SAMPARK

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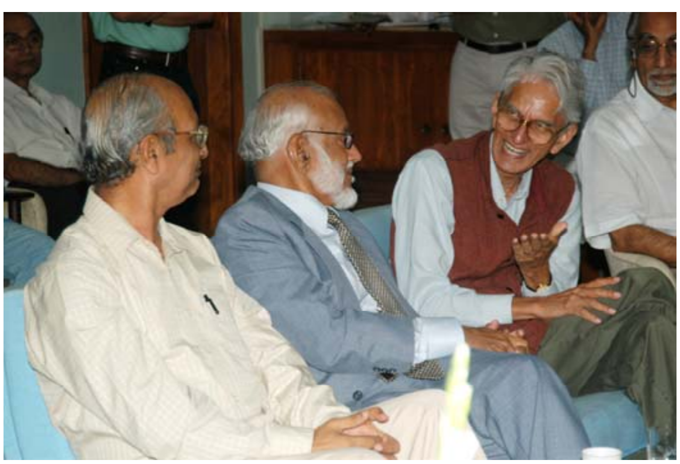
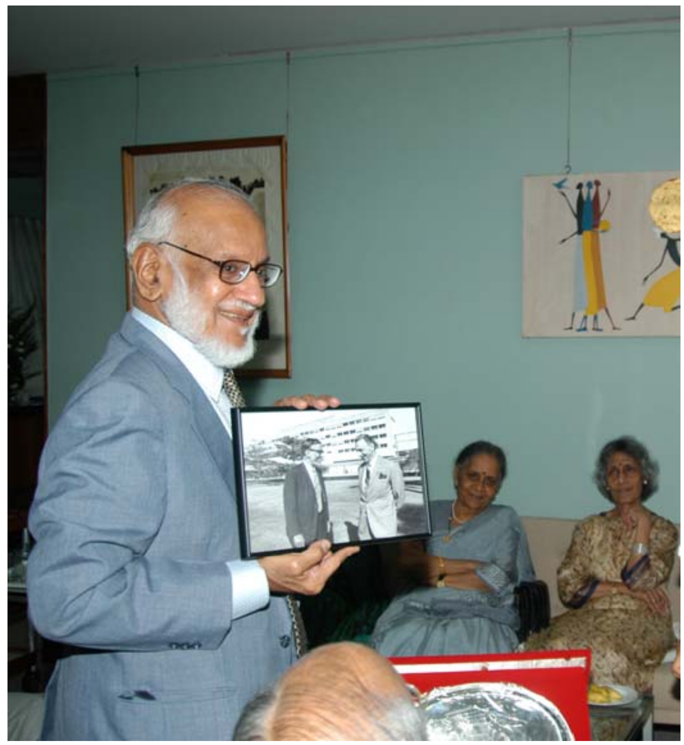
J.R.D. Tata's Centenary at TIFR

Prof. S.S. Jha, Prof. B.V. Sreekantan, Prof. S. Bhattacharya, Prof. M.G.K. Menon, Dr. M.R. Srinivasan Dr. H.N. Sethna, Dr. Anil Kakodkar, Dr. P.K. Iyengar





Glimpses from Public Lecture by Prof. M.G.K. Menon and other events on the occasion of JRD Tata's Birth Centenary day celebrations.

Festival of Colloqia at TIFR to commemorate Birth Centenary of JRD Tata (July 29, 2004)

1. *Designed by death: the making of multicellular organisms* by Dr. (Ms.) Apurva Sarin, NCBS, Bangalore
2. *From the Royal Caravan: Some Glimpses into Mathematics at the Tata Institute* by Dr. V.B. Mehta, School of Maths, TIFR.
3. *A brief tour of string theory* by Dr. G. Mandal, DTP, TIFR
4. *Current trends in radio astronomical research at TIFR* by Dr. J.N. Chengalur, NCRA, Pune
5. *Fast heavy-ion atomic collisions: From simple atoms to solids via clusters* by Dr. L.C. Tribedi, DNAP, TIFR

Prof. Kesav V. Nori, President of TAA since 2004 in conversation with Prof. R. Narasimhan

Dark Energy: The Cosmological Challenge of the Millennium

by

T. Padmanabhan

TAA celebrated the National Science Day 2005, by having a public lecture by Prof. T. Padmanabhan (IUCAA, Pune) in the Homi Bhabha Auditorium.

Observational cosmology has been making remarkable progress in the last couple of decades. Thanks to advances in technology and large dedicated projects devoted to cosmological problems, we now understand the vital statistics of the universe much better than ever before. These advances have also brought to the forefront a major problem that will probably hold the attention of the theoreticians for the next several decades. In this talk, I shall overview this question and its implications.

The key issue concerns the composition of our universe. Observations have now confirmed that our universe has a fairly weird composition. To begin with, the mean energy density of the universe which drives its expansion seems to be very close to the critical density, which is the density required to just make the universe collapse again. (The expanding universe is thus similar to a body thrown from the Earth, say, with exactly the escape velocity.) Of this, only about 4 per cent is contributed by normal matter made of baryons, i.e., protons and neutrons. Another 26 per cent or so of the energy density arises from non-baryonic particles usually called wimps - an acronym for weakly interacting massive particles. These particles – unlike baryons - do not couple to photons and hence do not emit any electromagnetic radiation, which earns them the name dark matter. The existence of dark matter is established indirectly through its gravitational effects; observations show that normal galaxies are embedded in much bigger dark matter halos. The evidence for dark matter was mounting over the last two decades and it is generally believed that high energy particle physics models will eventually provide a suitable candidate for the wimp. The really surprising result, which emerged in the last six years or so, concerns the remaining 70 per cent of the energy density. It is made of a very exotic species called dark energy that exerts negative pressure. This is more esoteric than anything that has been observationally determined in cosmology in the past and has thrown up a serious challenge.

