Shivnarayan Dhuppar

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RESEARCH INTEREST

Computational Methods, Microscopy, Single-Cell Genomics, Immunology, Cancer, DNA Damage

EDUCATION

2013 - 2020 **Tata Institute of Fundamental Research, India**

PhD, Physics

Thesis: ***On Cell Cycle Dependent DNA Damage Responses and Gene Expression as Assayed from Microscopic Image Analysis***

2010 - 2013 **The Maharaja Sayajirao University of Baroda, India**

B.Sc. (Hons) Physics

RESEARCH EXPERIENCE

2023 - present **Massachusetts General Brigham**

Long-term health effects of prenatal stress (MGH)

Exposure to prenatal stress interferes with brain development. I am investigating the pathways that can be targeted to reduce if not reverse the adverse effects of prenatal stress using single-cell sequencing technologies and brain interventions (stereotaxic surgeries). The project is part of the Biology of Adversity Project at the Broad Institute of Harvard and MIT.

Roles of miR-92a in colitis and colorectal cancer (BWH)

miR-92a from the oncogenic miR 17-92 cluster is upregulated in many cancers, including colorectal cancer. In this project, I investigated the roles of miR-92a in colitis and colorectal cancer using miR-92a KO mice models. The project formed the basis of an (now successful) R01 application for the PI.

Roles of miR-21 in Multiple Sclerosis (BWH)

In this collaborative project I investigated how miR-21, a pro-inflammatory microRNA often associated with immune activation/autoimmunity, drives pathogenic Th17 cells, showing that Type I interferon limits CNS autoimmunity by regulating the miR-21–FOXO1 axis.

2020 - 2021 **Children's Hospital of Philadelphia, USA**

At CHOP, I spent 6 months post PhD to extend my thesis work on the cell cycle-dependent changes in genome architecture using chromosome capture technology and Crispr-knock-ins.

2014 – 2019 **Tata Institute of Fundamental Research (TIFR), India**

Cell Cycle Staging from Image Analysis

In this project I developed a fully automated image analysis routine to stage cells in the cell cycle from high-resolution microscopy images. The module was used to study cell cycle-dependent nuclear architecture, and DNA damage response at single cell resolution by combining DNA FISH with RNA FISH and IF (resulting in two corresponding author papers).

Studying Defects in Crystalline Media Using Algebraic Topology

In this project, I modeled ordered, periodic systems such as liquid crystals in terms of their underlying molecular symmetries, which define the appropriate order parameters. This formalism enabled a rigorous study of defects—singularities in the order-parameter space—using tools from algebraic topology.

AWARDS, HONORS AND FELLOWSHIPS

2021 **Indian Institute of Science**

Institute of Eminence Postdoctoral Fellowship (declined)

2020 **Department of Science and Technology, Government. of India**

AWSAR Award for best popular science article

2019 **Science Engineering and Research Board, India**

Travel grant for presenting our study at Single Cell Analyses conference hosted by Cold Spring Harbor Laboratory

2015 **Department of Atomic Energy, Government of India**

Senior Research Fellowship for years 2015 - 2019

2013 **Department of Atomic Energy, Government of India**

Junior Research Fellowship for years 2013 - 2015

2012 **Circuits and Electronics (6.002x) from MITx**

Part of the founding batch with Prof. Anant Agarwal.

2011 **A R Rao Mathematical Society**

First in the State Math Olympiad

2010 **National Board for Higher Mathematics**

Award for distinctive performance at Mathematics Training and Talent Search

TALKS AND PRESENTATIONS

2019 **Single Cell Analyses, Cold Spring Harbor Laboratory Meetings**

Talk and poster: *Investigating Central Dogma in the Context of Nuclear Architecture and Cell Cycle at Single-Cell Resolution*

*Travel supported by Science and Engineering Research Board (SERB), India.

