ARITRA DAS

"But I have promises to keep, and miles to go before I sleep"

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PERSONAL DETAILS

Gender	Male
Date of Birth	28/10/1998
Place of Birth	Kolkata, India
Passport No.	P0218154
Place of Issue	Kolkata
Expiry Date	06/07/2026
Languages	English (C2), Bengali (C2), Hindi (B1), French (A2)
Residential Address	1/257 Naktala, Kolkata 700047 West Bengal, India
Current Address	212/81 Cooyong Street, Metropol 1, Reid, Canberra, ACT 2612, Australia
Academic Profiles	ORCID, ResearchGate, LinkedIn

EDUCATION

Australian National University *December 2021 — ongoing*
Ph.D. Student Supervisor: Ping Koy Lam
Department of Quantum Science & Technology, ANU Quantum Optics Group
Research School of Physics

Indian Institute of Technology Kanpur *July 2016 — July 2020*
Four-year Bachelor of Science (BS) CPI: 8.7/10
Department of Physics

Semester	SPI	CPI
1	8.4	8.4
2	9.2	8.8
3	7.8	8.4
4	9.2	8.6
5	8.4	8.6
6	9.2	8.7
7	8.3	8.6
8	9.0	8.7

The Future Foundation School *2000 — 2016*
Council for the Indian School Certificate Examinations
Science Stream

Standard	Examination	Year Taken	Score
10th	Indian Certificate of Secondary Education	2014	96.8%
12th	Indian School Certificate	2016	97%

TEST SCORES

GRE General *6th September, 2019*
Quantitative Reasoning: 170/170, Verbal Reasoning: 163/170, Analytical Writing: 4/6.

TOEFL *12th October, 2019*
Reading: 30/30, Listening: 29/30, Speaking: 30/30, Writing: 27/30.

GRE Subject *26th October, 2019*
Physics: 960/990.

RESEARCH INTERNSHIPS

Institute for Quantum Science and Technology, University of Calgary *May — July, 2019*
Calgary, Alberta, Canada *Link to article*

- Worked under Prof. Barry Sanders, Director, Institute for Quantum Science and Technology, University of Calgary.
- Studied the quantum phase estimation algorithm, its iterative and Kitaev-improved versions, and explored the possibility of their in a Quantum Fully Homomorphic Encryption setting.
- Studied the delegation of Shor's factorization of 15 in a blind quantum computation scenario.
- Developed circuits for the blind quantum factorization of 21, with the modular exponentiation compiled for base 4. This results in an odd-period circuit, requiring non-Clifford elements including Toffoli gates, the design of which represents a significant advance over the previous blind quantum factorization of 15.
- Verified the designed circuits via both simulation and experiments using IBM's Qiskit software and cloud-based quantum computers.
- This internship was fully funded by the Shastri Indo-Canadian Institute, under the Shastri Research Student Fellowship program.

Indian Association for the Cultivation Of Science *May — July, 2018*
Kolkata, West Bengal, India *Link to article*

- Worked under Emeritus Prof. Jayanta K. Bhattacharjee, ex-Director of Harish-Chandra Research Institute, Allahabad.
- Investigated the convective instabilities in driven active matter and established connections with RB instabilities in the Lorenz model.
- Analyzed the fluid motion above instabilities by modeling them as Lorenz-like equations and studied the dynamical behavior close to the critical points.
- Studied the existence of Hopf bifurcations and limit cycles in the parameter space.
- Verified theoretical predictions with numerical simulations at various parameter values.

Indian Statistical Institute *June — July, 2017*
Kolkata, West Bengal, India *Link to article*

- Worked in a team of two, under Prof. Guruprasad Kar, Physics and Applied Mathematics Unit, ISI Kolkata.
- Studied literature on links between Bayesian game theory and quantum nonlocality.
- Explicitly constructed a Bayesian game where mixed-entangled advice yields higher payoffs than the maximum possible classically, per player.
- Employed the concept of a social welfare solution, or pseudo pareto correlated equilibrium, to find a mixed-entangled state that acts as quantum social welfare advice in this game.
- Leveraged a relatively novel two-party, two-outcome, three-action nonlocal inequality, I−3322, that distinguishes classical strategies from mixed quantum strategies unlike the CHSH inequality.

