

Sourabh Singh Chauhan

School of Physical Sciences
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Personal Information

Date of Birth 12 November 1993
Birth place Kanpur, Uttar Pradesh, India
Current Address National Institute of Science Education and Research, Bhubaneswar

Education

2010–Cont. **Integrated MSc (Physics)**, National Institute of Science Education and Research, Bhubaneswar, CGPA 8.32 (including 9th sem).
2009–2010 **State board (U. P.) (Class 12)**, Pt. Deendayal Upadhyay Sanatan Dharm Vidyalaya, Kanpur, 86%.
2001–2008 **State board (U. P.) (Class 10)**, Chacha Nehru Smarak Inter College, Kanpur, 72.16%.

Qualifying Examinations

Gen. GRE **316/340**, Quant. 163/170 (Percentile 86%), Verbal 153/170 (Percentile 56%), Analytical writing 3.5 (Percentile 38%).
Sub. GRE **810/990**, Percentile 73%.
TOEFL **101/120**, Listening 28/30, Speaking 23/30, Writing 25/30, Reading 25/30.

Academic Merits

- 2014
- Selected for Indian Academy of Sciences Summer Research Fellowship Program (**IAS SRFP**)-2014 to work at ARIES, Nainital.
 - Selected for summer project at **NCRA**, Pune as VSRP 2014.
 - Co-authored a paper in density function theory to be published in 'Physics Review A'(in arxiv).

2013

- Co-authored two peer-reviewed papers, one published in *Journal of Plasma Physics* and the other one in *Physica Scripta*.
- Attended 'NCBS-ICTS Monsoon School' on Physics of Life (10th June-21st June).
- Attended Indian Institute of Space science and Technology Winter School-2013 to be held from 2nd Dec to 11th Dec.
- Selection of abstract for a poster presentation on 'A study of irregularities in solar cycle' in 'Frontiers in Physics-2013', Fergusson College, Pune during Dec. (not attended)

2012

- Selected for Indian Academy of Science Summer Research Fellowship Program to work at Saha Institute of Nuclear Physics (SINP), Kolkata during May to July.
- Poster presentation in a conference on Plasma Physics named 'ICCPNDS-2012'.

2011

- School of Physical Sciences batch 2010 2nd rank in semester 3.

2010

- NISER 2010 Batch 2nd rank (9.21 CGPA) in semester 1.
- Rank 184 in National Entrance Screening Test (for admission in NISER and becoming an 'INSPIRE' fellow.)
- Qualified for All India Engineering Entrance Examination.
- Qualified for National Level Science Talent Search Examination 2009 (NSTSE).

Research Interests

- Cosmology
- Astrophysics.
- Particle Physics.

Skills

Computer.

- Programming languages : C, C++, Shell, Python* (beginner).
- Packages : MATLAB, GnuPlot, Mathematica, L^AT_EX, Origin, VIREO, html*,IDL* . (*-beginner)

Astronomy.

- Member **Astronomy club NISER**.
- Binocular observations.
- Observation using an equatorial mounted 8 inch reflector telescope.

Misc.

- Awarded "Tratiya Sopan" in Scouts and Guides movement.
- "Bhartiya Sanskrati Gyan Pariksha" two time gold medalist.
- Qualified for "Bal ratana Khoj Pariksha" school level.
- Badminton, Carrom, Chess and other games.

Conferences and Schools

- Presented a poster in conference 'ICCPNDS-2012'(International Conference On Complex Processes In Plasmas And Nonlinear Dynamical Systems) during 6th to 9th November 2012 held at Institute for Plasma Research IPR, Ahmadabad.
- Attended 'NCBS-ICTS Monsoon School' on Physics of Life (10th June-21st June 2013)
- Attended IIST winter school on astronomy and astrophysics (Dec 2013).