Considering its importance and the rather strange nature, one might wonder how firm is its observational evidence. The earliest indication that the universe contained something like dark energy came in 1990 in a galaxy survey study led by G. Efsthathiou of Cambridge. The analysis of observational data in 1992 by several groups (including by myself and D. Narasimha of TIFR) led to the same conclusion. A more comprehensive analysis of observations was performed in 1996 by me, J.S. Bagla and J.V. Narlikar which clearly suggested that the observations demanded nearly 30 per cent of dark matter and 70 per cent dark energy. The key direct evidence, however, came in late 1990ies from the analysis of distant supernova data that allowed astronomers to measure the rate of expansion of the universe precisely. This study suggested that the universe is currently accelerating - that is, its rate of expansion itself is increasing with time. It is very simple to show from general relativity that such an accelerated expansion is not possible unless the dominant component in the universe has negative pressure. Thus observations thrust upon the theoreticians a universe dominated by a fluid with negative pressure.

How does one model such a bizarre entity? Normal gaseous systems have positive pressure. If a balloon filled with such a gas expands, its energy content will decrease because the pressure will have to do work in expanding the balloon. If the pressure is negative, a system can expand without its energy density decreasing. Incredibly enough, Einstein himself has suggested decades back a mechanism that has this feature. He postulated - for completely different reasons that are no longer relevant - an extra term in his equations that mimic a fluid with negative pressure. This term, Λ, called the ***cosmological constant*** can account for all the current observations provided its value is carefully fine-tuned. It is possible to form a dimensionless number using Λ and the three fundamental constants in physics G, h and c in the form $\Lambda(Gh/2\pi c^3)$; observations suggest that this number is close to 10^{-120} !! If the dark energy is indeed cosmological constant, then the theoretical challenge is to understand why this dimensionless number is so tiny but yet non-zero. (Disturbed by this possibility, people have attempted to model the dark energy by other means like, for example, postulating the existence of certain scalar fields with specific interactions etc. Unfortunately, all these models are ad-hoc and cannot make predictions that are testable by observations.)

One natural - and, in fact, inevitable - contribution to cosmological constant arises from the energy density of quantum vacuum fluctuations. The trouble is, we do not know how to compute the gravitational effects of quantum fluctuations of the vacuum from first principles. Naive estimates suggests that this will give $\Lambda(Gh/2\pi c^3) \sim 1$ which misses the correct result by 120 orders of magnitude! It is possible to get around this difficulty and get the correct value but only if we are prepared to make some extra assumptions. The appearance of G and h together strongly suggests that the problem of dark energy needs to be addressed by quantum gravity. None of the currently popular models of quantum gravity has anything meaningful to say on this issue (let alone predict its correct value). In fact, explaining the observed value of the dark energy is the acid test for any quantum gravity model and all the models currently available flunk this test. There is no doubt that, when we eventually figure this out, it will lead to as drastic a revolution in our conceptual understanding as relativity and quantum theory did.

TIFR ALUMNI ASSOCIATION BEST THESIS AWARDS 2004-05

We congratulate the following alumni for being selected for TAA awards and honorable mention in the respective fields.

Physical Sciences:

TAA-Geeta Udgaonkar Award

Dr. Bipul Pal, *Department of Condensed Matter Physics and Materials Science.*

Honorable mention to Dr. P.P. Rajeev, *Department of Nuclear and Atomic Physics*

Mathematics and Computer Science:

TAA-Harish Chandra Memorial Award

Dr. Ritumoni Sarma, *School of Mathematics*

Biological and Chemical Sciences:

TAA-Zita Lobo Memorial Award

Dr. K. Sridevi, *NCBS*

Honorable mentions to Dr. Anindya Ghosh Roy & Dr. J. Balaji, *Department of Biological Sciences*

All the three best Ph.D. thesis awards at TIFR are co-sponsored by *Sasken Communication Technologies Limited, Bangalore.*

An Indian patent [Application No. 195956 of 05th November 2002] has been granted for the invention of* "A liquid phase epitaxy process for manufacturing separately confined strained heterostructure devices such as diode lasers emitting in narrow wavelength region within 650-1600 nm"*. The inventors of this process are: Dr. S. S. Chandvankar, Mr. A.P. Shah, Dr. Arnab Bhattacharya and Prof. B.M. Arora of Dept. of Cond. Matter Physics & Mat. Science, TIFR.

Recent HONOURS to ALUMNI

Elected Vice-Chairman of Commission J of the International Union of Radio Science for the Triennium 2005-2008: **Dr. S. Ananthakrishnan**

Padma Sri, 2006: **Dr. R Balasubramanian**

Hellman Family Faculty Fellowship, 2002, Yale University: **Dr. Sarbani Basu**

"Scientific Consultant on an Honorary Basis in the matters related to Innovation and IPR in the Office of Principal Scientific Adviser to the Govt. of India": **Dr. P. Ganguli**

Life Time Achievement Award by the Indian Chemical Society: **Dr. G. Govil**

2005 World Technology Award in Energy: **Dr. S. Guha**

DAE SSPS Golden Jubilee Young Achievers Award 2005: **Dr. K. Maiti and Dr. V.P.S. Awana**

King Faisal International Prize for 2006: **Dr. M. S. Narasimhan**

Third World Academy of Sciences Award: **Dr. R. Parimala**

Wisitex Foundation awarded the Vigyan Ratna in Science (2004-2005): **Dr. Shobhona Sharma**