CONFERENCES AND WORKSHOPS ATTENDED

Quantum Australia *Feb 20 — 22, 2024*
Sydney, NSW, Australia *Homepage*

- Attended industrial research talks from Horizon Quantum Computing, D-Wave, IBM Quantum, Microsoft Quantum, Google Quantum AI, Riverlane & Amazon Web Services
- Networked with industry leaders and international policy experts in the quantum domain

AIP Summer Meeting *Dec 3 — 8, 2023*
Canberra, ACT, Australia *Homepage*

- Attended talks on optical, photonic and silicon-based quantum technologies, including quantum computing platforms, quantum memories, quantum repeaters and quantum sensors
- Delivered oral presentation on "Asymptotic non-utility of collective quantum measurements"

CQC^{2}T Workshop *May 27 — June 1, 2023*
Hunter Valley, NSW, Australia *Homepage*

- Delivered oral presentation on "Equivalence between squeezing and maximum entanglement for two-mode Gaussian states"
- Presented poster on "An Expressive Ansatz for Low-Depth Quantum Optimisation"

ANU-UT Workshop *April 12 — 14, 2023*
University of Tokyo, Japan *Homepage*

- Attended talks on optical quantum computing & quantum memories
- Delivered oral presentation on "Equivalence between squeezing and maximum entanglement for two-mode Gaussian states"

CQC^{2}T Workshop *May 30 — June 2, 2022*
Hobart, TAS, Australia *Homepage*

- Attended talks on quantum error correction, quantum memories & quantum computation from researchers across Australian universities

Quantum Australia *Feb 23 — 25, 2022*
Sydney, NSW, Australia *Website*

- Attended talks by industry professionals from Microsoft, IBM & PsiQuantum on quantum software and hardware

XXX IUPAP Conference on Computational Physics *July 29 — August 2, 2018*
University of California, Davis, USA *Website*

- Delivered oral presentation on "Social Advantage with Mixed Entangled States"
- Attended talks from Microsoft & IBM on challenges in implementing quantum algorithms, particularly quantum Monte Carlo algorithms
- Article published as conference proceedings in JPCS IOP Conference Series.

Workshop on Quantum Computation and Information Theory *May — June 2017*
Indian Statistical Institute, Kolkata, India *Homepage*

- Introduced to quantum computing & information theory
- Studied quantum foundations including entanglement, Bell inequalities and non-locality
- Constructed a quantum game where mixed-state entanglement is pareto-optimal

OTHER PROJECTS

Ordered & Chaotic Dynamics of a 3-DOF Pendulum System *August 2019 — March 2021*
Undergraduate Research Project (PHY556A & PHY557A) *Link to article*

- Mentored by Prof. Sagar Chakraborty, Department of Physics, IITK.
- Extensively studied literature on the dynamics of non-integrable Hamiltonian systems.
- Analyzed the regular dynamics of the spring–mass–spherical–pendulum using canonical & Birkhoff-Gustavson perturbation theory.
- Used two-timing to explain the precessional dynamics and energy exchange between modes.
- Employed fast Lyapunov indicators to demonstrate the emergence of chaos from resonance.

Communication & Computation on Quantum Access Structures *March — April, 2019*
Quantum Computing Course Project (CS682A) *Project Report*

- Mentored by Prof. Rajat Mittal, Department of Computer Science, IITK.
- Studied literature on quantum access structures, threshold structures, maximal structures.
- Studied literature on quantum error correction, stabilizer codes and CSS codes.
- Closely studied "Computing on Quantum Shared Secrets for General Quantum Access Structures".
- Verified the correctness of the inductive algorithm to construct arbitrary access structures.

