

## Nishtala Appala Narasimham: Tribute to a great spectroscopist

N. A. Narasimham, former Head, Spectroscopy Group at Bhabha Atomic Research Centre (BARC), Mumbai (nee Bombay), passed away on 8 April 2002 at Mumbai. In his death, the country has lost one of its leading scientists and one who rendered invaluable service in building a world-renowned spectroscopy laboratory at BARC.

Narasimham was born on 15 August 1922 in Parlakimidi, Orissa. He obtained BA (Physics) degree in 1942 from Andhra University, Waltair standing first-class first in the university; he obtained M Sc (Physics, spectroscopy) degree in 1945 from Banaras Hindu University (BHU), Varanasi with a first class. He then wanted to pursue his Ph D, but in those days, unlike now, financial assistance for research was not easily available and he had to take up a teaching job for a brief period. He worked for two years, 1945–47, as a lecturer in Physics in Mrs A.V.N. College, Visakhapatnam (the present writer had the good fortune of being his student in Inter Science during this period) and later as a lecturer in Physics in a college at Bijapur from 1947 to 1949.

When a research scholarship became available with R. K. Asundi at BHU, Narasimham joined him in 1949 for his Ph D programme; he obtained Ph D (Physics, spectroscopy) degree in 1952. One of the problems on which Narasimham worked for his Ph D degree was the quantitative determination of the intensities of the first and second positive bands of the  $N_2$  molecule produced in the electrical discharges used in the studies on the Joshi effect (now popularly known as the opto-galvanic effect).

After obtaining Ph D, Narasimham proceeded to USA and Canada for post-doctoral research work. He first worked for about a year in the Physics Department in the University of Wisconsin, Madison and later worked with J. R. Nielsen at the University of Oklahoma, Norman till 1955. During this period he carried out very significant work on the infrared and Raman spectra of fluorinated benzene molecules.

In 1955 Narasimham obtained the prestigious National Research Council of Canada (NRCC) postdoctoral fellowship which provided him with a unique opportunity of working with the Nobel Laureate, Gerhard Herzberg at Ottawa.

In collaboration with him, Narasimham discovered the spectra of the astrophysically important molecular ions,  $PH^+$  and  $P_2^+$  and subsequently carried out high-resolution spectroscopic studies on them. The association with Herzberg remained a life-long one and played an important role in shaping Narasimham's scientific career. While he was working at NRCC, Homi J. Bhabha happened to visit the NRCC laboratories at Ottawa. During this visit he met Narasimham and asked him to join the Atomic Energy Establishment at Trombay (AEET) which was later named as Bhabha Atomic Research Centre. Soon after finishing his post-doctoral assignments Narasimham returned to India and joined the Spectroscopy Section of the Analytical Division at



AEET in 1957. By that time R. K. Asundi, after his retirement from BHU, had joined the Department of Atomic Energy as a scientific adviser. With the help of a dedicated group of workers, Asundi and Narasimham, developed and standardized several spectrographic methods for the analysis of reactor fuels, heavy water and other reactor materials. This service contributed in a large measure to the successful implementation of the atomic energy programmes in our country.

Realizing the importance of basic and applied research for technological development, Asundi and Narasimham put up a proposal to Bhabha for setting up a spectroscopic research laboratory, which was readily accepted by the latter who gave all support for this purpose. Under the able guidance of Asundi, Narasimham took up the responsibility of setting up the spectroscopy research laboratory

virtually from scratch. For this purpose he recruited persons from different branches of spectroscopy both in India and abroad. With their collaboration and with the help of the young talent drawn from the BARC training school which had just then started, Narasimham began setting up facilities for carrying out spectroscopic research work in different areas of atomic and molecular spectroscopy.

In atomic spectroscopy, studies of the high resolution spectra of rare earth atoms using interferometric techniques, uranyl and rare earth ions in crystals and X-ray spectra were taken up.

In molecular spectroscopy, studies of infrared and Raman spectra of polyatomic molecules, high resolution electronic spectra of diatomic and polyatomic molecules and of free radicals in the vacuum ultraviolet, near ultraviolet and visible regions were taken up. For obtaining the high resolution spectra, a 21 ft grating spectrograph was set up; in this effort Herzberg gave valuable assistance by providing the high-precision wavelength drive and guide bars for the grating spectrograph. In spite of lack of adequate space and infrastructure facilities at the Cadell Road laboratory of AEET, high quality research was accomplished within a short period. In collaboration with his colleagues in the Division, Narasimham carried out extensive work on the high resolution spectra of  $NH$ ,  $NS$ ,  $PS$ ,  $PO$ ,  $SO$ ,  $P_2$ ,  $PD^+$  and  $O_2^+$  and discovered that the missing lines of the  $S_2$ :  $^3\Pi_g-^3\Sigma_u^+$  to be antisymmetric rotational lines, thus establishing the nuclear spin of  $^{34}S$  to be zero. Narasimham's discovery of the rare instance of dissociation by rotation in the  $c^1\Pi$ ; state of  $NH$  also merits particular mention.

