

## B. S. Ramakrishna (1921–2011)

B. S. Ramakrishna, the doyen of acoustics in India passed away on 12 February 2011. He was born in Vizianagaram, Andhra Pradesh in 1921, and received the B Sc degree from Andhra University and M Sc degree in physics from Banaras Hindu University, Varanasi. After two brief teaching stints, he received a Government scholarship to specialize in acoustics at the Illinois Institute of Technology, Chicago, USA, where he obtained the Ph D degree in 1949. Soon thereafter, he joined Indian Institute of Science (IISc), Bangalore as a lecturer in the Department of Electrical Communication Engineering (ECE). He served this institution in various capacities and with great distinction for over three decades.

One of the first tasks undertaken by Ramakrishna at IISc was the development of an acoustics laboratory and introduction of a course in acoustics in the curriculum for students in ECE. The laboratory had acoustic test and research facilities, including an anechoic chamber, a reverberation chamber, a recording studio with adjustable acoustic characteristics, and a water tank with anechoic walls, all of which were built in India for the first time through his efforts. He also devised several simple experiments for the instruction of students and kept augmenting this set over the years. A striking example was the development of a simple laboratory set-up for obtaining spectrograms of speech signal suitable for instruction. He taught undergraduate and graduate-level courses in acoustics, vibrations, wave propagation, information theory, probability theory and random processes, and these subjects acquired a less intimidating and more interesting hue in his classroom.

Research in acoustics and linguistics thrived in IISc under the guidance of Ramakrishna. His passion for research and the joy he derived from its pursuit were infectious. His research contributions covered practically all aspects of acoustics, from vibrations and electroacoustics, to speech and hearing, noise and vibration control, architectural acoustics, and ocean acoustics. One of his earliest works was a theoretical and experimental analysis of vibrations of Indian musical drums, mridangam and tabla, which explained the unique property of the harmonic character of their overtones. This

was indeed a remarkable piece of 'pure research' which attracted the attention of C. V. Raman, who had been the first to observe the above-mentioned property. Ramakrishna next turned his attention to the problems of nonlinear vibrations of strings and active control of string vibrations. He and his students made substantive contributions to the literature in these fields. His abiding interest in the 'open window' problem (study of sound



propagation through an open window) led to a seminal study of non-exponential decay of sound in rooms. He also developed a statistical theory of audience sound absorption in concert halls that enables a better prediction of expected sound absorption from the audience. Another piece of pioneering research by Ramakrishna and his associates was the development of information theoretic models of linguistic communication and language transcription, and studies of relative efficiencies of English, German, and several Indian languages, and relative efficiencies of Devanagari, Tamil and Roman scripts. This was followed by a study of prose styles in literature from the point of view of communication theory, and a linguistic analysis of stuttering patterns among monolinguals and bilinguals. A hallmark of all his work was the balance between theory and experiment, and his talent for devising simple experiments to demonstrate key theoretical concepts and results.

Some of the most acclaimed and visible contributions of Ramakrishna are towards the design of the acoustics and sound reinforcement systems of several auditoria, concert halls, theatres, conference rooms, etc. He provided the acoustical designs for some of the earliest and finest multipurpose auditoria in the country, including the 3500-seater Centenary Auditorium of Madras University. He was acutely aware of the fact that visual cues enhanced the auditory experience, and attention to aesthetics was one of the highlights of his designs. He strove hard and succeeded in creating awareness of the need for a scientific approach to acoustical design of buildings in the community of architects and builders in India.

Ramakrishna became the Chairman of the ECE Department at IISc in 1969. Soon thereafter, he led a team of IISc faculty members to the National Conference on Electronics organized by the Government of India to review the status of the field of electronics in the country. This culminated in the establishment of the Centre for Information Processing (CIP) in 1971 at the ECE Department, IISc under his chairmanship, with a substantial grant from the Defence Research and Development Organisation (DRDO). He nurtured the growth of several emerging areas of research such as acoustical/optical information processing, surface acoustic wave devices and microwave materials/technology under the aegis of CIP, and also ensured the merger of these activities into the parent ECE Department at the end of the 8-year grant period. In 1979, he initiated research in ocean acoustics, again with a major grant from DRDO. Introduction of the new areas of research in the decade of the seventies led to the emergence of a stronger and more vibrant ECE Department.