Diffraction Effects in a Mechanically Chopped Laser Pulse *October — November, 2018*
Modern Physics Laboratory Course Project (PHY315A) *Project Report*

- Mentored by Prof. Krishnacharya Khare, Department of Physics, IITK.
- Detected periodic intensity undulations at edges of a mechanically chopped laser pulse using photodetectors.
- Captured 1-dimensional diffraction profile from straight-edge of the chopper in time domain.
- Accurately measured the wavelength of the laser beam from the undulation frequency.
- Experimentally verified results of "Diffraction effects in mechanically chopped laser pulses".

Solving Boundary Value Problems using Green's Method *May — July 2018*
Saha Institute of Nuclear Physics, Kolkata, West Bengal

- Introduced to Green's functions and their use in solving inhomogeneous boundary-value problems.
- Studied applications of this method to problems in classical electrodynamics and quantum mechanics.

LIST OF PUBLICATIONS

Published:

1. "Social Advantage with Mixed Entangled States", Aritra Das & Pratyusha Chowdhury, *Journal of Quantum Information Science*, **10**, 11—22, DOI: 10.4236/jqis.2020.102002 (2020). Also in *Proceedings of XXX IUPAP Conference on Computational Physics* (2018).
2. "Transition to Turbulence in Driven Active Matter", Aritra Das, Jayanta K. Bhattacharjee & Ted R. Kirkpatrick, *Physical Review E*, **101(2)**, 23103—23115, DOI: 10.1103/PhysRevE.101.023103 (2020).
3. "Hopf Bifurcation Analysis and Existence of Heteroclinic Orbit and Homoclinic Orbit in an Extended Lorenz System", Aritra Das, Soumya Das & Pritha Das, *Differential Equations and Dynamical Systems*, DOI: 10.1007/s12591-020-00556-2 (2020).
4. "Order and Chaos around Resonant Motion in Librating Spring–mass–spherical pendulum", Anurag, Aritra Das & Sagar Chakraborty, *Nonlinear Dynamics*, **104**, 3407—3424, DOI: 10.1007/s11071-021-06455-7 (2021).
5. "Blind quantum factorization of 21", Aritra Das & Barry C. Sanders, *Physical Review A*, **106**, 012421—012427, DOI: 10.1103/PhysRevA.106.012421 (2022).
6. "On the equivalence between squeezing and entanglement potential for two-mode Gaussian states", Bohan Li, Aritra Das, Spyros Tserkis, Prineha Narang, Ping Koy Lam & Syed M. Assad, *Scientific Reports*, **13**, 11722, DOI: 10.1038/s41598-023-38572-1 (2023).
7. "An expressive ansatz for low-depth quantum approximate optimisation", V. Vijendran, Aritra Das, Dax Enshan Koh, Syed M. Assad & Ping Koy Lam, *IOP Quantum Science and Technology*, **9** 025010, DOI: 10.1088/2058-9565/ad200a (2024).

Ongoing:

1. "Holevo Cramér-Rao bound: How close can we get without entangling measurements?", Aritra Das, Lorcán O. Conlon, Jun Suzuki, Simon K. Yung, Ping Koy Lam & Syed M. Assad, submitted to *Quantum* (2024). (arXiv preprint)

2. "Quantum Fisher Information for Measurements", Aritra Das, Simon K. Yung, Lorcán O. Conlon, Ping Koy Lam, Zhao Jie & Syed M. Assad, to be submitted (2024).

RELEVANT COURSEWORK & TEACHING EXPERIENCE

Physics (Theory) Classical Mechanics I & II, Nonlinear Dynamics & Chaos, Statistical Mechanics, Optics, Classical Electrodynamics, Quantum Physics, Quantum Mechanics I, Special Relativity, Thermal Physics, Mathematical Methods I, Computational Physics, Evolutionary Game Dynamics.

