John's Story

The ancestral courtyard in Karapuzha was quiet except for the rhythmic slap of water in the Karapuzha river flowing towards the backwaters. The house seems to hold its breath, preserving the memory of generations. It was here that Pucadyil Ittoop Writer had once dipped an iron stylus into ink to record the first history of the Syrian Christian Church, setting down the chronicles of a community that had taken root along the Malabar Coast in the first century.

For me, that history was not merely a collection of names on yellowed parchment; it was an inheritance of purpose. My father, John Ittoop, a disciplined officer with the Forward Bank and later the State Bank of Travancore, carried himself with the quiet precision of a man who measured the world in balance sheets and strict integrity. Yet in me, the youngest branch of the family tree, that precision took a different form. Where my ancestors saw the flow of history or the motion of commerce, I saw invisible currents—the unseen forces that held matter together and set the universe in motion.

The Beginning

My journey towards knowledge began along the shaded paths of CMS High School in Kottayam, one of the oldest schools founded by Christian missionaries in Kottayam. My affinity for science was strengthened by the science teachers here. This was followed by a year at the University Intermediate College in Trivandrum. Science was not merely an academic subject to me; it was an awakening. By the time I completed the Bachelor's degree in Physics at St. Berchman's College in Changanassery and moved to Union Christian College in Aluva for my Master's, my course was set. In 1962, M.Sc. degree in hand, I stood at the threshold of a world eager for discovery.

Two Summers in Kothamangalam

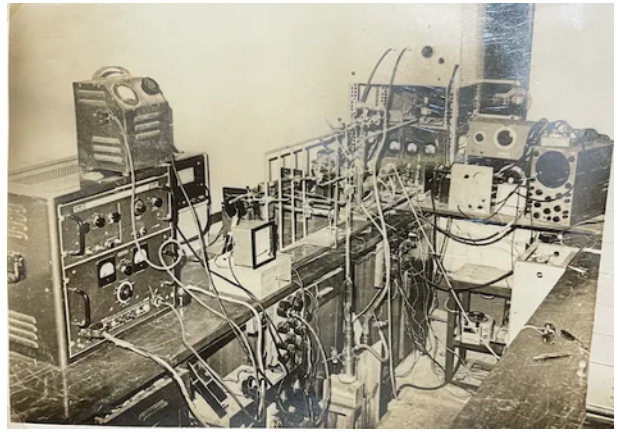
My early teaching post at Mar Athanasius College in Kothamangalam seemed at first to be a quiet interlude, but it quickly became a proving ground. The young Arts College was operating out of borrowed space in the engineering building, lacking a home of its own. When the dynamic Prof. M. P. Verghese organized an ambitious public lottery to raise construction funds, I threw myself into the effort. Managing logistics, coordinating volunteers, and tracking operations across the region revealed something

unexpected: I realized that I did possess an innate talent for orchestrating complex human endeavors. It was a skill that would later build giant machines, but its foundation was laid in two memorable years at Kothamangalam. This was when I first realized my ability to plan and execute complex plans and involving a large number of people.

The Years at Aligarh

By 1964, the pull of fundamental research was irresistible. I packed my trunks and traveled north to Aligarh Muslim University, a vast seat of learning where the air smelled of dusty textbooks, old brickwork, and intense ambition. At the time, the physics department had lost its previous dominance in Cosmic Rays, Nuclear Physics, and Spectroscopy. During my first meeting with Prof Rais Ahmed, the department head who had recently returned from Britain and was familiar with the work in Thermonuclear fusion there, he suggested that I should take up my PhD work in Plasma Physics, the study of the fourth state of matter, where gases ionize into a chaotic soup of charged particles. Plasma Physics was virtually unheard of in the department. I accepted the suggestion without realizing the risk that I was taking.

The proposal was brilliant, but the laboratory space allocated was completely empty. There were no specialized power supplies, no vacuum chambers, and no funding earmarked for high-frequency plasma sources. Undeterred, I became an investigator of discarded equipment. I scavenged unused transformers from forgotten storerooms, cannibalized broken radio transmitters, borrowed meters from neighboring labs, and hand-soldered connections late into the night.



