Aditya Pathak

Curriculum Vitae

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Age: 21 *Nationality*: Indian *Sex*: Male

Research Interests: High Energy Physics, Mathematical Physics

Educational Background

- Bachelor of Technology with honors in Engineering Physics, with a minor in Electrical Engineering
  Indian Institute of Technology, Bombay
  Cumulative Performance Index (CPI) score of 9.09/10.00

Research Experience

- Senior Thesis: *Measurement of Underlying Activity in p-p collisions at the LHC using Drell-Yan Processes*
  Advisor: Prof. Kajari Mazumdar, *Autumn 2010 – Present*
  Department of High Energy Physics,
  Tata Institute of Fundamental Research, Mumbai

  At Present I am doing my senior thesis project on using the Drell-Yan processes for investigating various tunes of PYTHIA simulations which describe the underlying event in proton-proton collisions at the LHC. These simulations will be compared with the data from the CMS experiment to select the best tune. Further plans are to improve the accuracy of the simulations by varying various parton distribution function parameters in PYTHIA. Data analysis is performed in the PAW framework.

  Earlier Projects:

- *Characterization of Silicon Drift Detector with low flux and low energy Protons*
  Advisor: Prof. Torsten Soldner, *Summer 2010*
  Department of Physics, E-18, Technical University of Munich

  We characterized a Silicon Drift Detector using a low energy low flux proton accelerator. The tests included preparing a well collimated proton beam, installing the detector and readout electronics and measuring the proton spectra for different beam energies and impact points. The beam composition was studied by combining the measurement results with SRIM (Stopping and Range of Ions in Matter) simulations. Data analysis was performed in the ROOT framework.

- Junior Thesis: *Measurement of Elliptic Flow in Heavy Ion Collisions*
  Advisor: Prof. Basanta K. Nandi, *Autumn 2009*
  Department of Physics, IIT Bombay

  I studied the concepts of quark-gluon plasma, its signatures and various techniques and strategies for analysis of elliptic flow in relativistic heavy ion collisions. I developed an algorithm for extracting elliptic flow from heavy ion collisions data. The azimuthal distributions of particles were calculated by a method based on a cumulant expansion of multiparticle azimuthal correlations.

- *Photometric Study of M15 Globular Cluster using IRAF*
  Advisor: Prof. Bhaswati Mookerjea *Winter 2009*
  Department of Astrophysics, Tata Institute of Fundamental Research

  I attended the Winter School on Astronomy and Astrophysics at Tata Institute of Fundamental Research (TIFR) which included this project along with the lecture series. We observed the M15 globular cluster and a standard star 'Enif' with Celestron 14" telescope and analysed the data using Image Reduction and Analysis Facility (IRAF) software. The magnitudes of stars thus measured were used to plot the Hertsprung-Russell (HR) graph for this cluster.

- *Finite Element Analysis of eddy current model of an induction furnace*
  Advisor: Prof. S. V. Kulkarni *Autumn 2009*
  Department of Electrical Engineering, IIT Bombay

  I solved the eddy current problem of an induction furnace using finite element method. The project was carried out in two stages. In the first stage, the problem was solved using a commercial software, ANSYS, and in the next stage by numerical computation in MATLAB.

- *Signal analysis of an array of particle detectors*
  Advisor: Prof. Pradeep Sarin *Autumn 2009*
  Department of Physics, IIT Bombay

  The project started out as an attempt to build a cosmic ray detector out of common fluorescent tube-lights. The end result was a multi-hit Time to Digital signal Converter (TDC) implemented using a programmable microcontroller. This TDC could be used to detect the coincidence of two nanosecond pulses and measure time difference between two signals generated in two particle detectors.

- *Synthesis and Characterization of Cadmium Sulphide Nano-structures*
  Advisor: Prof. Bodh Raj Mehta *Summer 2009*
  Department of Physics, Indian Institute of Technology, Delhi

  We worked on fabrication of cadmium sulphide nano-rods with applications in nano-structured solar cells. We tried several synthesis methods and characterised the samples by various analytical tools: Transmission Electron Microscopy, High Resolution TEM, Scanning Electron Microscopy, Selected Area Electron Diffraction, Energy-dispersive X-ray Spectroscopy, X-Ray Diffraction and absorbance spectra from Spectrophotometer. The results of this work helped the group to choose the most appropriate synthesis method for desired characteristics of nano-rods.

- *Quantum computation using spintronics*
  Advisor: Prof. N. Venkataramani *Spring 2009*
  Department of Mutallurgical Engineering and Material Science, IIT Bombay

  I gave a seminar talk on the two main implementation schemes for using the electron spin as a 'Qubit' for quantum computation - using Quantum Dots and Surface Acoustic Wave (SAW). I studied the various techniques of spin injection, spin read out, coupling of the quantum dots and the decoherence effects.

Coursework Completed by April 2011

- *Advanced Physics Courses* – Elementary Particle Physics, Group Theoretical Methods in Physics, General Theory of Relativity, Advanced Simulation Techniques, Advanced Statistical Mechanics

- *Electrical Engineering* – Digital Electronics (Theory and Practical), Analog Electronics (Theory and Practical), Nano-electronics, Computational Electromagnetics, Microprocessors, Signal Processing, Semiconductor Devices and Circuits, Controls and Communication
- *Mathematics* – Real Analysis, Complex Analysis, Linear Algebra, Differential Equations, Numerical Analysis, Data Analysis and Interpretation

Schools and Conferences Attended

- International Conference on Physics and Astrophysics of Quark Gluon Plasma (ICPAQGP 2010), Dec. 2010, Goa, India.
- Summer Research Fellowship Program at Indian Institute of Technology Delhi, 2009.
- Winter School on Astronomy and Astrophysics at Tata Institute of Fundamental Research, Mumbai, 2009.

Scholastic Achievements

- Was awarded DAAD-WISE scholarship by German Academic Exchange Service (DAAD) for 3 months research internship in Germany.
- Secured National Rank 2 in the National Science Olympiad 2006 conducted by Science Olympiad Foundation with over 2,50,000 participants.
- Recipient of CBSE Merit Scholarship for Professional Studies (awarded to top 0.1% students in India who appeared in the AIEEE examination).
- Selected in IIT-JEE 2007 (the joint entrance examination for all IITs) with an All India Rank of 520 out of approximately 3,00,000 students.
- Secured an All India Rank of 354 and State Rank 17 in AIEEE 2007 (All India Engineering Entrance Examination) out of approximately 5,00,000 students.

Extra Curricular Activities

- Awarded PAF Color for outstanding performance in Performing Arts Festival in IIT Bombay (2009).
- Interested in music and am a guitarist for a rock band.
- Interested in sketching and fine arts. My sketches were displayed in 'Kala Darshan' (2008, 2009), the annual fine arts exhibition held in IIT Bombay.
- Held the post of Internship Coordinator of Physics Department in my third year.
- Served as a cadet in National Cadet Corps (NCC) for 1 year and have cleared B certificate examination.

References

- Prof. Kajari Mazumdar — mazumdar@tifr.res.in
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  Tata Institute of Fundamental Research
- Prof. Pradeep Sarin — pradeepsarin@iitb.ac.in
  Department of Physics, Phone: +91-22-2576-7591
  Indian Institute of Technology, Bombay
- Prof. Torsten Soldner — soldner@ill.fr
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- Prof. Basanta K. Nandi
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- Prof. Bodh Raj Mehta
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