Physics (Experiment) Optics, Modern Physics, Experimental Physics.

Mathematics Logic, Calculus, Complex Analysis, Partial Differential Equations, Linear Algebra, Abstract Algebra, Topics in Topology.

Computer Science Fundamentals of Computing, Data Structures & Algorithms, Quantum Computing.

Engineering Engineering Graphics, Introduction to Electronics, Manufacturing Processes I & II, Fluid Mechanics.

Teaching Experience Fibre Optics (PHYS3060, 2022) & Classical Mechanics (PHYS2201, 2023).

ACADEMIC AND EXTRA CURRICULAR ACHIEVEMENTS

2023	Winner of Founder's Day Physics Quiz at the Australian National University
2019	Shortlisted for Chinese Government Scholarship 2019-2020 for undergraduate programs
2019	Recipient of Shastri Research Student Fellowship (SRSF) 2018-19, awarded by Shastri Indo-Canadian Institute, Govt. of India for an 11-week internship on "Secure Quantum Computing on the Cloud" under supervisor Prof. Barry Sanders, Director, Institute for Quantum Science and Technology, University of Calgary
2019	Stood first in band and pair-on-stage competition in Galaxy 2019 (annual inter-hall cultural championship at IITK)
2018	Youngest candidate selected for an oral talk at the Conference on Computational Physics, UC Davis
2017	Keyboardist in college band which competed in Mantra (Indian rock band competition) at Mood Indigo (biggest cultural fest in Asia, hosted by IIT Bombay) and stood fourth
2016	Recipient of INSPIRE award, Department of Science & Technology, Government of India, based on JEE Advanced rank
2016	West Bengal Joint Entrance Examination rank 92 (> 0.15 million candidates)
2016	Joint Entrance Examination Mains rank 2376 (> 1.2 million candidates)
2016	Joint Entrance Examination Advanced rank 2354 (> 0.14 million candidates)
2016	Award for Excellence in Science and Math at 12th grade
2014	Award for Excellence in Social Science, Science and Math at 10th grade
2013 & 2012	Certificate of Excellence in IAIS Assessments, McMillan Education, UNSW Global
2012	Certificate of Excellence, Lycee Francis de Pondichery, LLG Paris exam
2011	Senior Diploma in keyboards, Sri Aurobindo Institute of Culture

TECHNICAL STRENGTHS

Languages	Java, C, Python, Javascript, HTML, CSS
Scientific Software	MATLAB, Mathematica, Qiskit, LaTeX, Git
Other Software & Tools	Autocad, Inventor, Photoshop, Illustrator, Logic Pro
Operating Systems	Windows, Macintosh, Linux

POSITIONS OF RESPONSIBILITY

Music Club, MnC Council, Students' Gymkhana, IITK *July 2018 - March 2019*
Coordinator *Certificate*

- Managed a club of ≈ 40 musicians along with two other coordinators.
- Conducted annual and biannual flagship events where we performed original compositions and covers of songs from genres like blues, progressive rock, jazz, funk and Indian.
- Composed, recorded and performed original music at college fests and music competitions.

Counselling Service, IITK *July 2017 - March 2018*
Academic Mentor, Physics, UG Wing *Certificate*

- Helped freshmen with electrodynamics (PHY103) through one-on-one doubt-clearing sessions.
- Taught freshmen at hall-level and institute-level doubt-clearing sessions.
- Personally guided academically weak freshmen through all their courses.

HOBBIES AND PASSIONS

Music	Composing and playing jazz fusion; I have studied western piano formally for 10 years and self-learnt the guitar and bass. I also learned some Indian classical vocals and Rabindra Sangeet early on. SoundCloud profile
Photography	Natural landscape photography and digital photo editing
Travelling	Experiencing the culture and gastronomy of people worldwide (USA, Canada, England, France, Italy, Turkey, Egypt, Middle East, Asia, China, Thailand etc.)

(As of October, 2024)