**, (2010) 695-712.

9. Changes in Thermodynamic Properties of DNA Base Pairs in Protein-DNA Recognition: S. Samanta, J. Chakrabarti and D. Bhattacharyya, **J. Biomol. Struct. Dynam. 27**, (2010) 429-442.

2009

10. Inhibition of a Zn(II)-containing enzyme, alcohol dehydrogenase, by anticancer antibiotics, mithramycin and chromomycin A(3): P.G. Devi, P.K. Chakraborty and D. Dasgupta , **J Biol Inorg Chem**. **14**, (2009) 347–359.

11. Mechanism of p300 Specific Histone Acetyltransferase Inhibition by Small molecules : M. Arif, S.K. Pradhan, G.R. Thanuja, B. M.Vedamurthy, S. Agrawal, D. Dasgupta and T.K. Kundu, **J Med Chem. 52(2)**, (2009) 267-77.

12. Binding of Indanocine to the Colchicine Site on Tubulin Promotes Fluorescence, and Its Binding Parameters Resemble Those of the Colchicine Analogue AC: L. Das, S. Gupta, D. Dasgupta, A. Poddar, M.E. Janik and B. Bhattacharyya, **Biochemistry 48(7)**, (2009)1628-35.

13. Sanguinarine Interacts with Chromatin, Modulates Epigenetic Modifications, and Transcription in the Context of Chromatin: B.R. Selvi, S. K. Pradhan, J. Shandilya, C. Das, B. S. Sailaja, G. Naga Shankar, S. Gadad Shrikanth , A. Reddy, D. Dasgupta and T. K. Kundu, **Chemistry & Biology 16**, (2009) 203–216.

14. Inhibition of Lysine Acetyltransferase KAT3B/p300 Activity by a Naturally Occurring Hydroxynaphthoquinone, Plumbagin: C. Kodihalli. B. Ravindra, R. Selvi, M. Arif, B. A. Ashok Reddy, G. R. Thanuja, S. Agrawal, S. K. Pradhan, N. Nagashayana, D. Dasgupta, and T. K. Kundu, **J. Biol. Chem. 284**, (2009) 24453-24464.

15. Novel compound with potential of an antibacterial drug targets FtsZ protein: D.Dasgupta, **Biochem J. 423(1)**, (2009) e1-3. Invited Commentary (commissioned article).

16. Ground- and excited-state proton transfer and antioxidant activity of 7-hydroxyflavone in model membranes: absorption and fluorescence spectroscopic studies: S. Chaudhuri, B.P. Pahari, and P. K. Sengupta , **Biophysical Chemistry 139**, (2009) 29-36

17. Structural properties of polymeric DNA from molecular dynamics simulations: S. Samanta, S. Mukherjee, J. Chakrabarti, and D. Bhattacharyya, **J. Chem. Phys 130**, (2009) 115-103.

2008

18. Self-association of the anionic form of the DNA-binding anticancer drugmithramycin: S. Lahiri., P.G. Devi, Majumder, S. Das and D. Dasgupta, **J Phys Chem B**. **112**, (2008) 3251-3258.

19. Multiple functions of generic drugs: future perspectives of aureolic acid group of anti-cancer antibiotics and non-steroidal anti-inflammatory drugs: H. Chakraborty, P.G. Devi, M. Sarkar and D. Dasgupta, **Mini Rev Med Chem**. **8(4)**, (2008) 331-49. Review.

20. Interaction of 7-hydroxyflavone with serum albumin: A spectroscopic study: A.Banerjee, K. Basu, and P.K. Sengupta , **J. Photochem. Photobiol. B: Biology**. **90,** (2008) 33 -40.

21. Ground and excited state proton transfer and antioxidant activity of 3-hydroxyflavone in egg yolk phosphatidylcholine liposomes: Absorption and fluorescence spectroscopic studies: S. Chaudhuri, K.Basu, B. Sengupta, A. Banerjee and P. K. Sengupta, **Luminescence. 23,** (2008) 397-403.

22. The Trans Hoogsteen/Sugar Edge Base Pairing in RNA. Structures, Energies and Stabilities from Quantum Chemical Calculations: A. Mladek, P. Sharma, A. Mitra, D. Bhattacharyya, J. Sponer and J.E. Sponer, **J. Phys. Chem. B 113**, (2008) 1743-1755.

23. Overall Cluster Effectiveness Index: An Instrument for Assessment of Development Programs for Industrial Clusters in Developing Countries: J. Basu, D. Bhattacharyya and B. Sarkar, **Sedme Journal 35**, (2008) 70-94.

24. Thermal Histerisis of some important physical properties of Nanoparticles: T. Sarkar, S. Roy, J. Bhattacharya, D. Bhattacharya, C.K. Mitra and A.K. Dasgupta, **J. Colloid Interfac Sci. 327**, (2008) 224-232.

25. Twist-Dependent Stacking Energy of Base-Pair Steps in B-DNA Geometry: A Density Functional Theory Approach: S. Samanta, M. Kabir, B. Sanyal and D. Bhattacharyya, **Int. J. Quant. Chem**. **108**, (2008) 1173-1180.

26. Quantum Chemical Studies of Structures and binding in Noncanonical RNA Base pairs: The Trans Watson Crick/WatsonCrick family: P. Sharma, A. Mitra, S. Sharma, H. Singh and D. Bhattacharyya, **J.**

Biomol. Struct. Dynam. 25, (2008) 709-732.

27. Structure, Stability, and Dynamics of Canonical and Noncanonical Base Pairs: Quantum Chemical Studies: A. Roy, S. Panigrahi, M. Bhattacharyya, and D. Bhattacharyya, **J. Phys. Chem. B 112**, (2008) 3786-3796.

28. Electronic properties of nano-graphene sheets calculated using quantum chemical DFT: S. Banerjee and D. Bhattacharyya, **Comput. Mater. Sci**. **44**,(2008) 41-45.

29. Role of turmeric in ultraviolet induced genotoxicity in a bacterial system: A. Pal, M. Ghosh and A. K. Pal, **Natural Product Communications 3(2)** (2008) 227 – 228.

30. Regulation of Nuclear Lamin Polymerization by Importin α: S.A.Adam, * K. Sengupta * and R.D. Goldman, **Journal of Biological Chemistry** Mar 28; **283(13)**, (2008) 8462-8.

31. The Highly Conserved Nuclear Lamin Ig-fold Binds to PCNA: Its Role in DNA Replication: D.K. Shumaker, ‖ L. Solimando, ‖ K. Sengupta, T. Shimi, S.A. Adam, A. Grunwald, S. Strelkov, U. Aebi, M.C. Cardoso and R.D. Goldman, **Journal of Cell Biology** Apr 21; **181(2)**, (2008) 269-80.

32. Nuclear Lamins: Major Factors in the Structural Organization and Function of the Nucleus and Chromatin: T. Dechat, K. Pfleghaar, K. Sengupta, T. Shimi, D.K.Shumaker, L. Solimando and R.D. Goldman, **Genes & Development** Apr 1; **22(7),** (2008) 832-53.

2007

33. Association of antitumor antibiotics, MITHRAMYCIN and CHROMOMYCIN, with Zn(II) : P.G. Devi, S. Pal, and D. Dasgupta, **J. Inorganic. Biochem. 101**, (2007) 127-137.

34. Effect of β-cyclodextrin nanocavity confinement on the photophysics of robinetin: A. Banerjee, K. Basu and P.K. Sengupta, **J. Photochem. Photobiol. B: Biology**. **89**, (2007)88-97.

35. Interaction of flavonoids with red blood cell membrane lipids and proteins: Antioxidant and antihemolytic effects: S. Chaudhuri, A. Banerjee, K. Basu, B. Sengupta, and P. K.Sengupta , **Int. J. Biol. Macromol**. **41**, (2007) 42-48.

36 Theoretical Analysis of Noncanonical Base Pairing Interactions in RNA Molecules: D. Bhattacharyya, S.C. Koripella, A. Mitra, V.B. Rajendran and B. Sinha , **J. Biosci**. **32**, (2007) 809-25.

37. BioSuite: A comprehensive bioinformatics software package (A unique industry academia collaboration), The NMITLI-BioSuite Team, **Current Science**, **92**, (2007) 29-38.

Book Chapters:

1. P Majumder, S.K Pradhan, P Grihanjali, Devi, S Pal, and D Dasgupta,. Chromatin as a target for the DNA binding anti-cancer drugs. *Subcellular Biochemistry* Volume 41 (Springer Press), 41: 145-89(2007)

Conference Abstracts & Proceedings:

1. S. S. Ray, S. Halder, D. Bhattacharyya in Proceedings of Frontiers of Interface Between Statistics and Sciences Dec. 30, 2009-Jan 2, 2010, Hyderabad. pp. 724-733 (2009).

2. Pradhan SK, Selvi BR, Shandilya J, C.Das, T.K.Kundu, D.Dasgupta, Structural Perturbation of Chromatin by Plant Alkaloid Sanguinarine and Its Functional Consequences JOURNAL OF BIOMOLECULAR STRUCTURE & DYNAMICS Volume: 26 Issue: 6 Pages: 913-913 (2009)

3. D. Bhattacharyya and S. Basu, “Hydrogen Bonds in Nature: Structure, Energy and Variability”, in *Physics in Biology: A Synergy* (P. Anantha Lakshmi & V. Srivastava, Eds.) pp. 85-101. (2010).

4. R.Bhattacharya, Environmental impact on Rhizobium sp. cell. Microorganisms in Industry and Environment, From Scientific and Industrial Research to Consumer Products Proceedings of *BioMicroWorld Conference*, 2010

Books Edited:

Chromatin and Disease (editors: Tapas K. Kundu & Dipak Dasgupta)
Series: Subcellular Biochemistry , Vol. 41 Springer Press (2007)

Dipak Dasgupta (Date of Birth: 27th May, 1953)

Academic Qualifications: B.Sc (Calcutta University) with Chemistry (Major), Physics & Mathematics (Subsidiary); **M.Sc (**Calcutta University) in Chemistry with (Physical Chemistry as Special Paper); **Ph.D. (1980,** Biochemistry Department, Indian Institute of Science, Bangalore (**Title of Ph.D. Thesis**: Sequence Specificity in Protein-Nucleic Acid Interaction)

Academic profile including earlier appointments, awards

Research Fellow (1975-1979) in Biochemistry Dept., Indian Institute of Science, Bangalore; **Research Associate (1980-81)** in Inorganic & Physical Chemistry Dept, Indian Institute of Science, Bangalore; **Post-doctoral Fellow and Instructor (1981 - 1985)** at Department of Biological Chemistry & Pharmacology, Harvard Medical School, Boston, USA; **Research Associate (1986 - 1987)** in Molecular Biophysics Unit, Indian Institute of Science, Bangalore & Biochemstry Department, Indian Institute of Science, Bangalore **Reader 'D' (Jan, 1988- July, 1991)** in Saha Institute of Nuclear Physics, Calcutta. **Associate Professor 'E' (Aug, 1991 – July, 1996)** in Biophysics Division of Saha Institute of Nuclear Physics, Calcutta. **Professor 'F' (Aug, 1996 – July, 2002)** in Biophysics Division of Saha Institute of Nuclear Physics, Calcutta. **Professor 'G' (Aug, 2002 – Jan, 2007)** in Biophysics Division of Saha Institute of Nuclear Physics, Calcutta. **Professor 'H' (February, 2007 – till date)** in Biophysics Division of Saha Institute of Nuclear Physics, Calcutta. **Head of Biophysics Division (Dec, 2000 till date)**
Awards & honours: Elected member of Guha Research Council, India ;Member, International Advisory Editorial Board of the Series, Subcellular Biochemistry Springer Press; Bestowed the post of Professor in Homi Bhabha National Institute (HBNI), Department of Atomic Energy, Mumbai, India.; Advisory Committee Member of recently started National Institute of Pharmaceuticals and Experimental Research (NIPER), in Indian Institute of Chemical Biology, Kolkata; COE Visiting Professorship from MONBUSHO, Japan (Oct'98 – Oct'99) Molecular Genetics Department, National Institute of Genetics, Mishima, Japan; National Science Foundation (USA) Travel Award as a member of Indian delegation of biologists to attend a Conference and visit different laboratories in USA
Invitation to edit series volume & contribute review artcle : Edit a volume(Chromatin & Disease) in the Subcellular Biochemistry Series; invited review articles/commentary in the journals Current Medicinal Chemistry (Bentham Press), Biochemical Journal (Portland Press); Biochimica Biophysica Acta (Elsivier B.V.)

Essential strength of research/development output
Chemical and structural biology with emphasis on thermodynamic basis of biomolecular recognition, structure – function correlation of proteins and nucleic acids, and molecular pharmacology have been the theme areas of my research activities and strength of my research output. More specifically, field of activities have been : DNA(double stranded and quadruplex)-ligand (with chemotherapeutic potential) interaction, molecular basis of transcription initiation in prokaryotes, modulation of chromatin structure as a target of DNA - binding anticancer drugs and additional target validation (with potential in chelation therapy) for generic drugs like aureolic acid group of anticancer antibiotics and myoinositol trisphosphate mediated signal transduction process in plants,. A major outcome of the above basic research activity of mine is elucidation of molecular mechanism(s) of action of small molecules with proven therapeutic

ability or disease remedy potential. The techniques applied are mostly biophysical with emphasis upon Biocalorimetry and Spectroscopy.

Our studies in the last five years and the ongoing studies have led us to propose that in the context of chromatin structure, the intracellular target of the small DNA-binding transcription inhibitors, they should be classified in two broad groups vis-à-vis their interaction with chromatin: ***single binding and dual binding mode***. Single binding mode enlists the small molecules which bind selectively to DNA in the chromatin by any one of the binding mechanisms of intercalation or groove binding. On the other hand, dual binding mode signifies the ability of the small molecule to bind both DNA and associated core histones.

Recently we have shown that bivalent metal ion chelation property of the aureolic acid group of antitumor antibiotics, mithramycin and chromomycin A3, leads to the disruption of the structure of Zn(II) containing enzymes like alcohol dehydrogenase and alkaline phsphatase. It culminates in the loss of function of the enzyme. This finding has the potential of employing them for diseases originating from metal ion misbalance inside the cell.

Future research plan: Modulation of chromatin structure and dynamics by DNA binding anticancer agents; Thermodynamic aspects of molecular basis of the recognition of histone modification agents with the function of modulating epigenetics modifications; Effect of quadruplex DNA binding small molecules upon the quadruplex structure and function; Alternate mode of action of the generic anticancer drug, mithramycin. A few of them have collaborative components.

List of few important publications before 2007 (total number till date = 75, publications during the period 2007-2010 are given in the cumulative list of publications from the Division, No. of PhD outputs = 10, Current Predoctoral students = 5)

Das, S., Grihanjali Devi, P., Pal, S. & **Dasgupta, D**. Effect of complex formation between Zn^{2+} ions and the anticancer drug mithramycin upon enzymatic activity of zinc(II)-dependent alcohol dehydrogenase.*J Biol Inorg Chem.* 10(1):25-32 (2005).

Sen, Ranjan and **Dasgupta , D**.Simple fluorescence assays probing conformational changes of Escherichia coli RNA polymerase during transcription initiation. *Methods Enzymol.*; 370: 598-605 (2003)

Chakrabarti, S. , Bhattacharyya, B. & **Dasgupta, D.** Interaction of Mithramycin and Chromomycin A_3 with $d(TAGCTAGCTA)_2$: Role of Sugars in Antibiotic-DNA Recognition, *J. Of Phys. Chem.B* 106(26): 6947 – 6953 (2002).

Padmanabhan, U., Dasgupta, S., Biswas, B.B. and **Dasgupta, D.** High affinity association of myo – inositol trisphosphates with phytase and its effect upon the catalytic potential of the enzyme, *Jl. Of Biol. Chemistry*, 276(47), 43635 –44 (2001).

Mohd. Ayoub Mir & **Dasgupta, D.** Association of anticancer antibiotic Chromomycin A3 with the nucleosome: Role of core histone tail domains in the binding process, *Biochemistry,* 40(38), 111578 – 85 (2001**)**

Sangita Majee, Ranjan Sen, Suranjana Guha, Dhananjay Bhattacharyya & **D. Dasgupta,** Differential Interactions of the Mg^{2+} Complexes of Chromomycin A3 and Mithramycin with poly(dG-dC) and PolydG.polydC. *Biochemistry,* **36,** 2291-2299 (1997)

Shashiprabha Dasgupta, **D. Dasgupta**, Mita Sen, Susweta Biswas, and B.B.Biswas, Interaction of myoinsitol trisphosphate-phytase complex with the receptor for intracellular Ca(II) mobilization in plants, *Biochemistry*, **35**, 4994-5001 (1996)

Palok Aich and **D. Dasgupta**, Role of Magnesium ion in the Interaction between Mithramycin and DNA --- Binding of Mithramycin-Mg(II) complexes with DNA, *Biochemistry*, **34,** 1376-1385 (1995)

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Senior Professor (H), Biophysics Division
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Education:
Ph.D. (Molecular Biophysics), Florida State University, 1980 (Mentor: *Michael Kasha*).
Post-M.Sc Associateship diploma (Bioscience), SINP, 1973-74
M.Sc (Physics, splzn: Biophysics), Calcutta Univ, 1971.
B.Sc (Physics Hons), Presidency College,Calcutta Univ, 1969.
Academic profile :

***Appointments held*:**
Saha Institute of Nuclear Physics: Faculty member, June 1985-present (Senior Professor H, Biophysics Division, since Feb. 2007).
University of Michigan , Ann Arbor (Biophysics Research Division): Assistant Research Scientist (1984); Postdoctoral Scholar, 1981-84 (Mentor: Prof.Samuel Krimm).
University of California, San Diego (Department of Chemistry): Postgraduate Research Chemist (Mentor: Prof. Murray Goodman)- 1980-81.
Florida State University (Institute of Molecular Biophysics): Graduate Research Assistant (Mentor: Prof. Michael Kasha)-1975-80

Honors and Awards :.
Elected Fellow, West Bengal Academy of Science and Technology, 1998
National Science Talent Search scholarship winner, 1966
National Scholarship/Certificate of merit award winner, 1966

Research/Development output

Prof. P.K. Sengupta's research focus has been on Biomolecular Spectroscopy emphasizing biophysical, and of late , biomedically relevant applications. His early researches on the electronic spectroscopy of plant flavonols (with M. Kasha) led to the seminal discovery of excited state proton transfer (ESPT) in such molecules, which, for the first time, explained the origin of their unusual luminescence properties. His subsequent studies on the vibrational spectroscopy of polypeptides (with S. Krimm) involving Raman, IR and normal mode analyses, revealed the role of side chain structure on main chain vibrational modes, resolved earlier discrepancies between Raman and X-ray findings, and provided other fundamental insights relating to polypeptide/protein conformations. Prof. Sengupta joined SINP in 1985 and laid the initial basis for research on biomolecular spectroscopy at this institute. Sengupta's group has pioneered novel uses of the exquisitely sensitive 'two color' fluorescence of therapeutically important plant flavonoids (effective against free radical mediated and other diseases, including atherosclerosis, ischemia, cancers, diabetes, viral diseases etc) to explore their interactions with representative biological targets (proteins, DNA, biomembranes), and the encapsulation of these compounds in 'nanovehicles' for drug delivery. Using this novel approach, target binding sites and binding constants have been

successfully determined, and intercalative binding to DNA shown. Recent studies by Sengupta et al. revealed that flavonoids exhibit significant protective (antioxidant and antihemolytic) effects in RBC membranes, which crucially depend on their locations (inferred from fluorescence studies) in the membrane matrix. Such findings have attracted remarkable attention and triggered a surge of research activities around the world. Other notable contributions by Sengupta et al. include: discovery of the promising potentials of tryptophan octyl ester and 7-azatryptophan as highly sensitive fluorescence probes for water restricted environments (relevant to interfacial membrane proteins); novel uses of fluorescence anisotropy and multiparametric fluorescence probes for monitoring structural phase transitions and microenvironments in biomembrane mimetic organized assemblies; recognizing the occurence of solvent dipolar relaxation effects including red edge excitation shift (REES) in relevant flavonoid derivatives; elucidating the mode of encapsulation of the neuro-hormone serotonin in cyclodextrin nano-cavities, via fluorescence spectroscopy and molecular modeling studies. Prof. Sengupta's works have been extensively cited by the international scientific community, cutting across disciplines **(total cit >1000; av. total cit/year during last 5 yrs. >100; h-index=19).**

Selected important publications. (citation data from *Web of Science*)

- Chaudhuri S, Chakrabarti S. and **Sengupta PK** (2010)Encapsulation of serotonin in beta-cyclodextrin nano-cavities: Fluorescence spectroscopic and molecular modeling studies, **J. Molecular Structure** 975, 160-165. (0 Citation)
- Chaudhuri S, Banerjee A, Basu K, Sengupta B and **Sengupta PK** (2007) I*nteraction of flavonoids with red blood cell membrane lipids and proteins: Antioxidant and antihemolytic effects.* **Int. J. Biol. Macromol**. **41** 42-48**.** (**25** Citations)**.**
- Banerjee A and **Sengupta PK** (2006) Encapsulation of 3-hydroxyflavone and fisetin in beta-cyclodextrins :Excited state proton transfer fluorescence and molecular mechanics studies, **Chemical Physics Letters 424** 379-386**. (10 Citations)**
- Sengupta B, Banerjee A and **Sengupta PK** (2005) *Interactions of the plant flavonoid fisetin with macromolecular targets: Insights from fluorescence spectroscopic studies,* **J. Photochem. Photobiol B: Biology 80** 79-86. (**19** Citations).
- Sengupta B, Banerjee A and **Sengupta, PK** (2004) *Investigations on the binding and antioxidant properties of the plant flavonoid fisetin in model biomembranes*', **FEBS Letters 570** 77-81. (**25** Citations)
- Sengupta B and **Sengupta PK** (2002) *The interaction of quercetin with human serum albumin: A fluorescence spectroscopic study',* **Biochem. Biophys. Res. Commun**. **299** 400-403. (**72** Citations).
- Guharay J, Sengupta B and **Sengupta PK** (2001) *Protein - flavonol interaction: Fluorescence spectroscopic study*, **Proteins: Structure, Function and Genetics 43** 75-81. (**72** Citations).
- **Sengupta PK** and Krimm S (1985) *Vibrational analysis of peptides, polypeptides and proteins. α-poly (L-Glutamic Acid)*', **Biopolymers 24** 1479-1491. (**38** Citations).
- **Sengupta PK** and Kasha M (1979) *Excited state proton-transfer spectroscopy of 3-hydroxyflavone and quercetin*, **Chemical Physics Letters 68** 382-385. (**284** Citations).
- **Future plans**- To continue and further extend our ongoing spectroscopic and other related studies on bio-relevant natural products in relation to their target binding, antioxidant properties, and nanoencapsulation in drug delivery vehicles.

Faculty Profile of Dhananjay Bhattacharyya

B.Sc. Physics (hons.), Chemistry, Mathematics; University of Calcutta; 1981
M.Sc. Physics (Solid State Physics, Special Paper); University of Calcutta; 1983
Post M.Sc. (Physics); Saha Institute of Nuclear Physics; 1984-85
Ph.D. (Molecular Biophysics); Indian Institute of Science, Bangalore; 1992

Previous Positions held:

1. Research Associate – Indian Institute of Science; 1992
2. Visiting Fellow - Saha Institute of Nuclear Physics; 1992-93
3. Visiting Fellow - Division of Computer Research & Technology, National Institutes of Health, Bethesda, Maryland, USA; 1993-95
4. Visiting Fellow - Saha Institutes of Nuclear Physics; 1995-96

Essential strength of research/development output:

1. We have been working on structure and flexibility of DNA double helix through analysis of available X-ray single crystal structures, quantum chemical calculations and molecular dynamics simulations. We have shown that DNA double helix flexibility, which can modulate its binding to different gene regulatory proteins, such as TATA box binding protein or histone etc., can depend on its base sequence. We have further shown that absence or presence of cross-strand bifurcated hydrogen bonds between successive base pairs in stacking geometry is the main reason for such sequence dependent flexibility. Pyramidal nature of the nucleotide base amino groups can increase and enhance strength of these hydrogen bonds, which was also demonstrated.
2. Determination of crystal structures of RNA molecules of various length is now quite standardized, however, their structural analysis remained in its nascent stage. We have developed a software for detection of different types of Watson-Crick or other non-canonical base pairs in RNA structures, which are stabilized by two or more hydrogen bonds. The subsequent analysis indicated presence of non-canonical base pairs of different variety at a huge proportion. We have throughly analyzed their structure, dynamics and interaction strength by *ab initio* quantum chemical methods.
3. As collaborative projects we have extended our knowledge of molecular modeling and quantum chemical calculations to understand various unusual properties of different model compounds. We have characterized ground and excited states of pyrine-dimethylaniline,

Dibenzo[a,c]phenazine, Amino-/N/-Methylphthalimide. We have characterized unusual edge properties of nano-graphene and analyzed its wetting properties manifested by formation of hydrogen bonds with water.