Firodia Science Award (2004), Sir Syed Ahmed Khan Lifetime Achievement Award (2004), and Padma Vibhushan 2006: **Dr. O. Siddiqi**

Appointed the "Maxwell visiting Fellow" at King's College, London: **Dr. S. Sarkar**

Herschel Medal of Royal Astronomical Society, 2006: **Dr. Govind Swarup**

Astronautical Society of India Award, 2004: **Dr. K.P. Singh**

4th Prize in Gravity Research Foundation (USA) Essay Competition (2004): **Dr. T.P. Singh**

Goyal Prize for young scientist for the year 2003: **Dr. L.C. Tribedi**

Election to Academies

Dr. R.V. Gavai: *Fellow of the Indian National Science Academy.*

Dr. S. K. Ghosh: *Fellow of the Indian Academy of Sciences.*

Dr. G. Venkatesh: *Fellow of the Indian National Academy of Engineers (FNAE).*

EXECUTIVE COMMITTEE: 2003-2005

Patron	Prof. S. Bhattacharya, Director TIFR *shobo@tifr.res.in*
President	Prof. K. V. Nori *kesav.nori@tcs.com*
Vice President	Prof. R. Pinto *rpinto@ee.iitb.ac.in*
Ex- President	*Dr. P. Ganguli* *ramgang@vsnl.com*
Secretary	Prof. K.P. Singh *singh@tifr.res.in*
Joint Secretaries	*Prof. S. Kumaresan* *kumaresa@sankhya.mu.ac.in* *Dr. M. Krishnamurthy* *mkrism@tifr.res.in*
Treasurer	*Prof. Vijay Kumar* *vijay@math.tifr.res.in*
Addl. Secretaries	*Prof. A.K. Grover* *grover@tifr.res.in* *Prof. T. Padmanabhan* nabhan@iucaa.ernet.in
Co-opted Members	Prof. R. Parimala [Endowment Fund] *parimala@math.tifr.res.in* Prof. M.N. Vahia [Public Outreach] *vahia@tifr.res.in* Prof. Amit Roy [Delhi Chapter] *roy@nsc.res.in* Dr. Jyoti Chordia

Jyoti34@vsnl.com
Prof. Karamjit Arya [U.S. Chapter]
arya@sjsu.edu

Email: alumni@tifr.res.in
URL: //www.tifr.res.in/~alumni/Alumni_main.html
Tel: 91 22 22804545 (Ext 2669 for the Secretary)
Fax: 91 22 22804610/4611

JRD Tata - his influence on science and scientific institutions

Devendra Lal

*Public Lecture on the occasion of **Shri J.R.D. Tata's Centenary year**, 28th January 2005, at Homi Bhabha Auditorium, Tata Institute of Fundamental Research, Mumbai.*

Today Science is widely spread in India. We have a large stock of highly trained scientists in all disciplines of science. We have several of distinguished Science Academies in India. It is well recognized that the biggest change in the scientific landscape of India occurred only after it gained independence. Prior to 1900, science was carried out in a few places: in Universities, in Surveys of Govt. of India, and in the Association for the Cultivation of Science. The unique scientific institution, Indian Institute of Science at Bangalore was born on 27th May 1909, as a result of Jamshetji Tata's initiative to build an institution for scientific research. It remained as a teaching institution until Raman arrived in 1933. Homi Bhabha's arrival at the institute opened up research in novel fields: field theory, and the nature of high-energy nuclear interactions produced by cosmic ray particles. With the help of grants from Sir Dorabji Tata trust, the TIFR was set up at the Indian Institute of Science in 1945. Homi Bhabha continued intensive studies in the field of cosmic rays with emphasis on production of mesons, and electron cascades. Experimental work in these areas was carried out with full force and emphasis on research in the field of cosmic radiation when the TIFR was set up at Bombay. TIFR also served as a cradle to the highly successful program of Atomic Energy in India.

It is my personal conviction that although a number of events spurred growth of science in India just after independence, for example the setting up of the National Laboratories, the Raman Research institute, the Saha Institute, by far the biggest impact on Indian Science came from the establishment of the TIFR, and the Atomic energy program in India. Central to setting up these organizations lay three main themes in the Homi Bhabha philosophy for spurring growth of science and technology in India: (i) growing a large group of trained scientists in the field of nuclear physics so that when atomic energy became a reality, India had the trained scientists at hand to avail of this energy source for power production, (ii) spreading sophisticated technology in the fields of electronics, high vacuum techniques and nuclear physics to colleges, institutes and to the common man, and finally, (ii) implanting and sharing highly trained scientists in universities as teachers. The first two ideas met with great success whereas the third idea met only lukewarm reception, but had this not be the case the universities would not have been in the position that they are in today.

The first two decades of TIFR

The TIFR was bustling with scientists and scientific research during the first two decades of its existence. Everybody was busy thinking and working as if his or her life depended on it. Dr. Bhabha had close contacts with several great thinkers and visionaries, who often visited the TIFR. The list is huge. It included P. M. S. Blackett, J. D. Cockroft, George Gamow, Wolfgang Pauli, Jawaharlal Nehru and JRD Tata.

Although Homi Bhabha had to spend a great deal of his time doing administration to give us the facilities at the TIFR, and towards building the Atomic Energy program, he spent a considerable amount of time doing research himself. He built Geiger Muller counter arrays, launched balloons for cosmic research, and carried out his theoretical research with reasonable intensity. He was up front with the way science was growing rapidly all over the world; post World War II, a period, which can be likened to freeing the global human population from bondage. The human spirit was seeking to discover the fundamental laws of Nature, and in India, Homi Bhabha made a major contribution to this effort.

