

Name in full: Anindita Banerjee

Designation: Senior Quantum Technologist, Project Manager

Name of the Institution Centre for Development of Advanced computing

Date of Birth: 19th August 1981

Gender: Female

Nationality: Indian

Address

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Educational Qualifications:

Degree/Diploma	University/Institution	Year
PhD, Quantum Information	Jaypee Institute of Information Technology	2011
Masters of Science Electronics	Gujarat University	2004
Bachelor of Science Electronics	Gujarat University	2002

Brief Bio:

Anindita is a Senior Scientist at CDAC Pune who leads various quantum-related initiatives of CDAC. At present, she is working on fiber QKD, QRNG and aerial quantum communication platforms. In the area of quantum computing, she is working on different quantum computing applications on accelerated platforms. Earlier, she worked as Quantum Research Head and VP at QuNu Labs Pvt Ltd, focusing on quantum-safe solutions for cybersecurity. At QuNu Labs, she developed India's first fiber-based QKD system from TRL 2 to TRL6. Specifically, she realized the distributed phase reference protocols for QKD in fiber-based systems. She was also involved in theoretical security proofs, simulation and key rate analysis. Further, she developed India's first QRNG based on Time-of-Arrival and mixed QRNG. Further, during PhD, Anindita had developed novel quantum communication protocols and worked on synthesis and optimization of quantum circuits. As a post-doctoral fellow, she established a quantum optics lab in Bose Institute, Kolkata and conducted some foundational experiments. The products developed by her are tested by various government and industry organizations. She has already received 4 US and 1 Indian patents as recognition of her success in converting academic research into useful products. She has also written several well-cited research papers.

Special contributions to teaching, promotion and management of science.

She leads a team of young researchers in Pune. She has trained many scientists and student interns over the year. She has also co-authored a book published by SPIE (Optical quantum information and quantum communication, A. Pathak and A. Banerjee, SPIE Spotlight Series, SPIE Press (2016) ISBN: 9781510602212) which has helped many researchers and students to learn the basics of optical quantum information. She is part of the AICTE committees that developed courses for minor degree and MTech degree in Quantum Technologies. She has also developed a course materials called CAKES for CDAC employees interested to learn quantum technologies. She has also delivered a Ted talk and several invited talks to promote and popularize the area of quantum information in India. In addition, the following may be noted.

Initiative in Quantum Education:

Curated and Launched "Quantum Education Course" for C-DAC internal employees across 12 centres in 2024 March

At present she is working on an educational kit" Single qubit quantum computer"

Patent:

S.no.	Patent title	Name of applicant(s)	Patent no.	Award date	Agency/ country	Status
1	System and method to generate random numbers	Anindita banerjee	385370	29th dec 2021	Indian	Grante d
2	System and method for transmitting time information and quantum states on an optical medium	M t karunakaran, ganesh yadav, anindita banerjee, krishnan rajesh kumar	114896 70	May 20, 2021	US	Grante d
3	Quantum key distribution system and method for securely distributing quan tum keys in a network	Karunakaran m t, anindita banerjee, rajesh kumar krishnan	426503		India	Grante d
			115952 00	February 28, 2023	US	Grante d
4	Quantum key distribution system and method for performing differential phase shift in a quantum network	Anindita banerjee, rajesh kumar krishnan	117430 37	29th aug 2023	US	Grante d

Projects:

Agile and Ad-Hoc Free Space based Quantum Communication using Drone, 13 Cr MeitY Funded

Project 1

i) Project Title: Agile and Adhoc free space-based quantum communications using drone

ii) Funding Agency (or Internal funding): **MeitY**

iii) Brief Project Summary:

Drone-based Quantum Communication (D-QC), is a potential candidate for free space quantum communication. We are developing Ground-Drone- Ground QKD and Drone-to-Drone QKD. This will pave way to the creation of a mobile quantum network and secure communication between the nodes via drone for multiple applications.

iv) Technical Status vis-a-vis objectives:

Project 2

i) Project Title : FinteQ: Quantum Secure the financial transactions using QKD and secure dongle

ii) Funding Agency (or Internal funding): **MeitY**

iii) Brief Project Summary:

B2B: Financial transactions between financial institutions:

These transactions will leverage fiber-based Quantum Key Distribution (QKD) to exchange the symmetric keys securely. These keys will then be used to secure any transaction using symmetric-key cryptography (e.g., AES-256).

