

Shivam Garg

Curriculum Vitaé

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Research Objective

I am an undergraduate student, currently studying in 5th year BSMS at Indian Institute of Science Education and Research (IISER), Kolkata, India. I am currently looking for a PhD position in the field of computational or observational cosmology.

Education

- 2012–2017 **Integrated BSMS Dual Degree**, *Indian Institute of Science Education and Research*, Kolkata.
Majoring in Physics, currently in final semester (10th semester) with a CGPA of 8.68/10
- 2012 **Higher Secondary (12th Standard)**, *Seth M.R. Jaipuria School*, Lucknow, 97%.
Subjects - Physics, Chemistry, Mathematics, Computer Science, English
- 2010 **High School (10th Standard)**, *Seth M.R. Jaipuria School*, Lucknow, 95.6%.
Subjects - Physics, Chemistry, Mathematics, Computer Science, English

Master's thesis

- Title *Quantum Field Theory in Curved Spacetime and Anomalies*
- Supervisor(s) Dr. Sunandan Gangopadhyay
- Description Hawking radiation and Unruh effect are two well known examples of the effect of quantum fields in curved spacetime. Anomalies play an important role in quantum field theory. It has been shown that anomalies can be used to find Hawking temperature. In this Master's thesis, we reviewed Quantum Field Theory in Curved Spacetime (including Unruh and Hawking effects) and then studied the application of gravitational anomalies for deriving Hawking radiation in Schwarzschild spacetime.

Research Experience

- Aug–Dec 2016 **Multifractal Detrended Fluctuation Analysis using Wavelets.**
Advisor: Prof. P.K. Panigrahi (IISER Kolkata)
In this project, I studied the multifractal detrended fluctuation algorithm and wavelets. The detrending of the time series was done using polynomial fit and wavelet fit.
- Jan–April 2016 **N-body simulation of Ideal and Non-Ideal Gas.**
Advisor: Dr. Ananda Dasgupta (IISER Kolkata)
We simulated a 2-D gas using the basic assumptions of the kinetic theory of gases. The Boyle's law is verified and the Maxwell-Boltzmann curve is also calculated. We also used the Lennard-Jones potential and simulated N particles interacting via the potential.

- June–July **Stellar spectrum analysis.**
 2015 Advisor: Prof. Praveen Nagar (Dept. of Maths and Astronomy, Lucknow University)
 My main aim was to study the observational, computational and theoretical tools for measuring and interpreting stellar spectra. The basic physics of spectral analysis (including spectral classification, magnitudes) was studied. Models of radiation from stellar photospheres and its effect on the spectral lines were considered.
- July 2014 **Pulsar Observation for Students (POS), Radio Astronomy Centre, Ooty.**
 POS was a follow-up program to RAWs. There were a series of lectures on radio astronomy and pulsars. In the subsequent observation session, I made observations of several pulsars with the Ooty Radio Telescope (ORT). I gave a presentation on the final results obtained for the B2310+42 pulsar including its period, dispersion measure and modulation index.
- June 2014 **Investigation of modified gravity theories and application to cosmology.**
 Advisor: Dr. Subinoy Das (Indian Institute of Astrophysics, Bangalore)
 This was a project aimed at studying modified general relativity theories to explain dark energy. I studied the basics of general relativity and cosmology (Friedmann equations and their solutions). Then I explored dark energy and the theories for it which included the cosmological constant, quintessence and chameleon field theories.
- May 2014 **Mathematical Modeling and Numerical Simulation of Rainbows.**
 Advisor: Prof. T.R. Seshadri (Department of Physics and Astrophysics, University of Delhi)
 My aim was to study how rainbows are formed and the theories and mathematical formulation related to it. This project introduced me to color theory including color matching functions, xy chromaticity diagram, CIE 1931 color space.
- March 2014 **GW@ASI 2014: Satellite Workshop on Gravitational Waves.**
 This was a one-day workshop which featured lectures providing an overview of gravitational waves and its detection. There was also an afternoon hands-on session where I did analysis of simulated GW signal for detecting the Gravitational Wave “chirps” using the matched filtering technique.
- December 2013 **Radio Astronomy Winter School (RAWs).**
 This was a 10 day workshop with a series of lectures and hands-on experiments' session. There were lectures on a variety of topics including radio astronomy, gravitational wave astronomy, pulsars. In the hands-on session we did characterization of radio antenna. We also did observations of the Sun and the 21-cm Hydrogen line in the Milky Way with a 4-m radio telescope at the Radio Physics Laboratory (RPL).
- June 2013 **Dark Matter.**
 Advisor: Prof. Pankaj Jain (Indian Institute of Technology Kanpur)
 The aim was to investigate dark matter and the related experiments being conducted to find it. I researched the evidence for dark matter (galaxy rotation curves, gravitational lensing, CMBR, large scale structure) which supported its existence. I went on to study how indirect and direct searches are being conducted for dark matter.

Teaching Experience

- Jan – April 2017 **Undergraduate Teaching Assistant for CS1201.**
 Second part of the two-semester long primer on computer programming.
- Aug – Nov 2016 **Undergraduate Teaching Assistant for CS1101.**
 Introductory course on Linux, Python, Gnuplot and their application to scientific programming.

Talks and posters

- Submitted a talk titled “Chameleon field theories” for my summer project at Indian Institute of Astrophysics.
- Presented a poster at RAWSC titled – “Black Holes and their Signatures”.

Awards and Achievements

- Awarded the INSPIRE fellowship by DST, Govt. of India (2012-2017)
- Awarded the best poster and presentation award at Radio Astronomy Winter School, organized by National Centre for Radio Astronomy, Pune.

Computer skills

Operating Systems	I have extensive experience with working in both the Windows and Linux operating systems.
Programming Languages	C, Java, Python, FORTRAN, R
Web designing	JavaScript, CSS, HTML

Languages

Language 1	English	<i>Proficient</i>
	My ToEFL iBT score is 114/120. The breakdown is as follows: <ul style="list-style-type: none">○ Reading – 29/30○ Listening – 30/30○ Speaking – 27/30○ Writing – 28/30 In the Verbal and Analytical Writing sections of General GRE, I had scores of 165/170 and 4.5/6 respectively.	
Language 2	Hindi	<i>Native Language</i>
Language 3	Bangla	<i>Basic</i>

Interests

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| Music | I am an avid guitar player and a decent singer. I am a graduate in vocal singing (5 years of classical Hindustani training) |
| Sports | I play multiple sports including Table Tennis, Volleyball, Basketball and Football. I have participated and won Gold Medals in intra- and inter- college events. |
| Other | State level champion in abacus mathematics competition. Quizzing and Spelling events' accolades winner. |



References

- Reference 1 **Dr. Sunandan Gangopadhyay.**
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- Reference 2 **Dr. Anandamohan Ghosh.**
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