A very distinguished cosmic ray physicist, Bernard Peters, who had discovered the presence of multiply charged heavy nuclei in cosmic radiation, came to India in 1950 to conduct balloon flights for studying the composition of and nuclear interactions of energetic particles in the cosmic radiation. In 1951, Dr. Bhabha invited him to join the TIFR, which he did. The joining of Peters made a huge impact on the quality of research in the fields of cosmic radiation, high energy and elementary particle physics and geophysics, within a period of less than 8 years that he spent at the TIFR. *It would be fair to say that the contributions of the cosmic ray group during the fifties helped greatly in putting TIFR on the global science map.*

His approach to science was simple but one that is difficult to practice! He asked himself if he could find answers to questions that were important: questions that could immediately open further critical questions. What Bernard Peters did was to establish within a short span of time that we in India had all the capability to make discoveries, to do fundamental research, at par with the West, only if we had the confidence in ourselves. And he assured us that this confidence had to be built by doing science. What was considered good science? Again here the answer can be found in the fundamental approach of Peters: to ask critical questions.

During 1952-1958, a large number of discoveries were made in the field of cosmic rays:

a) New elementary particles, and the nature of their interactions, that was made possible by the development of a continuously sensitive block of nuclear emulsion pellicles, which allowed tracing tracks of secondary particles to their origin. Among other discoveries this study also established associated production of two different types of elementary particles in one nuclear interaction.
b) Discovery of ^{10}Be produced by cosmic rays, opening up the field of cosmic ray geophysics.
c) Discovery of more than a half a dozen cosmic ray produced radionuclides, further highlighting the role of cosmic radiation in studying terrestrial processes in diverse branches of earth sciences.

The story of development of cosmic ray geophysics began in 1954. It is still a very busy field, and ^{10}Be itself is one of the two most important tracers in geophysics; it is employed as an important tracer in many branches of earth sciences including paleo-climatolgy. I would like to tell you that cosmic ray produced ^{10}Be can be measured in about 1 milligram of soil from the surface of the Earth.

The major strides made in the cosmic ray field, including studies of underground cosmic rays, fostered renewed excitement and intense research activity in other groups in TIFR. There was an excitement all over the TIFR, in other groups as well, in the fields of low temperature physics, nuclear physics and theoretical physics.

Fundamental Research in India

The TIFR was expressly designed to do fundamental research in mathematics and physics, including nuclear physics, and later on in the field of molecular biology. The question before us is where we stand today in context to fundamental research? And what is basic or fundamental research? This is by no means easy to define. Webster’s dictionary calls it as relating to the foundation or the base, and exploration of the laws of the universe. One way of defining it by examples of scientists who opened up new vistas for further research, to elucidate how Nature works. The examples of Newton and Galileo are too dramatic because they set the stage for carrying out fundamental research in to Nature. In India, we have superb examples of researches in the pre-independence era: J. C. Bose, S. N. Bose, Srinivas Ramanujan, Megnath Saha and C. V. Raman.

Since independence, very large sums of money have been invested in science and education, and a large proportion of that was channeled into basic research. It is probably fair to ask the question whether in this time frame, about 55 years, whether we can show examples of pioneering research work done as was done in the pre-independence era by J. C. Bose, Meghnad Saha, Srinivas Ramanujan and C. V. Raman, even though they had the minimal facilities and support. Their work is seminal in quality and will remain in the portals of science for a long long time.

<u>How many such names can we come up with today for the post-independent era?</u> There is a serious problem here: can we come up even with a few names. Maybe it is too early to make an assessment, only ~ 5 decades after independence? At this time I would like to hasten to make a confession. Any remarks, which I make now, exclude the contributions made by TIFR in the fields of Molecular Biology and Mathematics, fields about which I know so little.

After the first 2 decades, a number of factors changed the setting at the TIFR, and the world over. One of the biggest reasons is that we lost our leader very early on. Dr. Bhabha passed away on 24th Jan. in an Air India accident. Other factors, some including the general environment in the country are:

(i) Within 2 decades of independence there occurred a general erosion of culture and increase of social imbalance and honesty.

(ii) Basic research, which was considered as a privilege for a few, became a salaried profession.

(iii) Scientific leadership was transformed into diffuse leadership at the hands of a large number of individuals.

(iv) The process of peer review that existed in the early days of TIFR has virtually totally disappeared today. Researchers receive guaranteed funds irrespective of their performance.

(v) Research topics were largely selected on the basis of research abroad.

(vi) Good scientists clamored for jobs at the Center.

The early exciting days of TIFR, however, lasted until 1970 only. There were many reasons but I would like to reiterate that the most important reason was that we lost our leader very early on. Dr. Bhabha passed away on 24th Jan. in an Air India accident. During the first 2 decades of TIFR, indeed we worked in this ideal fashion. We were deeply engaged in theoretical elementary particle physics, and underground cosmic ray physics, areas where a great potential existed for fundamental discoveries. At the same time it was quite apparent that there existed some areas of science which had not been touched, and where TIFR was capable of making a big dent. Let me give you an example here:

It was quite obvious that the optical window was only one of the windows for peeping in to the Universe. The optical window provided color images of the Universe, but it had little information on the structure of matter. It was clear that one has to look at the universe in all wavelengths of the electromagnetic radiation that covered a range of 15 orders of magnitude in energy. TIFR was fully capable of opening new windows to the Universe, which were in fact opened by the West, microwave, X-rays, infra-red and ultra-violet. The only window in which the TIFR made pioneering efforts was the cosmic ray window, and here I hasten to add that the TIFR scientists did make pioneering contributions in the first 2 decades.