4. It was well known that ribosome is the machinery of protein synthesis but its mechanism was never clear and also the catalizing enzyme was not known. We have proposed a reaction mechanism for protein synthesis where one of the amino-acid caring tRNA acts as catalyst. This model was later confirmed by experimental studies.

Future research/development plan:

1. We would like to utilize sequence dependent DNA flexibility to predict its function. As the database adopted to determine such flexibility was not rich enough, we are planning to supplement it with theoretical calculations.
2. We would like to use possibility of non-canonical base pairs in prediction or RNA secondary and tertiary structures from its sequence alone. Presently only Watson-Crick base pairs are considered for such structure prediction and hence prediction accuracy is too low. We would first determine stacking free energy between different dinucleotide sequences, containing canonical as well as non-canonical base pairs, and use these results to prediction of structures.
3. We would like to use variability of amino groups in hydrogen bond formation between different receptors and their ligands, which can be used to determine drug-like compounds.

Important Publications:

1. S. Samanta, S. Mukherjee, J. Chakrabarti, and D. Bhattacharyya (2009) Structural properties of polymeric DNA from molecular dynamics simulations. J. Chem. Phys **130**:115103.
2. A. Roy, S. Panigrahi, M. Bhattacharyya, and D. Bhattacharyya (2008) Structure, Stability, and Dynamics of Canonical and Noncanonical Base Pairs: Quantum Chemical Studies, J. Phys. Chem. B **112**: 3786-3796
3. J. Das, S. Mukherjee, A. Mitra and D. Bhattacharyya (2006) Non-Canonical Base Pairs and Higher Order Structures in Nucleic Acids: Crystal Structure Database Analysis *J. Biomol. Struct. Dynam.* **24**, 149-161.
4. K. Sen, S. Basu and D. Bhattacharyya (2006) Ab Initio Studies on Excited State Intramolecular Electron Transfer in 4-Amino-/N/-Methylphthalimide and 3- Amino-/N/-Methylphthalimide *Int. J. Quantum Chem.* **106**, 913-927.
5. S. Mukherjee, S. Majumdar and D. Bhattacharyya (2005) Role of Hydrogen Bonds in Protein-DNA Recognition: Effect of Non-planar Amino Groups, *J. Phys. Chem. B* **109**, 10484-10492.
6. D. Bandyopadhyay and D. Bhattacharyya (2000) Effect of neighboring residues in base-pair doublet geometry: A molecular dynamics study *J. Biomol. Struct. Dynam.* **18**, 29-43.
7. D. Bhattacharyya, S. Kundu, A.R. Thakur and R. Majumdar (1999) Sequence Directed Flexibility of DNA and the Role of Cross-strand Hydrogen Bonds *J. Biomol. Struct. Dynam.* **17**, 289-300.
8. G.K. Das, D. Bhattacharyya and D.P. Burma (1999) A Possible Mechanism of Peptide Bond Formation on Ribosome without Mediation of Peptidyl Transferase *J. Theor. Biol.* **200**, 193-205.
9. M. Bansal, D. Bhattacharyya and B. Ravi (1995) NUPARM and NUCGEN: Software for Analysis and Generation of Sequence Dependent Nucleic Acid Structures *CABIOS* **11**, 281-287.
10. K. Nagaich, D. Bhattacharyya, S.K. Brahmachari and M. Bansal (1994) CA/TG Sequence at the 5'-end of Oligo A-Tracts Strongly Modulates DNA Curvature *J. Biol. Chem.* **269**, 7824-7833.

1. Name Radha Bhattacharya

Education

Degree	Year	College/Institution	University	Subject
PhD	1981	Bose Institute	Calcutta	Botany
MSc	1974	University College of Science	Calcutta	Botany
BSc.	1972	Presidency	Calcutta	Botany(Hons)

Title of PhD thesis

Transformation of steroid hormones by microorganisms.

2. Academic profile including previous appointments

Junior research fellow C.S.I.R at Bose Institute ,Calcutta from 1975-1978
Senior research fellow C.S.I.R. at Bose Institute, Calcutta from 1979-1981
Research associate I.C.M.R. at Bose Institute,Calcutta from 1981-1984
Research associate S.I.N.P,Calcutta from 1985-1988
Faculty (at present Scientist G) S.I.N.P,Kolkata since 1989.

3. Essential strength of research /development

Development:

a) Modulation and standardization of different steps involved in ultrathin sectioning technique for biological samples.
b) Ultrastructural research for biological samples at Biophysics Division.

Research:

a) Ultrastructural changes in *Vibrio cholerae* upon adverse conditions which had a meaningful insight in Cholera research.
b) The chemo prevention of cadmium, β carotene and Vitamin D in carcinogen treated hepatocytes of rat at ultrastructural level. This structural study has great importance in the field of cancer research.
c) Environmental impact on *Rhizobium sp.* cell which will helps to develop strength and better understanding in agricultural field.

4. Future research /development

Continuation of the project "Environmental impact on *Rhizobium sp.* cell", since it has great importance in agriculture.

5. List of important publications starting with recent publications

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i) **Radha Bhattacharya** Environmental impact on *Rhizobium sp.* cell. Microorganisms in Industry and Environment, From Scientific and Industrial Research to Consumer Products (Proceedings of BioMicroWorld 2009) accepted for publication.

ii) Sheuli Dasgupta, Tapan K. Roy and **Radha Bhattacharya** (2005). Endosulfan treated *Rhizobium* sp.cells : A study. Annals of Microscopy 85-92

iii) Sheuli Dasgupta, Tapan K. Roy and **Radha Bhattacharya** (2004). Effect of nitrogenous fertilizers on *Rhizobium* sp. cells. Annals of Microscopy, **4**: 96-102.

iv) Barun Kanti Saha, **Radha bhattacharya** and Malay Chatterjee (2001) 1α, 25-dihydroxyvitamin D_3 inhibits rat liver ultrastructural changes and the development of γ-glutamyltranspeptidase-positive foci diethylnitrosamine-initiated and streptozotocin-induced diabetes promoted hepatocarcinogenesis Cell Biology and Function **19** : 1-10.

v) Ranjan Basak, **Radha Bhattacharya** and Malay Chatterjee (2000) 1α,25-dihydroxyvitamin D_3 inhibit rat liver ultrastructural changes in diethyl-initiated and phenobarbitol promoted rat hepato-carcinogenesis.Journal of Cellular Biochemistry **81**(2): 357-367

vi) Ranajit Karmakar, **Radha Bhattacharya** and Malay Chatterjee(2000) Biochemical, haematological and histopathological study in relation to time dependent cadmium induced hepatotoxicity in mice. Biometal **13**: 231-239.

vii) **Radha Bhattacharya** and Tapan K. Roy(2000) Microbiological and electron microscopic studies of urea treated *Rhizobium* sp. cells, Acta Microbiologica Polonica **49**(3-4) : 201-206.

viii) **Radha Bhattacharya** and S. N. Chatterjee(1994) Effect of rehydrating fluid 'Electral' on *Vibrio cholerae* cells, Indian J. Exp. Biol. **32**: 44-48.

ix) **Radha Bhattacharya**(1989) An adaptive response of *Vibrio cholerae* strain OGAWA 154 to furazolidone, Mutation research, **225**: 43-47.

x) **Radha Sen** and T. B. Samanta (1981) Influence of the substituents at C_{11} on hydroxylation of C_6 steroids by *Syncephalastrum racemosum,* Journal of Steroid Biochemistry**, 14**: 307

Name: Arun Kumar Pal.

Educational background: Ph. D. (Sc.)

Academic Profile including earlier appointments/awards etc.:
Passed M. Sc. in Physics from the University of Calcutta and started working in the Biophysics Division of SINP as a Research Fellow since the end of 1980 and obtained a Ph. D. (Sc.) degree from the University of Calcutta in 1989.
Obtained a permanent position at SINP as "Scientist SB" in the year 1987, while I was working in the Biophysics Division as a Research Fellow.

Essential strength of research development output:
I started my research career as a Fellow in the Biophysics Division, SINP and started working on the screening of potential mutagens and carcinogens, using short-term bacterial assay systems. We established the genotoxic potential of a number of synthetic nitrofuran group of drugs used extensively in human diseases. I was also working on some properties of a lysogenic vibrio phage kappa – its induction due to cellular responses and the liberation of aberrant forms of the lysogenized virus using density gradient and electron microscopic techniques.
At this time I was engaged in the installation of the Hitachi Transmission electron microscope H 600, including planning and supervision of all the pre-installation requirements viz. construction of a vibration-proof foundation, laying of separate electrical cables from the main electrical bus bar to the site of installation of the E. M. etc. Very soon it was declared a "Central Facility " and I used to render services to all the users of the facility on a routine basis till the institute recruited a number of personnel in the facility. I also trained the new recruits in the facility and helped them regularly, till they became independent to work with the machine.
I continued my endeavour in the study of genotoxic compounds in the environment. Different aspects of genotoxicity of a pesticide viz. endosulfan was carried out at this time.

Just after this, I focused my attention to some natural products in order to assay their genotoxic activity, if any, and also the modulation of the genotoxicity induced by them in bacterial systems. A number of these products are known to contain antioxidants, which might modulate the genotoxic activity of some DNA damaging agents. I picked up turmeric at the first instance. It was believed at that time that Curcumin was the only bioactive component of turmeric. We found for the first time that apart from Curcumin, turmeric contained one more bioactive component and that produced genotoxicity (Pal and Pal, 2000) in at least two different bacterial systems. We did not, however, find any genotoxic activity of Curcumin, rather it imparted radioprotection against radiation induced DNA damage in bacterial systems (Pal and Pal 2005). Subsequently it was also found by us that the two components stated above, having distinctively different effects on bacterial system are expressed selectively depending on the nature and extent of DNA damage inflicted in the bacterial system under study. Simaltaneously, we are also working with a number of other spices and have obtained interesting results in relation to their role as radio-protectors in bacterial cells exposed to different types of radiations and harboring different types of DNA damage.

Future research/development plan:

Chirality and structural rigidity, which are known to enhance compound specificity and efficacy as a drug, are found to be much higher in natural compounds as compared to compounds in combinatorial chemistry libraries. Natural products are also believed to have lesser side effects and therefore, they stand better candidates for potential lead molecules. Keeping this in mind, attempts will be made to separate the individual components of the natural products, under study in our laboratory, using modern separation techniques, in order to study their individual roles in bacterial system vis-à-vis the extract as a whole. This may provide useful information and insight in the use of these natural products as essential lead molecules and also help in designing effective drugs in curing diseases.

List of important publications starting with recent publications :

Arijit Pal, Mita Ghosh and Arun Kumar Pal (2008) Role of turmeric in Ultraviolet induced genotoxicity in a bacterial system. *Natural Products Communications*, Vol. 3, No. 2, 227 –228.

A. Pal and A.K. Pal (2005) Radioprotection of Turmeric extracts in bacterial system, *Acta Biologica Hungarica*, 56, 333 – 343.

A. Pal and A. K. Pal (2000) Studies on the genotoxicity of turmeric extracts in bacterial system, *Int. J. of Antibacteral Agents*, 16, 415 – 417.

K. Chaudhuri, S. Selvaraj and A. K. Pal (1999) Studies on the genotoxicity of endosulfan in bacterial systems, *Mutation Research*, 439, 63-67.

A. K. Pal, Md S. Rahman and S. N. Chatterjee (1993) Electron microscopic study of phages and aberrant structures produced by induction of prophage kappa in *Vibrio cholerae* el tor cells, *Indian Journal of Experimental Biol*ogy, Vol.31, 955-962.

Md. S. Rahman, A. K. Pal and S. N. Chatterjee (1993) Induction of SOS like responses by nitrofurantoin in *Vibrio cholerae* el tor cells, *Archives of Microbiology*, 159, 98-100.

A. K. Pal, Md. S Rahman and S. N. Chatterjee (1992) On the induction of umu gene expression in *Salmonella typhimurium* strain TA 1535/pSK1002 by some nitrofurans, *Mutation Research*, 280, 67-71.

Kaushik Sengupta (Date of Birth – 1st September, 1974)

Academic Qualifications:
B.Sc (Calcutta University) with Chemistry (Major), Physics & Mathematics (Subsidiary) 1996; **M.Sc (**Calcutta University) in Biochemistry 1998; **M.Tech** (I I T Bombay) in Bio-medical Engineering 2000; **Ph.D** (J.W. Goethe University/Max Planck Institute for Biophysics, Frankfurt am Main, Germany) in Biochemistry 2004

Academic profile including earlier appointments:

Research Fellow (2001-2004) at International Max Planck Research School, MPI Biophysik, Frankfurt Under the guidance of Prof. Dr. Heinz Rüterjans, Department of Biophysical Chemistry, J.W.Goethe Universität, Frankfurt am Main, **Germany**
Postdoctoral Research Fellow (2004-2010) at Department of Medicine & Department of Cell & Molecular Biology, Northwestern University Feinberg School of Medicine, Chicago, **USA**
Associate Professor – E (July 2010 – till date) at Biophysics Division, Saha Institute of Nuclear Physics, Kolkata, **India**

Awards & Honors:

BAT/IIa Ph.d Fellowship from International Max Planck Research School in Germany
GATE Fellowship (1998) for All India Rank 2,India
Shanti Bhakta Memorial Award (1996) from Department of Biochemistry, Calcutta University. India
National Merit Scholarship (1991) India

Area of Research & Future Directions:

My doctoral thesis focused on the structure-function analysis of a global transcription regulator RcsB of eubacteria. The project encompassed the structural elucidation of the protein for the first time by NMR spectroscopy. The mode of interaction of this regulator with DNA targets was elucidated by Gel Shift assays, Chemical cross-linking and Surface Plasmon Resonance experiments. Still by other numerous biochemical assays it was shown that a particular domain of the protein binds to DNA targets which in turn are the promoters of different genes responsible for the growth and locomotion of the bacteria. This paved the way for my future research interest in DNA-protein interaction.
My postdoctoral research is based on an Intermediate filament protein family, Lamins which are ubiquitiously present in all mammalian cells and in higher eukaryotes. This protein is nuclear in origin and is shown to play diverse roles inside the nucleus starting from the scaffolding to controlling and fine tuning Replication and Transcription. Mutations of Lamin A/C has the greatest implications in the pathogenesis of various diseases like Hutchinson Gilford Progeria Syndrome, Emery Dreyfuss Muscular Dystrophy, Dilated Cardiomyopathy etc. the list being an ever expanding one with the discovery of new mutations in LaminA/C in patients. These diseases are broadly classified as Laminopathies and have become a major research hotspot for the Lamin biologists. I was able to show the novel role of Importin α in the polymerization of Lamins in Xenopus laevis system. Parallel experiments in the role of Lamin in replication allowed

us to show a novel interaction of the Lamin tail with PCNA. All these experiments and publications allowed me to investigate and understand the role of Lamins in Nuclear architecture and function with greater clarity.

My research as a faculty in this institute would deal with understanding the role of Lamins especially Lamin A/C in the context of Dilated Cardiomyopathy (DCM). There are both biophysical and cell-biological aspects of the function/malfunction of Lamin A/C in this disease. The biophysical aim is to delineate the mode of association and state of oligomerization of mutant lamins and their implications thereof. Another interesting approach that will be implemented is the measurement in change of persistence length and elasticity of the Lamin polymers. This is novel and these biophysical parameters would be very interesting in deciphering the change in elasticity of the cardiomyocytes and their abnormally shaped nuclei in DCM. The cell biology of the mutant Lamins would be examined based on the morphological analysis of the nuclei from DCM mutant Lamin induced cells and also examining the rigidity of those nuclei following the treatment. This marriage of Biophysics and Cell Biology would be an ideal scenario in a deeper understanding of the behaviour of the cardiomyocytes particularly with respect to the multifaceted properties of Lamins.

Publications in Peer Reviewed Journals

1. Adam, S.A[*]., **Sengupta, K[*]**. & Goldman, R.D. **(2008)** Regulation of Nuclear Lamin Polymerization by Importin α. ***Journal of Biological Chemistry*** **Mar 28;283(13):8462-8**
[*]Authors contributed equally to this work Impact factor: 5.581

2. Shumaker, D.K[‖]., Solimando, L[‖]., **Sengupta, K.**, Shimi, T., Adam, S.A., Grunwald, A., Strelkov, S., Aebi, U., Cardoso, M.C. & Goldman, R.D. **(2008)** The Highly Conserved Nuclear Lamin Ig-fold Binds to PCNA: Its Role in DNA Replication. ***Journal of Cell Biology*** **Apr 21;181(2):269-80**
[‖]Authors contributed equally to this work Impact Factor: 9.598

3. Dechat, T., Pfleghaar, K., **Sengupta, K**., Shimi, T., Shumaker, D.K., Solimando, L. & Goldman, R.D. **(2008)** Nuclear Lamins: Major Factors in the Structural Organization and Function of the Nucleus and Chromatin. ***Genes & Development*** **Apr 1; 22(7):832-53 Impact Factor: 14.795**

4. Sengupta, K., Klammt, C., Bernhard, F., Rüterjans, H. **(2003)** Incorporation of Fluorescence Labels into Cell- Free Produced Proteins. ***Cell-Free Protein Expression***, James R. Swartz (Ed), SPRINGER VERLAG.
5. Pristovšek, P., **Sengupta. K.,** Löhr, F., Schäfer, B., Wehland von Trebra, M., Rüterjans, H., Bernhard, F. **(2003)** Structural Analysis of the DNA-binding Domain of the *Erwinia amylovora* RcsB Protein and Its Interaction with the RcsAB Box. ***Journal of Biological Chemistry*** **278(20)**, 17752-17759. Impact factor: 5.581

Electron Microscope Facility

Name : Pulak Ray

Academic Qualifications:
Masters in Technology (Applied Physics, 1985)

Professional qualifications: Charter Engineer

Earlier appointments:

Sl. #	Position held	Organization	Period	
			From	To
1.	R & D Engineer	Sonodyne Television Co. Pvt. Ltd.	1.6.85	4.8.86.
2.	Service Engineer	Blue Star Ltd.	5.8.86.	30.4.90.
3.	Senior Service Engineer	Blue Star Ltd.	1.5.90.	31.10.90
4.	Assistant Manager-Customer Support	Blue Star Ltd.	1.11.90.	10.5.91.

Developmental work:

Involved actively to install the new 200kv Transmission Electron Microscope in 2006. The instrument is now used regularly by more than 30 faculty members of our Institute.

- Improvised resolution to 0.204nm which is lower than specification of the system (0.244nm)

The old 100kv Transmission Electron Microscope (Hitachi, H-600) was installed in 1986. Now we do not get spares from the principal and the instrument is not under Annual Maintenance Contract. I always improvise some means to rectify the faults by indigenous components or modify the circuit accordingly. Some major troubleshooting are listed below:

- Shifted the instrument from Belgachia Campus to Salt Lake Campus and installed successfully.
- Repaired CPU PCB by writing new program to the ROMs.
- Repaired SMPS of the D.C. Power Supply.
- Fabricated ‘Camera Valve’ in workshop and replaced the defective one.
- Repaired the specimen stage by fabricating the required parts in workshop
- Repaired the ‘High Voltage Transformer’ which lost insulation at 100KV.
- Repaired the ‘Logic PCB’ by modification of the circuit to overcome one-third image obstruction on the screen.
- Repaired the defective micro-switch by indigenous one and modify the circuit as per need at the camera chamber.

Till date the instrument is in working condition.

Publications:

1. Proceedings of the International Symposium on Opto-Electronics Imaging, pp.450- 454, 1985 (published by Tata Mcgraw-Hill)

2. Biochemical Pharmacology, vol. 56, pp.1471-1479, 1998.

C&MB Division

Crystallography and Molecular Biology Division

Permanent Members of the Division

Scientific	Technical	Administrative/Auxillary
Nitai P. Bhattacharyya, Prof. and Head	Utpal Basu, Sci Officer	Durga Hzra, Superintendent
Chandana Chakrabarti , Prof.	Ashis K. Dutta, Scientific Assistant	Chinmoy Chatterjee, Helper
Sanghamitra Raha, Prof.	Abhijit Bhattacharyya, Scientific Assistant (SA)	Bipin Bose, Helper
Rahul Banerjee, Prof	Bikram Nath, SA	Sakal Dev Ram, Helper
Sampa Biswas, Prof	Susanta Debnath, SA	
Partha Saha, Prof.	Saikat Mukhopadhya, SA	
Udayaditya Sen, Prof	Samir Kr. Majumder, Technician	

Emeritus Scientist (CSIR)
Prof. J. K. Dattagupta

Research Associate/Post doctoral fellow (2007-onward)

Antara Dey, Rona Banerjee, Nipa Bhadhuri, Alakananda Goswami, Kuldip Jana, Madhumita Dandopath Patra, Lily Goswami, Sumana Roy, Debi Choudhury (DST-women scientist scheme), Sruti Dutta (CSIR Project)

Ph. D students (2007-onward)

Dipankar Bhandari, Anup Kr. Maity, Anupama Ghosh. Moumita Datta, Jayeeta Ghosh
Sudip Mazumder, Kamalika Roy Choudhury, Eashita Das, Kasturi Sengupta,
Sankar Ch. Basu, Saurav Roy, Barnali Waugh, Seema Nath, Ramanuj Banerjee (CSIR Fellow), Srijit Das (CSIR Fellow)

Ph.D. awarded (2007-till date)
Prosenjit Sen, Doel Roy, Prabir Kumar Chakrabarti, Suman Datta, Soumyajit Banerjee Mustafi, Sanjib Dey, Shantanu Roy, Rakha Ghosh, Susmita Khamrui, Pritha Majumder, Utpal Ghosh, Swasti Raychaudhuri, Manisha Banerjee, V. Venugopal

Major Equipment and Resources in the Division
Rotating anode X-ray generator and MAR345dtb imaging plate
Beckman Coulter Cell Lab quanta Flow Cytometer
Fluorescence microscope
Two-dimensional gel electrophoresis system
Fluorescence and phosphorimager scanner (Typhoon)
Automated DNA sequencer
Microarray Scanner and hybridization Oven

Research activities
Members of the C&MB division are engaged in broader research areas of (a) macromolecular crystallography and (b) cellular and molecular biology for understanding biological processes in cancer, infectious diseases and Huntington's disease (HD). In macromolecular crystallography, the major activities center on cloning, expression, purification, crystallization and determination of protein structures using X-ray diffraction and other spectroscopic techniques. Structure based protein engineering approaches have been used to enhance the stability and to impart collagenolytic activity in papain, and enhance catalytic efficiency of ervatamin-C, a thermostable protease belonging to the papain family.

Protein structures complexed with the substrates/inhibitors/drug have also been solved. Various cell and molecular biology techniques are used to decipher the signaling pathways in *Entamoeba histolytica,* mRNA turn over in *Leishmania donovani* and telomerase regulation in mammalian cells in culture. Similar techniques are used to determine mechanism(s) of transcriptional deregulation either by HIPPI or by deregulation micro RNA in HD model.