In 1974, Ramakrishna was appointed Chairman of the Division of Electrical Sciences of IISc, and also the Chairman of the Indo-Swiss Joint Committee constituted by IISc according to the provisions of an Indo-Swiss Agreement for setting up a Centre for Electronics Design and Technology (CEDT) in collaboration with Swiss Federal Institute of Technology (ETH-Zurich). The role of the proposed Centre was to provide specialized education and training in electronics design and technology to engineering

graduates in Indian industry through a one-year PG diploma course. The committee headed by Ramakrishna completed, within a span of two years, several tasks, including obtaining sanctions for grants, construction of laboratories and other facilities, planning and procurement of equipment, recruitment and training of faculty/technical staff, design of curriculum, and procurement of academic approval for the one-year PG diploma programme. CEDT became operational in February 1976, and it has now grown into a highly regarded centre of excellence in electronics design and technology.

Ramakrishna was the architect of a major re-structuring of academic programmes in IISc. This included introduction of a credit system based on unitization of courses, introduction of the semester scheme, examination reforms such as continuous internal evaluation followed by semester-end examination, award of numerical grade points, grade-point averages and letter grades, and fixing of norms for passing and for award of class/distinction. Other concurrent and related tasks included preparation of user-friendly documents/manuals, graduation of courses into 100/200/300 levels for UG/PG/research programmes, and design of IISc-wide Scheme of Instruction, syllabi and time-tables. Ramakrishna

conceived and formulated the entire package, held extensive consultations with other faculty members, and piloted the scheme through the academic and administrative bodies of IISc for approval and implementation. The new scheme, introduced in 1971, has proved to be beneficial to teachers and students alike, offering flexibility in academic work and enhancing the quality of academic programmes. All leading universities/academic institutions in India have adopted similar schemes following the reforms introduced by IISc.

Ramakrishna was a founder Fellow and former President of the Acoustical Society of India. He was elected to the Fellowship of the Indian Academy of Sciences in 1975. He was a Fellow of the Acoustical Society of America and the Institution of Electronics and Telecommunication Engineers, India, and a member of the International Commission of Acoustics from 1976 to 1981. He was the recipient of the Bhagawantham Award in 1984 for his contributions to acoustics, and the Raman Centenary Gold Medal in 1988.

Prior to his retirement from IISc in 1981, Ramakrishna went on deputation to Hyderabad in September 1980 as Vice-Chancellor of University of Hyderabad. He was responsible for the plan-

ning, design and construction of the Science Complex, the administrative building and other buildings of the then nascent University. On completion of this assignment in January 1986, he returned to Bangalore and immersed himself once again in the pursuit of his scientific interests, offering advice and consultancy in acoustical design of auditoria and other buildings, and reading voraciously. He was a regular invitee and an active participant in several scientific gatherings, enjoyed discussions with his students and former colleagues, and often quizzed them about current developments in their areas of expertise. His students and younger associates remember with warmth and gratitude, his role as a teacher, mentor, guide and philosopher. His passing away is a great loss not only to his family and friends, but also to the large community of his students and to the country, as there is no one to match his contributions to the field of acoustics.

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## Rahul Basu (1956–2011)

Rahul Basu was one of the first students of George Sterman, an expert on strong interactions and the theory of quantum chromodynamics (QCD), at the State University of New York, Stony Brook, USA. Hence, from the very beginning, Rahul took up hard problems rooted in QCD, which needed a lot of insight and perseverance, such as factorization proofs for collider physics, resummation and higher-order corrections to physically observable processes. He also developed the expertise related to the associated software, and in fact, took a great interest in all things computational.

Rahul had wide-ranging interests, and moreover, a wide-ranging group of collaborators numbering more than 35 in all. Although he spent most of his professional career at the Institute of Mathe-

matical Sciences (IMSc), Chennai, his collaborators were dispersed all over India and the world. His most recent work (January 2011) was a part of a continuing collaboration with Patrick Auranche, Rohini Godbole and Michel Fontannaz, a study of next-to-leading



order (NLO) corrections in various electro-production processes such as hadrons with large transverse energy, prompt photon production and neutral pion production. He had also worked on soft processes at NLO, such as jet-jet correlations at Tevatron energies and forward particle-jet correlations at the HERA collider. Along with Eric Laenen, Anuradha Misra and Patrick Motylinski, Rahul had earlier worked on the inclusion of the so-called soft-collinear effects in prompt photon production at HERA, and was currently working on an extension of this to the fragmentation component.

Rahul helped in the early development of factorization proofs for collider physics: his thesis was on factorization at higher twist of hadron-hadron scattering