Science is global. In as much as we can join the mainstream of the West, the west can also join in original research efforts in India. History tells us that the West indeed took active part in projects which could be executed in India with advantage. This spirit existed in the first 2 decades, but it rapidly declined. We still take on ambitious projects but execute them at a slow pace. This has cost us quite a bit. We lost a great deal by way of scientific output in the past 3 decades. In an important sense, we are poorer today than we were earlier.

The TIFR has always been a busy bee. It set up its own balloon facility to carry out experiments in cosmic rays, and optical and infra-red astronomies. It built the unique radio-astronomy telescope, the GMRT (Giant Meter Wave Radio Telescope). It is engaged in several sophisticated fields: Theoretical physics, High energy physics, Astronomy and Astrophysics, Nuclear and Atomic physics, Condensed Matter physics and materials science, Chemical Sciences and Biological Sciences, at the cutting edge of science. There is no other institution in India like the TIFR. One would also not easily find a similar institution elsewhere.

By hindsight we all do acknowledge clearly that the TIFR *indeed selected* research areas at the cutting edge, such as elementary particle physics and neutrino physics, areas in which Nobel Prizes were awarded. However, our lukewarm successes in the past 3 decades in spite of very active involvement in a number of frontier sciences only means that we were not adventurous; we did not choose to take risks, or we failed to intensify our researches at the right time. *It is easy to see that in science, it is an easy task to be productive if one follows the mainstream, however, for breaking new grounds, one has to choose an original path. We did not continue to take this path which I believe is the reason why we have not made fundamental contributions in the past 2-3 decades.*

In spite of my having said earlier that TIFR does not have an exemplary track record in fundamental research during the past 3 decades, I still feel that it is an institute that is capable of performing at a very high level into the fields of basic research. The present health of TIFR is superb. Good health is a necessary but not a sufficient condition to contribute to fundamental research.

We are a very unique country whose gene pool is very rich, deriving our superior intellectual heritage from our ancestors who were great philosophers and pioneers in many fields including medicine. By this fact, we should feel confident that we can rise to greater heights in fundamental research should we chose to so dedicate ourselves.

SUPPLEMENTARY LIST OF REGISTERED MEMBERS OF TIFR ALUMNI ASSOCIATION

(This list consists of names of new members and those that did not appear in previous editions of the Newsletters available as PDF files on the TAA website.)

Name & Email Address	M.No
Dilip G. Banhatti *banhatti@uni-muenster.de*	295
Gautam Bhattacharya *gautam@theory.saha.ernet.in*	308
Sandip Kumar Chakrabati *chakraba@bose.res.in*	298
S.S. Chandvankar *sschand@tifr.res.in*	313
Sanjeev Vishnu Dhurandhar	304

sanjeev@iucaa.ernet.in	
Debashis Ghoshal *ghoshal@mri.ernet.in*	302
Dinesh Kumar Gupta *Guptadinesh25@hotmail.com*	297
Prasenjit Guptasarma *pg@uwm.edu*	306
A.V. John *john@tifr.res.in*	300
George Joseph *josephgeor@yahoo.com*	305
Rohit Joshi *rohitjoshi76@yahoo.com*	291
N. Harish Kumar *harish@physics.iitm.ac.in*	287
Sandeep Kumar *Sandeep_er@hotmail.com*	292
A. C. Kunwar *kunwar@iict.res.in*	315
Ram Kumar Mishra *ramkmishra@hotmail.com*	288
D.K. Mohanty *mdhirendra@yahoo.com*	293
Vasundhara Navadgi *vasubp@yahoo.com* *vasu@icgeb.res.in*	312
Vasanthi Padmanabhan vasanthi@abhimanya.iucaa.ernet.in	299
Vishwas Patil *ivishwas@yahoo.com*	285
C.S. Rajan *rajan@math.tifr.res.in*	296
S. Ramanan *s_rmn@yahoo.com*	290
S.S. Rangachari *ranga@tifr.res.in*	294
Anindya Ghosh Roy *anindyagr@yahoo.com*	303
K. Sadagopan sadagopankris@yahoo.com	309
Subir Sarkar s.sarkar@physics.ox.ac.uk	316
Subhojit Sen ssen@mail.nih.gov	286
Anu Sheth *sheth_@vsnl.com*	301
Mukul Kumar Sinha *mukulksinha@gmail.com*	314
Rashmi Sood *rashmi.sood@bcw.edu*	307
Satish Srivastava, IRAS *ssrivastava27@yahoo.co.in*	289
Neela Sukthankar *sukthankar@gmail.com*	317
Hardeep K. Vora *yourfriend_hkv@yahoo.com*	311
Gaurang B. Yodh *gyodh@uci.edu*	310

Satellite Radio: Its Global Impact

by
S. Rangarajan

Public lecture delivered on October 14, 2005 at the Homi Bhabha Auditorium.

After Marconi successfully demonstrated the concept of broadcasting more than a hundred years ago, radio has gone through several stages of evolution. The latest in this series is the concept of a Satellite Radio, where a satellite in a geo-stationary orbit delivers crystal-clear music and news directly to listeners. A satellite radio can deliver a diversity of formats, languages, genre and universal reach that cannot be met by terrestrial systems. Satellite radio has taken advantage of the tremendous advancement of digital technology and incorporates forward error correction, selective addressing and advanced compression for the audio.

