

RAVI MOHAN

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EDUCATION

Integrated Masters in Physics — GPA 7.99/10.00

July 2009 - May 2014

Indian Institute of Technology Roorkee, Roorkee, India.

- Coursework:
 - **Physics** — GPA 8.52/10
 - * *Undergraduate courses:* quantum mechanics, special theory of relativity, classical mechanics, elementary condensed matter physics, electricity and magnetism, nuclear & particle physics, atomic physics, numerical analysis and complex analysis & partial differential equations.
 - * *Graduate courses:* advanced nuclear physics, quantum theory of solids, quantum mechanics II and mathematical physics.

RESEARCH

Fluid/gravity duality *Studying the black hole membrane paradigm in large D dimensions. Research project with Prof. Shiraz Minwalla and collaborators at TIFR.*

September 2014 - present

- Surveyed the literature on general relativity in large dimensions, by Emparan et al. Observed the presence of a decoupled sector of gravitational dynamics at low frequencies, in the spectrum of quasinormal modes of the Schwarzschild black hole.
- Obtained the scaled AdS Kerr metric for arbitrary dimensions in hydrodynamical variables and established equality with Myers-Perry black holes for the rigid rotations.
- With the aim of determining the effective description of the slow modes, at the nonlinear level, we are explicitly constructing the relevant manifold of slow solutions in gravity, order by order in an expansion in $1/D$.

Stochastic gravity *Investigating the role of gravity in decoherence.*

June 2014 - present

Research project with Prof. Tejinder P. Singh at TIFR.

[Notes](#)

- Established a link between Penrose criterion of gravity-induced collapse time and characteristic time of decoherence in Diosi model.
- Investigated the Schrödinger-Newton (SN) equations for the proposed collapse mechanism. Concluded that the equations lead to localization of wavefunction without decoherence.
- Investigated the back reaction on the space-time metric due to stress-energy fluctuations, described by Einstein-Langevin equation, in Newtonian limit and discovered a stochastic correction in the gravitational source of SN equations. Obtained the stochastic SN equations with non-white noise.
- Surveying literature on Itô calculus. Decoherence at the density matrix level is expected.

Condensed Matter Physics *Quantum mechanical scattering and Feshbach resonance. Dissertation with advisor Prof. Gauri Shankar Singh at IIT Roorkee.*

January - June 2014

[Thesis](#)

- Surveyed the Feshbach resonance literature and reviewed scattering theory.
- Developed a theoretical two-channel harmonic-oscillator model of Feshbach resonance.

[Presentation](#)

Quantum Computing *Self study and research with Dr. Ajay Wasan at IIT Roorkee.*

June 2013

- Studied realisation of quantum computers using linear ion-trap and laser beams.
- Surveyed article by J. I. Cirac and P. Zoller (Phys. Rev. Lett. 74, 4091 (1995)) and learnt to realise $(C)^N$ – NOT gate using laser pulses.
- Discussed advantages/disadvantages of ion-traps over Nuclear Magnetic Resonance (NMR) spectroscopy for quantum computation.

Quantum Computing *Selected for Summer Research Fellowship organised by IAS.*

May-July 2012

Worked with of Prof. Anil Kumar at IISC Bangalore.

Project report

- Studied the basic principles of NMR and pros & cons of using it for Quantum Computation.
- Designed a quantum circuit to implement Grover's search algorithm for an unstructured 3 qubit database.
- Worked out NMR pulse sequence to realise the circuit.
- Attended lectures on quantum algorithm, quantum measurements, NMR computing and quantum correlations. Visited NMR laboratory to survey the experimental set-up at Quantum Computing Summer School.

Precursor to Quantum Computation *Self study and research with*

December 2011

Dr. Rajdeep Chatterjee at IIT Roorkee.

Project report

- Studied the principles of quantum mechanics and learnt to apply them in quantum computation.
- Surveyed *Feynman Lectures volume III*, part I and II of *Quantum Computation and Quantum Information* by Nielsen & Chuang.
- Surveyed EPR paper (Phys. Rev. 47, 777-780 (1935)) and discussed the concepts of reality, locality and entanglement.

AWARDS AND MERITS

- Cleared graduate entrance examination conducted by Tata Institute of Fundamental Research (TIFR). 2013
- IAS (Indian Academy of Sciences) Summer Research Fellowship to support the research at Indian Institute of Science (IISc), Bangalore. 2012
- INSPIRE fellowship awarded for academic excellence. 2009-2014
- Cleared IIT-JEE examination (99 percentile). 2009

TEACHING

Delivered a series of blackboard lectures at Physics Journal Club, IITR.

- Linear Algebra Notes
- Postulates of Quantum Mechanics Notes
- Interpretations of Quantum Mechanics and Quantum Measurements

TALKS

Decoherence and transition from Quantum to Classical *IDEAS, Cognizance 2013, IIT Roorkee.*

March 2013

Presentation

- Presented a talk on transition from quantum physics to classical physics, supporting many-universe interpretation of quantum mechanics.
- Discussed John von Neumann's postulate to explain the measurement process and how system-detector-environment correlation chain can be used to demonstrate the emergence of "classicality" from "quantumness".
- Won first prize while competing with nine groups of undergraduates and post-graduates from various institutes.

PROJECTS

Open-source *Wrote unrealscript mods, for Unreal Tournament G.O.T.Y, compiled in Unreal Engine I, using WOTGreal IDE.*

2009-2012

- **ACEManager**: A server controller add-on with graphical user interface (GUI), supplementary to anti cheat engine (ACE), used to ban players on a game server based on hardware ID (obtained by ACE).
- **SmartDM & SmartCTF**: Mutators to enhance gameplay, calculate additional ingame statistics and display them on custom scoreboard for DeathMatch and Capture the Flag gametypes. SmartCTF has been developed in collaboration.

- Other mutators include **FlagAnnouncements** and **Denied** which are small hacks to produce desired effects in the game.

Robotics *Worked at hobbies-club workshop to create:*

January-March 2010

- Hovercraft:
 - 80×80 cm of plywood base, capable of levitating 10-12 cm above ground.
 - Powered by remote controlled 12V brushless DC motor running on lithium polymer battery (LiPo).
 - Worked in a team of three students, as team leader and robot designer.
- Mechanical rope walking monkey:
 - A simple 30×20 cm wooden robot, powered by a 9V DC motor, capable of walking on rope with its two arms rotating in a overhead vertical circle.
 - Worked in a team of three to arrange and assemble the components.
 - Won third prize in Shrishti (annual festival organised by **Hobbies Club**).

TECHNICAL SKILLS

Programming & Utility software: java, latex, c++, matlab, unreal engine 1, mendeley, gimp and drupal.

Operating Systems: linux (ubuntu) and windows family.

SERVICE

- Taught basic arithmetic to underprivileged children as a member of **NSS team**, IITR.
- Proposed course structure for Integrated M.Sc. Physics programme which led to modifications in the curriculum.