National Technological reports:

- 6G Taskforce report on Multi-Disciplinary Innovative Solutions in Bharat 6G Report by DoT,
- <https://dot.gov.in/sites/default/files/Taskforce>
- Contributed in the Standard on Generic Requirement for Quantum Key Distribution system, STANDARD FOR GENERIC REQUIREMENTS No. TEC 91000:2022
- Contributed as champion and supporting lead for Inter Ministerial Committee on Quantum Communications Technology by Department of Telecommunications (standards R&D innovation Division, GOI)
- Contributed as convenor and drafting for Inter Ministerial Committee on Quantum Computing
- Technologies by Ministry of Electronics and Information Technology, R&D in Electronics Group, GOI
- Organized as Convenor, First International Symposium on Quantum Computing in C-DAC, Pune, 30th and 31st Jan 2023

Fellowship:

S.No.	Position held	Institution	From	To	Research Focus/Interests
1	Visiting Research Fellow	Institute for Quantum Science and Technology University of Calgary	March 2008	July 2008	Efficient algorithms to simulate sparse Hamiltonian.
2	Visiting Research Fellow	Computer Science, University of New Brunswick, Canada	July 2010	Aug 2010	Synthesis and cost-optimization of reversible circuits. Synthesis of quantum circuit in IBM quantum computer, quantum tomography and quantum cost optimization templates.

Award:

S.No.	Name of Award	Awarding Agency	Year
1	Pune's Woman Leaders	World Women Leadership Congress	2023
2	Executive Director's Commendation Award	C-DAC Pune, India	2023
3	Quantum Manager	Qkrishi, India	2022
4	TEDxPESU Speaker	PES University, located in Bangalore	2022
5	CSIR Pool Officer	Council of Scientific and Industrial Research	2016
6	Xavier's Medal of Excellence	St. Xavier's College, Ahmedabad	2004
7	INDIAN OIL GOLD MEDAL	Indian Oil Corporation	2002

8	State Topper in consecutive 3 years	Youth Festival Gujarat in Classical Dance	2006-2008
9	Alankar in Kathak	Prayag Vishwa Vidyalaya	
10	Anchor	DD Bharati, Delhi	2005
11	Featured in The Quantum Insider on 28th Sept 2021 in the Women in Quantum Series		

Membership:

1. Government representative iCET (India) group, India-U.S. Critical and Emerging Technologies Initiative.
2. Membership of the BIS panel "LITDC/P 5 Quantum Computing
3. Expert AICTE Committee member for Curriculum on Quantum Technologies at Post Graduate Level- reg.
4. Expert AICTE Committee member for Curriculum on Quantum Technologies at Undergraduate level.
5. Designated Responsible Member (DRM) for International collaborations in Quantum Computing Mission Activities DIGICONNECT

BOOK:

S.No.	Title	Publisher	Year of Publication
1	Optical quantum computation and quantum communication, ebook,	SPIE Spotlight Series,	Published: 9 June 2016, ISBN: 9781510602212. Vol.SL14, pp 58.

Publications

S.No.	Authors	Title	Journal	Volume	Pages	Year
1	Umang Dubey, Prathamesh Bhole, Arindam Dutta, Dibya Prakash Behera, Vethonulu Losu, Guru Satya Dattatreya Pandeeti, Abhir Raj Metkar, Anindita Banerjee, Anirban Pathak,	A review on practical challenges of aerial quantum communication,	Physics Open,	19	100210	2024
2	Manish Modani, Anindita Banerjee & Abhishek Das	Multi-GPU- Enabled Quantum Circuit Simulations on HPC-AI System. In: Sharma, N., Goje, A., Chakrabarti, A., Bruckstein, A.M. (eds) Data Management, Analytics and Innovation	Lecture Notes in Networks and Systems	662	pp 845–854	2023
3	Deepika Aggarwal, Karthick Balaji R1, Rohit Ghatikar, Sruthi Chennuri1 and Anindita Banerjee	Generation of 1 GB full entropy random numbers with the enhanced- NRBG method	Phys. Scr.	Volume 98, Number 12	125112	2023
4	Shahapure, A., Banerjee, A., Deshmukh, R.	The Effect of Comorbidity on the Survival Rates of COVID- 19 Using	Lecture Notes in Networks and Systems	vol 662. Springer, Singapore.	pp. 833-844	ICDMAI 2023. 2023

		Quantum Machine Learning.	(https://doi.org/10.1007/978-981-99-1414-2_57)			
5	Bhattacharyya, S., Das, A., Banerjee, A., Chakrabarti, A.	Comparative Study of Noises Over Quantum Key Distribution Protocol	Lecture Notes in Networks and Systems, (https://doi.org/10.1007/978-981-99-1414-2_54)	vol 662. Springer, Singapore	pp. 759-782	ICDMAI 2023 2023
6	Vinod N Rao, Anindita Banerjee and R Srikanth	Quantum counterfactuality with identical particles	Commun. Theor. Phys.	Volume 75, Number 6	065102	2023
7	Sethia, Anuj, and Anindita Banerjee.	A MATLAB-based modelling and simulation package for DPS-QKD	Journal of Modern Optics	Volume 69 Issue 7	392-402.	2022
8	Banerjee, A. In: Thampi, S., Martinez Perez, G., Ko, R., Rawat, D. (eds) Security in Computing and Communications. SSCC 2019. Communications in Computer and Information Science,	Security of Quantum Cryptography.		vol 1208. Springer, Singapore. https://doi.org/10.1007/978-981-15-4825-3_15		2020