Important Results

a. Macromolecular crystallography

Cloning, expression, purification and preliminary X-ray diffraction analysis of Psu, an inhibitor of the bacterial transcription terminator Rho and CheY3, a response regulator that directly interacts with the flagellar 'switch complex' in Vibrio cholerae have been reported. Through crystal structure and biochemical studies on three chimeric proteins ECI (L)-WCI(S), ETI(L)-WCI(S), and STI(L)-WCI(S), where the inhibitory loop of ECI, ETI, and STI is placed on the scaffold of their homolog WCI, a set of novel scaffolding residues have been identified that remotely controls the inhibitory property so much so that a set of loop residues (SRLRSAFI) offering strong trypsin inhibition in ETI, act as a substrate when they seat on the scaffold of WCI *i. e.* in ETI(L)-WCI(S). Absence of these three novel scaffolding residues Trp88, Arg74, and Tyr113 makes the inhibitory loop flexible in ETI(L)-WCI(S) leading to a loss of canonical conformation, explaining its substrate-like behavior. Incorporation of this barrier back in ETI(L)-WCI(S) through mutations increases its inhibitory power, supporting our proposition. Analysis of the structure of NP24-I, a thaumatin-like protein, explains its glucanase and allergenic properties. Structures of cyclophilin from *Leishmania donovani* at 1.97 Å resolution and the complex of cyclophilin with cyclosporin at 2.6 Å resolutions have been solved.

Crystal structures of two papain-like cysteine proteases ervatamin-A and ervatamin-C, complexed with an irreversible inhibitor, together with enzyme kinetics and molecular dynamic simulation studies are reported. Comparisons of these results with the earlier structures solved from this division, indicates a higher enzymatic activity of ervatamin-A, which can be explained from the three-dimensional structure of the enzyme and in the context of its helix polarizibility and active site plasticity. Simple and efficient expression and purification procedure to obtain a yield of active recombinant papain, a plant cysteine protease, which is the highest reported so far for any recombinant plant cysteine protease, was developed. A structure-based rational design approach has been used to improve the thermostability of papain, without perturbing its enzymatic activity, by introducing three mutations (K174R, V32S and G36S) at its interdomain region. A double (K174RV32S) and a triple (K174RV32SG36S) mutant of papain have been generated, of which the triple mutant shows maximum thermostability with the half-life (t(1/2)) extended by 94 min at 60 degrees C and 45 min at 65 degrees C and the temperature of maximum enzymatic activity (T(max)) and 50% maximal activity (T(50)) increased by 15 and 4 degrees C, respectively compared to the wild type (WT).The values of t(1/2) and T(max) for the double mutant lie between those of the WT and the triple mutant. These results have been substantiated by molecular modeling studies.

b. Cell biology and Molecular Biology

Stress related signaling in *Entamoeba histolytica*

Survival strategies of the parasite *Entamoeba histolytica,* the causative agent of amoebic dysentery, are important in the propagation of the disease. We observed that heat stress does not cause cell death but hydrogen peroxide stress induces cell death in the parasite. Investigations also revealed that the only typical MAPK in the Entamoeba genome, identified and characterized earlier by us, was activated by stresses the parasite can withstand but not by lethal stresses. The activation mechanisms of EhMAPK in terms of autophosphorylation and substrate phosphorylation were characterized. Another key protein kinase from *E. histolytica*, a p21 activated Kinase (EhPAK3), was identified and characterized. The EhPAK3 enzyme was localized in the caps of parasite membranes during capping, a process the parasite may use during evasion of the host immune mechanism.

Regulation of mRNA turnover in *Leishmania donovani*

We characterized a multi-domain protein LdCSBP from *Leishmania donovani,* which interacts with RNA containing the (C/A)AUAGAA(G/A) motif in the UTR of S phase specific mRNAs through its unique CCCH-type Zn-finger motifs. This protein possesses RNA endonuclease activity, which is down regulated due to its ubiquitination, suggesting a novel regulatory mechanism of mRNA turnover through the post-translational modification in *Leishmania donovani*.

Cancer Biology: Effects of natural products on the pro-survival signal transduction pathways

We observed that some of the signaling pathways associated with the anti-apoptotic effects of oxidative stress and heat stress were common but there were important divergences in the activation of signaling pathways caused by the two forms of stress. The key controlling element for regulation of survival genes in chronic heat/H_2O_2 stress was found to be p38MAPK. We also observed that Resveratrol, a phytoallexin, when used simultaneously with the stress exposure can impede the anti-apoptotic pathways activated by stress and inhibit the activities of the survival kinases p38MAPK and Akt. We demonstrated that Resveratrol downregulated a survival gene Hsp70 and induced apoptosis in chronic myeloid leukaemia cells K562. The involvement of upstream Akt and ERK1/2 pathways in the transcriptional regulation of Hsp70 were elucidated.

Studies of J-domain containing proteins in mammalian stress response and cell cycle regulatory pathways

Human J-domain containing chaperonin Mrj was shown to be upregulated in mitosis phase of cell cycle implicating its role in mitosis. Interestingly, the protein is dispersed throughout the cell during late mitosis and is localized in the nucleolus during interphase, confirming that the activity of Mrj is regulated by its cell cycle specific expression together with its differential sub cellular localization.

Telomerase regulation and apoptosis induction by the inhibitors of poly (ADP-ribose) polymerase

Inhibitors of poly(ADP-ribose) polymerase (PARP) reduce telomerase activity and induce apoptosis in cultured cells. Reduction of expression of PARP-1 by siRNA increased cellular NAD(+) level, decreased general poly(ADP-ribosyl)ation of proteins and telomerase activity. Telomerase reverse transcriptase (hTERT) was poly(ADP-ribosyl)ated in HeLa cells and such modification was decreased in cells with reduced PARP-1 expression. In addition, the expression of telomerase-associated protein 1 (TEP1/TP1) subunit of human telomerase holoenzyme reduced significantly in PARP-1 knock down HeLa cells.

Huntingtin interacting protein HYPK and HIP1: possible role in HD pathogenesis

HYPK, known to interact with hutingtin (HTT) is characterized to be an "intrinsically unstructured protein", posses chaperone like activity in vitro and in vivo, reduces mutant HTT aggregates and the toxicity in cell model of HD. HIP-1, another HTT interacting protein that interacts with HIPPI is required for translocation of HIPPI into the nucleus from cytoplasm. Nuclear HIPPI then interacts with specific motif present at promoter sequences of capase-1 gene through R393 and regulates expression of caspase-1 and other genes. Among many micro RNA altered in the cell model of HD, down regulated miR-146a targets HTT interacting protein TBP.

Collaborators

a. Internal

Prof. D Mukhopadhyay, Structural Genomics Division, Prof. P.K. Mohanty, Theoretical Condensed Matter Physics, Pros. S. Basak, Chemical Science Division, Prof. Munna Sarkar, Chemical Sciences Division, Prof. D, Bhattacharya, Biophysics Division,
Prof. D. Dasgupta, Biophysics Division

b. External

Dr. K Chaudhuri and her students, Indian Institute of Chemical Biology IICB), Dr. A Lahiri and his student, Calcutta University, Prof. S Dey and his student, Presidency College, Dr. A.K Datta, IICB, Dr. Ranjan Sen, CDFD, Hyderabad, Dr. Jhimli Dasgupta, St Xaviers College, Kolkata

List of publications (2007-till date)

In Journals

2010

1. Banerjee Mustafi S, Chakraborty PK, Raha S (2010) Modulation of Akt and ERK1/2 pathways by resveratrol in chronic myelogenous leukemia (CML) cells results in the downregulation of Hsp70, **PLoS One, 5,** e8719
2. Ghosh AS, Dutta S, Raha S (2010) Hydrogen peroxide-induced apoptosis-like cell death in Entamoeba histolytica, **Parasitol Int., 59,** 166-172**.**
3. Sinha M, Ghose J, Eashita Das E and Bhattacharyya NP (2010) Altered micro RNAs in STHdhQ111/HdhQ111 cells: miR-146a targets TBP, **Biochem Biophys Res Commun,** 396, 742-747
4. Banerjee M, Datta M, Majumder P, Mukhopadhyay D, Bhattacharyya NP (2010) Transcription regulation of caspase-1 by R393 of HIPPI and its molecular partner HIP-1, **Nucleic Acids Res**., 38, 878-892
5. Khamrui S, Majumder S, Dasgupta J, Dattagupta J K, Sen U (2010) Identification of a novel set of scaffolding residues that are instrumental for the inhibitory property of Kunitz (STI) inhibitors, ***Protein Sci.,*** 19, 593-602
6. Khamrui S, Ranjan A, Pani B, Sen R, Sen U (2010) Crystallization and preliminary X-ray analysis of Psu, an inhibitor of the bacterial transcription terminator Rho, **Acta Crystallogr Sect F**, 66, 204-206
7. Khamrui S, Biswas M, Sen U, Dasgupta J (2010) Cloning, overexpression, purification, crystallization and preliminary X-ray analysis of CheY3, a response regulatorthat directly interacts with the flagellar 'switch complex' in Vibrio cholerae, **Acta Crystallogr Sect F**, 66, 944-947
8. Choudhury D, Biswas S, Roy S and Dattagupta JK (2010) Improving thermostability of Papain through structure-based protein engineering, **Protein Engineering, Design and Selection**, 23, 657-667.
9. Dutta S, Ghosh R, Dattagupta JK and Biswas S (2010) Heterologous expression of a thermostable plant cysteine protease in *Escherichia coli* both in soluble and insoluble forms, **Process Biochemistry**, **45**, 1307-1312.

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10. Ghosh U, Giri K, Bhattacharyya NP (2009) Interaction of aurintricarboxylic acid (ATA) with four nucleic acid binding proteins DNase I, RNase A, reverse transcriptase and Taq polymerase, **Spectrochim Acta A Mol Biomol Spectrosc**., 74, 1145-1151
11. Ghosh U, Bhattacharyya NP (2009) Induction of apoptosis by the inhibitors of poly (ADP-ribose) polymerase in HeLa cells, **Mol Cell Biochem**., 320, 15-23
12. Banerjee Mustafi S, Chakraborty PK, Dey RS, Raha S (2009) Heat stress upregulates chaperone heat shock protein 70 and antioxidant manganese superoxide dismutase through reactive oxygen species (ROS), p38MAPK, and Akt.**Cell Stress Chaperones,** 14, 579-589
13. Dey, Sanjib, Banerjee, Paromita and Saha, Partha (2009) Cell cycle specific expression and nucleolar localization of human J-domain containing co-chaperon Mrj. **Mol and Cell Biochem,** 322**,**137-142.
14. Venugopal, V, Datta, A, Bhattacharya, D, Dasgupta, D & Banerjee, R (2009) Structure of cyclophilin from Leishmania donovani bound to cyclosporin at 2.6 A resolution: correlation between structure and thermodynamic data, ***Acta Cryst. D*** 65, 1187-1195
15. Tsai SJ, Sen U, Zhao L, Greenleaf WB, Dasgupta J, Fiorillo E, Orrú V, Bottini N, Chen XS (2009) Crystal structure of the human lymphoid tyrosine phosphatase catalytic domain: insights into redox regulation, **Biochemistry**, 48, 4838-4845

(Work carried out abroad during sabbatical leave)

16. Choudhury D, Roy S, Chakrabarti C, Biswas S and Dattagupta JK (2009) Production and recovery of recombinant pro-papain with high yield, **Phytochemistry,** 70, 465-472

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17. Chakraborty PK, Mustafi SB, Raha S (2008) Pro-survival effects of repetitive low-grade oxidative stress are inhibited by simultaneous exposure to Resveratrol. **Pharmacol. Res.,** 58, 281-289
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19. Bhattacharyya NP (2008) Huntington's disease: a monogenic disorder with cellular and biochemical complexities, **FEBS J.** 275, 4251.
20. Bhattacharyya NP**,** Banerjee M, Majumder P (2008) Huntington's disease: roles of huntingtin-interacting protein 1 (HIP-1) and its molecular partner HIPPI in the regulation of apoptosis and transcription, **FEBS J,** 275, 4271-4279
21. Raychaudhuri S, Sinha M, Mukhopadhyay D, Bhattacharyya NP (2008) HYPK, a Huntingtin interacting protein, reduces aggregates and apoptosis induced by N-terminal Huntingtin with 40 glutamines in Neuro2a cells and exhibits chaperone-like activity, **Hum Mol Genet., 17**, 240-255.
22. Holden LG, Prochnow C, Chang YP, Bransteitter R, Chelico L, Sen U, Stevens RC, Goodman MF, Chen XS. (2008) Crystal structure of the anti-viral APOBEC3G catalytic domain and functional implications, **Nature**, 456, 121-124.

(Work carried out abroad during sabbatical leave)

23. Ghosh R, Chakraborty S, Chakrabarti C, Dattagupta JK and Biswas S (2008) Structural insight into the substrate specificity and activity of Ervatamins: the papain-like cysteine proteases from a tropical plant *Ervatamia coronaria*, **FEBS Journal**, 275, 421-434
24. Raka Ghosh and Chandana Chakrabarti (2008) Crystal structure analysis of NP24-I: a thaumatin-like protein, **Planta,** 228, 883-890
25. Jhimli Dasgupta and Jiban K Dattagupta (2008) Structural Determinants of V. cholerae CheYs that Discriminate Them in FliM binding: Comparative Modeling and MD Simulation Studies. Journal of Biomolecular Structure and Dynamics, 25, 495-504

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26. Dutta S, Sardar A, Ray D, Raha S (2007) Molecular and functional characterization of EhPAK3, a p21 activated kinase from Entamoeba histolytica. **Gene, 402, 57-67**
27. Raychaudhuri S, Majumder P, Sarkar S, Giri K, Mukhopadhyay D, Bhattacharyya NP (2007) Huntingtin interacting protein HYPK is intrinsically unstructured, **Proteins. 71**, 1686-1698
28. Majumder P, Raychaudhuri S, Chattopadhyay B, Bhattacharyya NP (2007) Increased caspase-2, calpain activations and decreased mitochondrial complex II activity in cells expressing exogenous huntingtin exon 1 containing CAG repeat in the pathogenic range, **Cell Mol Neurobiol. 27**, 1127-1145
29. Majumder P, Choudhury A, Banerjee M, Lahiri A, Bhattacharyya NP (2007) Interactions of HIPPI, a molecular partner of Huntingtin interacting protein HIP1, with the specific motif present at the putative promoter sequence of the caspase-1, caspase-8 and caspase-10 genes. ***FEBS J.*** **274**, 3886-3899.
30. Majumder P, Chattopadhyay B, Sukanya S, Ray T, Banerjee M, Mukhopadhyay D, Bhattacharyya NP (2007) Interaction of HIPPI with putative promoter sequence of caspase-1 in vitro and in vivo. **Biochem Biophys Res Commun** , 353, 80-85.
31. Roychoudhury P, Pandit B., Pathak R, Chaudhuri K., Bhattacharyya NP (2007) Increased expression of genes in a radioresistant cell strain: modulation of hnRNP E2, Hsp90 and SSBP2 genes in γ-irradiated Chinese hamster V79 cells, **Int. J Low Radiation**, 4, 313-331
32. Pathak R, Khuda Bukhsh AR, Dey SK, Ghosh U, Sen Gupta B, Semwal M and Bhattacharyya NP (2007) Resistance to induction of micronuclei, chromosomal aberrations and apoptosis by 60Co gamma radiation in a cell strain derived from Chinese hamster V79 cells, **Journal of Radioanalytical and Nuclear Chemistry,** 274, 441-447

33. Ghosh U, Das N, Bhattacharyya NP (2007) Inhibition of telomerase activity by reduction of poly (ADP-ribosyl)ation of TERT and TEP1/TP1 expression in HeLa cells with knocked down poly(ADP-ribose) polymerase-1 (PARP-1) gene. **Mutat Res.** 615, 66-74
34. Venugopal, V., Sen, B., Datta, A.K. and Banerjee, R. (2007) Structure of cyclophilin from *Leishmania donovani* at 1.97 Å resolution, ***Acta Cryst.*** **F 63**, 60 - 64.
35. Sen. B., Venugopal, V., Chakrabarty, A., Datta, R., Dolai, S., Banerjee, R. and Datta, A.K. (2007) Amino acid residues of *Leishmania donovani* cyclophilin key to interaction with its adenosine kinase: biological implications, **Biochemistry,** 46, 7832 -7843.
36. Bhandari, Dipankar & Saha, Partha (2007) mRNAcycling sequence binding protein from Leishmania donovani (LdCSBP) is covalently modified by ubiquitination, **FEMS Microbiol Lett,** 273**,** 206–213
37. Ghosh R, Dattagupta JK and Biswas S (2007) A thermostable cysteine protease precursor from a tropical plant contains an unusual C-terminal propeptide: cDNA cloning, sequence comparison and molecular modeling studies, **Biochem Biophys Res Commun,** 62, 965-970.

In Monograph/Books

Banerjee, R (2008) Buddha and the Bridging Relations, Progress in Brain Research 168, 215-246

Raychaudhuri S, De S. Roy K, Mukhopadhyay D, Bhattacharyya NP (2007), Intrinsically disordered proteinsin Huntington's disease: studies on Huntingtin interacting protein HYPK as a model protein. **In Perspectives in Cytology and Genetics, Volume XIII (eds Giri AK, Ghosh PD and Mukherjee A**) All India Congress of Cytology and Genetics, PP125-132

Bhattacharyya NP Datta M, Banerjee M, Das S, Mukhopadhya S (2010) Huntingtin Interacting Proteins: Involvement in Diverse Molecular Functions, Biological Processes and Pathways, In **"Huntington's Disease: Etiology and Symptoms, Diagnosis and Treatment"** (Ed Editors: Thomas J. Visser**),** Nova Science Publishers, Hauppauge NY 11788-3619, USA (In Press)

Book Edited

Models of Brain and Mind, (Eds. R. Banerjee and B. K. Chakrabarti), Progress in Brain Research, Vol. 168, Elsevier, Amsterdam (2008)

1. Name: Nitai P. Bhattacharyya, Ph. D

Crystallography and Molecular Biology Division, Saha Institute of Nuclear Physics, Kolkata

2. a. Academic Profile

Degree/ Position	Year	University/Institution
Head, C&MB Division	2007 -till date	Saha Institute of Nuclear Physics (SINP), Calcutta
Professor (SG)	2006- till date	SINP
Professor (SF)	2002-2006	SINP
Associate Professor	1998-2002	SINP
Reader	1994-1998	SINP
Research Associate	1992-1994	University of Utah, U. S.A
Research Associate	1991-1992	Imperial Cancer Research Fund, London
Visiting fellow	1989-1991	SINP
Research Associate	1986-1989	Michigan State University, U. S. A.
Ph.D.	1986	Calcutta University

Teaching experiences: Post M.Sc. (Biophysical Sciences) at SINP and Bioinformatics, Genomics and proteomics in Calcutta University (Biotechnology), West Bengal University of Technology, and Kalyani University, NEHU

Number of students awarded Ph.D**.:** 8, Number of students working for Ph.D.: 6

Numbers of papers in peered reviewed journal 75 and in Monograph: 20

2.b. Awards: None

3. Essential strength of research/development output

Genetics and various aspects of biology of human genetic diseases are the essential strength of my research. I actively collaborated with Neurologists from Kolkata and also from different parts of India for studying neurodegenerative diseases caused by the expansion of triplet repeats. These diseases include Myotonic dystrophy (DM), Huntington's disease (HD), Spinocerebellar ataxia subtypes 1 (SCA1), -2 (SCA2), -3 (SCA3), -6 (SCA6), -7 (SCA7), -8 (SCA8), -12 (SCA12), -17 (SCA17), Dentatorubral-pallidoluysian atrophy (DRPLA) and Friedreich's Ataxia (FRDA). Detection of mutations in patients, polymorphic markers linked with the mutations together with variations of repeats and linked markers in diverse normal populations of India provided information on the origin of mutation and probable prevalence of the diseases in eastern India. Subsequently, we identified that HIPPI a molecular partner of Huntingtin (HTT, whose mutation causes HD) interacting protein HIP1, regulates expression of genes, explaining some proportion of altered genes observed in HD. Regulation of genes in HD by short non-coding RNA, known as micro RNA, is recently shown by us. In addition, we observe that HYPK, a HTT interacting protein, is intrinsically unstructured, posses chaperone like activity and reduce mutant HTT aggregates. This novel finding may lead to the possible intervention of the devastating HD, for which presently no treatment is available.

4. Future research/development plan

During next few years, I wish to concentrate on the mechanisms of deregulation of genes in HD using various cell models and high throughput "next generation DNA sequencer". This sequencer allows sequencing of RNA including short RNA. Digitised counts of the reads in such sequencing approach would provide differential expressions of coding and non-coding RNA. Chromatin immunoprecipitation followed by sequencing (popularly known as ChiP-Seq) is expected to reveal genome wide regulation of coding genes as well as micro RNA genes by HIPPI. Combinatorial regulation of genes by HIPPI and other transcription factors (TF), HIPPI and micro RNA will be studied by data mining and experimental approaches. Experimental and bioinformatics approach will be made to determine pathway-pathway, miRNA-miRNA, and miRNA-TF interactions in collaboration with faculty of the Institute. Experimental determination of targets of micro RNA is the most challenging task in micro RNA biology. Various low throughput as well as high throughput approach will be made

to determine the targets of the micro RNAs altered in cell and animal models of HD, as shown by us recently. Role(s) of the altered micro RNA in regulating diverse biological processes will also be studied. Identification of interacting partners of HYPK, validations and identification of their role in HD pathogenesis will be continued.

5. List of important publications starting with recent publications

1. Sinha M, Ghose J, Eashita Das E and Bhattacharyya NP (2010) Altered micro RNAs in STHdhQ111/HdhQ111 cells: miR-146a targets TBP, **BBRC** (accepted for publication)
2. Banerjee M, Datta M, Majumder P, Mukhopadhyay D, Bhattacharyya NP (2010) Transcription regulation of caspase-1 by R393 of HIPPI and its molecular partner HIP-1, **Nucleic Acids Res**. 38, 878-892
3. Raychaudhuri S, Sinha M, Mukhopadhyay D, Bhattacharyya NP (2008) HYPK, a Huntingtin interacting protein, reduces aggregates and apoptosis induced by N-terminal Huntingtin with 40 glutamines in Neuro2a cells and exhibits chaperone-like activity, **Hum Mol Genet. 17**, 240-255.
4. Bhattacharyya NP, Banerjee M, Majumder P (2008) Huntington's disease: roles of huntingtin-interacting protein 1 (HIP-1) and its molecular partner HIPPI in the regulation of apoptosis and transcription, **FEBS J,** 275, 4271-4279 (Invited review)
5. Majumder P, Chattopadhyay B, Mazumder A, Das P, Bhattacharyya NP (2006). Induction of apoptosis in cells expressing exogenous Hippi, a molecular partner of huntingtin-interacting protein Hip1.**Neurobiol Dis**. 22, 242-56.
6. Chattopadhyay, B., Gangopadhyay, PK, Das SK, Roy T, Sinha SK, Jha DK, Mukherjee SC, Chakraborty, A, Singhal BS, Bhattacharya, AK and Bhattacharyya N.P (2003) Modulation of age of onset in Huntington's disease and spinocerebellar ataxia type 2 patients originated from eastern India, **Neuroscience Letters**, 345, 393-396
7. Basu P., Majumder P. P., Roychoudhury S. and Bhattacharyya N.P. (2001) Haplotype analysis of genomic polymorphisms in and around the myotonic dystrophy locus in diverse populations of India, **Human Genetics, 108, 310-317**
8. Basu P., Chattopadhyay B., Gangopadhaya P.K Mukherjee S.C., Sinha K.K., Das.S.K., Roychoudhury S. and Majumder P. P. and Bhattacharyya N.P**.** (2000) Analysis of CAG repeats in SCA1, SCA2, SCA3, SCA6, SCA7 and DRPLA loci among spinocerebellar ataxia patients and distribution of CAG repeats at the SCA2 and SCA6 loci in nine ethnic populations of eastern India, **Human Genetics**, 106, 597-604
9. Pramanik S**.** Basu P., Gangopadhaya P.K., Sinha K. K., Jha D.K., Sinha S., Das S.K., Maiti B. K., Mukherjee S.C., Roychoudhury S. and Majumder P. P. and Bhattacharyya N.P (2000) Analysis of CAG and CCG repeats in *Huntingtin* gene among HD patients and normal populations of India, **European Journal of Human Genetics**, 8, 678-682
10. Bhattacharyya, N.P., Basu P., Das M., Pramanik S., Banerjee S., Roy B. Roychoudhury S. and Majumder P. P. (1999) Negligible male gene-flow across ethnic boundaries in India, revealed by analysis of Y-chromosomal DNA polymorphisms. **Genome Research, 9,** 711 – 719
11. Bhattacharyya, N. P., Skandalis, A., Ganesh, A., Groden, J. and Meuth, M. (1994) Mutator phenotypes in human colorectal carcinoma cell lines, **Proc. Natl. Acad. Sci. USA,** 91, 6319-6323

Name : Chandana Chakrabarti (SINP ID : 219)
Date of birth : March 22, 1951
Ph.D. : Calcutta University (1984)
Present position : Professor "G" (since 2006) at Crystallography and Molecular Biology Division, SINP
Date of joining as a permanent member : November 1, 1989

Teaching and Research guidance

Teaching in the Post M.Sc. (Biophysical Sciences) program of SINP, including laboratory courses.

