

Prashant Kumar

CONTACT INFORMATION

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RESEARCH INTERESTS

I am interested in theoretical physics. My broad research interests are as follows:

- General relativity and Cosmology, especially geodesics and geodesic deviation in a space-time.
- Phase Transitions, particularly Quantum and Black Hole phase transitions.
- Quantum Optics, specifically Entanglement and Parametric-Down Conversion.
- Writing computer programs to calculate properties of physical systems like atoms, solids, etc.

EDUCATION

Undergraduate:

Indian Institute of Kanpur, Kanpur, India
5th year M.Sc. (Integrated), Physics
July 2009 - June 2014 (Expected)
CPI:- 9.8/10.0 (After 8 semesters)

ACADEMIC RECORD & ACHIEVEMENTS

1. Currently **ranked first in the department** on the basis of CPI.
2. **Fellow of the prestigious Kishore Vaigyanic Protsahan Yojana** (KVPY) since 2008 (SA stream), awarded to 125 students out of approximately 15,000 participants by Government of India.
3. Secured **All India Rank 826** in **IIT-JEE** out of approximately 4,00,000 participants in 2009.
4. Received **Academic Excellence Award** for the sessions **2009-10, 2010-11** and **2011-12**.
5. Selected for **summer camp through National Initiative for Undergraduate Science** (NIUS) in 2010 organised by HBCSE (TIFR), Mumbai.

PUBLICATIONS & CONFERENCE PROCEEDINGS

1. *Geodesics in Information Geometry: Classical and Quantum Phase Transitions* (Prashant Kumar, Subhash Mahapatra, Prabwal Phukon and Tapobrata Sarkar) Phys. Rev. E, **86**, 051117, 2012 (6 pages). [arXiv:1210.7135](https://arxiv.org/abs/1210.7135) [cond-mat.stat-mech]
2. *Geodesic congruences and their deformations in Bertrand space-times* (Prashant Kumar, Kaushik Bhattacharya and Tapobrata Sarkar) Phys. Rev. D, **86**, 044028, 2012 (8 pages). [arXiv:1206.4249](https://arxiv.org/abs/1206.4249) [gr-qc]
3. *Possible Potentials Responsible for Stable Circular Relativistic Orbits* (Prashant Kumar and Kaushik Bhattacharya) Eur. J. Phys., **32**, 895-903, 2011. [arXiv:1103.3338](https://arxiv.org/abs/1103.3338) [physics.class-ph]
4. *Geodesic flows and their deformations in Bertrand space-times* (Prashant Kumar, Kaushik Bhattacharya and Tapobrata Sarkar) To appear in conference proceedings of **13th** Marcel Grossmann Meeting. [arXiv:1208.5327](https://arxiv.org/abs/1208.5327) [gr-qc]
5. *Geodesics in Information Geometry and universal exponents* (Prashant Kumar, Subhash Mahapatra, Prabwal Phukon and Tapobrata Sarkar) Under preparation

PROJECTS DONE

1. *Geodesics in Information Geometry and Universal Exponents* (Publ. No. 5) (under Dr. Tapobrata Sarkar, IIT Kanpur, in 9th semester as M.Sc. project)
 - Studied geodesics in Information geometry for systems showing phase transitions.
 - Derived the properties of ESR parameters and showed that the expansion parameter diverges near phase transitions.
 - Showed that the nature of the divergence is same for all the systems, indicating certain universal exponents.
2. Basics of AdS/CFT correspondence and String Theory (under Dr. Rajesh Gopakumar, HRI Allahabad in July 2013)
 - Read chapters 1-23 of the book "A First Course in String Theory" by Barton Zwiebach.

3. Calculations of electronic states in Atoms and Solids
(under Dr. Deshdeep Sahdev, QuazarTech New Delhi during May-June 2013)
 - Studied surface states in Solids in 1-dimension using scattering theory approach.
 - Implemented DFT calculations with LDA functional for all atoms in Periodic table using a universal Gaussian basis set in Python.
 - Studied LAPW method of band structure calculations in detail and tried to implement it for Al FCC lattice.
 4. *Black Hole Phase Transitions*
(under Dr. Kaushik Bhattacharya, IIT Kanpur in the course PHY590: Special Topics in Physics, 8th semester.)
 - Studied basics of Black Hole thermodynamics.
 - Studied phase transitions in constant volume ensembles in KN-AdS and Kerr-AdS Black Holes.
 5. *Geodesics in Information Geometry: Classical and Quantum Phase Transitions*, (Publ. No. 1)
(under Dr. Tapobrata Sarkar, IIT Kanpur during May-June 2012)
 - Research project on the behaviour of geodesics in Information geometric formulations of Van der Waals gas, Curie-Weiss model, Infinite Ising model and Transverse XY spin chain.
 - Showed that geodesics are confined to a single phase in both Classical and Quantum phase transitions.
 6. *Geodesic congruences and their deformations in Bertrand space-times*, (Publ. No. 2, 4)
(under Dr. Kaushik Bhattacharya and Dr. Tapobrata Sarkar, IIT Kanpur during 2011-12)
 - Research project on energy conditions and nature of geodesics in Bertrand space-time II.
 - Studied ESR parameters for some particular cases of geodesic congruences.
 - Studied the validity of various energy conditions in Bertrand space-time II.
 7. Basic Theory of Neutrino Mass, Mixing and Oscillation
(under Dr. D. P. Roy, HBCSE, TIFR Mumbai in December 2010 and July 2011 through NIUS)
 - Studied how mass of fermions is described by the Standard Model and the problem in assigning mass to neutrinos.
 - Studied the See-Saw model and neutrino Oscillations.
 8. *Possible Potentials Responsible for Stable Circular Relativistic Orbits* (Publ. No. 3)
(under Dr. Kaushik Bhattacharya, IIT Kanpur in May 2010)
 - Research project on generalization of Bertrand's Theorem in Special Relativity
 9. General Theory of Relativity and Black Holes
(under Dr. Tapobrata Sarkar, IIT Kanpur in December 2009)
 - Studied tensor algebra and Einstein equations.
 - Studied the Schwarzschild solution and Black Holes.
- (Research projects are shown in italic.)*

RELEVANT
COURSES

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| <ul style="list-style-type: none"> • Quantum Mechanics I & II • Condensed Matter Physics I • Introduction to Atomic and Nuclear Physics • Quantum Field Theory • Coherence and Quantum Entanglement* | <ul style="list-style-type: none"> • Special and General Relativity • Classical Electrodynamics I & II • Statistical Mechanics • Particle Physics • Non-Equilibrium Statistical Mechanics* |
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() marked courses currently under Progress.*

Secured maximum grade in all the completed courses.

COMPUTER
SKILLS

1. **Languages:** Python, C, LaTeX, Visual basic.
2. **Software:** Mathematica, GNUPlot, Matlab.