Publications

- Co-authored a peer-reviewed paper published in **Journal of Plasma Physics** with title '*Continuous wavelet transform analysis for self-similarity properties of turbulence in magnetized DC glow discharge plasma*' [pdf](#)
- Co-authored a peer reviewed paper in **Physica Scripta** with title '*Comparative study on nonlinear dynamics of magnetized and un- magnetized DC glow discharge plasma*'. [pdf](#)
- Co-authored a peer reviewed paper in **Physics Review A** with title '*Excited-state density-functional theory revisited: study based on Hohenberg-Kohn, Gunnarsson-Lundqvist and constrained-search formalism*' (<http://arxiv.org/abs/1407.1959> yet to be published) [pdf](#).

Projects and talks

Further details

MSc. Thesis project (July 2014 - now)

Mass functions of dark matter halos revisited, National Institute of Science Education and Research, Bhubaneswar.

I am doing this project with Dr. Nishikanta Khandai at present. I am generating random walks for an arbitrary shape of barrier and trying to look for the mass functions produced. I am going to test all the assumptions that go into getting analytical forms of mass functions with comparative study of analytical models, simulations and correlated random walk results.

Summer Project 2014 (May-July)

Analytical models of ionized bubble distribution during the epoch of reionization, National Centre for Radio Astrophysics, Pune.

This project was done under the guidance of Dr. Tirthankar Roy Choudhuri. In the evolution of universe reionization of the IGM marks one of most important phase and one of the least understood problems. In this work we discussed two models (FZH and ESP) which can depict the growth of ionized regions during epoch of reionization. After doing a comparative study of the models we chose more physical and more accurate model to study size distribution of ionized regions. Furthermore we improved its efficiency by finding out analytical form of the barrier function calculation of which was the computationally most expensive step in the whole calculation. [Report](#)

- Semester Project 2014 (Jan-April) **Quantum stochastic optimization**, National Institute of Science Education and Research, Bhubaneswar.
This project was done as a part of course on quantum information and quantum computation under Dr. Colin Benjamin, NISER. Quantum stochastic optimization or quantum annealing is a quantum algorithm of optimizing a given cost function. This work takes one through a journey of improving classical optimization methods to reach a quantum one. A comparative study of techniques from both parts had been done. An alternate method to imaginary time quantum monte carlo based on fractional dynamics had also been discussed. [Report](#)
- Summer Project 2013 (May-July) **A study of solar cycle**, Indian Institute of Astrophysics, Bangalore.
This project was done under the guidance of Dr. Dipankar Banerjee. I started with microscopic theory of fluids and plasmas and went on to study macroscopic theories. Then I learnt its applications in astrophysics. After learning basics of stellar evolution, I learnt about observational aspects of 11 year cycle of sunspot number and sunspot area on photosphere of the sun. Then I learnt about solar dynamo theory which explains this 11yr cycle by mechanism of periodic production of toroidal and poloidal magnetic field. [Report](#)
- 6th Semester Project (Jan-May 2013) **Effective Local Potentials in excited states of Quantum Many body Systems**, National Institute of Science Education and Research, Bhubaneswar.
This project was done under guidance of Dr. Prasanjit Samal. In this project I tried to look for one to one correspondence between external potentials and density of excited states in quantum systems. We took an example of infinite square potential with noninteracting particles and then their states were transformed using a unitary transformation leaving density invariant. And then we looked for different effective potentials in excited states. Now we are looking for similar behavior in periodic harmonic oscillator potential with coulomb interaction between electrons. [Report](#)
- Summer Project 2012 (May-July) **Nonlinear analysis of chaotic oscillations observed in DC glow discharge plasma**, Saha Institute of Nuclear Physics, Kolkata.
This summer project was done with Prof. A. N. S. Iyengar as an IAS fellow at SINP, Kolkata. First I learnt about the plasma state using magnetohydrodynamics. Then I learnt about different kinds of waves and oscillations in plasma. After that I moved on to instabilities in plasma. These instabilities in plasma leads to nonlinear behavior. In order to understand the nonlinear behavior of DC glow discharge plasma a dusty plasma set up was used after some modifications. I calculated conditions for the glow in the discharge tube. For analyzing the floating potential fluctuations of plasma, the values of parameters for the set up were determined by Paschen curve. Floating potential fluctuations were analyzed using non linear time series analysis. The work for modeling the system using modified duffing equations is still going on. A part of nonlinear analysis work was presented in 'ICCPNDS-2012' in a poster presentation. Abstract for some other part of work was selected for a poster presentation in 'Plasma 2012'. [Report](#)
- Summer Project 2011 (May-July) **Classical Mechanics with a transition to chaos**, NISER.
It was a reading project under Prof. S.C. Phatak . After learning basic formalism for Analytic Mechanics (i.e. Lagrangian formulation, Hamiltonian formulation, Hamilton- Jacobi theory, canonical transformation), I came across some nonlinear systems like Duffing equation which in certain parameter value range showed weird behavior which led foundation for transition to chaos. In order to explore this phenomenon of chaos I went down to one dimensional maps and learnt their basics. [Report](#)
- Oct 2013 **Distance Measurements in Astronomy**, NISER.
This talk was given as a part of astronomy lecture series at NISER. I covered standard rulers and standard candles in astronomy which form a distance measurement ladder. [Presentation](#)
- Aug 2013 **Stellar Structure Equations**, NISER.
This talk was given as a part of astronomy lecture series at NISER. All equations were derived and explained. A numerical scheme to solve the equations for given initial conditions and parameters of star was also discussed. [Presentation](#)

