CURRICULUM VITAE

Name: DR. AMRITA BANERJEE

Current Position: **Assistant Professor**, **Head**, Department of Chemistry, Hiralal Mazumdar Memorial College for Women, Dakshineswar, Kolkata-700035, West Bengal, India since **29th June, 2017**.

(*Other Responsibilities: Science Coordinator of the College and Nodal Officer for the spoken tutorial programme in collaboration with IIT Bombay*)

Email: **banerjeeamrita86@gmail.com / amritabanerjeeju@gmail.com**.

Mobile: **+91-9836247206**

Area of Interest

Teaching and research at the interface of chemistry and biology using biophysical, biochemical and molecular biology tools.

Personal Details

Residential address: c/o Amitava Banerjee, Banerjee Para, LP/10/3/3/1, P.O. & P.S. Maheshtala, Kolkata – 700141, India.

Present address: c/o Dr. Ajoy Mukherji, 33D Prasanna Naskar Lane, Budir Bagan Complex (Gate 2), Picnic Garden, Kolkata – 700039, India.

Residential contact number: +91-33-2492-5127 / +91-33-23444120

Date of Birth: 21st March, 1986

Gender: Female

Nationality: Indian

Marital status: Married

Education and Research

2015-2017: DBT- Research Associate in CSIR-Indian Institute of Chemical Biology, Jadavpur, Kolkata, India from. Mentor: Dr. Krishnananda Chattopadhyay.

2014-2015: **Research Associate,** Biophysics & Structural Genomics Division, Saha Institute of Nuclear Physics, Block – AF Sector-I, Bidhan Nagar, Kolkata-700064, India.

2010-2014: **Doctoral Research**, Biophysics and Structural Genomics Division, Saha Institute of Nuclear Physics, Kolkata, India. Ph.D. degree obtained from Jadavpur University in **May 2015**.
Dissertation: Effect of small molecules on chromatin assembly.
Supervisor: Professor Dipak Dasgupta.

2009-2010: **Post M.Sc. in Biophysical Sciences.**
Saha Institute of Nuclear Physics (**71.7%, Rank 5**)

2007-2009: M.Sc. in Chemistry (Specialization: Physical Chemistry).
Jadavpur University, Kolkata, India (**75.5%, 1st class, Rank 1**)

2004-2007: B.Sc. in Chemistry (Hons.).
Jadavpur University, Kolkata, India (**72.9%, 1st class** with distinction in subsidiary subjects, **Rank 8**)

2004: Indian School Certificate (ISC) Examination.
Vivekananda Mission School (English Medium)
Council for the Indian school Certificate Examinations, New Delhi, India. (**91.5%)**

2002: Indian Certificate of Secondary Education (ICSE) Examination.
Vivekananda Mission School (English Medium)
Council for the Indian school Certificate Examinations, New Delhi, India. (**92.4%)**

Fellowships and Awards

a) **DBT-Research Associate (DBT-RA),** Structural Biology and Bioinformatics Division, CSIR-Indian Institute of Chemical Biology, Kolkata, India from July 2015 to June 2017.

b) **Research Associate (RA),** Biophysics & Structural Genomics Division, Saha Institute of Nuclear Physics, Kolkata, India from September 2014 to June 2015.

c) **Senior Research Fellow (SRF)**, Saha Institute of Nuclear Physics, Kolkata, India from August 2011 to August 2014.

d) **Junior Research Fellow (JRF)**, Saha Institute of Nuclear Physics, Kolkata, India from August 2009 to August 2011.

e) **National Eligibility Test (NET)** 2008 (December): Qualified (LS).

f) **Graduate Aptitude Test in Engineering (GATE) 2009**: Qualified (Percentile Score: 89.01)

g) **Indira Gandhi P.G. Scholarship** (2007-2009).

h) **University Medal** at the M.Sc. Examination for standing 1st in order of merit.

i) **Prof. M.N. Das Memorial Gold centered Silver Medal** for securing the highest total of marks in the special paper (Physical Chemistry papers).

j) **Sailabala Biswas Memorial Merit Scholarship**, Jadavpur University (2009-10).

k) **Bidyut Baran Chatterjee Memorial Merit Book Prize**, Jadavpur University (2009-10).