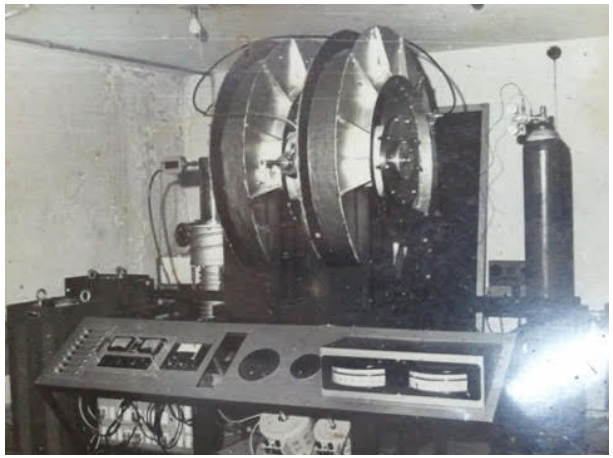
Piece by piece, a functional experimental rig emerged from the clutter. It consisted of a long fat glass tube made in TIFR by the help of Dr K A George, a Push pull oscillator made with Japanese power tubes scavenged from the Engineering College Stores etc. When the primary power switch was thrown for the first time, a pale, violet glow bloomed inside the glass envelope. I watched the purple light flicker and steady. In that modest, homemade vacuum vessel, I had created my first plasma.

My charter was to simulate the phenomenon of Ionospheric Cross Modulation, where a strong electromagnetic field modifies the plasma such that a weak wave passing through the plasma picks up the modulation of the strong wave. I received a Ph. D degree in Physics in 1969 and joined the faculty of the Physics Department, remaining there until 1972.

Several experiments on the interaction of strong electromagnetic fields with plasma were pursued in this period. Though deeply interested in teaching, I realized that my research aspirations would not be fulfilled given the limited resources that the department could offer.

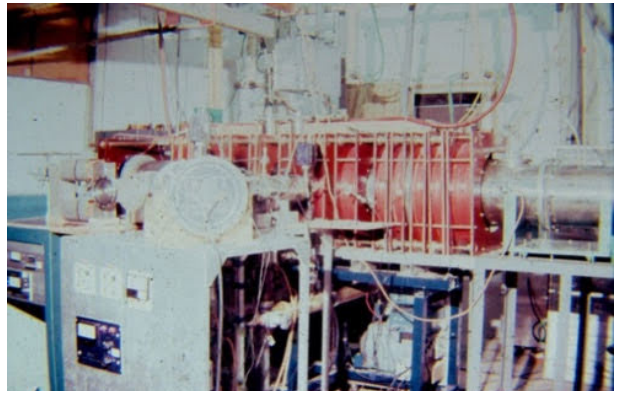
The PRL Years

In the early 1970s, the visionary scientist Vikram Sarabhai set out to revitalize plasma physics research in India. Following setbacks in global nuclear fusion experiments during the 1960s, TIFR, which had a toroidal pinch experiment, had abandoned the field. Sarabhai recognized that understanding plasma was essential not only for energy but for space exploration and astrophysics.



I received an invitation to join the prestigious Physical Research Laboratory (PRL) in Ahmedabad, facilitated by a visit of Prof Bimla Buti of PRL to the Physics Department. Arriving in Gujarat, I joined a small, exceptionally motivated group of young scientists tasked with establishing an experimental plasma physics program relevant to space plasma phenomena.

The experimental programme became a crucible of innovation. We designed experiments to simulate cosmic phenomena right on the laboratory benchtop. We recreated the turbulent plasma instabilities of the equatorial electrojet and modeled the complex boundary where solar winds sweep past cometary tails. Breakthroughs followed in rapid succession. We observed multiple lifetimes in mirror-trapped electrons, verified the stability of ion-acoustic solitons in non-uniform plasmas, and discovered the dramatic fissioning of large-amplitude rarefaction waves.

