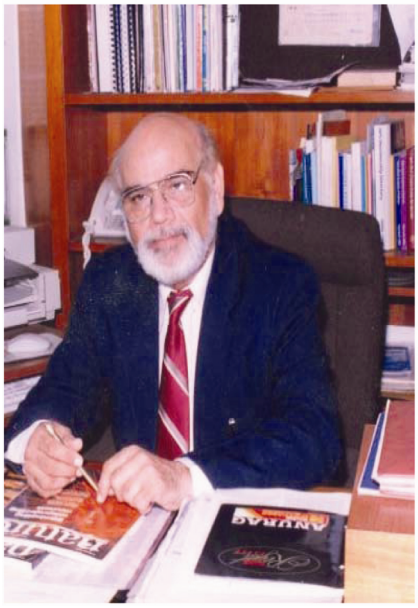
Narendra Kumar (1940–2017)

Professor Narendra Kumar, or simply Kumar as most of us have known him, was born on 1 February 1940 in Bilaspur of today's Chhattisgarh as the youngest of three sisters and two brothers. His father, Labh Mal Julka, was an electrical engineer who obtained his degree from the Banaras Hindu University and mother, Taravathi, was proficient in three languages Hindi, Urdu and Punjabi. His early childhood was spent in Ranchi, where he was taught at home by his father until the age of seven. It was then that he also learnt to speak Sanskrit. A fascination for magnetism had already developed in the heart of young Narendra, who constantly played with bar magnets and magnetic compasses and often slept with as many as twenty bar magnets under his pillow. He underwent his schooling in the Dayananda High school at Patna.

Narendra Kumar went on to study at IIT Kharagpur where he received his B Tech (Hons) in Electronics and Electrical Communication Engineering in 1961, obtaining a prize for the best dissertation and subsequently his M Tech degree in Ultrahigh frequency and microwave engineering in 1963. He stood first in the All India Engineering Services Examination conducted by UPSC in 1963 and joined the Institute of Armament Technology (IAT) at Pune as a Senior Scientific Officer. By that time, he had realized that his heart lay in working in Theoretical Physics, and much as he liked engineering, working on technological problems simply did not appear attractive to him. It was then that he faced a major challenge in shifting over to physics. While most institutions were interested in letting him to work on Engineering aspects, they did not believe that he could work on physics. Working at IAT, Kumar published one of his first papers in *Nature*, on microwave Faraday rotation in ferrite powders. His lucky break came in the form of an offer from K. P. Sinha, a theoretical Physical Chemist, who was a group leader in National Chemical Laboratory (NCL), Pune. The scientist who usually operated the NMR spectrometer in NCL, was then going abroad on study leave. Sinha offered Kumar the option of moving to NCL, if he applied his microwave engineering skills to keep the NMR spectrometer functioning and carry out NMR measurements, with the understanding that he could work on anything he pleased in his free time. As it happened, the NMR operator was not granted a visa after Kumar moved to NCL as a Scientist B, and Sinha nobly allowed the young engineer to work full-time on his passion – Theoretical Physics. After collaborating on a variety of problems in magnetism with Sinha, Kumar submitted his thesis to IIT Bombay for the grant of the Ph D degree. As C. Sivaram puts it, 'In today's world this would not have been possible because Professor Kumar could not have qualified in the NET examination!'.



Kumar as Director of RRI, Bangalore in 1999.

Kumar then proceeded to join the University of British Columbia in Canada to work as a pre-doctoral teaching associate. There he met Maurice H. L. Pryce, whose spirit of scientific inquiry and academic propriety left a lasting impression on him. He worked there on a variety of problems, including a notable one on the Jahn–Teller distortion causing attractive interactions between electrons and the effects on superconductivity, which was published in the *Physical Review B*. By then, the universalist in him had begun to blossom, with him publishing on various topics such as the relation of zero-point energy to cosmological evolution and pulsating neutron stars. He joined the Physics Department at Indian Institute of Science (IISc), Bangalore as a faculty member in 1972, where he stayed until 1993.