Other academic Activities :

External examiner of a Ph.D. thesis at IISc, Bangalore in 2010. Supervisor of five review papers submitted by post M.Sc students at SINP. Guidance to students doing summer projects in the Division.

Research guidance : Guidance to four Ph.D. students (awarded Ph.D. in 2001, 2005, 2009 and 2009 resp.).

Career profile

At SINP	Position	Field of work
1976-1984	RF	Crystal structures of small drugs (including Chloromycetin) and related molecules by X-ray crystallographic methods.
1984-1987	RA	Crystal structure analyses of molecular complexes of sulfa drugs, structure-function relationship. Assembly of a 4-ciurcle single-crystal diffractometer.
1987-1989	Pool Officer	Crystallization of protein molecules and structure analyses.
1989-1990	Scientist 'SB'	Protein Crystallography and diffractometry.
1990-1993	Lecturer 'SC'	Structure of biologically important molecules and Protein Crystallography.
1993-1996	Reader 'SD'	Protein structure determination and refinement of an inhibitor protein, crystallization of proteins.
1997-2001	Associate Professor 'E'	Structure-function correlation and cryocrystallography of the inhibitor protein, mutant structures, thiol protease project initiated, purification and crystallization of a transferrin protein.

At Biochemistry Department, Stockholm University, Sweden

May 2000-Jan., 2001	Visiting Scientist	Isolation, purification and expression of a bacterial protein, crystallization and refinement of ribonucleotide reductase proteins.

At SINP

2001- 2006	Professor 'F'	Thiol protease structures, modelling studies, isolation and purification of proteins from plant sources.
2006-onwards	Professor 'G'	Crystal structure of a thaumatin-like protein. Isolation and purification of plant cyclophilin-like proteins. Crystallization of a modified variant of recombinant pro-papain for crystal structure analysis.

Research highlights

I started my research career with the determination of crystal structures of small biologically important molecules and participated in the assembly of a 4-circle, single-crystal diffractometer in our laboratory for data collection. When our laboratory was converted to a macromolecular crystallography one, I actively participated in its development. My expertise is on the crystallization of proteins and their structure determination. I contributed significantly to the following macromolecular projects : I started with the first protein undertaken by us (WCI) and its mutants - to understand the importance of a conserved Asn residue. Then I worked on some cysteine proteases - the ervatamins. All these structures were determined at high resolution. Amino acid sequences of two ervatamins could be determined from our structures. Kinetic and molecular simulation studies were also done on these proteins to study the structure-function relationship of this class of proteins.

Future plans : I have crystallized a knock out stable mutant of pro-papain and am trying to produce diffraction quality crystals for structure determination, to explain certain interesting features expected from it.

I initiated a project on some plant antifungal (the thaumatin-like and cyclophilin-like) proteins. I have already determined the crystal structure of one such protein and some others have been isolated. This ongoing project is aimed at making a comparative analysis amongst the thaumatin-like proteins and also determining the 3-D structures of the cyclophilin-like proteins, as the structures of such plant antifungal proteins are yet unknown.

Selected publications

1. Debi Choudhury, Sumana Roy, Chandana Chakrabarti, Sampa Biswas and J. K. Dattagupta.(2009). Production and recovery of recombinant propapain with high yield. Phytochemistry, 70, 465-472.

2. Raka Ghosh and Chandana Chakrabarti (2008). Crystal structure analysis of NP24-I : a thaumatin-like protein. Planta, 228, 883-890.

3. Raka Ghosh, Sibani Chakraborty, Chandana Chakrabarti, Jiban Kanti Dattagupta and Sampa Biswas (2008). Structural insights into the substrate specificity and activity of ervatamins, the papain-like cysteine proteases from a tropical plant, *Ervatamia coronaria*. FEBS Journal, 275, 421-434.

4. Guha Thakurta, Piyali, Biswas, Sampa, Chakrabarti, Chandana, Sundd, Monica, Jagannadham, M. V. and Dattagupta, J.K. (2004). Structural Basis of the Unusual Stability and Substrate Specificity of Ervatamin C, a Plant Cysteine Protease from *Ervatamnia coronaria*. Biochemistry 43, 1532-1540.

5. Biswas, Sampa, Chakrabarti, Chandana, Suman Kundu, Medicherla, V. Jagannadham and Dattagupta, J.K. (2003). Proposed Amino Acid Sequence and the 1.63 A X-Ray Crystal Structure of a Plant Cysteine Protease, Ervatamin B : Some Insights Into the Structural Basis of Its Stability and Substrate Specificity. PROTEINS: Structure, Function, and Genetics, 51, 489-497.

6. S. Ravichandran, J. Dasgupta, C. Chakrabarti, S. Ghosh, M. Singh and J. K. Dattagupta (2001). The role of Asn14 in the stability and conformation of the reactive-site loop of winged bean chymotrypsin inhibitor : Crystal structures of two point mutants. Protein Engineering, 14(5), 349-347.

7. S. Ravichandran, U. Sen, C. Chakrabarti and Dattagupta, J.K. (1999). Cryocrystallography of a Kunitz-type serine protease inhibitor : The 90 K structure of winged bean chymotrypsin inhibitor (WCI) at 2.13 Å resolution. Acta Crystallographica D55, 1814-1821.

8. Dattagupta, Jiban K., Podder, Aloka, Chakrabarti, Chandana, Sen, Udayaditya, Mukhopadhyay, Debashis, Dutta, Samir K. and Singh, Manoranjan (1999). Refined Crystal Structure (2.3 Å) of a Double-Headed Winged Bean α-Chymotrypsin Inhibitor and Location of Its Second Reactive Site. PROTEINS : Structure, Function, and Genetics, 35(3), 321-331.

9. Dattagupta, Jiban K., Podder, Aloka, Chakrabarti, Chandana, Udayaditya Sen, Dutta, Samir K. and Singh, Manoranjan (1996). Structure of a Kunitz-type chymotrypsin inhibitor from winged bean seeds at 2.95 Å resolution. Acta Cryst. D52, 521-528.

10. Dattagupta, Jiban K., Chakrabarti, Chandana, Podder, Aloka, Dutta, Samir K. and Singh, M.(1990). Crystallization and Preliminary X-ray Studies of Psophocarpin B_1, a Chymotrypsin Inhibitor from Winged Bean Seeds. J. Mol. Biol. 216, 229-231.

Name: Sanghamitra (Roy)Raha

Education: B.Sc.(Hons.) Presidency College, Calcutta University,
Master's degree, College of Natural Sciences, University of Texas at Austin, USA. Doctoral degree in Human Biology (Biochemistry),Department of Human Medicine, Philipps University, Marburg, Germany, awarded 1984. Awards: National Science Talent Search Fellowship,NCERT, Govt.of India. Member, Academic Honour Society Phi Kappa Phi,USA.

Academic Profile:
Post-Doctoral: Univ. of Marburg, 1984. CSIR Pool Officer-Calcutta University (Biochemistry) and Indian Institute of Chemical Biology, Kolkata, 1985-1986. Fellow, Fondation pour la Recherche Medicale, INSERM,Paris,France and Visiting Scientist-Univ. of Marburg, Germany, 1986-1987,Univ. of Marburg, Germany 1989. Research Associate-University of Virginia, Charlottesville, USA, 1990-1991. CSIR Pool Officer and Senior Research Associate - Calcutta University (Biophysics)1992-1993, Awards: Fellow, Fondation pour la Recherche Medicale, France.

Essential Strength of research output:
Earlier work: I started out as a biochemist/cell biologist and during my pre-doctoral research I pursued two research projects on developmental aspects in the brain and bone marrow/blood. First part of my post-doctoral experience also involved developmental aspects of bone marrow cells. The latter part of post-doctoral research introduced me to the then nascent field of "Signal Transduction" in human blood platelets and in *Entamoeba histolytica*, a pathogen and causative agent of amoebic dysentery.
Since joining SINP in 1994: After joining SINP in 1994, I endeavoured to be active in the then rapidly growing field of signal Transduction and focussed on the signalling pathways associated with various stress responses in both higher and lower eukaryotes(mammalian cells and unicellular pathogen *Entamoeba*).
Time period 1995-1999-along with my PhD students, I showed tyrosine protein kinase and serine /threonine protein kinase activities and uncovered specific changes in the protein phosphorylation patterns during serum starvation stress in *Entamoeba*
(Funding from a CSIR project). We also studied calcium signalling and anti-oxidant defense mechanisms in chronically stressed fibroblasts. **Time period 2000-2007-** initially a chronic stress model in cultured fibroblasts was established. The chronically stressed cells were found to have a survival advantage over their unstressed counterparts as they were resistant to apoptosis in the face of a subsequent stronger stress. We discovered that several survival genes such as Bcl-2, catalase, Hsp70, and MnSOD were upregulated by chronic hydrogen peroxide or heat stress. The signal transduction pathways which were activated upstream of survival gene expression were p38MAPK, Akt, NF kB. We also established that Epigallocatechin gallate (EGCG), a component of green tea and Resveratrol, a phytoalexin from grapes, on simultaneous exposure with chronic stress blocked the anti-apoptotic effects of chronic stress. The exact modes of action of these two compounds were also elucidated. (Funding from a DST project).**Time period 2007-till date**-We extended our study on the anti-cancer properties of the natural product Resveratrol. We demonstrated that Resveratrol downregulated a survival gene Hsp70 in chronic myeloid leukaemia cells along with an induction in apoptotic cell death. The involvement of upstream Akt and ERK1/2 pathways in the transcriptional regulation of Hsp70 were elucidated. **Time period 2002-till date** –we investigated the signalling mechanisms associated with various stresses in *Entamoeba* . We uncovered the apoptosis like death mechanisms in this unicellular eukaryote. Our investigations also revealed that the only typical MAPK in the Entamoeba genome (identified

and characterized by us)was activated by stresses the parasite can withstand but not by lethal stresses.

Future Plans

1) In continuation of our previous studies of survival associated genes in chronic stress conditions and cancer , we are planning to examine different types of cancer cell lines along with chronically stressed normal cells. Our cellular targets include various survival pathways such as the beta-catenin pathway and the expression of oncogenes controlled by these pathways. We will identify the specific survival pathways such as heat shock proteins, beata-catenin etc. upregulated in various cancer types and chronically stressed cells and elucidate the effects of natural products originating from indigenous sources (mango, ginger, garlic etc.) on the different survival pathways overactive in specific cancer / chronic stress cell types.

Selected Publications

1. Banerjee Mustafi S, Chakraborty PK, Raha S. Modulation of Akt and ERK1/2 pathways by resveratrol in chronic myelogenous leukemia (CML) cells results in the downregulation of Hsp70. PLoS One. 2010 5(1):e8719.
2. Ghosh AS, Dutta S, Raha S. Hydrogen peroxide-induced apoptosis-like cell death in Entamoeba histolytica.Parasitol Int. 2010 59(2):166-72.
3. Banerjee Mustafi S, Chakraborty PK, Dey RS, Raha S. Heat stress upregulates chaperone heat shock protein 70 and antioxidant manganese superoxide dismutase through reactive oxygen species (ROS), p38MAPK, and Akt. Cell Stress Chaperones. 2009 14(6):579-89.
4. Chakraborty PK, Mustafi SB, Raha S. Pro-survival effects of repetitive low-grade oxidative stress are inhibited by simultaneous exposure to Resveratrol.Pharmacol Res. 2008 58(5-6):281-9.
5. Chakraborty PK, Mustafi SB, Ganguly S, Chatterjee M, Raha S.Resveratrol induces apoptosis in K562 (chronic myelogenous leukemia) cells by targeting a key survival protein, heat shock protein 70.Cancer Sci. 2008 99(6):1109-16.
6. Dutta S, Sardar A, Ray D, Raha S. Molecular and functional characterization of EhPAK3, a p21 activated kinase from Entamoeba histolytica.Gene. 2007;402(1-2):57-67.
7. Sen P, Chakraborty PK, Raha S.Tea polyphenol epigallocatechin 3-gallate impedes the anti-apoptotic effects of low-grade repetitive stress through inhibition of Akt and NFkappaB survival pathways. FEBS Lett. 2006 580(1):278-84.
8. Sen P, Chakraborty PK, Raha S. p38 mitogen-activated protein kinase (p38MAPK) upregulates catalase levels in response to low dose H2O2 treatment through enhancement of mRNA stability.FEBS Lett. 2005 15;579(20):4402-6.
9. Ray D, Dutta S, Banerjee S, Banerjee R, Raha S. Identification, structure, and phylogenetic relationships of a mitogen-activated protein kinase homologue from the parasitic protist Entamoeba histolytica.Gene. 2005 14;346:41-50.
10. Sen P, Mukherjee S, Ray D, Raha S. Involvement of the Akt/PKB signaling pathway with disease processes.Mol Cell Biochem. 2003 253(1-2):241-6. Review.
11. Sen P, Mukherjee S, Bhaumik G, Das P, Ganguly S, Choudhury N, Raha S. Enhancement of catalase activity by repetitive low-grade H2O2 exposures protects fibroblasts from subsequent stress-induced apoptosis.Mutat Res. 2003 28;529(1-2):87-94.
12. Gear AR, Suttitanamongkol S, Viisoreanu D, Polanowska-Grabowska RK, Raha S, Camerini D. Adenosine diphosphate strongly potentiates the ability of the chemokines MDC, TARC, and SDF-1 to stimulate platelet function.Blood. 2001 97(4):937-44.
13.Chaudhuri S, Choudhury N, Raha S. Growth stimulation by serum in Entamoeba histolytica is associated with protein tyrosine dephosphorylation. FEMS Microbiol Lett. 1999 15;178(2):241-9.
14. Raha S, Giri B, Bhattacharyya B, Biswas BB.Inositol(1,3,4,5) tetrakisphosphate plays an important role in calcium mobilization from Entamoeba histolytica. FEBS Lett. 1995 362(3):316-8.
15. Raha S, Jones GD, Gear AR..Sub-second oscillations of inositol 1,4,5-trisphosphate and inositol 1,3,4,5-tetrakisphosphate during platelet activation by ADP and thrombin: lack of correlation with calcium kinetics. Biochem J. 1993 292 (Pt 3):643-6.

Name : Rahul Banerjee

Date of Birth : 22.03.1965

Present Position : Professor 'F'

Academic Qualifications :

a) B.Sc.	Delhi University	1986	Physics(Hons)	76.2%
b) M.Sc.	Indian Institute of Technology (Madras)	1988	Physics	9.01
c) GATE		1988	Physics	99.82
d) UGC/Joint CSIR_UGC		1989	Life Sciences	JRF
e) PhD	Indian Institute Science of (Bangalore)	1994	Protein Crystallography	

Research Output: The work carried out in our laboratory can be discussed under the following heads – 1. Structural studies using x-ray crystallography of potential drug targets from pathogenic organisms. 2. Analysis of side chain packing within proteins. 3. Electroencephalographic (EEG) studies of different meditative techniques. 4. Studies on plant signaling and memory. The greatest strength of our laboratory remains in the use x – ray crystallography to solve the three dimensional crystal structures of relevant proteins from pathogenic organisms and implementation of computational methods to analyze packing modes within proteins. The crystal structure of cyclophilin from *L. donovani* has been solved complexed with the drug cyclosporine. In addition several other proteins are currently undergoing crystallization trials for structural studies. Computational approaches analyzing side chain packing motifs within proteins is also nearing completion. The inclusion of the last two topics as research programs has been fairly recent. An EEG study of a Buddhist meditative technique has just been completed. Experimental work characterizing the time course in the expression of heat shock proteins under repetitive heat and arsenic stress has also been communicated. Prof. Sanghamitra Raha has been the principal investigator in this project.

Future Developments : A series of proteins have been identified for structural studies using x-ray crystallography (Adenosine Kinase : *L. donovani* ; Aldose Reductase : *L.*

donovani ; vacuolar protein sorting 29 : *P falciparum* ; Uvrd1 : *M. Smegmatis* ; Ku : *M. Smegmatis*). In collaboration with Prof. Partha Saha , selected proteins from the genome of *L. donovani* will be cloned for x-ray studies. Till now only static geometrical aspects of atomic packing within proteins have been investigated. In the next phase, dynamical features of protein contact networks will be studied. Concerning the work on Indian meditative techniques, manuals will be written from classical sources documenting first – person techniques. EEG record of subjects will then be taken performing specific meditative methods in an attempt to characterize different conscious states. Lastly , 'priming' is a technique adopted in plants , wherein pre – treatment of seeds and plants enables them to effectively withstand future biotic and abiotic stresses. All forms of priming involve plant memory. An attempt will be made to elucidate the signaling pathways involved in priming and also develop priming protocols to enhance crop productivity (in field trials) under abiotic stress.

List of Selected Publications :

1. Venugopal, V, Datta, A, Bhattacharya, D, Dasgupta, D & Banerjee, R Accepted for publication in *Acta Cryst. D* (2009) Structure of cyclophilin from Leishmania donovani bound to cyclosporin at 2.6 A resolution: correlation between structure and thermodynamic data.

2. The candidate is both an Editor and a Contributor :
Banerjee, R. Buddha and the Bridging Relations
Progress in Brain Research Volume 168 (2008) , Elsevier Amsterdam.

3. Sen. B., Venugopal, V., Chakrabarty, A., Datta, R., Dolai, S., Banerjee, R. and Datta, A.K. *Biochemistry* (2007) 46(26) , 7832 - 43. Amino acid residues of *Leishmania donovani* cyclophilin key to interaction with its adenosine kinase: biological implications.

4. Banerjee, R., Sen, M., Bhattacharya, D. & Saha, P. *J. Mol. Biol.* (2003) 333, 211 – 226. The jigsaw puzzle model : search for conformational specificity in protein interiors.

5. Dutta, M., Delhi, P., Sinha, K. M., Banerjee, R. & Datta , A. K. *J. Biol. Chem.* (2001) 276 (22), 19294 – 19300. Lack of abundance of cytoplasmic – cyclosporin A – binding protein renders free living *Leishmania donovani* resistant to cyclosporin A.

6. Banerjee, R., Das, K., Ravishankar, R., Suguna, K., Surolia, A., Vijayan. M. *J. Mol. Biol.* (1996) 259, 281 – 296. Conformation, protein – carbohydrate interactions and a novel subunit association in the refined structure of peanut lectin – lactose complex.

7. Banerjee, R., Mande, S.C., Ganesh, V., Das, K., Dhanaraj, V., Mahanta, S. K., Suguna, K., Surolia, A. & Vijayan. M. *Proc. Natl. Acad. Sci. USA* (1994), 91, 227 – 231. Crystal structure of peanut lectin, a protein with an unusual quaternary structure.

Prof. Udayaditya Sen

Crystallography and Molecular Biology Division

udayaditya.sen@saha.ac.in

M. Sc. in Physical Chemistry (1990) Burdwan University

Ph. D. in Chemistry (1999) Saha Institute of Nuclear Physics

Postdoctoral research (1998-2000): The Scripps Research Institute, California, USA

Joined Saha Institute of Nuclear Physics as a Reader in 2000

Postdoctoral research (2006-2007): University of Southern California, California, USA

My basic research interest is structure function relationship of different biologically important proteins using X-ray crystallographic method. For that, we clone, over-express and purify the proteins of interest, crystallize it and perform X-ray diffraction experiments and solve the structure. The structural results obtained from X-ray crystallography are used in combination with structure based protein engineering, different biochemical and biophysical methods of functional/structural assay and database analysis to decipher their structure function relationship and if needed to modify the function. For the last few years I worked on serine protease inhibitor-enzyme interactions aiming to identify the key structural elements required to explain the high inhibitory power exhibited by these inhibitors. The results are useful for effective design of protese inhibitors.

Recently I am switching my focus towards different pathogenic bacterial proteins. Initially I have targeted the proteins that are involved in different important pathways of the bacterial machinery. This includes proteins involved in their transcription e.g. NusG, Rho and Yae; signal transduction e.g. Tyrosine Phosphatases, Histidine phosphatases, acetyl phosphatases; Sugar binding proteins involved in pentose phosphate pathways, ABC transporters e.g. Ribokinase. So far I was working with in-house x-ray source, but now for some of the targeted proteins and trapping reaction intermediates, synchrotron facility is to be needed.

Selected Publications:

1. Khamrui S, Majumder S, Dasgupta J, K Dattagupta J, **Sen U**. (2010) Identification of a novel set of scaffolding residues that are instrumental for the inhibitory property of Kunitz (STI) inhibitors. ***Protein Sci.*** 19(3):593-602.

2. Tsai SJ, **Sen U**, Zhao L, Greenleaf WB, Dasgupta J, Fiorillo E, Orrú V, Bottini N, Chen XS.(2009) Crystal structure of the human lymphoid tyrosine phosphatase catalytic domain: insights into redox regulation. ***Biochemistry. 48(22):***4838-45.

3. Holden LG, Prochnow C, Chang YP, Bransteitter R, Chelico L, **Sen U**, Stevens RC, Goodman MF, Chen XS. (2008) Crystal structure of the anti-viral APOBEC3G catalytic domain and functional implications. ***Nature, 456(7218)***:121-4. Epub 2008Oct 12.

4. Jhimli Dasgupta, Susmita Khamrui, Jiban K Dattagupta and **Udayaditya Sen**. (2006) Spacer Asn determines the fate of Kunitz (STI) inhibitors, as revealed by the structural and biochemical studies on WCI mutants. ***Biochemistry, 45(22):***6783-92.

5. Susmita Khamrui, Jhimli Dasgupta, Jiban K Dattagupta and **Udayaditya Sen** (2005) Single mutation at P1 of a chymotrypsin inhibitor changes it to a trypsin inhibitor: X-ray structural (2.15 Å) and biochemical basis. ***Biochimica et Biophysica Acta-proteins and proteomics***, ***1752***: 65-72

6. **Udayaditya Sen**, Jhimli Dasgupta, Debi Choudhury, Poppy Datta, Abhijit Chakrabarti, Sudipa Basu Chakrabarty, Amit Chakrabarty and Jiban K Dattagupta, (2004) Crystal structures of HbA_2 and HbE and modeling of Hemoglobin δ_4: interpretations of the thermal stability and the antisickling effect of HbA_2. ***Biochemistry*** **43(39)**, 12477-88.

7. Jhimli Dasgupta, **Udayaditya Sen** and J.K.Dattagupta (2003) *In-silico* mutations and molecular dynamics studies on a Winged bean Chymotrypsin Inhibitor protein. ***Protein Engineering, 16(7*)**, 489-96.

8. **Udayaditya Sen**, Sona Vasudevan, Gowtham Subbarao, Richard A. McClintock, Reha Celikel, Zaverio M. Ruggeri and Kottayil I. Varughese, (2001) Crystal Structure of the von Willebrand Factor Modulator Botrocetin***. Biochemistry***, **40(2)**, 345-52.

9. Zapf J*, **Sen U.***, Madhusudan, Hoch J. A and Varughese K. I. (2000) A transient interaction between two phosphorelay proteins trapped in a crystal lattice reveals the mechanism of molecular recognition and phosphotransfer in signal transduction. ***Structure Fold Des***. **8(8)**, 851-62.

10. Dattagupta JK, Podder A, Chakrabarti C, Sen U, Mukhopadhyay D, Dutta Samir K and Singh M., (1999) Refined Crystal Structure (2.3 Å) of a Double-Headed Winged Bean α-Chymotrypsin Inhibitor and Location of Its Second Reactive Site. ***Proteins: Structure, Function and Genetics,***35(3), 321-331.

Name:

Dr. Sampa Biswas
(SINP ID: 223)
Ph.D Calcutta University (1996).
Professor at Crystallography & Mol. Biology Division,
Saha Institute of Nuclear Physics, Kolkata.