Nov 2012 **Introduction to magnetohydrodynamics**, NISER.

It was a part "NISER Physics Student Seminar". This introductory talk covered all basic equation of Magnetohydrodynamics and its applications in astrophysical context. (Black board presentation)

Jan 2011 **One dimensional maps and chaos**, NISER.

It was a part "NISER Physics Student Seminar". Chaos and non linear dynamics was introduced using logistic map. [Presentation](#)

Major Courses

- **Mathematics**
 - Linear Algebra
 - Real analysis
 - Probability theory
 - Differential equations
 - Complex analysis
 - Differential Geometry
 - Calculus of several variables
- **Physics(Basic)**
 - Mechanics and thermodynamics
 - Classical mechanics-I,II
 - Quantum Mechanics-I,II
 - Electrodynamics-I,II,III
 - Mathematical Methods -I, II
 - Statistical Mechanics
 - Condensed matter physics
 - Atoms, molecules and radiation
 - Special theory of relativity
 - Electronics
- **Physics (Advanced)**
 - General relativity
- Introduction to cosmology
- Quantum Field theory
- Nuclear physics
- Particle Physics
- Many body physics
- Quantum information and computation
- Density Functional theory
- Quantum optics
- **Physics(Laboratory)**
 - Optics and General Physics laboratory
 - Basic Electronics and Optics Laboratory
 - Digital and Analog Electronics Laboratory
 - Solid State Physics Lab
 - Modern Physics Lab
 - Computation lab on numerical methods
 - Ellipsometry [Report](#)
 - Negative group delay [Report](#)

Academic Referees

Dr. Tirthankar Roy Choudhuri.

National Centre for Radio Astrophysics, Pune
email:tirth@tifr.res.in

Dr. Dipankar Banerjee.

Indian Institute of Astrophysics, Bangalore
email:dipu@iiap.res.in

Dr. Nishikanta Khandai.

National Institute of Science Education and Research, Bhubaneswar
email:nkhandai@niser.ac.in

Dr. Prasanjit Samal.

National Institute of Science Education and Research, Bhubaneswar
email:psamal@niser.ac.in

Some additional links

- Academia <https://niser.academia.edu/sourabhsingh>
- Researchgate https://www.researchgate.net/profile/Sourabh_Singh_chauhan
- NISER <http://www.niser.ac.in/~sourabh/>