Radio is perceived to be an individual's possession because of its portability. To broadcast “direct-to-person” from a satellite is thus more demanding than broadcast “direct-to-home” for the TV programmes. In the satellite radio the signal from the satellite is about 100 times more powerful than a conventional communication satellite so as to make the radio compact, low-cost and low-power. Also, the electromagnetic spectrum allocated for this Digital Audio Broadcast (DAB) service is less prone to rain attenuation and other degradations.

In the U.S. there are two systems providing DAB, namely, XM and Sirius. Both started 3-4 years ago, but have registered a steep subscriber growth. They use ground repeater network to augment the satellite signal.

MBSAT is a DAB satellite that provides service over Japan and Korea. For most other parts of the globe the only service is from the WorldSpace satellites.

WorldSpace Satellite Radio has designed its system expressly to serve the developing world. It uses satellites to broadcast digital audio and multimedia programs directly to compact, portable receivers. It operates two satellites: AfriStar™, serving Africa, the Middle East and Europe, and AsiaStar™, which serves Asia. Together, the two satellites reach a potential audience of over three billion people. With an ability to surmount barriers of geography, ethnicity and poverty, WorldSpace system holds great potential for improving the quality of life across Africa and Asia.

For example, WorldSpace has dedicated one channel on its AfriStar™ satellite to broadcast education to 11 million children in Kenya's 18,617 primary and 3,245 secondary schools.. According to the Government of Kenya, compared to the WorldSpace solution, neither contracting with the local individual broadcasters to deliver the lessons, nor investing in a terrestrial broadcast channel, comes close to providing a complete and cost-effective package for instructional broadcasting and information dissemination.

It is interesting to adapt the satellite radio design to serve the data needs of underserved communities with one-way delivery of digital contents to multiple locations simultaneously. Digital technology provides the WorldSpace system with versatility far beyond traditional radio as it can deliver text, data, images and even streaming video. For some topics, learning is definitely aided by video, multimedia, computers, etc. Moreover, a WorldSpace receiver connected to a personal computer acts like a wireless modem, capable of downloading several megabytes of data every hour. This data distribution capability has critical importance in areas where Internet access is expensive, unreliable or simply nonexistent.

Yet another solution from WorldSpace combines its audio capabilities with data delivery to create a virtual classroom via Combined Live Audio & Slide Show (CLASS). Using this technique a speaker from Brisbane, Australia is to deliver a live presentation to an audience at the Indo-US workshop at Aurangabad on Oct 17, 2005. The speaker would take questions from the audience on an Internet return link.

Other applications of the digital satellite radio include Cyclone warning for fishermen, cockpit delivery of real-time weather, digital signage for billboard update, health information delivery etc. It is seen that the type of use of such a digital satellite broadcast could be quite different in different regions, depending on the affluence, available infrastructure, pressing demands and demographics.

Remembering Prof. R.R. Daniel

Professor Ranjan Roy Daniel who was a member of TIFR for over 42 years and played a crucial role in its development, passed away on March 27, 2005. Prof Daniel had an illustrious academic career leading a long list of achievements. He was a Fellow of several national and international academies (Third World Academy of Science, Indian Academy of Sciences, Indian National Science Academy & National Academy of Sciences) and also served several national and international bodies like: SERC of DST, ISRO Council, Indian Academy of Astronautics, Cabinet, Government of India (Scientific Advisory Committee), ICSU (Scientific Secretary). He was decorated with the Padma Bhushan.

Prof R. R. Daniel was born in Nagercoil in 1923 where he also had his schooling. For college education, he moved to Loyola College, Madras (Chennai), and later to Benares (BHU) for M Sc. His research career began in 1947 when he joined TIFR to work with Homi Bhabha on particle interactions and scattering. He was sent to University of Bristol for carrying out research on heavy mesons using nuclear emulsion detectors exposed to high energy cosmic rays. He completed his Ph. D. on production of heavy meson under the guidance of D. H. Perkins in 1953 at Bristol.

Prof Daniel played an important role at TIFR in initiating research on primary cosmic rays, their composition, energy spectra and high energy interactions. These involved balloon-borne experiments using emulsion detectors. Thereafter, he started measurement of energy spectrum of high energy cosmic ray electrons. Later he made use of the opportunity to conduct an experiment (solar neutron gamma) onboard the very first Indian satellite (Aryabhata). Daniel pioneered exploration of the far infrared waveband of the electromagnetic spectrum for astronomical studies in India. This involved development of balloon borne platform with high angular precision of stability and pointing among several other technological challenges. After overcoming initial difficulties, this led to a successful and matured far infrared astronomy programme.

Finally, Prof Daniel broadened his interest into various national programmes related to the use of space technology for atmospheric sciences and other applications.

I was the last Ph D student to be guided by Prof Daniel. Here, I cannot resist sharing with you, some of my personal impressions and reflections. Prof Daniel was like a 'father-figure' to me during my early years at TIFR (I joined as an immature small-town boy aged 19, in 1975, trying to cope with rigors of fundamental research). Prof Daniel taught me not only physics or research methodology, but a whole lot more that was far more crucial for building of a character. These include objectivity in life, truly honest assessment of situations, decision making under severest threats, etc.

Prof Daniel was a true leader, who took care of every subordinate member. Although he was a hard task master and always probed to bring out weaknesses of any method being used for research, his true intention was always to improve the method. In the end, after being convinced, he would defend the method at any forum.

His efforts in improving facilities, quality of research, etc are well known. He was different from many others in the fact that Prof Daniel was 100% honest in each endeavor, without any other motives. I am yet to come across another human being with similar scientific leadership and devotion to work as Prof Daniel. With the departure of Prof Daniel, the entire nation has lost a fine human being with numerous contributions.