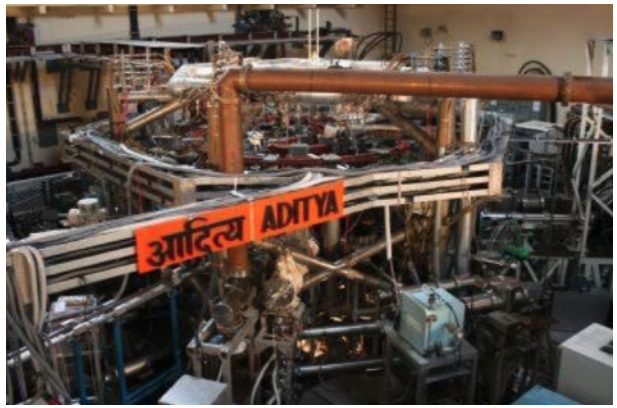


Beyond simulation of space plasma phenomena, I set my sights on pulsed power technologies, to enable us to acquire technical competence in areas relevant to Fusion research. Under a collaborative initiative between PRL and the National Science Foundation in the United States—working alongside specialists from Cornell University and the University of Tennessee—I led the indigenous development of Gigawatt Pulsed Power systems. These massive electrical discharges were used to form intense relativistic electron beam rings in toroidal devices.

By the late 1970s, the small team at PRL had proven that Indian experimentalists could build world-class hardware and discover fundamental physical phenomena. The stage was set for a much larger leap: the dream of every plasma physicists: Fusion.

The ADITYA Venture

In 1982, I stood alongside a determined group of scientists who made a bold proposal to the Government of India: the nation needed its own dedicated, indigenous research program in thermonuclear fusion. Unlimited clean energy was the ultimate goal, and mastering controlled fusion was the key. The government



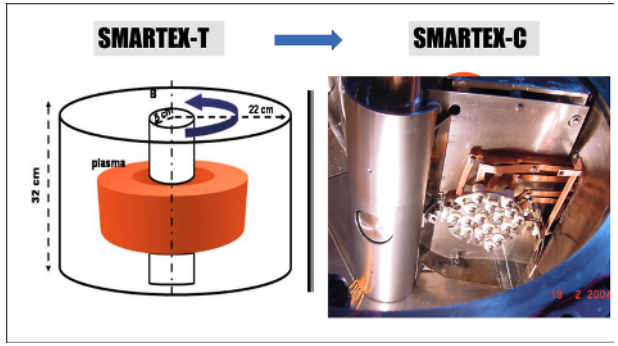
agreed. What began as the Plasma Physics Programme (PPP) expanded rapidly, evolving in 1986 into the autonomous Institute for Plasma Research (IPR) in Bhat, Gandhinagar.

The first Indian Tokamak, ADITYA was built under this programme and was successfully commissioned in 1989 to produce Million degree plasmas. My role in this project was to provide the multi megawatt pulsed power for the experiment and lead the erection and commissioning activity.

A tokamak is a donut-shaped magnetic confinement device designed to trap superheated plasma at millions of degrees. Building ADITYA required extraordinary technical precision—heavy copper coils, ultra-high vacuum systems, complex diagnostic arrays, and power systems capable of delivering tens of thousands of amperes in precise second-long pulses.

Experiments on ADITYA yielded profound insights into tokamak physics. ADITYA research focused heavily on the edge region of the plasma—the boundary layer near the vessel wall. It was discovered that particle loss across the magnetic field was not a steady, continuous leakage as previously assumed, but occurred in sudden, concentrated bursts. This discovery of intermittency in tokamak edge turbulence published in the Journal: Nuclear Fusion made waves internationally, prompting a re-evaluation of plasma transport models in laboratories around the world.

Fundamental research in collaboration with Ph. D students included pathbreaking experiments on Non-Neutral Electron Plasmas. Major contributions have been in the first-time discovery of low aspect ratio toroidal non-neutral plasma equilibrium, invention of a technique for the steady state formation of non-neutral toroidal plasmas, improvement in confine= ment and suppression of instabilities in current free plasmas by azimuthal rotation by a radial electric field. These studies helped increase our understanding of the formation of electron plasmas in a low-aspect-ratio torus, their equilibrium and the instabilities leading to transport. I conceptualised a toroidal version of the Malmberg trap with parallel electron injection and realised it through an experiment. The work is being continued with important observations of non-neutral equilibrium and the first observations of toroidal diocotron instabilities. In its later phase, the experiments included studies of the formation of electron clouds by parallel injection and electrostatic trapping of electron clouds in low aspect ratio toroidal devices.