2016 **Optics Within Life Sciences (OWLS)**

Poster: *Exploring Regulatory Roles of Genomic Organization in Gene Expression and DNA Repair Using Fluorescence Microscopy*

2011 **Mathematics Training and Talent Search**

Talk: *Geometric Interpretations of Algebraic Operations in the Complex Plane.*

PUBLICATIONS

2025 ***Type I interferon limits central nervous system autoimmunity by modulating the microRNA-21/FOXO1 axis in pathogenic T helper 17 cells***

J. Varghese, A. Cannon, …, **S. Dhuppar,** …, M. Gopal, *Science Transl Med, 2025*

2025 ***miRNAs in the Biology and Hallmarks of Neurodegeneration***

S. Dhuppar*, W. Poller, M. Gopal, *Trends in Molecular Medicine*, 2025

2024 ***Combined 3D DNA FISH, Single Molecule RNA FISH and Immunofluorescence***

S. Sen, **S. Dhuppar**, A. Mazumder, *MIMB (Springer) Book Chapter, 2023*

2024 ***Type I IFN signaling limits CNS autoimmunity by modulating miR-21-Foxo1 axis in pathogenic Th17 cells***

M. Fujiwara, J. Varghese, A. Cannon, L. Garo, A. K. Ajay, R. Kadowaki-Saga, G. Gabriely, **S. Dhuppar**, et. al. (in preparation)

2023 ***Protocol for analyzing transforming growth factor β signaling in dextran-sulfate-sodium-induced colitic mice using flow cytometry and western blotting***

M. Fujiwara, L. Garo, A. k. Ajay, A. Cannon, P. Kolyapetri, **S. Dhuppar**, G. Murugaiyan, *Star Protocol,* 2023

2022 ***MicroRNA effects on Gut Homeostasis: therapeutic Implications for Inflammatory Bowel Disease***

S. Dhuppar and M. Gopal, *Trends in Immunology*, 2022

2020 ***Investigating Cell Cycle-Dependent Gene Expression in the Context of Nuclear Architecture at a Single-Allele Resolution***

S. Dhuppar* and A. Mazumder*, *Journal of Cell Science*, 2020

2020 ***γH2AX Peak in the S Phase After UV Irradiation Corresponds to DNA Replication and Does not Report on the Extent of DNA Damage***

S. Dhuppar*, S. Roy and A. Mazumder*, Molecular and Cellular Biology, 2020

2020 ***CTCF Mediated Genome Architecture Regulates the Dosage of Mitotically Stable monoallelic Expression of Autosomal Genes***

K. R. Chandradoss, B. Chawla, **S. Dhuppar**, R. Nayak, R. Ramachandran, S. Kurukuti, A. Mazumder, and K. S. Sandhu, Cell Reports, 2020

2018 ***Measuring Cell Cycle-Dependent DNA Damage Responses and p53 Regulation on a Cell-by-Cell Basis from Image Analysis***

S. Dhuppar and A. Mazumder, *Cell Cycle*, 2018

*** Corresponding author**

PROFESSIONAL AFFILIATIONS / SERVICES

2024 - present	**Biology of Adversity Project and the Broad Trauma Initiative**
2023 - present	**AACR, NYAS, AAAS**
2018 - present	**Reviewer for Nature, PLOS, Frontiers, Taylor and Francis**
2021 - 2023	**4D Nucleome Project, NIH common funds**

KEY SKILLS

Programming and data	- High-throughput sequencing data (scRNA seq, ATAC-seq, Hi-C) analysis in R and Python - SLURM, Google GCP, Apptainer (Singularity), Bash/Linux, C - AI/ML libraries: Scikit-learn, Gensim, RDKit, PyTorch - Computer vision (Matlab, Python)
Microscopy	- light-sheet microscopy (LaVision UMP II), confocal, FCS, FRET, FRAP, live cell imaging,
Mol Biology	- CRISPR knock-ins, siRNA knockdowns, Cloning, - qPCR, WB, high dimensional flowcytometry (ARIAs), EÍLISA - *in situ* Hybridization (ISH)-based techniques: smFISH, DNA FISH
Animal and cell Models	- Mouse handling, stereotaxic surgeries, cell culture (stem cells, differentiated cells)
Theory	- Statistical Physics: theory and simulations (Monte Carlo, Markov)

REFERENCES

Wolfram Poller	**Assistant Professor, Harvard Medical School and Massachusetts General Hospital, USA**	**wpoller@mgh.harvard.edu**
Murugaiyan Gopal	**Associate Professor, Harvard Medical School and Massachusetts General Hospital, USA**	**mgopal@bwh.harvard.edu**
Aprotim Mazumder	**Associate Professor, Tata Institute of Fundamental Research, India**	**aprotim@tifrh.res.in**