Academic Profile:

1989-1994: CSIR JRF/SRF, Bose Institute, Kolkata.
1995-1996: CSIR RA, Central Drug Research Institute, Lucknow.
1996-1997: RA, SINP.
1997-2000: Scientist C, SINP.
2000-2004: Scientist D, SINP.
2004-2007: Associate Professor E, SINP.
2007- : Professor F, SINP.

Teaching:

1. Post-M.Sc (Biophysical Science) teaching program of SINP.
2. M.Sc Biophysics and Molecular Biology Department, Calcutta University (2009-).
3. M.Sc Chemistry Department, Presidency College, Calcutta University (2005-2008).
4. Other Academic Activities: Reviewer of Ph.D thesis: IISc Bangalore and CDFD, Hyderabad. Guide to Summer project students of Saha Institute and students of WBUT, Calcutta University, IIT-Kanpur, IIT-Roorkee etc. Guide in the review work of Post-M.Sc students of SINP.

Essential strength of research/development output:

Area of research interest: Structural Biology, Structure-based protein engineering, Protein crystallography and molecular modeling.

Current research projects:

1. Structure-based protein engineering of plant proteases to alter thermostability and activity.

2. Structure-function correlation of plant enzymes from *Ervatamia coronaria* .

Future research/development plan:

1. Structural insights into the effects of causative mutations of human cathepsin K responsible for bone deformations.

2. Role of pro-peptide part in folding and maturation of papain-like cysteine proteases.

Publications (during 11th plan project: 2007-onwards)

1. "Improving thermostability of Papain through structure-based protein engineering" Debi Choudhury[#], **Sampa Biswas**[#], Sumana Roy and J K Dattagupta. ***Protein Engineering, Design and Selection*** (2010) **23**, 657-667.

# Equal contributions.

2. "Heterologous expression of a thermostable plant cysteine protease in *Escherichia coli* both in soluble and insoluble forms" Sruti Dutta, Raka Ghosh, J.K Dattagupta and **Sampa Biswas**. ***Process Biochemistry*** (2010) In press [doi:10.1016/j.procbio.2010.04.020].

3. "Production and recovery of recombinant pro-papain with high yield" Debi Choudhury, Sumana Roy, Chandana Chakrabarti, **Sampa Biswas** and J.K. Dattagupta. ***Phytochemistry*** (2009) **70**, 465-472.

4. "Structural insight into the substrate specificity and activity of Ervatamins: the papain-like cysteine proteases from a tropical plant *Ervatamia coronaria*" Raka Ghosh, Sibani Chakraborty, Chandana Chakrabarti, Jiban Kanti Dattagupta and **Sampa Biswas**. ***FEBS Journal*** (2008) **275**, 421-434.
   (The article is also selected in a FEBS Journal special '**Virtual Issue of Structural Biology'** on the celebration of 50 years of protein crystallography, 2009.)

5. "A thermostable cysteine protease precursor from a tropical plant contains an unusual C-terminal propeptide: cDNA cloning, sequence comparison and molecular modeling studies" Raka Ghosh, Jiban K. Dattagupta and **Sampa Biswas**. ***Biochemical and Biophysical Research Communications*** (2007) **62**, 965-970.

Some important earlier publications:

1. "Structural basis of the unusual stability and substrate specificity of ervatamin C, a plant cysteine protease from *Ervatamia coronaria*" Piyali Guha Thakurta, **Sampa Biswas**, Chandana Chakrabarti, Monica Sundd, Medicherla V. Jagannadham and Jiban K. Dattagupta. ***Biochemistry*** (2004) **43**(6) 1532-1540.

2. "Functional properties of Soybean Nodulin26 from a comparative three dimensional model." **Sampa Biswas**. ***FEBS Lett.*** (2004) **558**, 39-44. (Cover page article)

3. "Proposed Amino Acid Sequence and the 1.63 Å X-ray Crystal Structure of a Plant Cysteine Protease, Ervatamin B: Some Insights into the Structural Basis of its Stability and Substrate Specificity" **Sampa Biswas**, Chandana Chakrabarti, Suman Kundu, Medicherla V. Jagannadham and Jiban K Dattagupta. ***Proteins: Structure, Function, and Genetics*** (2003) **51** (4), 489-497.

Summarized Carrier Profile

1. Name: **Partha Saha**

Present Position: Professor 'F'
Crystallography and Molecular Biology Division

Phone Extension: 1309 **Mobile:** 94330 35979

2. Education:

B.Sc. Chemistry (Hon), Physics and Maths. Calcutta University, India. 1986. Ist Class.

M.Sc. Biotechnology. Indian Institute of Technology, Bombay. 1989. India. Ist Class.

Ph.D.(Sc) Jadavpur University, Kolkata, India. 1995

Awards:

1989 – 1991 : **Junior Research Fellowship** by Council of Scientific and Industrial Research, India.

1992 – 1994 : **Senior Research Fellowship** by Council of Scientific and Industrial Research, India.

Professional Experience:

April, 1998 – present : **Faculty** at Crystallography & Molecular Biology Division, Saha Institute of Nuclear Physics.
Professor 'F' : Aug, 2007 – present
Associate Professor 'E' : Feb, 2003 – July,2007
Reader 'D' : Feb, 2000 – Jan, 2003
Lecturer 'C' : April, 1998 – Jan, 2000

Feb, 1995 – April, 1998 : **Post-doctoral research fellow** at Department of Pathology, Brigham and Women's Hospital, Boston, Massachusetts, USA.

Sept, 1994 – Feb, 1995 : **Research assistant** at Indian Institute of Chemical Biology, Kolkata, India.

Membership of professional bodies: **Society for Biological Chemists (India)**
Indian Society of Cell Biology

3. Research:

Major area of specialization: Biochemistry, Molecular Biology, Cell Biology.

Field of Interest: Regulation of DNA replication and cell cycle in eukaryotes.

Major Findings:

- Subcellular localization of human co-chaperon Mrj regulates its cell cycle dependent activity
- Identification of S-phase cell cycle kinase in *Leishmania donovani* and some their substrates, one of them being parasite specific and so potential therapeutic target.
- Regulation of endonucleolytic cleavage of S-phase specific mRNAs through ubiquitination of a multi-domain interacting protein in *Leishmania donovani*. Implication of ubiquitination mediated regulation of mRNA turnover in eukaryotes for the first time.

Extramural grants (in addition to participation in intramural projects):

- Studies of cell cycle regulation in *Leishmania* parasite. CSIR, India. 6/00-6/04. Rs.8 lakh
- Characterization of a *Leishmania donovani* cycling sequence binding protein – a member of posttranscriptional process of gene expression. TWAS, Italy. 7/05-12/06. Rs.2.5 lakh
- Identification and characterization of endogenous substrates of *Leishmania donovani* cyclin dependent kinases. CSIR, India. 10/05-9/08. Rs. 15 lakh
- Regulation of S-phase specific gene expression in *Leishmania* parasites. DBT, India. Ongoing. Rs. 27.5 lakh

Guiding Experience: Ph.D. students **:** Completed: **3** Ongoing: **3**
Postdoctoral Fellow**:** Completed: **3**

4. Future Plan:

- To study the regulation of differential gene expression through mRNA turnover in eukaryotes.
- To study the regulation of histone acetylation and their effect on DNA replication.
- To characterize the cellular roles of phosphorylation of the identified substrates of cell cycle kinase. All the above-mentioned studies might elucidate some unknown aspects of cell proliferation which are deregulated in various diseases.
- To search for potential therapeutic agents against *Leishmania* parasites (collaborator: Prof. Rahul Banerjee).

5. List of Important Publications :

1. Bhandari D, Sengupta K, Bhaduri N and **Saha P** (2010) Ubiquitination of mRNA cycling sequence binding protein from *Leishmania donovani* (LdCSBP) modulates the RNA endonuclease activity of its Smr domain. *Revised Manuscript to be submitted soon*

2. Dey, Sanjib, Banerjee, Paromita and **Saha, Partha** (2009) Cell cycle specific expression and nucleolar localization of human J-domain containing co-chaperon Mrj. *Mol and Cell Biochem*. **322:**137-142.

3. Bhandari, Dipankar and **Saha, Partha** (2007) mRNA cycling sequence binding protein from *Leishmania donovani* (LdCSBP) is covalently modified by ubiquitination. *FEMS Microbiol Lett* **273**: 206–213.

4. Banerjee S, Sen A, Das P and **Saha P** (2006) *Leishmania donovani* cyclin1 (LdCyc1) forms a complex with cell cycle kinase subunit CRK3 (LdCRK3) and is possibly involved in S-phase related activities. *FEMS Microbiol. Lett.* **256**: 75-82.

5. Banerjee S, Banerjee R, Das R, Duttagupta S and **Saha P** (2003) Isolation, characterization and expression of a cyclin from *Leishmania donovani*. *FEMS Microbiol Lett.* **226(2):** 285-289.

6. Banerjee R, Sen M, Bhattacharya D and **Saha P** (2003) The jigsaw puzzle model: search for conformational specificity in protein interiors. *J Mol Biol*. **333(1):** 211-226.

7. **Saha P**, Chen J, Thome KC, Lawlis SJ, Hou ZH, Hendricks M, Parvin JD, Dutta A (1998) Human CDC6/Cdc18 associates with Orc1 and cyclin-cdk and is selectively eliminated from the nucleus at the onset of S phase. *Mol Cell Biol.* **18(5):** 2758-2767.

8. **Saha P**, Eichbaum Q, Silberman ED, Mayer BJ, Dutta A (1997) p21CIP1 and Cdc25A: competition between an inhibitor and an activator of cyclin-dependent kinases. *Mol Cell Biol*. **17(8):** 4338-4345.

Chemical Science Division

Chemical Sciences Division

Permanent Members of the Division

Faculty Members	Technical Staff	Administrative/Auxiliary Staff
Soumen Basak (Senior Professor, Head)	Ajay Das (Sci. Assistant)	Subir Bandopadhyay (Senior Assistant)
Samita Basu (Professor)	Chitra Raha (Sci. Assistant)	Deepak Kumar Ram (Helper)
Amitabha De (Professor)	Avijit Shome (Sci. Assistant)	Jitendra Nath Ray (Helper)
Susanta Lahiri (Professor)	Bablu Ram (Technician)	
Munna Sarkar (Professor)		
Maitreyee Nandy (Professor)		

Ph.D.'s awarded (2007 onward):
Samir Maji, Anupam Banerjee, Asima Chakraborty, Debarati De, Aditi Bose

Ph.D. students (2007 onward):
Partha Sarathi Guin, Brotati Chakraborty, Sutapa Mondal Roy, Manas Kumar Sarangi, Sreeja Chakraborty, Mousumi Banerjee, Binita Dutta, Swadesh Mondal, Ajoy Mandal, Kallol Bera, Moupriya Nag, Sujay Ghosh, Ankan Dutta Chowdhury, Kaustab Ghosh

Postdoctoral Research Associates/Visiting Fellows (2007 onward):
Rupali Gangopadhyay, Madhuri Mandal, Kalpita Ghosh, Kalyan Giri, Hirak Chakraborty, Moumita Maiti, Archana Ghatak, Aurkie Ray

Equipments and Resources in the Division:

1. UV-Visible Spectrophotometer
2. Spectrofluorometer (for steady-state fluorescence spectroscopy)
3. Spectropolarimeter (for Circular Dichroic spectroscopy)
4. Fourier Transform Infrared (FTIR) Spectrometer
5. Picosecond Fluorescence Lifetime Measurement System (using TCSPC technique)
6. Nanosecond Flash Photolysis Setup for time-resolved absorption spectroscopy
7. Millisecond Stopped-Flow System for Absorption/Fluorescence study of reaction kinetics
8. Potentiostat/Galvanostat system for Electrochemical Analysis
9. Low-temperature (down to 10 K) Resistivity Measurement setup
10. Home-assembled setup for Fluorescence Correlation Spectroscopy (FCS)
11. Facility for synthesis of conducting polymers, nanomaterials and small organic molecules
12. Semi-automated Peptide Synthesizer
13. FPLC Apparatus for peptide purification
14. Alpha-spectrometer
15. Gamma-spectrometer (using HPGe and NaI(Tl) Scintillation Detectors and Compton Suppressor System)
16. Inductively Coupled Plasma Mass Spectrometer (ICPMS) with GC, HPLC and Lase Ablation (LA) attachments
17. Inductively Coupled Plasma Optical Emission Spectrometer (ICPOES)
18. Class 10000 Clean Room
19. Co^{60} radioactive source

Research Activity:
Faculty members work on topics covering a somewhat broad area, such as biophysical chemistry including protein folding and molecular mechanism of action of drugs (NSAIDs), photophysics and

photochemistry of small organic molecules and biomolecules, synthesis and characterization of conducting polymers and nanocomposite materials, and nuclear and radiochemistry.

Important Results:

Protein Folding, Misfolding and Aggregation

The folding/unfolding behaviour of the intrinsically unstructured proteins, caseins, was studied as a function of pH and temperature and in presence of surfactants and metal ions. Caseins, which are 'intrinsically unstructured' in the native state, were shown to adopt partially folded structures on binding with μM concentrations of Zn^{2+} and Al^{3+}. Their chaperonic activity was also found to be severely inhibited by binding with the metals. The conformational tendencies and cellular toxicity of synthetic peptides, which mimic the polyalanine segments of the disease-related protein PAPB2, were studied as a function of the number of alanine repeats to elucidate the mechanism behind protein aggregation. It was found that β-sheet formation was the most likely trigger for the aggregation process, which occurred for peptides with more than ten alanine repeats, and for the highly enhanced cellular toxicity of those peptides. Incubation of the peptides at high pH (>10) or in aqueous mixtures of simple (MeOH, EtOH) or fluorinated (TFE, HFIP) alcohols led to formation of well defined fibrils via the nucleation-controlled polymerization pathway, as indicated by the measured time and concentration dependence of the process. The fibrils, in turn, formed fractal-like superstructures on precipitation from solution, raising the possibility of growing novel peptide-based materials. In another study on the effect of glycation on hemoglobin structure, reduction of native α-helix structure and concomitant growth of β-type structure was shown to correlate with the extent of glycation damage (including aggregation).

Molecular mechanism behind new functions for the commonly used painkillers, NSAIDs

Although the principal function of Non Steroidal Anti-Inflammatory Drugs (NSAIDs) is to combat pain and inflammation, they show other functions, e.g. chemoprevention and chemo-suppression against different cancers, protection against neurodegenerative diseases, UV photo-sensitization and UV photoprotection. To elucidate the poorly understood molecular mechanism behind these diverse functions, the following studies are being pursued:

a) Spectroscopic characterization of NSAIDs in different environments to enable the use of their spectral properties as intrinsic reporters of their interaction with different biomolecules.

b) Interaction of NSAIDs with membrane mimetic systems/membranes.

c) Effect of NSAIDs on mitochondria and its consequences on downstream apoptotic signaling, since mitochondrial outer membrane permeabilization is a strategy for chemotherapy.

d) Interaction of NSAIDs with lipid monolayers to understand the physical reason behind the perturbing effect of these drugs on monolayer geometry.

e) Possible biological applications of complexes of NSAIDs with bioactive metals.

Some important results emerging from these studies are:

a) The oxicam NSAIDs, viz. piroxicam, meloxicam and tenoxicam, can cause membrane fusion in absence of any other fusogenic agents even at the very low drug/lipid ratio of 0.018. This is very interesting since such small drug molecules cannot rely on conformational reorganization to drive membrane fusion, an advantage shared by the most common fusogenic agents, viz. proteins/ peptides. The detailed mechanism behind this phenomenon, including the effect of different physical and chemical parameters of the drugs and the participating lipids, is being deciphered.

b) Indomethacin, a traditional painkiller, can probe structures of local clusters in binary mixtures of primary alcohols and water.

c) Cu(II) complexes of some oxicam NSAIDs can directly bind to the DNA backbone.

Photoinduced molecular phenomena probed by spectroscopy and magnetic field effect

Photophysical and photochemical studies were performed on (i) inter- and intra-molecular electron/proton transfer and hydrogen abstraction reactions with small chemically and biologically important molecules and (ii) interactions of small drug-like molecules with proteins and DNA bases in homogeneous and heterogeneous confined media. Steady-state and time-resolved spectroscopic techniques, magnetic field effects and theoretical modeling were employed. Experiments were designed to unravel some of the physical aspects, mainly the role of structure of participating molecules and the solvent matrix, in these reactions. In keeping with current interest in drug-DNA and drug-protein

interactions, studies were extended from small organic molecules to some model biomolecules. Experiments with polymeric film grafted with suitable chromophore provided a mimic situation of solid phase interactions. Although steady-state and time-resolved absorption and fluorescence help to identify steady-state products and transient intermediates respectively, the presence of magnetic field enables identification of the initial spin state (one of the deciding factors for ultimate products) as well as assessment of the intermediate distance in geminate spin-correlated radical ion pairs/ radical pairs produced as transients (very useful for studying 'distance-dependent' interactions in biomacromolecules). For the field-dependent studies, a setup was fabricated which could generate a DC magnetic field of ~0.1 tesla and AC magnetic field of ~0.02 tesla with phase sensitive detection (S/N ~1000:1) to monitor the enhancement of fluorescence intensity in the presence of magnetic field. The time resolution of these measurements will be improved from the present nanosecond to the picosecond level to identify and characterize the photoinduced intermediates more precisely.

Transport and Electronic Properties of Conducting Polymers and Nanocomposites

A set of poly-3,4 ethylenedioxythiophene (PEDOT) samples were synthesized by varying the oxidizing agent and its molar ratio with the monomer. The temperature dependence of their conductivity is in excellent agreement with that in the model prescribed by Aharony et al., which predicts a smooth crossover from the Coulomb-gap dominated variable-range hopping (VRH) at low temperatures to Mott's 3d-VRH at high enough temperatures. Electrical transport and magnetic properties of conducting polymer nanocomposites of PEDOT and different ferrite (Fe_3O_4, $NiFe_2O_4$, $CoFe_2O_4$) nanaoparticles were studied. The samples were characterized by TEM, XRD and TGA. Electrical, thermal and crystalline properties of the pure PEDOT were found to have improved after composite formation. In the temperature range 77–300 K, dc resistivity data for pure PEDOT as well as all the nancomposites fit well to the Mott VRH scaling relation, suggesting that the conduction mechanism does not change on inclusion of nanoparticles. However, the hopping parameters change in the nanocomposites. Magnetic study of ferrite nanoparticles and nanocomposites show superparamagnetic blocking. A distribution of particle size and freezing of surface spins are responsible for the difference of the temperature points T_B (at the maximum of M_{ZFC}) and T_S (at the point of separation between M_{ZFC} and M_{FC}).

Electrochemical properties of PEDOT based $NiFe_2O_4$ conducting nanocomposites were studied for their suitability as electrode materials for supercapacitor. Nanocrystalline nickel ferrites (5-20 nm) have been synthesized by sol-gel method. Reverse micro emulsion polymerization in n-hexane medium for PEDOT nanotube and aqueous miceller dispersion polymerization for bulk PEDOT formation using different surfactants were adopted. Cyclic voltammetry, galvanostatic charge-discharge and electrochemical impedance were used to study charge transfer, ion diffusion and capacitance of the PEDOT composite samples in an electrolyte containing 1M $LiClO_4$ in acetonitrile. Highest specific capacitance for the nanocomposites was found to be ~230 F/gm.

Nuclear and Radiochemistry:

The thrust of activity in this area has been in (i) accelerator based research and (ii) green chemistry. A systematic study of production and separation of no-carrier-added radionuclides by heavy ion activation has been carried out and alternative radionuclides with better nuclear properties for clinical application have been proposed. Exotic projectiles like ^{9}Be have been used to search for alternative production routes of longer-lived radionuclides ^{93,94,94m}Tc and $^{219\text{-}211}$At, which are termed 'ultimate radionuclides for targeted therapy'. The cross-section data generated in these studies are regularly updated in the widely used IAEA EXFOR database. Successful combination of green chemistry with radiochemical methods of analysis has been achieved; preparation of radioactive gold and gold-palladium bimetallic nanoparticles using minuscule amount of radioactivity and polyethylene glycol, an environmentally benign chemical, has been reported for the first time. Contribution in trans-disciplinary research areas has been made through development of a method of separation of ultra-trace nuscule amount of the Supernova-produced radionuclides ^{53}Mn, ^{146}Sm and ^{182}Hf from the interfering stable isobars ^{53}Cr, ^{146}Nd and ^{182}W, respectively. This research will have significant contribution in cosmochemistry. Several international collaborations have been established, of which the one with the superheavy element chemistry group of GSI, Germany and CERN-ISOLDE, Technical University of Munich, Germany are noteworthy. Co-discovery with an international group of scientists of the new radionuclide ^{277}Hs has been achieved.

List of Publications (2007 till date)

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1. 'Nanoparticle Induced Conformational Change in DNA and Chirality of Silver Nanoclusters', Sarita Roy, Soumen Basak and Anjan Kumar Dasgupta, J. Nanosci. Nanotech. 10 (2010) 819.
2. 'Inclusion of chrysin in beta-cyclodextrin nanocavity and its effect on antioxidant potential of chrysin: A spectroscopic and molecular modeling approach', Sandipan Chakraborty, Soumalee Basu, Ansuman Lahiri and Soumen Basak, J. Mol. Struct. 977 (2010) 180.
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4. 'Magnetic field effect in homogeneous medium for triplet born radical ions: a way for assessment of inter-radical distance in intermolecular photoinduced electron transfer' (Invited Review), Debarati Dey and Samita Basu, J. Ind. Chem. Soc. 87 (2010) 117.
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6. 'Simultaneous Occurrence of Energy Transfer and Photoinduced Electron Transfer in Interaction of Hen Egg White Lysozyme with 4-nitroquinoline-1-oxide', Mousumi Banerjee, Sourav Maiti, Ipsita Kundu, Abhijit Chakrabarti and Samita Basu, Photochem. Photobiol. (in press).
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Date of Birth	May 12, 1952
Designation	Senior Professor 'H' and Head Chemical Sciences Division

Academic qualifications

- Ph.D. (Experimental Condensed Matter Physics), The University of Chicago, 1982.
- Post-M.Sc. Associate (Physics), Saha Institute of Nuclear Physics, 1974.
- M.Sc. (Physics), University of Calcutta, 1972.
- B.Sc. (Physics Honours), Presidency College, University of Calcutta, 1970.

Awards, Honours or Distinctions

- Fellow, West Bengal Academy of Science and Technology (2004)
- Valentine Telegdi Prize for best performance in Ph.D. Qualifying Examination, Physics Department, University of Chicago (June 1975)
- National Science Talent Scholar, Dept. of Science and Technology, Govt. of India, 1967
- National Merit Scholarship, W.B. Board of H.S. Education, 1967

Earlier employment data with dates

- Postdoctoral Fellow, Physics Dept., Drexel University, Philadelphia, 1983-1986.
- Postdoctoral Fellow, Physics Dept., Ohio State University, Columbus, 1981-1982.
- Research Assistant, James Franck Institute, University of Chicago, Chicago (1976-1981).

Supervision of Doctoral Research (Student, Year of Award and Thesis Title):

1. Asima Chakraborty (2008): ***"Effect of structural perturbants on globular and natively unfolded proteins"***.
2. Kalyan Giri (2006): ***"Study of protein folding and misfolding in relation to disease"***.
3. Dilip Debnath (2004) (jointly supervised by Prof. A. Chakrabarti, Biophysics Division): "***Spectroscopic studies of structural changes in two monomeric proteins: Effects of pH, urea and phospholipids"***.
4. Mousumi Mondal (2003) (jointly supervised by Prof. A. Chakrabarti, Biophysics Division): ***"Studies of tertiary amine local anesthetics in phospholipid membranes and in membrane-mimetic systems"***.
5. Kasturi Mukhopadhyay (1996): ***"Spectroscopic studies of some bioactive peptides".***

Summary of Research Activity

Recent work mainly involves protein folding and misfolding. A few examples are:

- Investigation of thermodynamics of folding of both globular and intrinsically unstructured proteins, at low (millimolar) and high (molar) concentrations of denaturants, as functions of pH and temperature, and in presence of surfactants and metal ions.
- Study of conformational tendencies and cellular toxicity of model peptides mimicking polyalanine segments of aggregation-prone proteins that cause 'protein folding diseases'.
- Structural alteration (denaturation) of hemoglobin on interaction with sugar molecules and its detection using gold nanoparticles grown on protein templates.