Bridging the Gap

Throughout my years at IPR, I remained troubled by a glaring gap in the nation's scientific ecosystem: while national laboratories

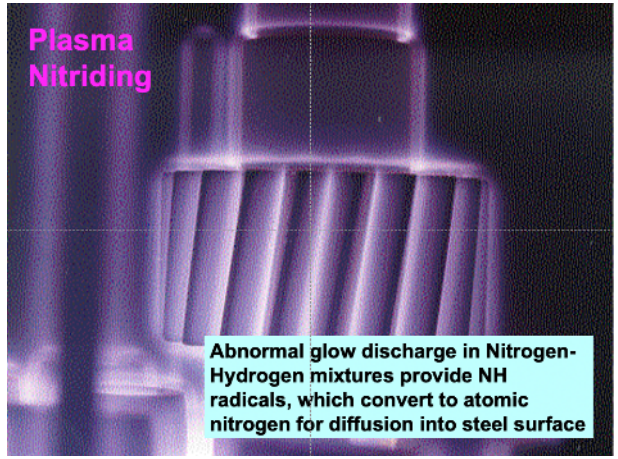
possessed sophisticated facilities and were well-funded, university departments often lacked the resources to perform meaningful experimental plasma research.

To bridge this divide, I, along with Prof Kaw, conceptualized the Satellite Research Projects in Plasma Physics under the Department of Science and Technology (DST). Serving as Chair of the Science and Engineering Research (SERC) Committee, I helped seed more than 30 research projects in universities across India. I organized national SERC Summer Schools and launched the Cross-Disciplinary Plasma Sciences Programme, bringing together physicists, metallurgists, chemists, and surface engineers. University labs were equipped, students were trained, and a generation of researchers was introduced to plasma science.

As Chairman of the SERC committee to implement this, I organized several inter-disciplinary workshops involving plasma, condensed matter and surface physicists, metallurgists and chemists, coordinated the preparation of state-of-art reports, and developed procedures for the evaluation of research proposals and funding them. This programme helped build partnerships between plasma scientists and practitioners of material science, nuclear and high energy physics, metallurgy, condensed matter physics etc. and generated intense creative activity in such diverse disciplines as plasma material interaction and plasma chemistry, surface engineering, collective particle acceleration, advanced radiation sources, free electron lasers etc.

Plasma as an Industrial Tool

In 1990, I took the initiative to apply our knowledge of Plasma Physics and device building to the development of industrially relevant applications of Plasma Physics. The vision was clear: translate esoteric physics into commercially viable, environment-friendly industrial processees. Plasma could alter surface properties without toxic chemicals, harden steel components in hours, and break down complex pollutants.The Plasma Processing Programme explored unique opportunities in high energy density material processing with high-value addition. The programme was industry-driven to make it agile and responsive to rapid changes and focused on a few thrust areas where immediate impact would be possible. Financial self- reliance was an important goal. The two decades of experience of the institute in the production and manipulation of plasmas and the expertise in associated technologies were mobilized for the generation and commercial diffusion of industry relevant technologies.



This commercialization of the IPR knowledge base in plasma sciences and associated technologies was sought to be achieved through developing strong linkage with industries via proactive interaction and supplying them with techno commercial information using a variety of platforms like newsletters, workshops for consultants and entrepreneurs, participation in national and international trade fairs etc. Various selection criteria, like commercial, societal and strategic benefits were used in short-listing technologies eventually selected for development. A mix of Industry - Institute - Government funding was used for the actual development and transfer of technologies.

The chosen thrust areas were PVD/PCVD, Plasma Ion Implantation, Pulsed Plasma Nitriding, Silicon Dioxide coating etc. The technologies transferred to industries include Plasma Nitriding, Plasma-Aided Silicon Dioxide deposition, Plasma Etching of Angora Wool for enhancing spinnability, Plasma Sources for nanoparticle generation, Cold plasma applicators for biomedical applications and Plasma Pyrolysis for Medical and Organic Waste.