9	Banerjee, A., Shukla, C., Thapliyal, K., Pathak, A., & Panigrahi, P. K.	Asymmetric quantum dialogue in noisy environment.	Quantum Informati on Processin g	16	1-23	2017
10	Behera, B. K., Banerjee, A., & Panigrahi, P. K. (2017)	Experimental realization of quantum cheque using a five-qubit quantum computer.	Quantum Informati on Processin g	16	1-12	2017
11	Banerjee, A., Thapliyal, K., Shukla, C., & Pathak, A.	Quantum conference.	Quantum informati on processin g	17	1-22	2018
12	Zuppardo, M., Krisnanda, T., Paterrek, T., Bandyopadhyay, S., Banerjee, A., Deb, P., Halder, S., Modi, K. and Paternostro, M.,	Excessive distribution of quantum entanglement.	Physical Review A	93	p.012305	2016
13	Shukla, C., Banerjee, A., Pathak, A. and Srikanth, R.,	Secure quantum communication with orthogonal states.	Internatio nal Journal of Quantum Informati on,	14(06)	p.1640021.	2016
14	Chitra Shukla, Anindita Banerjee, Anirban Pathak, and R. Srikanth	Secure quantum communication with orthogonal states	<u>Internati onal Journal of Quantu m Informat ion</u>	doi:10.114 2/S021974 991640021 9	<u>Vol. 14, No. 06, 1640021</u>	2016

15	Shukla, C., Banerjee, A. and Pathak, A.,	Protocols and quantum circuits for implementing entanglement concentration in cat state, GHZ- like state and nine families of 4-qubit entangled states	Quantum Informati on Processin g	14	pp.2077- 2099	2015
16	Aravinda, S., Banerjee, A., Pathak, A. and Srikanth, R.,	Orthogonal-state- based cryptography in quantum mechanics and local post- quantum theories.	Internatio nal Journal of Quantum Informati on,	12(07n08)	p.1560020.	2015
16	Banerjee, A., Pathak, A., Dueck, G.W.	Minimal Designs of Reversible Sequential Elements.	In: Yamashit a, S., Minato, Si. (eds) Reversibl e Computat ion. RC 2014. Lecture Notes in Computer Science,		vol 8507. Springer, Cham. https://doi.org/10.1007/978-3-319-08494-7_11	2014
17	Shukla, C., Banerjee, A. and Pathak, A	Bidirectional controlled teleportation by using 5-qubit states: a generalized view.	Internatio nal Journal of Theoretic al Physics	52	pp.3790- 3796	2013
18	Shukla, C., Kothari, V., Banerjee, A. and	On the group- theoretic structure of a	Physics Letters A	377(7),	pp.518-527.	2013

	Pathak, A.,	class of quantum dialogue protocols.				
19	Shukla, C., Banerjee, A. and Pathak, A.	Improved protocols of secure quantum communication using W states	International Journal of theoretical physics	52	pp.1914-1924	2013
20	Banerjee, A. and Pathak, A., 2012.	Maximally efficient protocols for direct secure quantum communication.	Physics Letters A	376(45)	pp.2944-2950.	2012
21	Rahman, M.M., Dueck, G.W., Banerjee, A.	Optimization of Reversible Circuits Using Reconfigured Templates.	In: De Vos, A., Wille, R. (eds) Reversible Computation. RC 2011. Berlin, Heidelberg. Lecture Notes in Computer Science, vol 7165. Springer,	doi:10.1007/978-3-642-29517-1_4		2012
22	Anindita Banerjee and Anirban Pathak	An algorithm for minimization of quantum cost.,	Appl. Math. Inf. Sci.	6(1)	157-165	2012
23	Banerjee, A., Patel, K. and Pathak, A.	Comment on “quantum teleportation via GHZ-like state”.	International Journal of Theoretical Physics,	50	pp.507-510.	2011

24	Pathak, Anirban, and Anindita Banerjee	Efficient quantum circuits for perfect and controlled teleportation of n-qubit non- maximally entangled states of generalized Bell-type	Internatio nal Journal of Quantum Informati on	9	389-403.	2011
25	Banerjee, A., Pathak, A.	Optically implementable designs of reversible sequential devices;	Indian J Phys	84	1063–1068	2010
26	Banerjee, A., Pathak, A.	Probabilistic Model of Fault Detection in Quantum Circuits.	In: Chandra, A., Das, A., Chakraba rti, B. (eds) Quantum Quenchin g, Annealin g and Computat ion. Lecture Notes in Physics,	802. Springer, Berlin, Heidelberg . https://doi. org/10.100 7/978-3- 642- 11470- 0_15		2010