My future plan is to:

- Study biophysical processes like protein aggregation using single molecule techniques, such as Fluorescence Correlation Spectroscopy, for which I am putting together a setup.
- Build an optical tweezers based setup that will use fluorescence resonance energy transfer to detect and measure structural transitions in individual protein/DNA molecules.
- Fabricate novel materials using the aggregated forms of proteins/peptides.

List of (selected) publications

1.'Nanoparticle Induced Conformational Change in DNA and Chirality of Silver Nanoclusters', S. Roy, S. Basak & A. K. Dasgupta, ***J. Nanosci. Nanotech.*** **10** (2010) 819-825.

2. 'Binding interaction of cationic phenazinium dyes with calf thymus DNA: A comparative study', D. Sarkar, P. Das, S. Basak & N. Chattopadhyay, ***J. Phys. Chem. B*****112** (2008) 9243-9249

3. 'Protein seeding of gold nanoparticles and mechanism of glycation sensing', R. GhoshMoulick, J. Bhattacharyaa, C. K. Mitra, S. Basak & A. K.. Dasgupta, ***Nanomedicine*** **3** (2007) 208-214.

4. 'Interaction with Al and Zn induces structure formation and aggregation in natively unfolded caseins', A. Chakraborty & S. Basak, ***J. Photochem. Photobiol. B*****93** (2008) 36-43.

5. 'Compensatory secondary structure alterations in protein glycation', R. Ghoshmoulick, J. Bhattacharya, S. Roy, S. Basak & A. K. Dasgupta, ***Biochim. Biophys. Acta*** **1774** (2007) 233-242.

6. 'pH-dependent self-assembly of polyalanine peptides', K. Giri, N. P. Bhattacharyya & S. Basak, ***Biophys. J.*** **92** (2007) 293-302.

7. 'Acid induced denaturation and refolding of prothrombin', D. Debnath, K. Mukhopadhyay & S. Basak, ***Biophys. Chem.*** **116** (2005) 159.

8. 'Stabilizing effect of low concentration of urea on reverse micelles', A. Chabkraborty, M. Sarkar & S. Basak**, *J. Coll. Interf. Sci.*** **287** (2005) 312.

9. 'Caspase 8 mediated apoptotic cell death induced by beta-sheet forming polyalanine peptides', K. Giri, U. Ghosh, N. P. Bhattacharyya & S. Basak, ***FEBS Lett.*** **555** (2003) 380.

10. 'Regulation (alteration) of activity and conformation of sucrase by co-aggregation with cellobiase in culture medium of *Termitomyces clypeatus*', S. Mukherjee, S. Basak & S. Khowala, ***Biotechnol. Prog.*** **18** (2002) 404.

11. 'Effect of cholesterol on interaction of dibucaine with phospholipid vesicles: A fluorescence study', M. Mondal, K. Mukhopadhyay, S. Basak & A. Chakrabarti, ***Biochim. Biophys. Acta*** **1511** (2001) 146.

12. 'Burst dynamics during drainage displacements in porous media: Simulations and experiments', E. Aker, K. J. Maloy, A. Hansen & S. Basak, ***Europhys. Lett.*** **51** (2000) 55.

13. 'Conformation induction in melanotropic peptides by trifluoroethanol: fluorescence and circular dichroism study', K. Mukhopadhyay & S. Basak, ***Biophys. Chem.*** **74** (1998) 175.

14. 'Structural alterations of horseradish peroxidase in presence of low concentrations of guanidium hydrochloride', A. Chakrabarti & S. Basak, ***Eur. J. Biochem.*** **241** (1996) 462.

15. 'Somatostatin in a water-restricted environment: fluorescence and circular dichroism study in AOT reverse micelles', K. Bhattacharyya & S. Basak, ***Photochem. Photobiol.*** **62** (1995) 17.

16. 'Kinetics of domain formation by sickle hemoglobin polymers', S. Basak, F. A. Ferrone & J. T. Wang, ***Biophys. J.*** **54** (1988) 829.

17. 'Conformational kinetics of triligated hemoglobin', F. A. Ferrone, A. J. Martino & S. Basak, ***Biophys. J.*** **48** (1985) 269.

18. 'Thermoelectric power of magnetic and non-magnetic amorphous metals', S. Basak, S. R. Nagel & B. C. Giessen, ***Phys. Rev. B*** **21** (1980) 4049.

19. 'Temperature dependence of the structure factor in Nb-Ni glasses', S. Basak, R. Clarke & S. R. Nagel, ***Phys. Rev. B*** **20** (1979) 4278.

20. 'Deformation potential theory for the mobility of excess electrons in liquid argon', S. Basak & M. H. Cohen, ***Phys. Rev. B*** **20** (1979) 3404.

1. **Ms. Samita Basu, M.Sc. Ph.D.**

Higher Scondary, WBSE, Holy Child Institute, Kolkata, 1975

B.Sc. (Chemistry Hons), Calcutta University, Presidency College, Kolkata, 1979 (1978 batch)

M.Sc. (Chemistry, Physical Chemistry special), Calcutta University, 1982 (1980 batch)

Ph.D., Jadavpur University, Indian Association for the Cultivation of Science, Kolkata , 1989.

2. **Academic Profile**

Lecturer, Department of Chemistry, St. Xavier's College, Kolkata (1990-92)
Lecturer, Chemical Sciences Division, Saha Institute of Nuclear Physics, Kolkata (!992-94)
Reader, CSD, SINP (1994-98)
Associate Professor, CSD, SINP (1998-2002)
Professor 'F' & 'G', CSD, SINP (2002-2007) & (2007-onwards).

Awards: National Scholarship in Higher Secondary Exam (1975)
Foundation Day Award for the year 2010 at Saha Institute of Nuclear Physics, Kolkata.

Honours: Teaching (M.Sc) at Chemistry Department , Calcutta University
Examiner at Calcutta University, Jadavpur University, Kalyani University and Scottish Church College, Kolkata
Reviewer of papers for publication in International (published by ACS, Elsevier, Wiley, etc.) and National Journals and Ph.D. thesis from IITs and other Universities
Member of Editorial Board of the journal, PHILOSOPHIC NATURE
Associated Professor, Homi Bhaba National Institute, BARC, Mumbai
Member of Board of Advisors, Jagadis Bose National Science Talent Search, Kolkata
Member of Selection Committee at NIT Durgapur, West Bengal
Member of International Spin Chemistry Committee from 2005
Invited Speaker in National and International Conferences in India and abroad.

3. **Research and Development**

Area(s) of research**:** Photophysical and photochemical studies on inter- and intra-molecular electron/proton transfer and hydrogen abstraction reactions with small chemically and biologically important molecules and interactions of small drug-like molecules with proteins and DNA bases in homogeneous and heterogeneous confined media using steady-state and time-resolved spectroscopic techniques, magnetic field effects and theoretical modeling.

Highlights of scientific contribution: Simple experiments have been designed to unravel some of the physical aspects, mainly the role of structure of participating molecules and the solvent matrix, in above mentioned reactions. In keeping with current interest in drug-DNA and drug-protein interactions, studies have been extended from small organic molecules to some model biomolecules. Moreover, experiments with polymeric film grafted with suitable chromophore provide a mimic situation of solid phase interactions. Although steady-state and time-resolved

absorption and fluorescence help to identify steady-state products and transient intermediates respectively, the importance of magnetic field effect lies in its ability to identify initial spin state, one of the deciding factors for ultimate products, as well as to assess the intermediate distance in geminate spin-correlated radical ion pairs/radical pairs produced as transients, which is very much useful to study 'distance-dependent' interactions in biomacromolecules.

Development: We had to set-up the nanosecond laser flash photolysis kinetic spectrometer. We fabricated a magnetic field set-up (d.c) inside its sample housing, which can generate field of the order of 0.1 tesla and an a.c. magnetic field set-up (0.02 tesla) with phase sensitive detection system (signal to noise ration is 1000:1) to monitor the enhancement of fluorescence intensity in the presence of magnetic field.

4. **Future Research/development**

The primary steps of most of the photoinduced phenomena occur within pico/sub-pico or femtosecond time scale. The present time-resolved techniques with time resolution within nano-second need up-gradation to pico or sub-pico second (femto) to identify and characterize the intermediates with greater precision.

6. **Recent publications**

Book: D. Dey, M.K. Sarangi and **S. Basu**, "Hydrogen bonding on photoexcitation" in Hydrogen bonding and transfer in the excited state; eds: Ke-Li Han and Guang-Jiu Zhao, WILEY publishers (in press).

1. B. Chakraborty and **S. Basu**, "Magnetic field effect on electron transfer reactions of acridine yellow with amines of varied structures in homogeneous medium" **Chemical Physics Letters**, 493, 76-82, **2010**.

2. D. Dey, N.R. Pramanik and **S. Basu**, "Exploring the Mechanism of Electron Transfer between DNA and a Ternary Copper Complex", **Journal of Physical Chemistry B**, 113, 8689–8694, **2009**.

3. A. Bose, D. Dey and **S. Basu**, "Interaction of Guanine and Guanosine Hydrates with Quinones: a laser flash photolysis and magnetic field effect study", **Journal of Physical Chemistry A** 112, 4914-4920, **2008**.

4. D. Dey, A. Bose, D. Bhattacharyya, **S. Basu**, S. S. Maity and S. Ghosh, "Dibenzo[a,c]phenazine: a polarity-insensitive hydrogen bonding probe" **Journal of Physical Chemistry A** 111, 10500-10506, **2007**.

5. S. Dutta Choudhury and **S. Basu**, "Interaction of 4-nitroquinoline 1-oxide with indole derivatives and some related biomolecules: a study with magnetic field", **Journal of Physical Chemistry B** 110, 8850-8855, **2006**.

6. S. Dutta Choudhury and **S. Basu,** "Exploring the extent of magnetic field effect on intermolecular photoinduced electron transfer in different organized assemblies" **Journal of Physical Chemistry A**, *109*, 8113-8120, **2005**.

7. T. Sengupta, S. Dutta Choudhury and **S.. Basu**, "Medium-dependent electron and H atom transfer between 2′-deoxyadenosine and menadione: a magnetic field effect study", **Journal of the American Chemical Society** *126*, 10589-10593, **2004**.

8. K. Sen, S. Bandyopadhyay, D. Bhattacharya and **S. Basu**, "Dielectric Dependence of Magnetic Field Effect: A tool for Identification of Exciplex and Triplex", **Journal of Physical Chemistry A**, 105, 9077-9084, **2001**.

9. T. Sengupta, S. Aich and **S. Basu**, "Isotropic and Anisotropic Magnetic Field Effect on the Exciplex between All-s-trans-1,6-diphenyl-hexa-1,3,5-triene and 1,4-dicyano- benzene", **Journal of Physical Chemistry B**., *103*, 3784-3790, **1999**.

10. S. Aich, T. Sengupta, A. Bhattacharyya and **S. Basu**, "Magnetic Field Effect on An Exciplex between N-vinyl carbazole Grafted on Cellulose Acetate Film and 1,4- dicyanobenzene", **Journal of Polymer Science Part A: Polymer Chemistry**, *37*, 3910-3915, **1999**.

11. S. Aich and **S. Basu**, "Magnetic Field Effect: A Tool for Identification of Spin State in a Photoinduced Electron-Transfer Reaction", **Journal of Physical Chemistry A**, 102, 722-729, **1998**.

12. S. Aich and **S. Basu**, " Laser Flash Photolysis Studies and Magnetic Field Effect on a New Heteroexcimer between N-Ethyl Carbazole and 1,4- dicyanobenzene in Homogeneous and Heterogeneous Media", **Journal of Chemical Society Faraday Trans**., 91, 1593-1600, **1995.**

Name: Amitabha De

Affiliation : Chemical Sciences Division
Designation : Professor G

Educational background:
M.Sc.: Passed M.Sc. in pure chemistry from University of Calcutta in 1979.
Ph.D. : Obtained Ph.D. degree from University of Calcutta in 1986, working in SINP as a research fellow

E-mail ID amitabha.de@saha.ac.in

Career Profile: One year post-doctoral fellow in Ecole Centrale de Lyon, Lyon, France with a French Government Fellowship during 1986-87.
Spend three years as CSIR Pool Officer, Government of India (1988-1990).
Joined as Faculty Member in SINP (1992)

Research Interests:

Earlier areas of research interest:

i) Radiochemical separation of tracer ions using synthetic inorganic ion-exchangers.
ii) Fabrication of chemical sensors using Ion Sensitive Field Effect Transistor (ISFET).
iii) Synthesis and studies on irradiation effects on various high T_c superconductors.

Present research interest:

Synthesis of various types of conducting polymer and conducting polymer based composites and nanocomposites using chemical and electrochemical polymerization techniques. Polymer based composites and nanocomposites involve combination of conducting polymers like polypyrrole, polyaniline and PEDOT with other conventional polymers like PVA, polystyrene or with nanoparticles of different inorganic oxides like ferric oxide, zirconium oxide, titanium oxide etc. Characterization of these materials using Transmission Electron Microscopy (TEM), X-ray diffraction, thermogravimetry and FTIR spectroscopy. Detailed studies regarding their electrical transport properties by temperature dependent conductivity, thermoelectric power measurement and AC impedance studies. Investigation of some of the potential application areas using these composites and nanocomposites e.g. as gas sensors, EMI shielding materials

Synthesis and study of electronic charge transport in conducting polymer nanotubes and nanowires. Synthesis of ferrite (iron, cobalt and nickel) based conducting PEDOT

nanocomposites, detailed study of their electrical and magnetic properties and application as supercapacitors.

Future research Plan:

Development of new materials based on nanostructured conducting polymers for detailed studies on application in the areas of electrochemical supercapacitors and amperometric biosensors.

Important Publications:

i) Electrochemical performances of poly(3,4-ethylenedioxythiophene)–$NiFe_2O_4$ nanocomposite as electrode for supercapacitor, Pintu Sen, Amitabha De, Electrochimica Acta, 55, 16, 2010, 4677-4684.

ii) Synthesis, characterization, electrical transport and magnetic properties of PEDOT-DBSA-Fe_3O_4 conducting nanocomposite, Amitabha De, Pintu. Sen, A. Poddar, A. Das, Synthetic Metals 159 (2009) 1002-1007.

iii) Enhancement of electron-electron interactions in chemically synthesized polymer nanowires. A. Rahman, M.K. Sanyal, Rupali Gangopadhay, A. De, Chemical Physics Letters 447, 268-273, 2007.

iv) Evidence of ratchet effect in nanowires of a conducting polymer. A. Rahman, M. K. Sanyal, Rupali Gangopadhay. A. De, I. Das; Physical Review B 73, 125313 (2006).

v) Transport and Dielectric Properties of Zirconium Phosphate -Polyaniline composite, S. De, Amitabha De, Ajoy Das and S. K. De, Materials Chemistry and Physics, 91, 477-483, 2005.

vi) Heavy Ion Irradiation on Conducting Polypyrrole and ZrO2-Polypyrrole Nanocomposites, A. De, A. Das, S. Lahiri, Synthetic Metals, 144, 303-307, 2004.

vii) Conducting Polymer Nanocomposites, by Rupali Gangopadhyay, Amitabha De. Chapter 6 -a review chapter in the book entitled "Handbook of Organic-Inorganic Hybrid Materials and Nanocomposites." Volume 2: Nanocomposites. Ed. H.S. Nalwa, American Scientific Publishers - May 2003.

viii) An electrochemically synthesized Conducting Pseudo-IPN from Polypyrrole and Poly (Vinyl alcohol), Rupali Gangopadhyay, Amitabha De. Journal of Materials Chemistry, 12(12), 3591-3598, 2002.

ix) Conducting Polymer Composites: Novel Materials for Gas Sensing, Rupali Gangopadhyay, Amitabha De. Sensors & Actuators B 77(1-2), 326, 2001.

X) Conducting Polymer Nanocomposites: A Brief Overview. Rupali Gangopadhyay and Amitabha De Chemistry of Materials, 12, 608, 2000.

1. **Name**: Professor Dr. SUSANTA LAHIRI
   Qualifications**:** M. Sc (University of Burdwan)
   Ph D (University of Calcutta),
   D. Sc (University of Calcutta)

2. Academic profile including earlier appointments, awards, etc

Publications:

A)	International peer reviewed journals:	138
B)	Conference/Symposia	155
C)	Edited books	04
D)	Book Chapters	11

Employment:

⇒ The University of Burdwan, Burdwan (1994 to 1997, Lecturer in Chemistry).
⇒ Saha Institute of Nuclear Physics, Kolkata, (1997 to continuing)

Awards/Recognition/Honours:

- Member of International Board of Biomonitoring (IBB) since 2006
- Associate Editor, Journal of Radioanalytical and Nuclear Chemistry (since 2005)
- Associate Membership of the Third World Academy of Sciences (TWAS) in Centre of Excellence at South (selected for two terms, 2000-2003, 2004-2007).
- Tarun Datta Memorial Award '96 for excellent research work in the field of Radioanalytical and Nuclear Chemistry in INDIA (bellow 35 years).
- Chaired sessions and delivered invited talks in many International Conferences.

Organization

I have started a new series of International Conference, Application of Radiotracers in Chemical, Environmental and Biological Sciences in 2006 and 2010 (ARCEBS-06, and ARCEBS-10). I have also organized CERN-INDIA collaboration workshop (2009), School on Trace Analysis (2007) and School on Trace Element Speciation (2008).

Research projects:

- Co-Principal Investigator, IUAC (Delhi)-KC College (Mumbai)-SINP (Kolkata) project
- Project Leader, DST-Russia Federation of Basic Sciences Project, 2008-10
- Project Leader: DST-Hungarian Academy of Sciences Project, 2007-09
- Project Leader: DST-DAAD Project, 2004-2006
- Project Leader: XI Five year Plan Project, Govt. of India, "Trace Analysis: Detection Dynamic and Speciation (TADDS) 2007-2012
- Principal Collaborator: BRNS Project 2004-2007
- Principal Investigator: DAE-BRNS Project, 1996-99 (in Burdwan University).

Research Guiding Experience

Ph. D degree awarded under my supervision	6
Present Ph. D. student	4
Post doctoral supervision	7

3. Essential strength of research/development output

The nuclear and radiochemistry is my main field of research wherein we have contributed significantly. However, the research interest has also been diversified in the areas of green chemistry as well as in trace elemental analysis using both nuclear and non-nuclear techniques. For the first time we used heavy ion projectiles for the production of no-carrier-added radionuclides which made easy access to the short-lived proton rich radioisotopes expanding the horizon of clinical radionuclides. We coined the term "tracer packet", which is path braking in tracer technology and allows one to deal with many similar radioactive tracers at-a-time in one experiment rather than setting up many experiments with individual tracers. We have combined for the first time "Green Chemistry" with radiochemistry.

We are collaborating with word reputed institutes like CERN (in connection with world's ultimate ISOL facility, EURISOL), GSI, Germany (chemistry of superheavy element), St. Petersburg University, Russia, Technical University of Munich, Germany, Institute of Modern Physics, China, ATOMKI, Hungary, etc. We are proud to be the part of the team who recently completed successful experiment on production and decay of element 114 and also discovered new radionuclides ^{277}Hs.

Essentially we have crossed the subject boundary and contributed in trans-disciplinary research areas. We developed method of separation of minuscule amount of supernova produced radionuclides ^{53}Mn, ^{146}Sm and ^{182}Hf from the interfering stable isobars ^{53}Cr, ^{146}Nd and ^{182}W respectively. This research will have significant contribution in cosmochemistry. We have developed method of removal of As contamination by green and cost effective method.

We received and executed successfully the XIth five year plan project, "Trace Analysis: Detection, Dynamics and Speciation (TADDS)". The ICPOES with LASER ablation technique, High efficiency Compton Suppressor System has been installed. From the other XI Five year plan project, CBAUNP, we have installed ICPMS coupled with HPLC and GC. All the instruments are housed in class 10000 clean room.

4. Future research/development plan

The dream is to set up modern up-to-date and the *state of art* trace analysis laboratory with both nuclear and non-nuclear techniques in XII five year plan. We would like to procure NEPTUNE PLUS ICPMS which will be capable of determining 1 atom in 10^{14}atoms, which in turn will be able to solve intricacies of natural processes including the cosmological puzzles. We would also like to extend our expertise in Accelerator Mass Spectrometry (AMS) and wish to set up sub-MeV AMS at SINP.

We would like to contribute more in the total science of proton rich radionuclides and its application in synthesizing radiopharmaceuticals useful for targeted therapy. We are also committed to be the part of discovering new element, element 119, along with the international team from various countries at GSI, Germany. The development of methods to isolate radionuclides of clinical and astrophysical interest from the proposed converter targets liquid Hg, or Pb-Bi is our immediate plan for the coming years.

5. List of important publications starting with recent publications

1. Susanta Lahiri, Moumita Maiti, Methods of Cosmochemical Analysis, In *Handbook of Nuclear Chemistry* (2nd ed.),Vol. 5, Eds. A. Vértes, S. Nagy, Z. Klencsár, Springer, 2010 (Book Chapter).
2. Ch.E. Düllmann, M. Schädel, A. Yakushev, A. Türler, K. Eberhardt, J.V Kratz, D. Ackermann, L.-L. Andersson, M. Block, W. Brüchle, J. Dvorak, H.G Essel, P.A. Ellison, J. Even, J.M. Gates, A. Gorshkov, R. Graeger, K.E. Gregorich, W. Hartmann, R.-D. Herzberg, F.P. Heßberger, D. Hild, A. Hübner, E. Jäger, J. Khuyagbaatar, B. Kindler, J. Krier, N. Kurz, S. Lahiri, D. Liebe, B. Lommel, M. Maiti, H. Nitsche, J.P. Omtvedt, E. Parr, D. Rudolph, J. Runke, B. Schausten, E. Schimpf, A. Semchenkov, J. Steiner, P. Thörle-Pospiech, J. Uusitalo, M. Wegrzecki, N. Wiehl, Production and decay of element 114: high cross sections and the new nucleus ^{277}Hs, *Phys. Rev., Lett.*. 104, (2010) 252701.
3. Moumita Maiti and Susanta Lahiri, New routes for production of proton-rich Tc isotopes, *Phys. Rev.* C 81, (2010) 024603.
4. Moumita Maiti and Susanta Lahiri, Production and separation of no-carrier-added ^{93,94,95}Tc from ^{9}Be activated Yttrium target, *Radiochimica Acta* 97 (2009) 663.
5. Moumita Maiti and Susanta Lahiri, Theoretical approach to explore the production routes of astatine radionuclides, *Phys. Rev. C* 79, (2009) 024611.
6. Kamalika Roy and Susanta Lahiri, In situ gamma radiation: One step environmentally benign method to produce gold-palladium bimetallic nanoparticles, *Anal. Chem.* 80 (2008) 7504-7507.
7. Kamalika Roy and Susanta Lahiri, "A green method for synthesis of radioactive gold nanoparticles", *Green Chemistry* 8 (2006) 1063–1066.
8. Samir Maji, Susanta Lahiri, Birgit Wierczinski and Gunther Korschinek, "Separation of trace level hafnium from tungsten: A step forward to solve astronomical puzzle", *Analytical Chemistry* 78 (2006) 2302-2305.
9. Samir Maji, Susanta Lahiri, Birgit Wierczinski and Gunther Korschinek, Separation of samarium and neodymium: a prerequisite for getting signals from nuclear synthesis, *Analyst*, 131 (2006) 1332-1334.
10. Susanta Lahiri, Dalia Nayak and Gunther Korschinek, "Separation of No-carrier-added ^{52}Mn from Bulk Chromium: A Simulation Study for AMS Measurement of ^{53}Mn", *Anal. Chem.* 78 (2006) 7517-7521.
11. Susanta Lahiri and Dalia Nayak "Tracer Packet: A New Conception for the production of tracers of micronutrient elements", *J. Radioanal. Nucl. Chem.* 254 (2002) 289-292.

Munna Sarkar,
Professor
Chemical Sciences Division
Saha Institute of Nuclear Physics.