The FCIPT Venture

In 1997, I set up the Facilitation Centre for Industrial Plasma Technologies (FCIPT) in a rented building in the industrial area of Gandhinagar, which successfully demonstra= ted that it was possible to translate knowledge in Physics into industrially and strategically relevant technologies in surface engineering, environmental remediation, material synthesis etc. in a commercially viable manner. In 2006, FCIPT moved into its campus in the Industrial Estate in Gandhinagar. It is now part of the Plasma Innovation Foundation, a Section 25 company dedicated to promoting startups using plasma-mediated technologies.

I was a nodal person in the TIFAC Surface Engin- eering Programme and Principal Investigator on a project on Plasma Immersion Ion Implantation under the Indo-German collaborative programme in association with Technical University, Clausthal and Institute for Ion Beam Physics in Dresden. This led to exchanges and training of scientists. I edited and published an International newsletter for one year in collaboration with the United Nations University, Tokyo.

A Viennese Interlude

In 2002-03 I spent close to a year at the International Atomic Energy Agency as the Head of its Physics Division. I acted as scientific secretary for the 40th meeting of the International Fusion Research Council at Lyon on October 13, 2002. The meeting assessed the increasing worldwide interest in fusion, discussed means of enhancing international cooperation, reviewed the International Tokamak Physics Activity, and noted the progress of ITER and the need to maintain a vigorous research programme once ITER construction starts. I acted as scientific secretary for the 19th Fusion Energy Conference at Lyon, France (October 14- 18, 2002). Significant developments in the performance of large fusion experiments, advances in critical technologies and new and innovative concepts were reported.

I organized the Co-ordinated Research Programme (CRP) on Compact Toroids at IAEA (28 October to 1 November 2002). The Research Co-ordination Meeting reviewed the present status of research in spherical tokamaks, spheromaks, and field-reversed configurations and gave directions for future work. I represented

the Agency at the meeting for planning the ICTP/IAEA Workshop on Plasma Physics held on November 25-26, 2002 at the International Centre for Theoretical Physics, Trieste, Italy. Critical inputs were given for a novel 'Host Experiment Programme' to be established in developing countries for capacity building in collaboration with developed countries.

I represented the Agency at the 32nd Meeting of the Fusion Power Co-ordination Committee held on 27 January 2003 at the International Energy Agency Headquarters, Paris, France. I reported on the Agency's activities in promoting Fusion and Plasma Research and discussed with the officials of the IEA various means of improving the cooperation between the Agency and IEA in promoting fusion research.

I represented the Agency at the Fifth Symposium on Current Trends in International Fusion Research: A Review held in Washington, USA from 24-29 March 2003. I was a member of the Steering Committee, Chair for the session on Magnetic Confinement and Other Approaches and Chair of a committee for preparing a report of the meeting to be published in the Journal of Fusion Technology. I reported on the Agency's activities in promoting international cooperation in plasma physics and fusion research. I discussed with many participants on enhancing the role of IAEA in supporting plasma physics and fusion research in the changed context of the ITER programme progressing into the execution phase.

In response to the Director General's request for ideas for new initiatives, I proposed the concept of Virtual IAEA: a digital history resource base to generate a retrievable collective institutional memory for the Agency.

Meghnad Saha Chair

Back in India after my IAEA assignment, I was offered the Meghnad Saha Chair in Plasma Science and Technology from 2004 to 2011. I was inducted as a member of the Standing Expert Committee on SST-1, the superconducting fusion device at IPR, I took part in the analysis of the failure of its commissioning which concluded that the absence of systematic engineering validation and rigorous component-level experiments in SST-1 were the causes. Work required in the redesign and re-engineering of the Superconducting magnet joints and other subsystems was identified. As Chairman of the SST Mission Board, I put into place procedures for ensuring greater transparency in matters of engineering associated with SST-1 activities. The practice of systematic experimental validation for verifying functional and design requirements of the subsystems was established. A technically credible programme of recommissioning SST-1 was put in place.

India Joins ITER

As part of India's effort to join the ITER (International Thermo-nuclear Experimental Reactor) project, I coordinated the visits of various international teams to India, which

assessed the status of Indian fusion research and industrial capability before India was considered for entry into ITER. The painstaking planning which went into the visit of various international teams to India and the positive impressions they gathered about Indian industrial capability and our competence in fusion research were decisive in India being invited to join ITER.