Foreign Travel Grants

Sanctioned by Department of Science and Technology (**DST**) and Council of Scientific and Industrial Research (**CSIR**), Govt. of India for participation and presentation of research paper in international conference (USA).

Research Experience

Post-Doctoral Research

Title: Protein folding and aggregation in the context of Amyotrophic Lateral Sclerosis.

Advisor: Dr. Krishnananda Chattopadhyay, Structural Biology and Bioinformatics Division, CSIR-Indian Institute of Chemical Biology, Jadavpur, Kolkata, India.

Currently I am working on protein folding and dynamics. My protein of interest is a cytosolic protein, human copper-zinc superoxide dismutase (SOD1). SOD1 aggregation has been identified as the prime cause behind familial and sporadic Amyotrophic Lateral Sclerosis (ALS). However, the mechanism via which the aggregated SOD1 exerts cytotoxicity to motor neurons is not yet known. The objectives of my present project includes the study of the conformational stability of WT SOD1, Apo SOD1 and key mutants (Cu mutant, H121F; Zn mutant, H72F; Cu-Zn mutant, H63F; and crucial ALS mutants, I113T, G93A and pseudo-wild type mutant) by unfolding transitions both in aqueous solution and in the presence of crowding agents. Owing to the structural and conformational heterogeneity of aggregation landscape associated with the neurodegenerative diseases, it is difficult to be resolved by conventional biochemical and biophysical methods. Therefore, we aim to use the single molecule resolution of our fluorescence based technique to solve some of these problems. Aggregation of SOD1 will be studied *in vitro* using fluorescence correlation spectroscopy (FCS) and thioflavin-T THT assay. We also intend to study and spatio-temporally explore the aggregation of WT and ALS mutants of SOD1 in live cells using surrogate and appropriate cell lines combining confocal microscopy and in-cell FCS. We would correlate the conformational stability of WT and mutant SOD1 with their aggregation propensity both *in vitro* and inside cellular environments. We have already cloned, expressed and optimized the method for WT SOD1, Apo SOD1 and H72F purification. Other mutants are being prepared. The WT and mutant proteins have been characterized in detail using gel electrophoresis, far and near UV CD, and steady state tryptophan fluorescence. Urea and guanidium hydrochloride induced unfolding transitions have already been probed using steady state tryptophan fluorescence. DSRed construct of SOD1 has been prepared for in cell studies.

I have mentored two Ph.D. students in our laboratory.

Doctoral Research

Title: Effect of small molecules on chromatin assembly.

Advisor: Professor Dipak Dasgupta, Biophysics and Structural Genomics Division, Saha Institute of Nuclear Physics, Kolkata, India.

In my thesis I have studied the interaction of three DNA-binding small molecules (two intercalators, propidium iodide and ellipticine and one minor groove binder, mithramycin) with hierarchical levels of chromatin emphasizing upon their histone-binding potential. Propidium iodide (PI) acts as a fluorescent DNA label and is widely used for nuclear staining. Mithramycin (MTR) is a clinically approved DNA-binding antitumor antibiotic which is currently in Phase 2 clinical trial at National Institutes of Health for treatment of osteosarcoma. Ellipticine (ELP) is a naturally occurring plant alkaloid which exhibits potent anticancer activity with minimal toxic side effects.

Combinations of biochemical and biophysical techniques have been adopted to illustrate the molecular basis of ligand-recognition at the chromatin level. An in-depth investigation of the structural and functional aspects of small molecule-chromatin interaction has been carried out. Fluorescence measurements have been employed to demonstrate the association of these ligands with chromatin components. The energetic scenario of the binding interactions has been characterized by isothermal titration calorimetry. Dynamic light scattering and circular dichroism spectroscopy have been used to examine the influence of these ligands on chromatin architecture. The effect of these ligands on post-translational histone modifications has been probed by western blot analysis, histone acetyl transferase assay and confocal microscopy.