Educational background: Passed B.Sc. and M.Sc from Calcutta University in Physics and completed Ph.D. in Physics (1994) from Saha Institute of Nuclear Physics, (Calcutta University). The thesis title was "Spectroscopic studies of some biologically important molecules"

Academic Profile:

Earlier employment data:

From March1993 till August 1993 worked as Post Doctoral Fellow in the group of Prof Astrid Gräslund (Secretary, Nobel Committee in Chemistry) at the Department of Medical Biochemistry and Biophysics in Umeå University, Umeå, Sweden. From August 1993 till June 1994 and from June 1995 till March 1998 continued working with her at the Department of Biophysics, Arrhenius Laboratories, Stockholm University Sweden .Between December 1994 till June1995 worked as Visiting Fellow at the Biophysics Division, Saha Institute of Nuclear Physics, Calcutta, India.
Joined Saha Institute of Nuclear Physics as Lecturer on 1st April 1998.

Post doctoral research area:
Structural studies of unusual DNA/RNA structures which included studying the effects of single deoxyribose sugar substitution in a ribose backbone and its implications in RNA-RNA interactions. Structural studies were also carried on oligonucleotides that model tertiary interactions in self splicing catalytic RNA molecules using optical and FTIR spectroscopy. In addition, ionic effect on the stability and conformation of complexes of a nucleic acid analogue, Peptide Nucleic Acid (PNA) with DNA was studied in detail.

Special Awards, honors or distinctions:
1) National Scholarship/Certificate of Meri**t** for Secondary examination (1976) from Ministry of Education Govt. of West Bengal, India. 2) Prof. S. R. Palit Memorial award of The Indian Chemical Society for paper presentation December 1988. 3).Silver jubilee award of the Indian Society for Photobiology for poster presentation Feb 1989.

Reviewer of the following journals: Journal of Medicinal Chemistry (ACS), Journal of Physical Chemistry: B (ACS), Inorganic Chemistry Communication (Elsevier), BBA: Biomembranes (Elsevier).

Present Research:

New functions for old drugs: Non Steroidal Anti-Inflammatory Drugs (NSAIDs).

NSAID group of drugs are the most common drugs used to combat pain and inflammation. Besides these principal functions, they also show several other functions viz. chemoprevention and chemosuppression against different cancers, protection against neurodegenerative diseases, UV photosensitizer and UV photoprotector. The mechanism behind these diverse functions of NSAIDs is poorly understood. The aim of our group is to elucidate the molecular mechanism behind the different functions of NSAIDs such that the old drugs can be used more effectively for their alternate functions and can also be used as templates for future drug designing. The molecular basis of these functions is probed using both biophysical and biochemical techniques including different spectroscopic, imaging and calorimetric techniques. The main areas that have already been studied or are being studied include: a) Interaction of NSAIDs with membrane

mimetic systems/membranes: b) Effect of oxicam NSAIDs on mitochondrial membrane morphology and its consequences on downstream apoptotic signaling: c) Interaction of NSAIDs with lipid monolayer d) Complexes of NSAIDs with bioactive metals and their biological applications.

We have discovered the following new functions of NSAIDs

1) The oxicam NSAIDs viz. piroxicam, meloxicam and tenoxicam cause membrane fusion. The detail mechanism is being studied.

2) Indomethacin, a traditional painkiller can probe the cluster structures in alcohol water mixtures.

3) Cu(II) complexes of some oxicam NSAIDs can directly bind to the DNA backbone.

Future work:

1) Effect of NSAIDS on signaling pathways as a possible mechanism for their anticancer effects.

2) Effect of NSAIDs on fibril formation by amyloid peptides implicated in Alzheimer's Disease (AD) to identify the reason behind their protective effect against AD.

List of ten important publications:

1) "Non Steroidal Anti-inflammatory Drug Induced Membrane Fusion: Concentration and Temperature Effects" *Sutapa Mondal and Munna Sarkar**, **Journal of Physical Chemistry B. 113, (2009) 16323-16331.**

2) **"**Indomethacin: A NSAID sensitive to micro heterogeneity in alcohol water mixtures. *Archana Ghatak, Parikshit C. Mandal and, Munna Sarkar** **Chemical Physics Letters 460 (2008) 521-524.**

3) "New function of Non Steroidal Anti-Inflammatory Drugs: Membrane Fusion". *Hirak Chakraborty Sutapa Mondal and Munna Sarkar** **Biophysical Chemistry, 137 (2008) 28-34** ***[appeared as news in Nature India 28th August 2008,]***

4) Interaction of piroxicam with mitochondrial membrane and cytochrome c. *Hirak Chakraborty, Prabir K. Chakraborty, Sanghamitra Raha, Parikshit C. Mandal and Munna Sarkar** **BBA: Biomembranes 1786 (2007) 1138-1146.**

5) "Direct Binding of Cu(II)-complexes of Oxicam NSAIDs with DNA Backbone. *Sujata Roy, Rona Banerjee and Munna Sarkar** **Journal of Inorganic Biochemistry 100 (2006) 1320-1331**

6)."Interaction of oxicam NSAIDS with DMPC vesicels: Differential partitionig of drugs. *Hirak Chakraborty, Sujata Roy and Munna Sarkar** **Chemistry and Physics of Lipids 138 (2005), 20-28.**

7) "Optical spectroscopic and TEM studies of catanionic micelles of CTAB/SDS and their interaction with a NSAID". *Hirak Chakraborty and Munna Sarkar** **Langmuir, 20 (2004), 3551-3558.**

8) "Host-Guest Complexation of Oxicam NSAIDs with β- Cyclodextrin" by *Rona Banerjee, Hirak Chakraborty and Munna Sarkar** **Biopolymers, 75 (2004), 355-365.**

9) . "Incorporation of NSAIDs in micelles: implication of structural switchover in drug-membrane interaction". *Hirak Chakraborty Rona Banerjee and Munna Sarkar** **Biophysical Chemistry 104(1) (2003) 315-325.**

10) Ionic effects on the stability and the conformation of Peptide Nucleic Acids (PNA) complexes." *Sebastian Tomac, Munna Sarkar, Tommi Ratilainen, Pernilla Wittung, Peter Nielsen, Bengt Norden and Astrid Gräslund*.* **J. American Chem. Soc.118 (1996) 5544-5552.**

1. Name:

Maitreyee Nandy
Professor
Chemical Sciences Division
Saha Institute of Nuclear Physics

Educational Background:
B.Sc. (Physics Honours) University of Calcutta (1986)
M.Sc. (Physics) University of Calcutta (1989) (Session 1986-88)
Post M.Sc. (Radiological Physics) Saha Institute of Nuclear Physics (1989-'90)
Ph.D. (Science) University of Calcutta (2000)

2. Academic Profile:

Earlier employment data:
Physicist, Cancer Centre Welfare Home & Research Institute , February 1991-April 1992
Visiting Scientist:

a) Laboratori Nazionali di Frascati (INFN), Frascati, Italy: December 9, 2001 to March 8, 2002
b) Laboratori Nazionali di Frascati (INFN), Frascati, Italy: January 2, 2003 to February 15, 2003.
c) High Energy Accelerator Research Organisation, Tsukuba, Ibaraki, Japan; February 18, 2003 and April 20, 2003:

Awards:
National Merit Scholarship, Madhyamik Pariksha, awarded by West Bengal Board of Secondary Education, Ministry of Education, Govt. of West Bengal.

Ph.D. work:
Studies on Preequilibrium Emissions in Nuclear Reactions

3. Essential strength of research/development output

Theoretical estimations and experimental measurements of radiation environment have been carried out in proton and heavy ion accelerators spanning the energy range from a few MeV to 1 GeV in terms of double differential yield of neutrons and photons and radioactivity induced by the primary beam and secondary radiation.
Study in this area involving proton projectiles with energy up to about 1 GeV finds important application for facility design and radiological safety analysis for upcoming Accelerator Driven Subcritical Systems (ADSS). The measured neutron data for heavy ion projectiles reflects the total ambient dose equivalent and organ dose to humans and radiation damage caused to instruments in these facilities in any accidental condition.
The empirical formalisms developed for low to intermediate energy proton and light ion induced reactions helps to asses the radiation environment in such facilities. The energy differential neutron yield distributions at different angles give insight into nuclear reaction mechanisms when compared with theoretically computed results.

4. Future research/development plan

- Theoretical study and experimental measurement of neutron and photon energy-angle, dose distributions and transport in ADSS facilities
- Radiation environment and safety studies for low energy positive ion accelerators

5. List of important publications:

1. Maitreyee Nandy, P. K. Sarkar, N. Nakao, T. Shibata, "Measurement and theoretical estimation of induced activity in ^{nat}In by high energy neutrons" *PRAMANA – Journal of Physics* Volume 73, Number 4 / 669-683 October, (2009)
2. Sunil C, A A Shanbhag, M Nandy, M Maiti, T. Bandyopadhyay, Sarkar P K, "Direction Distribution of Ambient Neutron Dose Equivalent from 20 MeV Protons Incident on Thick Be and Cu Targets", *Radiation Protection Dosimetry* **136**: 67-73; doi:10.1093/rpd/ncp146. (2009)
3. Sunil C, Maitreyee Nandy, P. K. Sarkar, Measurement and analysis of energy and angular distributions of thick target neutron yield for 110 MeV ^{19}F on Al, *Physical Review C* **78**, 064607(1-10) (2008)
4. Sunil C, Nandy M, Bandyopadhyay T, Maiti M, Shanbhag A A, Sarkar P K, "Neutron dose equivalent from 100 MeV ^{19}F projectiles on thick Cu target", *Radiation Measurement 43, 1278-1284 (2008)*
5. Maitreyee Nandy and P. K. Sarkar, "Estimation of induced activity in thick lead-bismuth and iron alloy targets by 30 MeV protons", *Nuclear Instruments and Methods in Physics Research A*, **583** 248-255, (2007)
6. Maitreyee Nandy, C. Sunil, Moumita Maiti and P.K. Sarkar, "Estimation of angular distribution of neutron dose using time of flight for ^{19}F+Al system at 110 MeV" *Nuclear Instruments and Methods in Physics Research A*, **576**, 380-388, (2007).
7. C. Sunil, Maiti M., Nandy M., Sarkar P.K., "Thick Target Neutron Dose Evaluation For ^{19}F+Al System", *Radiation Protection Dosimetry* (Oxford Journals) **123** pp.277-282 (2007).
8. M. Maity, Maitreyee Nandy, S.N.Roy and P.K.Sarkar, "Systematics and empirical expressions for neutron emission from thick targets in α-induced reactions", *Physical Review C* **71**, 034601(2005).
9. D.Dhar, S.N.Roy, Maitreyee Nandy and P.K.Sarkar, "Analysis of neutron emission spectra for 30-50 MeV alpha-particle induced reactions in thick targets", *Physical Review C* **67**, 064611 (1-5) (2003).
10. Maitreyee Nandy, Tapas Bandyopadhyay, P.K. Sarkar, "Measurement and analysis of neutron spectra from a thick Ta target bombarded by 7.2A MeV ^{16}O ions", *Physical Review C* **63**, 034610 (1-6) (2001).
11. P. K. Sarkar and Maitreyee Nandy, "Concepts in computation of preequilibrium nucleon emission from heavy ion reactions", *Physical Review E* **61**, (6) 7161-7168 (2000).
12. Maitreyee Nandy, Sudip Ghosh and P. K. Sarkar, "Angular distribution of Preequilibrium Neutron Emissions from Heavy Ion Reactions", *Physical ReviewC* **60**, 044607(1-10) (1999).
13. N. Chakravarty, P. K. Sarkar, Maitreyee Nandy and Sudip Ghosh, "Excitation Function Measurement and Reaction Mechanism Analysis for Alpha-induced Reactions on 197-Au" *Journal of Physics G* **24**, p.151-166, (1998).
14. Sudip Ghosh, Maitreyee Nandy, P. K. Sarkar, N. Chakravarty, "Neutron Skin Effect in Preequilibrium Nucleon Emissions", *Physical Review C* **49**, 1059-1065 (1994).

Structural Genomics Division

Structural Genomics Division (SG):

Permanent members of the Division:

Scientific	Technical	Adm/Auxiliary
A. Chakrabarti Prof.	R. Dutta Tech-B	S. Show Helper-B
S. Banerjee Prof.		M. Shamal Cook cum Halwai
D. Mukhopadhyay Assoc. Prof.		
O. Chakrabarti Assoc. Prof.		

Ph.D students & Post Doctoral Fellows (2007 onwards)
A. Sengupta Banerjee, M. Raychaudhuri, M.Chakrabarti, M.Sinha, S.Saha, A.Chakrabarti (CSIR), N.Pal-Basak, A.Roy (CSIR), S.Das, S.Halder, S.Kundu, S.Bakshi, A.Basu (CSIR), K.Roy, A.Deb (CSIR), S. Karmakar, M. Mitra.

Dr. L. Lahiri (DBT), Dr. A. Biswas (DBT), Dr. S. Roy

Ph.D Degrees awarded (2007 onwards)
P. Datta.

Equipments and Resources in the Division:
1. MALDI TOF-TOF;
2. Differential Gel Electrophoresis System (DIGE);
3. LC MALDI Spotter;
4. FACS Calibur/Aria;
5. Image Plate with rotating anode X-ray generator;
6. CD spectrometer;
7. Dynamic Light Scattering (DLS) setup;
8. Fluorescence Spectrometer with Time resolved setup;
9. Cell Culture Facility: Biosafety cabinet, CO_2 incubator, inverted microscope;
10. Live Cell Imaging-FRET, FLIM & FCS setup;
11. Real time PCR, PCR, Luminometer, Refrigerated Centrifuge etc;
12. Liquid N_2 Freezer, Ultra-High Freezer, Deep Freezer, Cold room, Dark room etc

Research Activities & Important Results:
The Structural Genomics Division was constituted in May 26, 2010 with the objective to "carry out basic and applied research to understand the underlying mechanism of human diseases". Starting initially as a Section in the Xth Plan period, the first proteomics laboratory in eastern India and one among the few labs in the country was established in 2005. Currently, the division is primarily carrying out research in two major areas - hematological disorders and neurodegenerative diseases. The widely prevalent disease of eastern India, β-thalassemia along with, sickle cell anemia, hereditary spherocytosis and leukemia are being studied as a model for hematological disorders while Alzheimer's, Huntington's, and the prion diseases are being studied for the neurodegenerative diseases.

Hematological Disorders:
Red cell diseases e.g. thalassemia, other types of hemolytic anemia and different categories of haematological malignancies have been the main focus of some of our members. Studies on folding of heme proteins in presence of erythroid spectrin led to discovery of chaperone-like activity in spectrin. Differential interactions of HbE and HbA with erythroid spectrin have been shown to be implicated in β- & HbEβ-thalassemia. Greater losses of phosphatidylserine (PS) asymmetry and cell surface glycophorins were observed in younger erythrocytes compared to the aged ones in thalassemia, hereditary spherocytosis and haemolytic anemia compared to the normal red cells in circulation. Such drastic loss of PS asymmetry leads to faster eryptosis, mediated by shedding of glycophorin-containing microvesicles

leaving highly PS exposed erythrocytes accessible to the phagocytes. Over the years our members have characterized and annotated about 100 proteins from the erythrocytes of peripheral blood using two dimensional gel electrophoresis based separation followed by MALDI/ToF/ToF tandem mass spectrometry. Differential regulation of redox proteins e.g. PRDX2, SOD, and chaperones e.g. AHSP and Hsp70 in erythrocyte proteomes for HbEβ-thalassemia and membrane associated proteins, Flotilin 1, β-spectrin & dematin in HbEβ-thalassemia with unique appearance of calpastatin in hereditary spherocytosis were demonstrated.

In order to design an effective method to eliminate leukemic cells, an episomal vector was designed to synthesize siRNA for the BCR-ABL gene to target $CD34^+$ hematopoietic stem cells isolated from CML patients. In order to understand how the leukemic cells evade the immune surviellance, transcriptional downregulation of MHC genes were observed. Specific transcription factors that regulate the expression of MHC enhanceosome viz. CIITA, RFX, NF-Y etc. were therefore cloned and expressed to elucidate their role in immune evasion. Our studies in cell proliferation and differentiation have implicated the role of self renewal pathways and cross talk between the cell signalling pathways in chronic to blast transformation of $CD34^+$ CML stem cells isolated from patients. Moreover, we have established that cytoplasmic sequestration of the cell cycle inhibitor, p27 leads to its interaction with polycomb group of genes (Bmi1, EZH2) and activation of the Rho/Rac GTPase pathway resulting in actin depolymerization which in turn causes cellular egression/mobilization from the bone marrow. Currently this pathway is also being investigated in understanding the process of metastasis in epithelial cancer using in vitro matrigel assay.

Neurodegenerative Diseases:

Among the various diseases that affect the nervous system, some of the most debilitating are neurodegenerative disorders such as Alzheimer's, Huntington and Prion Disease. These late onset, but eventually fatal diseases are all caused by altered metabolism of individual proteins that interfere with normal cellular homeostasis. The normal 'life cycle' of a protein characterized by its biogenesis, trafficking and degradation are deviated in these disorders resulting in misfolding, misprocessing or mislocalization of the protein. Most likely, the aberrant protein can then engage in atypical interactions and ultimately lead to a series of unknown events culminating in cell death. The major focus of our research in Alzheimer's disease (AD) is to study the downstream pathogenesis of the disease, mediated through AICD and its adaptor network. AICD possesses many conserved motifs that are now known to interact with cytosolic "adaptor" proteins and these interactions in turn affect different signaling pathways. We have shown that Grb2, one such adaptors, interact with AICD in late endosomal compartments. The excess protein, thus entrapped, could be degraded by autophagy. The structure of AICD-YENPTY motif takes a different conformation in presence of its binding partner Grb2-SH2 vis- a-vis that of other AICD structures. Currently our members are interested in understanding the molecular pathways that lead to the extensive neuronal death in late-onset prion disease too.

Collaborators:

Internal: N P Bhattacharyya (C & MB Divison), Kalyan Giri (CSD Division)

External: Prof. Chanchal Dasgupta (IISER, Kolkata), Dr. Sudipa Chakrabarty, Dr. Amit Chakrabarty(Thalassemia Foundation, Kolkata), Dr. Debashis Banerjee, Dr. Sarmila Chandra (R K Mission Seva Pratisthan, Kolkata), Dr. Biplab Acharya, Dr. Partha Chatterjee, Prof. B. Acharya, Dr. P. Chattopadhyay, Dr. A. Chatterjee, Dr. Sourav Iswarari (NRS Medical College), Dr. Santasabuj Das (NICED, Kolkata).

Publications (2007 –onwards)

2007:

1. Sengupta A, Banerjee D, Chandra S, Banerji SK, Ghosh RN, Roy R, Banerjee S (2007). Deregulation and cross talk among Sonic Hedgehog, Wnt, Hox and Notch signaling in Chronic Myeloid Leukemia progression. **Leukemia** 21: 949 - 955.
2. Sengupta A, Banerjee, S (2007). Pleiotropic p27 (Kip1), BCR-ABL and Leukemic Stem Cell: the trio in concert. **Leukemia** 21: 2559.
3. Raychaudhuri M., Mukhopadhyay D (2007). AICD and its Adaptors – in search of new players, **Journal of Alzheimer's Disease** 11: 343-58.
4. Bhattacharyya D, Mukhopadhyay D, Chakrabarti A (2007). Hemoglobin depletion from red blood cell cytosol reveals new proteins in 2D gel based proteomics study. (2007). **Proteomics - Clinical Applications** 1: 561-564.
5. Datta P, Chakrabarty S, Chakrabarty A, Chakrabarti A (2007). Spectrin interactions of globin chains in presence of phosphate metabolites and hydrogen peroxide: Implications in thalassemia. **J. Biosci.** 32, 1147-1151.

2008:

6. Basu S, Banerjee D, Chandra S, Chakrabarti A (2008). Loss of phospholipid membrane asymmetry and sialylated glycoconjugates from erythrocyte surface in HbE b-thalassemia. **Brit. J. Haematol.** 141: 92-99.
7. Chakrabarti A, Datta P, Bhattacharya D, Basu S, Saha S (2008). Oxidative crosslinking, spectrin and membrane interactions of hemoglobin mixtures in HbE beta-thalassemia. **Hematology** 13: 361-8.
8. Datta P, Chakrabarty S, Chakrabarty A, Chakrabarti A (2008). Membrane interactions of hemoglobin variants, HbA, HbE, HbF and globin subunits of HbA: effects of aminophospholipids and cholesterol. **Biochim. Biophys. Acta** 1778, 1-9.
9. Banerjee D, Basu S, Saha S, Chakrabarti A (2008). Porous red cell ultrastructure and loss of membrane asymmetry in a novel case of hemolytic anemia. **Eur. J. Haematol**. 81: 399-402.
10. Samanta D, Mukhopadhyay D, Chowdhury S, Ghosh J, Pal S, Basu A, Bhattacharya A, Das A, Das D, DasGupta C (2008). Protein folding by domain V of Escherichia coli 23S rRNA: specificity of RNA-protein interactions**. J. Bacteriol**. 190: 3344-52.
11. Chakraborty K, Ghosh S, Koley H, Mukhopadhyay AK, Ramamurthy T, Saha DR, Mukhopadhyay D, Roychowdhury S, Hamabata T, Takeda Y, Das S (2008). Bacterial exotoxins downregulate cathelicidin (hCAP-18/LL-37) and human beta-defensin 1 (HBD-1) expression in the intestinal epithelial cells. **Cell. Microbiol.** 10: 2520-37.
12. Raychaudhuri S, Majumder P, Sarkar S, Giri K, Mukhopadhyay D, Bhattacharyya NP. (2008). Huntingtin interacting protein HYPK is intrinsically unstructured. Proteins: Structure, Function & Bioinformatics 71: 1686-98.

2009:

13. Raychaudhuri S, Dey S, Bhattacharyya NP, Mukhopadhyay D (2009). The role of intrinsically unstructured proteins in neurodegenerative diseases. **PLoS One**. 4: e5566.
14. Basu S, Banerjee D, Chandra S, Chakrabarti A (2009). Eryptosis in hereditary spherocytosis and thalassemia: role of glycoconjugates. **Glycoconjugate Journal**. DOI 10.1007/s10719-009-9257-6.

2010:

15. Bhattacharya D, Saha S, Basu S, Chakravarty S, Chakravarty A, Banerjee D, Chakrabarti A (2010). Differential regulation of redox proteins and chaperones in erythrocyte proteomes in HbEβ-thalassemia. **Proteomics – Clinical applications** 4: 480-488.
16. Chakraborty M, Bhattacharya D, Mukhopadhyay C, Chakrabarti A (2010). Structure and conformational studies on dityrosine formation in the DNA binding domain of RFX5**. Biophys Chem**. 149: 92-101.

17. Basu S, Banerjee D, Ghosh M, Chakrabarti A (2010). Erythrocyte membrane defects and loss of asymmetry in paroxysmal nocturnal haemoglobinuria and myelodysplastic syndrome. **Hematology** 15, 236-239.
18. Das D, Samanta D, Das A, Ghosh J, Bhattacharya A, Basu A, Chakrabarti A, Das Gupta C (2010). Ribosome: The Structure-Function Relation and a New Paradigm to the Protein Folding Problem. **Israel J Chem**. 50, 109-116.
19. Raychaudhuri M, Mukhopadhyay D (2010). Grb2-Mediated Alteration in the Trafficking of A beta PP: Insights from Grb2-AICD Interaction. **Journal of Alzheimer's Disease** 20: 275-92.
20. Chakraborty M, Sengupta A, Bhattacharya D, Banerjee S, Chakrabarti A. (2010). DNA binding domain of RFX5: Interactions with X-box DNA and RFXANK. **Biochim Biophys Acta – Proteins & Proteomics** 1804: 2016-2024.
21. Sengupta-Banerjee A, Banerjee, S (2010). EBV encoded small non-coding RNAs induce cancer cell chemo-resistance and migration. **Mol. Carcinogenesis**. Manuscript accepted
22. Sarkar S, Biswas NK, Dey B, Mukhopadhyay D, Majumder P P (2010) A large, systematic molecular-genetic study of G6PD in Indian populations identifies a new non-synonymous variant and supports recent positive selection. **Infect Genet Evol**. Aug 14 (E-pub).
23. Raychaudhuri, M, Mukhopadhyay D (2010) AICD Over-expression in Neuro2A cells regulates expression of PTCH1 and TRPC5, **International Journal of Alzheimer's Disease** (in press)

Article in Book & Review Series:

1. Chakrabarti A (2009) A fluorescence quenching method to study interactions of hemoglobin derivatives with erythroid spectrin. **Rev Fluorescence** 2007. 363 - 378.
2.