In 2006, I represented the Government of India in a series of negotiation meetings primarily in Cadarache, France, but in exotic places like Jeju Island in South Korea, leading to India becoming a partner in the ITER project. I have been a member of the ITER Council from its inception and have made technical contributions as a member of the Science and Technology Advisory Committee of ITER. I served as a member of the Management Advisory Committee of ITER and have served as a member of the Independent Panel on ITER Cost. I served as the Co-Chairman of the Indo-Euratom Coordination Committee for Collaboration in Fusion Research between India and Euratom Partners.

I took a leading part in the conceptualization of the organizational structure of ITER-India, an empowered entity set up to deliver the Indian engineering and hardware contribution to ITER. I led the discussions on formulating a long-term programme on how India should face the formidable engineering challenges in the construction of fusion power plants of increasing size and complexity through a concurrent programme of multi-step reactor construction and the development of critical fusion technologies. A concept of an organization that can deliver the mission needs and also propagate fusion plans in India up to and beyond the DEMO reactor was developed. The management structure consists of networked research institutions in India, for carrying out the implementation of the fusion development programme since it would be impossible for any single research institution to sustain and contain such a multifaceted activity.

The National Fusion Programme

With India's entry into ITER, I developed the National Fusion Programme in 2008 to broaden the base of Indian research in fusion science and technology by funding universities and educational institutions in research. I served as Chairman, the Board of Research in Fusion Sciences and Technology (BRFST) until 2018 and established the administrative framework for funding educational institutions and industries in research and development essential in the long term for human resource development in fusion science and technology. Since the University participants

selected problems under the guidance of IPR faculty, the NFP programme acts in a way to extend the IPR efforts in all areas of fusion science and technology and build technical competence in the critical area of fusion technology. After BRFST was converted to Plasma and Fusion Research Committee (PFRC) under BRNS, I continued to serve as its chairman for a few years.

Travels and Talks

I have mentored a large number of plasma physicists and played a catalytic role in nucleating plasma physics research in universities through initiating and leading many programmes of the Department of Science and Technology. These include SERC Summer Schools in Plasma Physics, the DST Programme on Satellite Projects in Plasma Physics and the DST Cross-Disciplinary Plasma Sciences Programme. I am a fellow of the Indian Academy of Sciences and the Gujarat Science Academy. I was a consultant to the United Nations University in Tokyo and the International Atomic Energy Agency in Vienna.

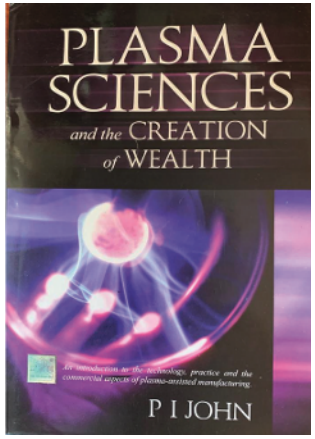
I have travelled extensively both as a member of Scientific Delegations of the Government of India as well as to represent my Institutes in scientific conferences. The former include visits to the Troitsk Institute for Innovation and Fusion Research (TRINITI), Soviet Union, visits to Fraunhoffer Institutes as a member of the Indian delegation for the Indo-German Initiative in Surface Engineering, visit to Cornell University under the India-NSF collaboration on Relativistic Electron Beam Experiments. Participation in the ITER negotiations demanded several trips to Caderache, France, Mito in Japan, Suzhou in China and Jeju in South Korea. Other memorable visits include attending the IEEE Conference on Plasma Science at Troy, New York, International Conference in Plasma Physics (ICPP) in Goteborg, Sweden, 10th Fusion Energy Conference in London, ICPP held in Innesbruck, Switzerland and Foz do Iguazu in Brazil.