The ambience of the Physics Department at IISc allowed Kumar to passionately immerse himself in his explorations of the world of physics. He now worked on a variety of problems with brilliant collaborators and students who surrounded him at the IISc. From problems of superfluidity and superconductivity, magnetism, phase transitions, quantum transport in disordered media to magnetism in rotating gravitating stars, his research now ranged over a plethora of topics. The only condition was that a problem should be interesting to his students and to him. Localization of waves in disordered media fascinated him and exact mathematical results on the distributions of measurable quantities in one-dimensional disordered wires were obtained by him. Quantum diffusion and transport in disordered mesoscopic systems occupied his thoughts and he contributed enormously to the understanding of the non-self-averaging nature of conductance fluctuations through one-dimensional systems with static disorder. Notable among these studies carried out with his students were the establishment of non-diffusive quantum motion in a medium with dynamic disorder, a universal distribution for the delay times of resonant backscatter from a one-dimensional disordered wire arising from Anderson localization, the connection between non-additivity of quantum resistance and low frequency noise, and the connections between information theory and conductance fluctuations. He could, however, not easily 'digest' as he would say, the single parameter scaling theory of localization and published notes pointing out possible discrepancies in the theory. This led to a lively debate in the community, wherein some of his objections were shown not to hold true, while some points made by him defined the limitations of the single parameter scaling theory and enriched the area.

The crowning glory of his contributions on mesoscopic systems was the description of quantum transport in multichannel disordered mesoscopic conductors, a work carried out in collaboration

with his close friend and long-term associate Pier A. Mello and P. Pereyra. By putting together the transfer matrices for the fields across small resistances in series, it was shown that equations to describe the statistical properties of physical ensembles of such resistances could be deduced. Today this equation is well known as the Dorokhov–Mello–Pereyra–Kumar (DMPK) equation. This development spurred major understanding of multi-channel mesoscopic conductors, with the original paper gathering over 500 citations as on date. The key, according to Kumar, was to find out a mathematical measure for the transfer matrices.

Kumar collaborated with many scientists in IISc and across the world, theorists and experimentalists as well. Among his major collaborators were Jean Heinrichs at the university of Leige, with whom he wrote several papers on classical and quantum transport in disordered materials, P. A. Mello of UNAM (noted before) and colleagues in the theory group of the Physics Department at IISc. He also collaborated extensively with experimentalists, notably S. V. Bhat and Ajay K. Sood at IISc. He travelled widely, engaging in scientific discussions with leading scientists to quench his thirst for knowledge. He visited the University of Leige, University of Warwick, Drexel University and the International Center in Theoretical Physics in Trieste for significant amounts of time. He was a senior Associate and then Staff Associate of the Condensed Matter Group at the ICTP and as Erio Tossatti from the ICTP/SISSA says 'a regular animator at many of our workshops and scientific occasions'.

By the 1980s, Kumar was well-known across the scientific circles in India and abroad. He was conferred with the Shanti Swarup Bhatnagar Award in 1985 by the CSIR and the TWAS Award in Physics (1992) in recognition of his works. He was elected a fellow of the Indian Academy of Sciences (Bangalore) in 1985 and of the Indian National Science Academy (New Delhi) in 1987. He was a member of many national committees that required him to travel and spend significant amounts of time on these assignments. He also served as the Chairman of the Physics Department during 1989–91 and as the Chairman of the Division of Physical and Mathematical Sciences during 1992–1994 at IISc.

In the early 1990s, Kumar had begun interacting strongly with the physicists in the Raman Research Institute (RRI) at Bangalore. In 1993 he was offered the position of the Director by the RRI Trust and was worried that the administrative duties of the director would take up considerable time away from his research. As the Administrative Officer, Krishnamaraju, of RRI recalls, Kumar agreed to become the Director the moment he realized that the demands on his time for administration would be minimal. He felt it was a great honour to head the Institution founded by C. V. Raman, whose life and accomplishments had inspired him highly. As he took up the position in 1994, his thoughts were to make the study of light (Raman's legacy) a mainstream activity in the Institute. To that end, he started a group entitled LAMP – Light, Atomic Molecular Physics and several faculty members were hired, making it now a major group of the Institute. He collaborated to initiate experimental work on random lasers and a major initiative on laser cooling of atoms – activities that were extremely topical then. Along with his students, he showed that random lasing from disordered amplifying media could originate from cavities formed by Anderson localization, and deduced universal distributions for the reflectivity and the delay times from a one-dimensional random amplifying medium. He stressed on unambiguous dynamical signatures for localization of light. His work on the *c*-axis conductivity of high T_c superconductors and the relation to the quantum Zeno effect is well known. He worked on quantum aspects of coherence, dephasing and de-coherence of systems at zero temperature.