He published the diffuse emission spectra of rare-gas halide molecules for the first time and showed that they involve bound-free transitions. The present-day high power rare-gas halide excimer lasers operate on these transitions. (Incidentally, this work was published in *Current Science*, 1965, **34**, 75–77).

For the purpose of keeping abreast with the latest developments in their respective fields, Narasimham arranged visits for the scientists working with him to various leading laboratories in USA, Canada, France and Germany under different exchange programmes. He felt that

by inviting leading scientists from abroad to give a series of lectures, a larger audience from the universities and other institutions in India would be benefited. With this in mind he had arranged a number of lecture-series by Nobel Laureates R. S. Mulliken and Kaestler, and noted scientists G. H. Dieke, J. R. Nielsen and Jacquinet.

After the Spectroscopy Section became an independent Division of BARC in 1966, Narasimham was appointed as Head of the Spectroscopy Division. When the Spectroscopy Division moved to Trombay in 1968, where more space and facilities became available, new activities were taken up. In order to augment the analytical capabilities of the Division, a direct reader spectrometer, X-ray fluorescence spectrometer and an inductively coupled plasma spectrometer were added. A 35 ft concave grating spectrograph for high resolution work on diatomic molecules was installed.

Narasimham realized the need for developing indigenous know-how for optical instrumentation. For this purpose he gave adequate support for setting up of the Optics Laboratory in the Division. It is the expertise generated in this optics laboratory which became useful in designing and setting up the vacuum spectrometer and the reflectors used in the vacuum ultraviolet and optical beam-lines at the Synchrotron Radiation Facility, INDUS-I at Indore.

The spectroscopy laboratory that Narasimham built and nurtured is now equipped with modern facilities like high resolution Fourier transform spectro-

meter, laser Raman spectrometer and excimer laser. Studies are also being carried out on laser cooling of atoms and other problems in quantum optics in collaboration with the Laser and Plasma Technology Division of BARC.

Narasimham organized the First International Conference on Spectroscopy in India at Mumbai in 1967, and also served on the organizing committees of several national and international conferences, including the International Conference on Raman Spectroscopy in Bangalore in 1978, held on the occasion of the Golden Jubilee of the discovery of Raman effect and the Second International Conference on Spectroscopy in Mumbai in 1996.

Narasimham was actively associated with several scientific institutions in the country; particular mention may be made of his association with the Indian Institute of Astrophysics (IIA) at Bangalore where he spent a major part of his time after his retirement from BARC. As a close friend of late M. K. V. Bappu and as a member of the governing council of IIA, he had given valuable help in the setting up of the 2.3 m telescope at Kavalur and also other developmental works of the institute. He was also deeply interested in the diffuse inter-stellar molecular spectra and the interpretation of their origin.

Narasimham was a Fellow of several academies, including Indian National Science Academy, Indian Academy of Sciences, Andhra Pradesh Academy of Sciences and Maharashtra Academy of Sciences. He was elected Recorder (1967,

1968) and President of the Physics Section (1975), Indian Science Congress; he had been Member and subsequently Chairman of the Indian National Committee for International Union of Pure and Applied Physics (IUPAP, 1975–81) and Member of the International Commission on Atomic and Molecular Physics and Spectroscopy (1981–87). He was also a member of many other national committees and councils.

Narasimham was on the editorial boards of journals like *Pramana*, *Indian Journal of Physics* and *Journal of Molecular Spectroscopy*. He was also connected with a number of academic bodies of several universities and guided more than 25 students for doctoral programmes.

Narasimham received several awards and honors – INSA Senior Scientist Award (1985–87), Plaque and Citation from Instruments Society of India (1983), Sir C. V. Raman Birth Centenary Medal (1988), K. Rangadhama Rao Memorial Lecture (INSA 1983), Silver Jubilee Lecture, Andhra Pradesh Academy of Sciences (1988) and Sanjeeviah Memorial Lecture, Sri Venkateswara University (1990).

Narasimham is survived by his wife, Kamala and son Prasad.

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