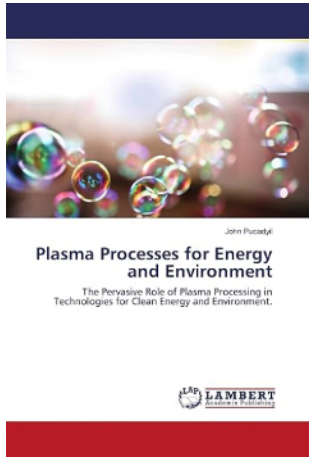
I attended the International Conference on Physics and Industrial Development (COPID 2000) hosted by the University of Natal in Durban, South Africa to talk about the Indian initiative in industrial plasma activities. Another trip to talk on the same subject took me to the United Nations University in Tokyo. Travels to Cham in Switzerland and San Diego in US were connected with visiting children abroad.

I have been invited to give talks on Fusion and Plasma Physics in different fora. Prominent of these are "Dr S. S. Ramaswamy Memorial Endowment Lecture" at 33rd DAE Safety & Occupational Health Professionals in March 2016 at the Entrepreneur Development Institute, Gandhinagar, Vikram Sarabhai Oration at Shri Vaishnav Vidyapeeth Vishwavidyalaya, Indore on 18 December 2018, National Conference on Advances in Nuclear Technology (ADNUTECH 2010), Department of Atomic Energy (DAE) and the Indian National Academy of Engineering (INAE) on December 2-3, 2010 Trombay and Institution of Engineers India), Guwahati and Assam Science and Technology University, Guwahati on 29 November 2017.

Writing About Plasma Physics

I enjoy writing articles and books to interpret plasma physics and its applications to the agents of change: students, entrepreneurs, businessmen, technocrats and consultants. A





newsletter " Plasma Processing Update" published by FCIPT informed them about the emerging developments in industrial applications.

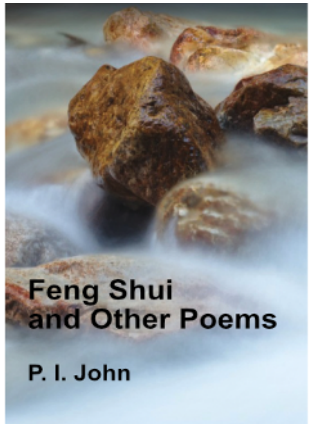
The book, "Plasma Sciences and the Creation of Wealth" published in 2005 discusses the versatility of plasma as an enabling tool for industrial, manufacturing, environmental and engineering applications. It is an introduction to the technology, practice and commercial aspects of plasma-assisted manufacturing. This book was published by the Tata-McGraw -Hill Publishers, New Delhi. This book has been translated into the Chinese language.

A second book, a monograph titled "Plasma Processes for Energy and Environment" explores the pervasive role of plasma in some areas related to energy and environment. This was electronically published by Lambert Publishers, Germany in 2013.

As Senior Professor and the Meghnad Saha Chair in Plasma Science and Technology at the Institute for Plasma Research, I have contributed significantly to the nucleation and growth of Plasma Physics and Fusion Research by contributing to capacity building, technology and human resource development and institution building.

In recognition of these contributions to Science and Technology, the Government of India honoured me with Padma Shri in 2010. This was followed by the Jacobite Syrian Christian Church honouring me by awarding the Athanasius Medal in the same year.

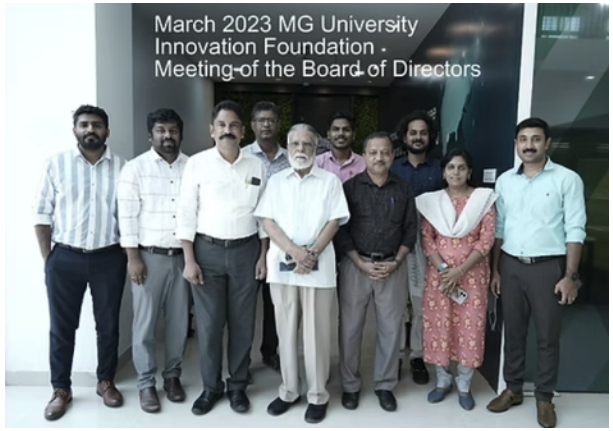
My interests transcend science. I paint in oils and write poetry. My book of poetry, Feng Shui and Other Poems has been published online. I am a mentor to InCube Ventures Ltd. Ahmedabad; the first social venture approved by SEBI.