Our studies show that these ligands impact both chromatin structure and function and alter specific epigenetic signatures. Propidium iodide induces chromatin compaction and releases DNA from chromatosome. It modulates acetylation of histone H3 at lysine 9 and acetylation of histone H4 at lysine 5 and lysine 8. In HeLa cells, PI alters the post-translational modifications to a greater extent compared to its structural analog, ethidium bromide. Mithramycin also binds to core histones. The major difference which distinguishes the interaction of MTR with DNA and histones is the absence of obligatory requirement of bivalent metal ion such as Mg^{2+} when the antibiotic binds to histone(s). As a consequence of its ability to interact with core histones, MTR inhibits histone H3 acetylation at lysine 18, an important signature of active chromatin, *in vitro* and *ex vivo*. Positively charged histones interact preferentially with the neutral form of ellipticine and negatively charged DNA interacts with the protonated form of the ligand. The hydrodynamic size of chromatin increases in presence of ellipticine. ELP disrupts the integrity of chromatosome triggering DNA release. It inhibits some of the important post-translational histone acetylation marks implicated in transcription activation.

In summary, the histone proteins in chromatin do not adversely affect ligand-chromatin interaction. These ligands exhibit dual binding mode in the chromatin context based on the

classification of single binders (bind only to chromosomal DNA) / dual binders (bind to both chromosomal DNA and histones), a concept which has been introduced in our laboratory to categorize chromatin binding molecules. The results provide useful information in deciphering the mode of interaction of the ligands with chromatin and suggest an additional pathway of their biological actions. We have also performed transcriptome analysis to monitor their effect on global gene expression.

I have trained some project interns in our laboratory during my research tenure.

Post M.Sc. project

Title: Studies of the effect of DNA-binding ligand, ellipticine upon the structure of chromatin.

Advisor: Professor Dipak Dasgupta, Biophysics and Structural Genomics Division, Saha Institute of Nuclear Physics, Kolkata, India.

The effect of putative anticancer drug ellipticine on chromatin was studied by employing various biophysical tools such as steady state fluorescence spectroscopy, isothermal titration calorimetry and dynamic light scattering. Chromatin was isolated from chicken liver. The apparent dissociation constant of ellipticine-chromatin association is in the micromolar range. The binding is predominantly entropy driven with a minimal contribution from enthalpy. The results demonstrate that the DNA-intercalating agent, ellipticine interacts with chromatin and induces chromatin aggregation.

M.Sc. project

Title: Excited state proton transfer reaction of 1-naphthol in micellar media of tweens.

Advisor: Professor Subhash Chandra Bhattacharyya**,** Department of Chemistry, Jadavpur University, Kolkata, India.

The excited state proton transfer reaction of 1-naphthol in micellar media of Tween 20 and Tween 40 have been studied employing steady state and time resolved fluorescence techniques. Different effects on the proton transfer process have been established from the relative emission intensities of the neutral form (364 nm) and the anionic form (474 nm) of 1-naphthol in the studied micellar environment. The emission intensities of the anionic and the neutral forms of 1-naphthol exhibited a break around the reported critical micellar concentration (CMC) of the studied micelles. Above CMC, intensity of emission from the neutral form has been enhanced in both Tween 20 and Tween 40 micellar media. The intensity of emission from anionic form has been enhanced for Tween 40 whereas for Tween 20, its intensity is decreased. This contrasting behavior of 1-naphthol in the two micelles has been attributed to the microploarity of the microenvironment surrounding the fluorophore after comparing similar studies of the probe in

varying composition of water-dioxan mixture. The structural difference between Tween 40 and Tween 20 may also be a reason for this anomalous behavior of 1-naphthol. In a nutshell, this report demonstrates that the excited state deprotonation of 1-naphthol is significantly retarded in micellar media of Tweens and provides an insight into the effect of micropolarity and micellar structure on the modified ESPT process of 1-naphthol in micellar media of tweens.

Technical Skills

Biophysical techniques

- Fluorescence Spectroscopy
- Absorbance Spectroscopy
- Circular Dichroism Spectroscopy (CD)
- Isothermal Titration Calorimetry (ITC)
- Differential Scanning Calorimetry (DSC)
- Dynamic Light Scattering (DLS)
- Time Correlated Single Photon Counting (TCSPC)
- Sample preparation for Transmission Electron Microscopy
- Sample preparation for Atomic Force Microscopy

Molecular Biological techniques

- Plasmid DNA isolation from bacteria
- Cloning
- Agarose gel electrophoresis
- SDS and non-denaturing Polyacrylamide gel electrophoresis
- Western Blotting techniques
- Polymerase Chain Reaction
- Histone Acetyl Transferase (HAT) assay
- RNA extraction from cultured cells