- Swarna Kanti Ghosh

MY FOUR YEARS AS SECRETARY

K. P. Singh

It has been a great privilege for me to serve the TAA as its secretary in its formative years. TAA came into existence in the year 2000 and was run by an interim executive committee that set in motion the drive to register TIFR alumni spread all over the world. When I took over as the first elected secretary of the TAA in 2001 with Ramu Ganguli as the first elected President, there were 90 registered members. Today I am very happy to say that we have 319 alumni registered with TAA, and we are completing two 2 year terms; the second term with Kesav Nori as the elected President. Most of this was accomplished through personal contacts by the executive committee. Somehow email contacts were not very effective in this regard. However, having chapters of TAA and members of the executive distributed geographically has helped somewhat and should be encouraged further. I laud the initiative that Amit Roy in Delhi took in this regard, and is an example that should be emulated. With TIFR now a deemed university, I expect that the graduate school of TIFR will play a major role in registering the alumni with TAA. In my view, an automatic registration for life membership of all the students taking their degrees from TIFR would be step in the right direction.

Any organization to be attractive to its members must have some visibility, interact with its members, and project them as part of the great family of TIFR that they belong to and have a few meaningful programs that make them proud to be associated with. A wish list of the various functions to be carried out by TAA were already laid down in the constitution of TAA created under the stewardship of S. S. Jha, the then Director of TIFR and the first patron of TAA. It was left to our executive committee to implement them. We started with setting up of web page for TAA. The web page outlay was decided by me with the help of Shobhona Sharma, and we chose NETWORKING as our motto. It is a repository of TAA activities and announcements and is easily accessible from the TIFR home page. However, I feel that it is something that can be improved further. A dedicated server that is interactive so that Alumni can update their contact information, and where the activities can be stored via streaming multimedia would make it much more useful. Please note that our main route for networking is via email, and it is very important that members keep us informed about their new email address. For example, currently about 40 addresses are outdated. So if you have not been getting any email notice from us, then please send us just one line email with your new address at tifraa@gmail.com or alumni@tifr.res.in.

One of our major initiatives, where I found a lot of enthusiasm in our team, particularly in Arun Grover, was in organizing a series of TAA and TIFR sponsored public lectures in the Homi Bhabha Auditorium. This required an all round support of the entire machinery of TIFR and it had always been forthcoming, and I am really thankful for that. I personally enjoyed linking up with the prospective speakers and communicating with them. Financial support for these lectures came from the Director's office and the Public Outreach Committee of TIFR. Most of the expense is in advertising through posters. Making posters for each public lecture is another job that a secretary has to shoulder. Considering that we have at least 3 public lectures a year, it would be good to identify a person for this job in future or hire an outside person to design the posters. Today public lectures by prominent alumni of TAA are quite popular and get a fairly healthy response. The high point of these lectures was the TATA tri-centenary celebrations via a festival of colloqia and lectures by M.G.K. Menon (published separately), D. Lal (reproduced here) and B.V. Sreekantan (to appear in Current Science). M. B. Kurup, Dean of the Natural Sciences Faculty of TIFR played a major role in arranging the program for the centenary, inviting and hosting various dignitaries. We bring you a few glimpses of these celebrations in a photo-feature in this newsletter.

Starting this newsletter, however, had to wait for the generous donation given by Karamjit Arya for the purpose, for which we shall always be indebted. Subsequently my proposal to the executive committee to increase the corpus for the printing of the newsletter by offering space to advertise in the newsletter was accepted. Sasken Technologies that has already contributed to the TAA - Best Thesis Awards, came forward and the second newsletter followed. Our President, Kesav Nori got TCS onboard for the next newsletter. (Director, TIFR is one of the sponsors for this newsletter). Mobilizing resources on a regular basis would help the newsletter to come out on time, unless we decide to go electronic only. I was helped by Kishore Menon, Arun Grover, and R. Pinto to design the layout of the newsletter. They also endorsed my suggestion for its name, have continued to help me with its editing. The design for the Logo of TAA was given to me by my daughter and was eventually drawn by the draftsmen in the Drawing section of TIFR.

Part-time secretarial help to register new members, update the membership directories, issue TAA ID cards, maintain the bank accounts of TAA, has been provided by Ms. Piedade Rodrigues. She also maintains all the records of the meetings and helps with various errands. Sh. Kishore Menon, SN Kulkarni, Sh. B.G. Kanchan (Accounts statements), Sh. V.J. Deshmukh (TAA elections), auditorium service personal, photography section, transport department, Canteen Manager and staff, Guest House staff have all helped us in a smooth functioning of TAA. In the end, I thank all the committee members of the last four years and who allowed me unlimited freedom to run the TAA. It is now time for a new team of executive committee members to take over and expand the TAA further, and I hope the above summary of my experiences would provide some guidelines for the tasks that lie ahead of them. I would, of course, be willing to help as and when required.

CONTENTS

Name:
Address: (Office and Residential):
Email:
Personal Homepage URL:
Phone no: (Off. and Resi.):
FAX no.:
Year of joining TIFR:
Year of leaving TIFR:
Position in TIFR: Student/Visiting fellow/Scientific Officer/Academic Staff
If student, degree obtained through TIFR: M. Sc./M. Tech. /M. Phil. /Ph. D. in:
Department while in TIFR:
Life membership (Rs. 1000 or US $25)
DD/Cheque No.:
Name of the Bank:

Demand Draft/Cheque payable to TIFR Alumni Association at Mumbai
Write your name at the back of the cheque and mail it to : Ms. P. Rodrigues at Room B-114, Tata Institute of Fundamental Research, Homi Bhabha Road, Colaba, Mumbai 400 005, INDIA

[Personal cheques are also acceptable, however, an addition of Rs. 40/- for bank charges for clearing outstation cheques, would be appreciated.]
[Please enclose 2 passport size photographs if you are interested in getting an identity card.]