Collaborators:
Internal: N P Bhattacharyya (C & MB Divison), Kalyan Giri (CSD Division)
External: Prof. Chanchal Dasgupta (IISER, Kolkata), Dr. Sudipa Chakrabarty, Dr. Amit Chakrabarty(Thalassemia Foundation, Kolkata), Dr. Debashis Banerjee, Dr. Sarmila Chandra (R K Mission Seva Pratisthan, Kolkata), Dr. Biplab Acharya, Dr. Partha Chatterjee, Dr. Sourav Iswarari (NRS Medical College), Dr. Santasabuj Das (NICED, Kolkata)

SUBRATA BANERJEE

Educational Background:

Ph. D. (Sc.), Saha Institute of Nuclear Physics (SINP), University of Calcutta, 1991;

M. Sc. (Physics), University of Calcutta, 1984;

B. Sc. (Physics), Presidency College, University of Calcutta, 1982

Academic Profile:

1991 - 1997: Post Doctoral/Research Associate: Lineberger Cancer Centre, University of North Carolina at Chapel Hill, USA (Lab: Prof. J-M. H. Vos);

1997 - 2001: Reader-'SD', Biophysics Division, SINP; (*Date of Joining*: Nov. 26, 1997)

2001 - 2005: Assoc. Prof.-'SE', Biophysics Division, SINP;

2005 - 2010: Prof.-'SF', Structural Genomics Section & Biophysics Division, SINP;

2010 - : Prof. 'G', Structural Genomics Division, SINP;

Honors/ Award: Fanconi's Anemia Inc., Postdoctoral Fellowship, USA: 1992-1995;
Leukemia Society of America Research Fellowship, USA: 1995-1997

Essential Strength of Research/Development Work:

As an independent investigator, in the early period, I had been involved in developing an extra chromosomal multicopy infectious Epstein Barr Virus (EBV) based vector to deliver therapeutic genes of interest into human cells. Our initial work based on this aspect delivered the human Factor VIII cDNA responsible in hemophilia A, the blood clotting disorder, into human B-cells in culture *(J. Gene Med.).* Later, we redesigned the vector to synthesize siRNA for the BCR-ABL gene into CD34+ hematopoietic stem cells isolated from CML bone marrow samples *(J. Gene Med.).* Bearing in mind the risk of insertional mutagenesis characterized by retroviral vectors, this novel, episomal vector carries the safety switch 'thymidine kinase-tk' and is thus well suited to be a potential candidate for suicide gene delivery in cancer. We had plans to transfer a genomic insert carrying the entire β-globin gene (~100 kB) into hematopoietic stem cells isolated from thalassemic patients and test the safety of this vector in NOD/SCID mice model.

This interest in therapeutic intervention of cancer motivated us to initiate research in the mechanism of cell proliferation, cell migration and immune evasion mechanism in cancer and leukemia. Our results indicate that malignant cells evade immune response by transcriptional regulation of HLA class I genes *(Cancer, Hum. Immun..)* Specific transcription factors that regulate the expression of MHC enhanceosome viz. CIITA, RFX, NF-Y etc. were being studied to elucidate their role in immune evasion *(Immunogenetics, Leuk. Res.).* We have cloned and are expressing these transcription factors to understand their mechanism of action in regulating MHC enhanceosome. Our studies in cell proliferation and differentiation have implicated the role of self renewal pathways and cross talk between the cell signaling pathways in chronic to blast transformation of CD34+ CML stem cells isolated from patients *(Leukemia).* We have established that cytoplasmic sequestration of the cell cycle inhibitor, p27 leads to its interaction with polycomb group of genes (Bmi1, EZH2) and activation of the Rho/Rac

GTPase pathway resulting in actin depolymerization which in turn causes cellular egression/mobilization from the bone marrow. Currently this pathway is being investigated in understanding the process of metastasis in EBV associated gastric cancer. Recently, the role of viral noncoding RNAs and miRNA have been established in deregulation of cell proliferation and migration using in vitro matrigel assay *(Mol. Carcinogenesis under revision).*

Presently, our main interest is to understand the process of differentiation in Hematopoitic Stem cells (HSC) with an eye towards leukemogenesis. We are isolating human cells at various stages of differentiation using lineage specific markers and flow cytometry, and are using the omics tools (Real-time PCR, Western/ELISA, Proteomics) to characterize the expression and role of various genes-proteins involved. Self renewal genes such as Notch, Hox, Shh, Wnt or their down stream molecules β-catenin, Gli1/3 etc are being transferred into primary CD34+ cells as well as hematopoietic cell lines (K562, HL-90, U937) as an *in vitro* model with this in mind.

Number of Students who have been awarded Ph.D. (Sc) degree on this program: 4;
Number of Students undergoing Ph.D. (Sc.) training on this program: 5

Future Research/development plan:

With the Proteomics program firmly established in our Division, we now plan to undertake a program on Mitochondrial Proteomics and Cell Differentiation. Mitochondria are dynamic organelles that constantly undergo continuous cycles of fission and fusion. A delicate balance between these two processes is important for many physiological outcomes such as cellular morphology, metabolism, apoptosis, autophagy, development and cellular chemotaxis. A deeper understanding of the remarkable dynamic nature of mitochondria and cellular differentiation will then help to understand the progression of many important pathological conditions including neurodegenerative diseases, cancer and leukemia.

List of important publications:

1)Sengupta A and Banerjee S: Pleiotropic p27(kip1), BCR-ABL and leukemia stem cell: the trio in concert Leukemia (2007) 21(12): 2559;

2) Sengupta A, Banerjee D, Chandra S, Banerji SK, Ghosh R, Roy R and Banerjee S: Deregulation and cross talk among Sonic Hedgehog, Wnt, Hox and Notch signaling in chronic myeloid leukemia progression Leukemia (2007) 21(5):949;

3) Sengupta A, Bandyopadhyay D, Chandra S & Banerjee S: Gene therapy for BCR-ABL+ human CML with dual phosphorylation resistant p27Kip1 and stable RNA interference using an EBV vector J. Gene Med. (2006) 8(10):1251;

4) Dutta N, Gupta A, Majumder DN & Banerjee S: Downregulation of locus specific Human Lymphocyte Antigen class I expression in Epstein Barr Virus associated Gastric cancer: Implications for viral induced immune evasion. Cancer (2006) 106(8):1685;

5) Basu U & Banerjee S: An engineered EBV vector expressing human factor VIII and von Willebrand factor in cultured B-cells. J Gene Med. (2004) 6(7):760;

***Name* :** Abhijit Chakrabarti (b 13 April, 1960)

***Academic qualification* :** Ph.D, 1990, Indian Institute of Science, Bangalore

Positions held (in chronological order)

Year (s)	*University / Institution*	*Positions held*
1990 – 1993	The Johns Hopkins University	Post Doc Fellow
1994 – 1996	Saha Institute of Nuclear Physics	Lecturer
1996 – 1999	Saha Institute of Nuclear Physics	Reader
1999- 2006	Saha Institute of Nuclear Physics	Asso. Professor
2007 till date	Saha Institute of Nuclear Physics	Professor

Research highlights :

I had done my postdoctoral work at the Department of Biology of The Johns Hopkins University while working on lateral association of MHC class I antigens with insulin receptor using flow cytometric FRET and FRAP techniques before joining Saha Institute of Nuclear Physics, (SINP), Kolkata, in June 1994. I have been working on erythrocyte membranes and its protein-based skeletal network for the last 16 years. Contributions from my lab in the understanding of protein-protein and lipid-protein interactions among the erythroid membrane components and binding of hydrophobic molecules used as probes, have been rather significant and led to better understanding of the biology of erythrocytes in terms of the integrity and architecture of the membrane and its skeletal proteins e.g. spectrin. My work on polarity estimate of the hydrophobic binding sites in spectrin by pyrene fluorescence is one among the earlier to estimate the apparent dielectric constant of the core of the protein (1). Studies on folding of heme proteins in presence of erythroid spectrin led to discovery of chaperone-like activity in spectrin and specific binding site for PE has been identified at the end terminal domain of spectrin (2,3). The work on the discovery of chaperone property of spectrin have been highly praised in the international meeting on Membrane Skeleton, organized by the European Membrane Skeleton Club in Zakopane, Poland during June 15th – 18th, 2008.

Red cell diseases e.g. thalassemia, other types of hemolytic anemia and different categories of haematological malignancies have been the main focus of my lab since past 8 years. Differential interactions of HbE and HbA with erythroid spectrin have been shown to be implicated in β- & HbEβ-thalassemia. Towards this a novel fluorescence quenching technique has been designed and applied to evaluate the binding affinity and the yield of formation of cross-linked molecular aggregates under oxidative stress, of hemoglobin variants and the globin chains with spectrin. Studies on, have been found to depend on the levels of HbE and the phosphate metabolites ATP & 2,3-DPG in HbEβ-thalassemia. Greater losses of phosphatidylserine (PS) asymmetry and cell surface glycophorins were observed in younger erythrocytes compared to the aged ones in thalassemia, hereditary spherocytosis and haemolytic anemia compared to the normal red cells in circulation. Such drastic loss of PS asymmetry leads to faster eryptosis, mediated by shedding of glycophorin-containing microvesicles leaving highly PS exposed erythrocytes accessible to the phagocytes (4).

Starting early 2000 I have been instrumental in setting up of a Structural Genomics laboratory and have established the first proteomics laboratory in eastern India and one among the 4-5 five labs in the country. Over the year myself and my students have characterized and annotated about 100 proteins from the erythrocytes of peripheral blood using 2DGE based separation followed by MALDI/ToF/ToF tandem mass spectrometry and have come up with an excellent hemoglobin depletion technique, published in Proteomics – Clinical Applications in 2007 and 2010 (5). The work has been "podcasted" and has received citations from article published in Nature Protocol. We have shown differential regulation of redox proteins e.g. PRDX2, SOD, and chaperones e.g. AHSP and Hsp70 in erythrocyte proteomes for HbEβ-thalassemia and among membrane associated proteins, Flotilin 1, β-spectrin & dematin in HbEβ-thalassemia with unique appearance of calpastatin in hereditary spherocytosis. More clinical proteomic studies are underway with serum and CD19+ cells isolated from blood samples of acute lymphoblastic leukaemia (ALL) patients. Future plans are centred around clinical proteomics studies of serum, urine and blood cells in haemoglobin disorders and to elucidate the role of membrane skeletal proteins in maintenance of asymmetric distribution of aminophospholipids and cholesterol.

Altogether, I have published fifty eight (58) papers till August 2010 and have supervised nine (9) thesis for PhD. The average impact factor of all 58 papers has been 2.80 with 13 papers those are cited for more than 13 times and 5 of them cited more than 20 times.

I have also been instrumental in designing and teaching courses on Membrane and Cell Biology and Protein Folding for advanced graduate students. Currently I head of the Centre for Advanced Research & Education (CARE), the mandate of which is to attract young talented students in basic science. The CARE was established as a project of SINP in the Xth 5-year plan period, with the purpose of initiating motivated and talented students of physics, chemistry and biology into advanced research.

List of the five recent and important papers published from SINP :

1. Md. Emdadul Haque, Sibnath Ray and *Abhijit Chakrabarti* (2000) Polarity estimate of the hydrophobic binding sites in erythroid spectrin : A stydy by pyrene fluorescence. J. Fluorescence **10**, 1-6.

2. Sibnath Ray and *Abhijit Chakrabarti* (2004) Membrane interaction of erythroid spectrin : Surface-density-dependent high affinity binding to phosphatidylethanolamine. Mol. Memb. Biol. 21, 93-100.

3. Malyasri Bhattacharyya, Sibnath Ray, Shekhar Bhattacharya and *Abhijit Chakrabarti* (2004) Chaperone activity and Prodan binding at the self-associating domain of erythroid spectrin. J Biol Chem. **279**, 55080-55088.

4. Sumanta Basu, Debasis Banerjee, Sarmila Chandra and *Abhijit Chakrabarti* (2008) Loss of phospholipid membrane asymmetry and sialylated glycoconjugates from erythrocyte surface in HbEβ-thalassemia. Brit. J. Haematol. **141**, 92-99.

5. Dipankar Bhattacharya, Sutapa Saha, Sumanta Basu, Sudipa Chakravarty, Amit Chakravarty, Debashis Banerjee and *Abhijit Chakrabarti* (2010) Differential regulation of redox proteins and chaperones in erythrocyte proteomes in HbEβ-thalassemia. Proteomics – Clinical applications **4**, 480-488.

Debashis Mukhopadhyay

Educational Background

1995-2000 University of Calcutta Kolkata, India.
- **Ph.D. in Biophysics, Molecular Biology and Genetics**. (***awarded in 2001***)
- Specialized in Protein X-Ray Crystallography.

1993-1995 University of Calcutta Kolkata, India.
- **M.Sc. in Biophysics and Molecular Biology.**

1989-1993 University of Calcutta Kolkata, India
- **B.Sc. Physics (Honours), Chemistry, Mathematics, English.**

Academic Profile

Positions held	Univ./Inst.	Period	
		From	To
Associate Professor 'F'	Structural Genomics division, Saha Institute of Nuclear Physics	2011 (Jan)	Cont
Associate Professor 'E'	Structural Genomics section, Saha Institute of Nuclear Physics	2007 (Aug)	2010 (Dec)
Reader 'D'	Structural Genomics section, Saha Institute of Nuclear Physics	2005 (Feb)	2007 (Jul)
Research Scientist	School of Medicine, University of California at San Diego, La Jolla, CA, USA	2004	2005 (Jan)
Guest Scientist	Division of Cellular Biology, Dept of Molecular & Experimental Medicine, The Scripps Research Institute, La Jolla, CA, USA	2004	2005
Research Associate	Division of Cellular Biology, Dept of Molecular & Experimental Medicine, The Scripps Research Institute, La Jolla, CA, USA	2000 (Nov)	2003

- Member, BOS in Biotechnology (Integrated M.Sc), St. Xavier's' (Auton) College, Kolkata (since May, 2009).
- Associate Editor, Journal of Alzheimer's Disease**,** IOS Press, Fairfax, USA.
- Skagg's Post-doctoral Research Fellowship (2001 – 2003)
- Qualified in NET (Govt of India), in December '94, for Junior Research fellowship and Lectureship.
- Academic stipend from "Verein der AusbildungsfÖrderung zur Selbsthilfe in indien e.V", Germany (`91-`96)
- Gov't of India National Scholarship for studies (1987-1995).
- President of India Award for securing rank 13 in the school leaving examination (1987).

Research Output

The study of downstream pathogenesis of Alzheimer's disease (AD), mediated through AICD and its adaptor network is the major focus which currently has the following facets:-

- **Molecular & Cell Biology of AICD – adaptor Protein (viz., Grb2) Interaction**
- **Structural Characterization of AICD Interactions Using Crystallography, Fluorescence & FCS**
- **Identification of New Members of AICD Interactome Using Proteomics Tools**
- **Modeling of Molecular & Pathway Cross-talk in Neurodegenerative Diseases**

Future Research Plan

- **Understanding AICD mediated Cellular Dynamics, Trafficking and Cytotoxicity in Mouse Model**
- **Protein Interactions in Regeneration – Spinal Cord Injury Proteomics**

List of publications

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3.Kamalika Roy, Kalpita Ghosh, Anupam Banerjee, **Debashis Mukhopadhyay**, Susanta Lahiri. Biochemical Engineering Journal, Volume 45, Issue 1, 1 June 2009, Pages 82-85

4. Raychaudhuri S, Dey S, Bhattacharyya NP, **Mukhopadhyay D**. PLoS One. 2009;4(5):e5566. Epub 2009 May 15.

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6.Samanta D, **Mukhopadhyay D**, Chowdhury S, Ghosh J, Pal S, Basu A, Bhattacharya A, Das A, Das D, DasGupta C. J Bacteriol. 2008 May;190(9):3344-52

7. Raychaudhuri S, Majumder P, Sarkar S, Giri K, **Mukhopadhyay D**, Bhattacharyya NP. Proteins. 2008 Jun;71(4):1686-98

8.Raychaudhuri S, Sinha M, **Mukhopadhyay D**, Bhattacharyya NP. Hum Mol Genet. 2008 Jan 15;17(2):240-55 –

9.Raychaudhuri S, Dey S, Roy Choudhury K, **Mukhopadhyay D,** Bhattacharyya NP. Perspectives in Cytology and Genetics, Vol XIII 2007, 125 – 132.

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15. Dewji, N.N., Mukhopadhyay, D., Singer, S.J. (2006) Proc. of Nat. Acad. of Sc. USA 103 (5), pp. 1540-1545.

16. Mukhopadhyay, D., Varughese, K.I. (2005). Jr Biomolecular Str. Dyn. 22 (5), pp. 555-562.

17. Debashis Mukhopadhyay, Udayaditya Sen, James Zapf and Kottayil I. Varughese, (2004) Acta Crystallographica D, 60(4), 638-45.

18. Mukhopadhyay D, J. Mol. Evol., Vol.50:3, Pg 214-223,2000.

19. Dattagupta JK, Podder A, Chakrabarti C, Sen U, Dutta SK, Mukhopadhyay D and Singh M, Proteins: Structure, Function & Genetics, Vol.35, Pg 321-331, 1999.

20. Dasgupta J, Ravichandran S, Mukhopadhyay D, Sen U, Podder A, Chakrabarti C and Dattagupta JK, in "Perspectives in Structural Biology", Prof.G.N Ramachandran Honorary Volume, ed. By Vijayan M et al., Pg 75-82,1999

21. Mukhopadhyay D and Dattagupta JK, Science and Culture, Vol. 65, Pg 128-132, 1999.

Name: Oishee Chakraborti

Academic qualification : Ph D, National Centre for Biological Sciences (NCBS), TIFR, Bangalore, 2003

Positions held (in chronological order)

Year (s)	*University / Institution*	*Positions held*
2003 – 2004	NCBS, TIFR, Bangalore	Post Doc Fellow
2004 – 2005	Harvard Medical School, USA	Post Doc Fellow
2005 – 2009	NICHD, National Institute of Health, USA	Post Doc Fellow
April 29, 2010 till date	Saha Institute of Nuclear Physics	Asso. Professor 'E'

Research highlights :

Cell Biology of Neurodegeneration: My laboratory is interested in understanding the molecular pathways that lead to extensive neuronal death in late-onset neurodegenerative diseases. Among the hundreds of diseases that affect the nervous system, some of the most debilitating are neurodegenerative disorders such as Alzheimer's, Parkinson's, Huntington's, and the prion diseases. These chronic, slowly progressing, but ultimately fatal diseases are all caused by altered metabolism of individual proteins that somehow interfere with normal cellular homeostasis to cause their death. This occurs when a protein deviates from its normal 'life cycle' characterized by its biogenesis, trafficking and eventual degradation. Errors in one or more of these events results in the generation of misfolded, misprocessed, or mislocalized variants of the protein. Presumably, the aberrant protein species can engage in atypical interactions and ultimately leads to a series of unknown events culminating in cell death. The nature of these downstream events leading from aberrant protein to cellular dysfunction to ultimately cell death are not well understood for any of the hundreds of protein misfolding diseases.

Prion disease: Our goals are to approach this fundamental problem using two model systems: one specific, using the prion protein (PrP) to study the pathways that mediate neurodegeneration in prion diseases. A novel interaction exists between cytosolic PrP (a form identified in some prion diseases and Mahogunin (Mgrn), a cytosolic ubiquitin ligase. Disruption of Mgrn function leads to similar spongiform neurodegeneration as identified in prion diseases (Fig1). We so far know that abnormal forms of PrP, capable of interacting with Mgrn can selectively affect endo-lysosomal trafficking pathways and lead to lysosomal dysfunction. What molecular players of the ESCRT (endosomal sorting complex required for transport)-pathway are involved in such interactions? How is the biogenesis of the lysosomal vesicles affected in this disease?
The lysosomes become an important vesicle in context of late-onset neurodegenerative diseases because degradation by these organelles plays a significant role in regulating the intensity and rate of onset of these diseases. These and other related questions are being addressed using biochemical, mass-spectrometric and high resolution imaging analyses of cultured cells and genetically modified mouse models.

Protein Aggregation: The age-dependent neurodegenerative diseases are multifactorial, while lysosomal dysfunction could be one of the causes; progressive aggregation of misfolded, misprocrocessed and mislocalized proteins also plays an important role in these diseases. The proteins which should have reached their desired destinations to optimally perform their expected functions instead can end up in

aggregates. So how does, or rather can a cell deal with the presence of protein aggregates? Does this get altered when a cell undergoes stress or is it possible to alleviate the aggregate burden of a cell? Can quality control mechanisms be altered so that cells proteins are prone to aggregation? Hence at a more general level, we are studying how aggregates are generated in a cell, also elucidating some key aspects of cellular homoeostasis. The dynamics of protein aggregation are being using real-time imaging of fluorescently labeled protein expressed in of cultured cells.

Publications

(2006-recent):

1. Rane, N.S., **Chakrabarti, O**., Feigenbaum, L. and Hegde, R.S. Signal sequence insufficiency contributes to neurodegeneration caused by transmembrane Prion protein. ***Journal of Cell Biology***, **188,** 515-526 (**2010**).

2. **Chakrabarti, O**. and Hegde, R.S. Functional depletion of Mahogunin by cytosolically exposed prion protein contributes to neurodegeneration. ***Cell***, **137**, 1136-1147 (**2009**).

3. **Chakrabarti, O**., Ashok, A. and Hegde R.S. Prion protein biosynthesis and its emerging role in neurodegeneration. ***Trends in Biochemical Sciences***, **34**, 287-295 (**2009**).

4. Rane, N.S., Kang, S-W, **Chakrabarti, O**., Feigenbaum, L. and Hegde, R. S. Reduced translocation of nascent prion protein during ER stress contributes to neurodegeneration. ***Developmental Cell***, **15**, 359-370 (**2008**).

5. **Chakrabarti, O**. and Hegde, R.S. Trafficking of the cellular prion protein and its role in neurodegeneration, in an ***Elsevier*** publication entitled "Protein Trafficking in the Neuron"; edited by Dr. Andrew Bean. (Academic Press, **2006**)

6. **Chakrabarti, O.**, Rane N.S. and Hegde, R.S. Cytosolic aggregates perturb the metabolism of mislocalized secretory and membrane proteins. (Manuscript in preparation).

7. Emerman, A., **Chakrabarti, O**. and Hegde R.S. Novel methods to identify and distinguish intracellular forms of various disease causing prion protein isoforms. (Manuscript in preparation).

2001-2006:

8. Veeraraghavalu, K., Subbaiah, V.K., Srivastava, S., **Chakrabarti, O**., Syal, R. and Krishna, S. Complementation of human papillomavirus type 16 E6 and E7 by Jagged1-specific Notch1-phosphatidylinositol 3-kinase signaling involves pleiotropic oncogenic functions independent of CBF1;Su(H);Lag-1 activation. ***Journal of Virology***, **79**, 7889-7898 (**2005**).

9. **Chakrabarti, O**., Veeraraghavalu, K., Tergaonkar, V., Liu, Y., Androphy, E.J., Stanley, M.A. and Krishna, S. Human papillomavirus type 16 E6 amino acid 83 variants enhance E6-mediated MAPK signaling and differentially regulate tumorigenesis by notch signaling and oncogenic Ras. ***Journal of Virology***, **78**, 5934-5945 (**2004**).

10. **Chakrabarti, O**. and Krishna S. Molecular interactions of "high risk" human papillomaviruses E6 and E7 oncoproteins: implications in tumour progression. ***Journal of Biosciences***, **28**, 337-348 (**2003**).

11. Rangarajan, A., Syal, R., Selvarajah, S., **Chakrabarti, O**., Sarin, A. and Krishna, S. Activated Notch1 signaling cooperates with papillomavirus oncogenes in transformation and generates resistance to apoptosis on matrix withdrawal through PKB/Akt. ***Virolology***, **286**, 23-30 (**2001**).