Cell Biological techniques

- Basic cell culture
- Slide preparation for immunofluorescence imaging
- Cell viability assay (MTT assay)
- Sample preparation for flow cytometry (FACS)

Protein Chemistry

- Isolation of Chromatin from chicken liver, rat liver and HeLa cells
- Density gradient centrifugation
- Nucleosome reconstitution
- TCA precipitation of proteins

Computer Programming Skills

- Fortran
- C

Software handling

- Adobe Photoshop
- ChemDraw
- CorelDraw
- ImageJ
- CD spectrum analyser program, Convex Constraint Analysis Plus (CCA+)
- PyMOL
- Origin
- EndNote

Publications (Cumulative Impact Points: **41.48**)

1. **Amrita Banerjee**, Sulagna Sanyala, Shreyasi Dutta, Payal Chakraborty, Prajna Paramita Das, Kuladip Jana, Madavan Vasudevan, Chandrima Das and Dipak Dasgupta. The plant alkaloid chelerythrine binds to chromatin, alters H3K9Ac and modulates global gene expression. ***J Biomol Struct Dyn.*** 2016; 1-9. ***Impact factor: 2.15***
2. **Amrita Banerjee,** Sulagna Sanyal, Parijat Majumder, Payal Chakraborty, Kuladip Jana, Chandrima Das and Dipak Dasgupta. Recognition of chromatin by the plant alkaloid, ellipticine as a dual binder. ***Biochem Biophys Res Commun.*** 2015; 462: 352-7. ***Impact factor: 2.37***
3. **Amrita Banerjee,** Sulagna Sanyal, Kirti K. Kulkarni, Kuladip Jana, Siddhartha Roy, Chandrima Das and Dipak Dasgupta. Anticancer drug mithramycin interacts with core histones: An additional mode of action of the DNA groove binder. ***FEBS Open Bio***. 2014; 4, 987-95. ***Impact factor: 2.1***
4. **Amrita Banerjee,** Parijat Majumder, Sulagna Sanyal, Jasdeep Singh, Kuladip Jana, Chandrima Das and Dipak Dasgupta. The DNA intercalators ethidium bromide and propidium iodide also bind to core histones. ***FEBS Open Bio***. 2014; 4: 251-9. ***Impact factor: 2.1***
5. **Amrita Banerjee,** Jasdeep Singh and Dipak Dasgupta. Fluorescence Spectroscopic and Calorimetry Based Approaches to Characterize the Mode of Interaction of Small Molecules with DNA. ***J Fluoresc.*** 2013; 23(4): 745-52. ***Impact factor: 1.667***
6. Parijat Majumder, **Amrita Banerjee,** Jayasha Shandilya, Parijat Senapati, Snehajyoti Chatterjee, Tapas K. Kundu and Dipak Dasgupta. Minor Groove Binder Distamycin Remodels Chromatin but Inhibits Transcription. ***PLoS One.*** 2013; 8(2): e57693. ***Impact factor: 4.49***
7. Pritha Bhattacharjee, Avinanda Banerjee, **Amrita Banerjee**, Dipak Dasgupta and Kaushik Sengupta. Structural Alterations of Lamin A Protein in Dilated Cardiomyopathy. ***Biochemistry.*** 2013; 52(24): 4229-41. ***Impact factor: 3.56***
8. Shreyasi Dutta, Shibojyoti Lahiri, **Amrita Banerjee**, Shriya Saha and Dipak Dasgupta. Association of antitumor antibiotic Mithramycin with Mn^{2+} and the potential cellular

targets of Mithramycin after association with Mn^{2+}. ***J Biomol Struct Dyn.*** 2015; 33(2): 434-46. ***Impact factor: 2.15***

