Jaydev Singh Rao

Curriculum Vitae

Undergraduate Student
IISER Bhopal (India)
jaydevsr.github.io
jaydev19@iiserb.ac.in

Interests

- Statistical physics and Complex Systems
- Computational Physics and Numerical Computing
- Open Source Scientific Software

Education

2019 – 2024 **Indian Institute of Science Education and Research**, Bhopal, India
Bachelor and Master of Science (BS-MS), Department of EECS [1]
CPI (current): 9.60/10.0

2017 – 2019 **Kendriya Vidhyalaya**, Udaipur, Rajasthan, India
AISSCE [2]*, Central Board of Secondary Education*
Performance: 92.0%

Research Projects

2021 – 2022 **Spin-systems and properties of their inter-configuration distances**
Supervisor: Prof. Markus Heyl, Theoretical Physics III, University of Augsburg, Germany

- Studied the theory of phase transitions in classical spin systems, mainly the Ising model and the XY model. Also implemented cluster based Monte-Carlo algorithm for these above models to study the critical point and the finite size effects.
- Used the Monte-Carlo generated configurations to study the behavior of nearest neighbor distances around the critical point and explored the possibility of characterizing the critical point using these distances.
- Derived probabilistic bounds which, along with numerical results helped in relating the the behavior of such distances to the structure factors of the individual configurations.
- Studied the theory of the quantum XY model and its solution using fermionic mapping. Also explored the possible application of previous results on this model using quantum Monte-Carlo.

2022 **Higher order susceptibilities in 3-state Potts model with applications to the QCD critical point**
Supervisor: Prof. Rajiv Gavai, Dept. of Physics, IISER Bhopal, India

- Implemented numerical simulation of 3-state potts model using cluster based Wolff Monte-Carlo algorithm. Also performed extensive analysis of the benefits of the cluster based algorithm near the critical point in contrast to Metropolis algorithm.
- Analyzed the behaviour of higher order susceptibilities i.e. higher cumulants of the mean magnetization, in the critical region.
- Explored the possibility of studying the crossover phenomena in this model using these higher order susceptibilities for applications in characterizing the QCD critical point using this model.

[1] Electrical Engineering and Computer Science
[2] All India Senior School Certificate Examination

2021 **Simulating the Maki-Thompson model on a network**
Supervisor: Prof. Kundan Kandhway, Dept. of EECS, IISER Bhopal, India

- Studied the theory of stochastic propagation of information through a population, particularly the Maki-Thompson model.
- Implemented the Maki-Thompson model on a network as a set of coupled differential equations for each node.
- Numerically studied the dependence of rumor spreading on the degree distribution of nodes and the interaction rates determining the flow through edges.

Software Projects

June – Sept 2022 **Open Source Contributor**, The Julia Programming Language
Mentored by: Dr. Joe Greener, MRC Laboratory of Molecular Biology, Cambridge, UK
Contributed to **Molly.jl** which is an open source molecular dynamics library in Julia, by implementing multi-threaded *Replica Exchange Molecular Dynamics (REMD)* algorithms and some general contributions such as unit test, potentials, fixes etc. This project was funded by **Google Summer of Code 2022**. Project Link.

Positions of Responsibility

April–July 2022 **Teaching Assistant**, *IISER Bhopal*, Introduction to Programming, ECS102.
Duties included guiding first year undergraduate student through *programming labs* and *invigilation* during exams.

Achievements and Honors

2022 Selected for **Google Summer of Code** for funding of an open source software project.

Software Skills

Programming Languages: Julia, Python, C

Scientific Softwares: Mathematica, Matlab

Others: HPC, LaTeX, Bash scripting, Git & GitHub