Kumar's infectious enthusiasm for science influenced all the scientists at RRI immensely. He won their admiration by his whole hearted participation in the seminars, colloquia and various research programmes of the Institute. His universalist approach to understand problems across physics, his genuine knowledge of various fields and unique mathematical capabilities enabled him to help colleagues in their work across the Institute. His kind human handling of all administrative issues was also highly appreciated by everybody. He firmly expected the scientists to conduct themselves in a manner that behove their status and their activity. It was almost magical the way he could set aside all administrative problems and empathize with the person he was interacting with, whether a student, staff member, faculty member or even a security guard. His heart was only filled with kindness and he always wanted to bring out the best in the other person. His ready wit and humorous nature allowed him to defuse very tense situations easily. He felt that RRI offered the most beautiful ambience to carry out scientific work.

In 1998, Kumar became the President of the Indian Academy of Sciences until 2000. Over the years, he took great interest in identifying brilliant young scientists, and initiating the process of their election to the Fellowship of the Academy. He felt that the most important events of the Academy were the election of the Fellows and the annual meetings when the new Fellows were introduced. In his presidential address at the annual meetings, he would focus on research that he was directly and personally involved in as he refused to talk about anything that he did not have deep knowledge about. During his term as the President, he took a number of important initiatives. Principal among them were the steps to herald significant cooperation among the three national scientific Academies in India. Within two decades, this important initiative has developed and matured; today, many important activities, particularly those related to improving science education in our universities as well as public outreach, are jointly sponsored by the three Academies. He believed that the Fellowship of the Academy should be numerically compact and of high quality with very strong interactions to reinvigorate science in the country.

Throughout his stay in RRI, recognitions and awards continued to pour on him. He was elected a Fellow of the American Physical Society, the Institute of Physics (UK) and the Third World Academy of Sciences. He was awarded the Mahendralal Sircar Prize in Physics (1997), Goyal Award in Physics (1998), FICCI Award for Physical Sciences (1998–99), C V Raman Birth Centenary Award (1999–2000) and the Meghnad Saha Medal (2000). He won the distinguished alumnus awards of both his alma-mater, IIT Kharagpur and IIT Bombay. These culminated in 2006 when the Government of India decorated him with the Padma Shri. After his retirement

as Director of RRI, he continued to work at RRI until 2010 as Homi Bhabha National Professor and then as Emeritus Professor. He continued carrying on his scientific research with his child-like curiosity in exactly the same manner as before until his last days. He co-authored four books and over 200 scientific publications in reputed journals over his lifetime.

Kumar was a generalist – nothing ever limited his interest. Everything and every question was amenable to scientific analysis, be it why trees grow so tall or why is the night sky not bright. He was filled with wonder about the world and had an unquenchable thirst to finding answers. He would often say that he only needed to look at the beautiful star-filled night sky to be inspired to do science. His enthusiasm would rub-off on all his students and colleagues who always found his company intellectually stimulating and invigorating. He had an absolute insistence on mathematical rigour and in turn wondered at the 'unreasonable effectiveness of mathematics in physical sciences and in natural sciences in general'. For him, the very process of solving the problem was to be savoured. As his student, Anil Kumar Abburi, recalls, upon realizing a solution to a problem, Kumar said 'Give me a few minutes, I want to enjoy this moment.'

The problem of the zero-point energy fluctuations was very dear to him and he was never tired of wondering if that meant actual motion in the ground state in the sense of Nelson's stochastic mechanics, knowing fully well that such questions could not be answered within the traditional Copenhagen interpretation of quantum mechanics. He was obsessed by the possibility of a first passage time for a quantum mechanical particle in analogy to the Kramer's first passage times for a diffusive process. That he began working on these theoretical questions in early 1980s and managed to deliver a partial solution only in 2014, speaks volumes of his tenacity to seek solutions to difficult problems. General relativity was another subject especially close to his heart.

Kumar was much more than just a physicist. He was a wonderful human being, full of affection for his students and colleagues, all of whom he treated equally. He always put his students' interests ahead of his own interests. He believed in the goodness of human nature and tried to see the virtuous side of everybody. Interactions with him were most pleasant and in general, everybody came out from a meeting with him feeling happy and enlightened. Most colleagues regarded him as most outstanding, both as a scientist and a human being. In every sense, he was truly Narendra (which means *King of men* in Sanskrit).

Over the past three years, Kumar had some health issues. But he bounced back from each crisis into his vivacious jovial self, thinking about interesting aspects of life. He finally passed away in the early hours of 28 August 2017 after an illness of about ten days. The Indian physics community lost an iconic figure, leaving a vacuum in the hearts of all who knew him. He is survived by his wife, Ann Kumar, and daughters, Revathi – a physical chemist and Rohini – a mathematician.

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