9. Dipak Dasgupta, Parijat Majumder and **Amrita Banerjee**. A revisit of the mode of interaction of small transcription inhibitors with genomic DNA. ***J Biosci.*** 2012; 37(3): 475-81. ***Impact factor: 1.759***
10. Mohankrishna Dalvoy Vasudevarao, Pushpak Mizar, Sujata Kumari, Somnath Mandal, Soumik Siddhanta, Mahadeva M M Swamy, Stephanie Kaypee, Ravindra C Kodihalli, **Amrita Banerjee**, Chandrabhas Naryana, Dipak Dasgupta and Tapas K Kundu. Napthoquinones mediated inhibition of lysine acetyltransferase KAT3B/p300, basis for non-toxic inhibitor synthesis. ***J Biol Chem.*** 2014; 289(11): 7702-17. ***Impact factor: 4.573***
11. Kirti K. Kulkarni, Kiran G Bankar, Rohit N Shukla, Chandrima Das, **Amrita Banerjee**, Dipak Dasgupta and Madavan Vasudevan. Global gene expression profiling data analysis reveals key gene families and biological processes inhibited by Mithramycin in Sarcoma cell lines. ***Genomics Data.*** 2015; 3: 8–14. ***Impact factor: 0.52***
12. Karthigeyan Dhanasekaran, Surabhi Sudevan, Pushpak Mizar, Soumik Sidhanta, **Amrita Banerjee**, Sarmistha Halder Sinha, Dipak Dasgupta, Chandrabhas Narayana and Tapas K Kundu. A dual non-ATP analogue inhibitor of Aurora kinases A and B, derived from Resorcinol with a mixed mode of inhibition. ***Chem Biol Drug Des.*** 2016; doi: 10.1111/cbdd.12728. ***Impact factor: 2.8***
13. Sujan Maity, Koel Mukherjee, **Amrita Banerjee**, Suman Mukherjee, Dipak Dasgupta and Suvroma Gupta. Inhibition of Porcine Pancreatic Amylase activity by Sulfamethoxazole: Structural and Functional Aspect. ***Protein J.*** 2016; 35(3):237-46. ***Impact factor: 1.029***
14. Sudeshna Das Chakraborty, Abhishek Sau, Denis V. Kuznetsov, **Amrita Banerjee**, Munmun Bardhan, Maireyee Bhattacharya, Dipak Dasgupta, Samita Basu, and Dulal Senapati. Development of a Triplet–Triplet Absorption Ruler: DNA- and Chromatin-Mediated Drug Molecule Release from a Nanosurface. ***J. Phys. Chem. B*** 2016; 120 (27), 6872–6881. ***Impact factor: 3.187***
15. Sourav Chowdhury, Sagnik Sen, **Amrita Banerjee**, Vladimir N Uversky, Ujjwal Maulik, Krishnananda Chattopadhyay. Network mapping of the conformational heterogeneity of SOD1 by deploying statistical cluster analysis of FTIR spectra. ***Cell Mol Life Sci.*** 2019; 76(20), 4145-4154. ***Impact factor: 7.03***

Conference Proceedings published after peer review

1. **Amrita Banerjee**, Chandrima Das and Dipak Dasgupta. Mithramycin interacts with core histones and modulates epigenetic modifications. ***Epigenetics & Chromatin***. 2013; 6(Suppl 1): P106.
2. **Amrita Banerjee**, Chandrima Das and Dipak Dasgupta. Mithramycin exhibits dual binding mode and acts as an epigenetic switch. ***Cancer Res.*** 2013; 73 (13 Suppl): Abstract nr B44.

Manuscript communicated

- Achinta Sannigrahi, Sourav Chowdhury, Bidisha Das, **Amrita Banerjee**, Animesh Halder, Athi N Naganathan, Sanat Karmakar, Krishnananda Chattopadhyay. Lipid Membrane induced aggregation of Cu/Zn Superoxide dismutase: Effect of metal ion cofactors and cholesterol.

