

# Amey Gaikwad

Indian Institute of Technology- Bombay

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## Research Interests

I am passionate about String Theory, Quantum Field theory and the mathematics behind the complex physical phenomena present. I am also eager to learn and understand Conformal Field Theory, Quantum Gravity, Theoretical Cosmology, Entanglement and Particle Physics.

## Education

- 2015-present **Indian Institute of Technology - Bombay, Mumbai.**  
B.Tech in Engineering Physics, Minor in Mathematics, *CPI - 9.83/10.0.*  
**Ranked 1st in the Physics Department and 2nd in the Institute.**
- 2013-2015 **Intermediate/+2, Pace Junior Science College, Nerul, Percentage - 94.95.**  
Topper in Maharashtra Board in **Physics** (100/100) and **Electrical Maintenance** (200/200)
- 2013 **Matriculation, Ryan International School, Kharghar, Percentage - 96.7.**

## Research Internship

- Summer **ICTS SN Bhatt Memorial Excellence Fellowship Program - Instantons and Monopoles in Non Abelian Gauge Theories.**

*Dr. Pallab Basu, Faculty, String group, ICTS-TIFR*

- Confinement: Instantons, solitons and monopoles in Non Abelian Gauge theories.
- Studied instantons in Yang Mills theory and in the double well potential.
- Studied spontaneous symmetry breaking and Higgs mechanism.
- Polyakov monopole and the BPST monopole via the Bogomol'nyi bound.
- Report: <https://github.com/ameypg16/Reports/blob/master/Amey-Report-SNBhatt.pdf>

- December **National Program on Differential Equations(NPDE)-Multistability of planar bistable liquid crystals.**

*Prof. Neela Nataraj, Department of Mathematics, IIT Bombay*

- Under the Landau-de Gennes free energy framework, analysed what drives the normal bistable liquid crystals into multistability.
- Applied numerical techniques (Finite Elements Method and the Newton Galerkin approximation) for carrying out the minimization of the energy functional.
- Numerical calculations were done on MATLAB along with the L2 errors which showed an expected decrease as the number of iterations increased.
- Report: <https://github.com/ameypg16/Reports/blob/master/NPDE-report.pdf>

- Code files: <https://github.com/ameypg16/NPDE-Final-D1>

## Course Projects

Autumn 2017 **Quantum Field Theory**, Dr. R. Loganayagam(*ICTS-TIFR*) and Prof. P. Ramadevi (*IITB*) .  
*EP 322 - Supervised Learning Project*

- Path integral formulation of Quantum mechanics.
- Zero and One dimensional Quantum Field Theory
- Schwinger Dyson equation, Perturbation Theory, Symmetry factors and Feynmann Diagrams.
- Scattering matrix through the path integral formalism.
- Basics of Grassmanian algebra, representation of Lorentz group and Second quantisation.
- Introduction to Quantum Electrodynamics.

Spring 2017 **Music Synthesis**, Prof. T. Kundu, Department of Physics, IITB.  
*EP 226 - Waves, Oscillations and Optics*

- Used the concepts of composition of music though combining notes and making chords so as to combine them into a song .
- A python code was developed so as to mimic the composition of the same song played through different instruments by varying the ADSR envelope function.
- Mimicking the effect of the song in different environments was done, like an auditorium or a parking lot, etc.
- Report:  
<https://github.com/ameypg16/Reports/blob/master/music-synthesis-report.pdf>

Spring 2017 **3 body Collider Simulation**, Prof. Pradip Sarin, Department of Physics, IITB.  
*EP 230 - Electronics Lab III*

- Simulated the process of three free bodies colliding against each other.
- Used VHDL as the programming language to use its parallelism as an advantage. The hardware use was an FPGA board.
- The advantages of using VHDL for the project and optimum usage of the FPGA board to simplify the logic and the algorithm for the collision was studied and documented in the report given below.
- Project Report :  
[https://github.com/ameypg16/Reports/blob/master/FPGA\\_project\\_3\\_body\\_collision.pdf](https://github.com/ameypg16/Reports/blob/master/FPGA_project_3_body_collision.pdf)

Autumn 2016 **Chaos in Cryptography**, Prof. Amitabha Nandi, Department of Physics, IITB.  
*PH 542 - Non Linear Dynamics*

- Analyzed the topological similarities between the two seemingly different fields of cryptography and chaos theory.
- The Baptista algorithm was implemented and chaotic maps were developed on the basis of

the logistic map and Lorenz's dynamical model.