After retirement and returning to Kottayam in 2012, I became actively involved with the Senior Citizens Forum, Kottayam and helped the elders acquire expertise in computer and internet usage through tutorial classes. I also acted as its President for a few years.

Innovation and MG University

I am a member of the Board of Directors of the the Mahatma Gandhi University (MGU) Innovation Foundation, a Section 25 Company conceived to create an innovation ecosystem to support innovative ideas to be transformed into commercial products to benefit society. In tune with the global trends in higher technological education, Mahatma



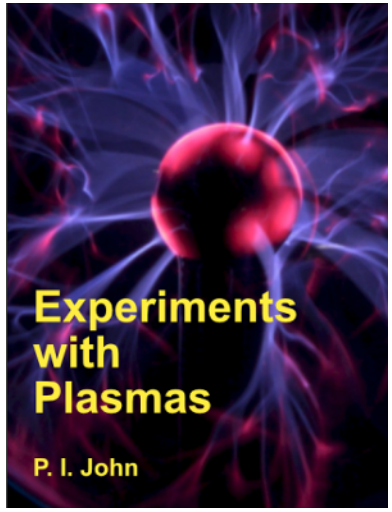
Gandhi University encourages entrepreneurship among the Faculty, Staff, Research Scholars, and Students. I have also been trying to promote the idea of a University of the Third Age to extend academic activities to Senior Citizens.

In June 2024, I was appointed a Professor of Practice by the University for three years, primarily to tap my extensive experience in project management and execution. I serve on the Board of Governors of the Institution of Green Engineers (IGEN), which connects green professionals worldwide, working towards sustainable development goals and providing solutions for a sustainable greener world. I also serve as the Honoray Advisor to the "Current Indian Science".

More on Writing

I brought out an e-book titled "Experiments with Plasmas", detailing my struggles with setting up and doing plasma physics experiments at the Aligarh Muslim University, the Physical Research Laboratory and the Institute for Plasma Research. The intention is to communicate with and motivate young research scientists and students about the triumphs as well as tribulations associated with a career in experimental Plasma Physics.

I enjoy reading and have acquired a collection of more than 1500 books and a large number of ebooks. The subjects are eclectic, biography, fiction, detective novels, history, science, science fiction and politics. The enforced seclusion caused by the spread of COVID made me a blogger. I had kept digital notes on my work, personal life, and professional experiences, which turned out to be handy raw materials for my blogs. Some blogs were on plasma physics experiments, plasma processing, thermonuclear fusion and other facets of plasma physics. Many posts covered my interests in movies, art, and technology.



I started writing on the Medium blogging site in 2022. These blogs attracted good responses and have created a following of 3500 readers on Medium. Very recently I have started writing stories based on plasma processing. Substantially science based, the stories extend science to the realm of fiction dealing with how the benefits of plasma processing have impacted people. These stories have been brought out by Amazon as a Kindle book.

The Pucadyil Family

I am married to Minnu who belongs to the Nellikal family, Kottayam. A devoted housewife, her days are spent on decorating the house and tending to her balcony garden, She is also active in the affairs of the Senior Citizens' Forum. We have two children.

Our elder son, Joseph serves with the Roche Diagnostics in Switzer- land as the International Business Leader; Labora- tory Software Solutions. He has now spent more than fifteen years in Switzerland and travels all over the globe. He is an exceptionally talented photographer and keeps a photography site name https/www. josephpucadyil.com/. Joseph's family consists of Janaki, his wife and Rahul their son. Janaki is a psychiatric counsellor and Rahul is a software developer.

Our second son, Thomas, a Biologist returned to India from his post doctoral work in the US and joined the Indian Institute of Science Education and Research (IISER), Pune, where he became a Professor. Passionately dedicated to revealing the secrets of the cell, he guides a number of students in research and runs his 'Reconstruction Biology Laboratory' in IISER. He won the Shanti Swarup Bhatnagar award for Biology in 2018. In April 2026, he assumed directorship of the DBT's National Centre for Cell Sciences in Pune. Thomas's family consists of his wife Shanti who is an administrator with IISER, Pune. Their son Nikhil is a student of the 11th Standard. He used to like to stage stand up comedy and is a passionate basket ball player. .