Presentations in Conferences

1. **Amrita Banerjee**, Suman Kalyan Pradhan. *Putative anticancer therapeutic sanguinarine alters chromatin structure: A Differential Scanning Calorimetric approach.* **Trends in Surface Science and Related Areas (TSSRA -2018).** 6th October, 2018, Sarojini Naidu College for Women & Indian Society for Surface Science & Technology, JU, Kolkata. **Poster Presentation. (National)**
2. **Amrita Banerjee**, Sourav Chowdhury and Krishnananda Chattopadhyay. *Effect of metal ion co-factor on the conformational landscape and aggregation profile of Copper-Zinc Superoxide dismutase.* **CRSI and GDCh, Angewandte Chemie Symposium and the 19th CRSI National Symposium in Chemistry.** 13th July to 16th July 2016, North Bengal University, Siliguri, India. **Poster Presentation. (National)**
3. **Amrita Banerjee,** Sulagna Sanyal, Chandrima Das and Dipak Dasgupta. *'Dual binders' can act as epigenetic modulators and impact global gene expression.* **International Symposium on Chemical Biology and Drug Discovery (ISCBDD-2016).** March 1-3, 2016, Taj Bengal, Kolkata, India. **Poster Presentation. (International)**
4. **Amrita Banerjee**, Saptaprni Ghosh and Dipak Dasgupta. *Biomolecular Recognition of Small Molecules by Chromatin and Telomeres.* **National Symposium on Frontiers of Biology: The DAE Spectra.** January 21-22, 2015, Saha Institute of Nuclear Physics, Kolkata, India. **Oral Presentation. (National)**
5. **Amrita Banerjee,** Sulagna Sanyal, Chandrima Das and Dipak Dasgupta. *Interaction of Ellipticine with chromatin assembly.* **17th Transcription Assembly Meeting**, March 17-18, 2014, Jawaharlal Nehru Centre for Advanced Scientific Research, Bangalore, India. **Oral Presentation. (National)**
6. **Amrita Banerjee,** Sulagna Sanyal, Siddhartha Roy, Chandrima Das and Dipak Dasgupta. *Anticancer Drug Mithramycin Interacts with Core Histones and Acts as a Potential Epigenetic Switch: An Additional Mode of Action of the DNA Groove Binder.* **National Conference on Photoscience: Contemporary Challenges and Future Perspectives**, December 12-14, 2013, Jadavpur University, Kolkata, India. **Poster Presentation. (National)**
7. **Amrita Banerjee,** Chandrima Das and Dipak Dasgupta. *Mithramycin exhibits dual binding mode and acts as an epigenetic switch.* **An AACR (American Association for**

Cancer Research) Special Conference on Chromatin and Epigenetics in Cancer, June 19-22, 2013, Loews Atlanta Hotel, Atlanta, GA, USA. **Poster Presentation. (International)**

8. **Amrita Banerjee,** Chandrima Das and Dipak Dasgupta. *Mithramycin Interacts with Core Histones and Modulates Epigenetic Modifications.* **Sixteenth Transcription Meeting**, March 3-5, 2013, Vedic Village, Kolkata, India. **Oral Presentation. (National)**
9. **Amrita Banerjee,** Jasdeep Singh and Dipak Dasgupta. *Interaction of two DNA binding molecules Propidium Iodide and Mithramycin with histones.* **Recent Advances in Chemical and Physical Biology (RACPB)**, March 5-7, 2012, organized by Saha Institute of Nuclear Physics, India and Mechanobiology Institute, National University of Singapore, Singapore. **Poster Presentation. (International)**
10. **Amrita Banerjee,** Parijat Majumder and Dipak Dasgupta. *Interaction of two structurally related DNA intercalators ethidium bromide and propidium iodide with chromatin: a comparative study.* **Annual Meeting of the Indian Biophysical Society (IBS - 2012)**, January 19-21, 2012, University of Madras, Maraimalai (Guindy) Campus, Chennai, India. **Poster Presentation. (National)**

Workshops attended

1. Science Policy Training Programme conducted by a team of instructors from the Department of Science, Technology, Engineering and Public Policy **(STEaPP), University College London (UK)** organized by British Council India and IISER Pune, **31st March to 2nd April 2016** at IISER Pune.

2. **UGC-funded** Seven Days **State Level Workshop on "Refreshing Chemistry for Biologists".** Barrackpore Rastraguru Surendranath College, **13th to 20th December, 2017.**

3. **CBCS** Workshop in Chemistry at West Bengal State University on **14th March, 2018.**

4. **CBCS** Workshop in Practical Chemistry UG at West Bengal State University on **23rd August, 2018.**

5. Refresher Course in 'Engineering, Physical Sciences & Management' organized by Bharati Vidyapeeth's Institute of Computer Applications and Management, (**BVICAM**), New Delhi, **22nd June to 4th July, 2020** and obtained A+ grade.

Webinars organized

1. **Topic:** 'Challenges in research during the pandemic & a mechanistic insight into the evolutionary trail & the structural facets of spike receptor binding domain of SARS-COV-2'.

Date: 6th July, 2020. Platform: Google Meet.

Speaker: Dr. Sourav Chowdhury, Harvard University, USA.

Participated in 7 webinars since March 2020.