- Results, advantages and disadvantages were analyzed from a theoretical and practical perspective.
- Project Presentation: <https://github.com/ameypg16/Reports/blob/master/NLDproject.pdf>

Autumn **Analysis of specific problems in Data Analysis**, Prof. Vikram Rentala,  
2016 Department of Physics, IITB.  
*EP 219 - Data Analysis and Interpretation*

- Developed algorithms in Python for Data analytical problems from theoretical and experimental physics.
- Pyplot, SciPy, NumPy and Matplotlib were used for plotting the data and inferring the results.
- A report was submitted for the weekly assignments consisting of the data and the inferences made out of the problem for the week.

Spring **Electronics project**, Prof. M.B. Patil, Department of Electrical Engineering,  
2015 IITB.  
*EE 112 - Introduction to Electronics*

- Modelled a **quiz buzzer circuit**.
- Learned the use and applications of analog and digital circuits.

Autumn **Hotel Management System**, Prof. Varsha Apte, Department of Computer  
2015 Science, IITB.  
*CS 101 - Introduction to Programming*

- Using the basic techniques of computer programming developed a monolithic algorithm for a Hotel Management System.
- Developed methods to make the program as robust and error free as possible.

Autumn **3D Project**.  
2015 *ME 119 - Engineering Drawing*

- Designed motorboat using **Solidworks and AutoCAD**.
- Efforts were made to make the motorboat as aerodynamically efficient as possible.

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## Academic Achievements

2016-2017 Ranked **second** in the institute among a batch of **900** students.

2016-2017 Topper in the Physics Department.

2015 **Awarded the Institute Academic Prize** by IIT Bombay for the year 2015-2016 (**3rd in the Institute - CPI-9.94**)

2015 Secured an **SPI of 10.0** in the first semester

2015-Present Awarded **AP** grade in Calculus and Numerical Analysis

2015-2016 **Department Rank 1** in the Physics Department

- 2015 Topper in Maharashtra Board in **Physics** (100/100) and **Electrical Maintenance** (200/200)
- 2015 Offered admissions in **CMI, ISI, and IISc**
- 2014-2015 Qualified in **National Top 1% in NSEP**
- 2014-2015 Qualified in **National Top 1% in NSEA**

## Scholarships

- 2015 Awarded eligibility for **INSPIRE Scholarship** (by qualifying within top 1% of Maharashtra board at class XII – March 2015)
- 2013 Kishore Vigyan Protsahan Yojana (**KVPY**) awarded by Department of Science and Technology, India for promotion of basic sciences among high school students.
- 2011-2012 National Talent Search Scholarship **NTSE** awarded by the National Council for Educational Research and Training.

## Positions Of Responsibility

None Yet

## Computer Skills

- Programming C++, Python, Java, VHDL
- Science Packages Numpy, Scipy, Matplotlib, MATLAB, Octave, Mathematica, Gravipy
- Softwares  $\text{\LaTeX}$ , Solidworks, AutoCAD, Quartus(FPGA), OriginPro, Arduino

## Key Courses

- Physics Non Linear Dynamics, Theory of Special Relativity, Classical Mechanics, Quantum Mechanics, Electromagnetism, Data Analysis and Interpretation, Thermal Physics, Wave, Oscillations and optics, General Theory of Relativity, Photonics (Ongoing), Group Methods in Physics (Ongoing) , Relativistic Quantum mechanics (Ongoing), Quantum Field Theory (Ongoing)
- Mathematics Calculus, Linear Algebra, Ordinary and Partial Differential Equations, Complex Analysis, Real Analysis, General Topology, Numerical Analysis, Basic Algebra (Ongoing)
- Others Introduction to Electronics, Digital Systems