Instructions for sending US $ 25 from USA electronically :
Wire Transfer using SWIFT mode to: Citi Bank N.A., New York, Branch Code number : CITIUS33 For account Number : 36072305 held in the name of Central Bank of India, Mumbai, India for Further Transmittal and credit to the Central Bank of India, Churchgate Branch, TIFR Extension Counter Account Number 3480 in the name of "TIFR Alumni Association ".

Do you know someone who is not a member of TAA? Please request him/her to contact the TAA at alumni@tifr.res.in and ask him/her to send the following information with a cheque/DD and 2 passport size photos for a TAA ID card. You can also direct them to the TIFR website at http://www.tifr.res.in/ for links to the TAA website where the membership form is available.

This issue of the newsletter has been co-sponsored by Professor Karamjit Arya and Director, TIFR.
Compiled, produced and edited by K.P. Singh
Photographs by the photography section of TIFR

Advertisement Feature

Tata Institute of Fundamental Research

Homi Bhabha Road, Colaba, Mumbai 400 005

The Tata Institute of Fundamental Research (TIFR), founded in 1945, has always been committed to the pursuit of excellence. In recent years, exciting advances in modern technology - many of these fuelled by an equally brisk advancement in the basic sciences - have brought new challenges. TIFR remains fully engaged in meeting these challenges through research in the basic sciences.

With an active Graduate Studies Programme and related initiatives, the institute plays a key role in nurturing exceptional young scientists. Since 2003, TIFR has been a Deemed University.

The institute has made impressive progress not only in conducting significant research, but also in maintaining and augmenting its already world-class infrastructure. Among recent developments, a Cray XI supercomputer is now engaged in performing calculations in the area of lattice gauge theory; a new state-of-the-art 800 MHz NMR spectrometer has been commissioned; a medium-energy heavy-ion accelerator, with Pelletron and Superconducting LINAC is functional; and the fully operational Giant Meter-wave Radio Telescope (GMRT), of the National Centre for Radio Astrophysics (NCRA) has begun to produce notable results.

In the seventh decade of its existence, TIFR is a national resource and a symbol of modern India.

TIFR Mumbai Campus:

- **School of Mathematics**
- **School of Natural Sciences**
  - Department of Theoretical Physics
  - Department of High Energy Physics
  - Department of Nuclear & Atomic Physics
  - Department of Chemical Sciences
  - Department of Astronomy & Astrophysics
  - Department of Biological Sciences
  - Department of Condensed Matter Physics & Materials Science
- **School of Technology and Computer Science**

TIFR Centres:

- **National Centre for Radio Astrophysics (NCRA), Pune** (www.ncra.tifr.res.in)
- **National Centre for Biological Sciences (NCBS), Bangalore** (www.ncbs.res.in)
- **Homi Bhabha Centre for Science Education (HBCSE), Mumbai** (www.hbcse.tifr.res.in)

TIFR Field Stations and Campuses:

- Cosmic Ray Laboratory (CRL), Ooty
- Radio Astronomy Centre (RAC), Ooty
- National Balloon Facility, Hyderabad
- Centre for Applicable Mathematics, Bangalore
- Gravitation Laboratory, Gauribidanur
- Giant Metre-Wave Radio Telescope (GMRT), Khodad
- High Energy Gamma Ray Observatory, Pachmarhi
- Centre for Computational Mathematics, Pune

Graduate Studies, Post-Doctoral Research and Nurturing Undergraduates

The Graduate Studies Programme of the institute leads to the award of a Ph.D. Degree, as well as M.Sc. and integrated Ph.D. in certain subjects. With its distinguished faculty, world class facilities and stimulating research environment, TIFR is an ideal place for aspiring scientists to begin their career. The Programme is classified into six subjects – Biology, Chemistry, Computer and Systems Sciences, Mathematics, Physics and Science Education. Admissions (in all subjects except Science Education) are based on a written test at one of several nationwide centres. Candidates who qualify in the written test are called for interviews.

TIFR also supports the Visiting Student Research Programme (VSRP) for the first M.Sc. and equivalent students in the summer vacation months.

Academic positions at TIFR

TIFR welcomes applications throughout the year for academic positions in all Faculties, Departments, and Centres. Please visit the respective TIFR websites for further details. Applications for all academic ranks may also be forwarded directly to:

The National Initiative on Undergraduate Science (NIUS), a new project of HBCSE, aims to nurture highly motivated students enrolled for the B.Sc./Integrated M.Sc. degree within the country. It also maintains a long-term engagement with the winners of the National Science Olympiads and the scholarship holders under KVPY stream.

For further details on programmes, eligibility and application procedure, please contact the University Cell, TIFR. Website: http//www.tifr.res.in/~gsoffice;
Email: gsch@tifr.res.in;
Fax: +91-22-2280 4555/4610;
Tel: +91-22-2278 2241/2875

The institute welcomes applications from Ph.D. holders for post-doctoral work at Visiting Fellow positions (two to three years' duration) in all its research programmes.

Prof. S. Bhattacharya
Director,
Tata Institute of Fundamental Research,
Colaba, Mumbai 400005, INDIA
e-mail : shobo@tifr.res.in Fax : +91-22-2280 4501;
Tel: +91-22-2280 4500

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