

**Institute of  
Mathematical  
Sciences**

**Annual Report  
1983 1984**

**Madras-600 113  
India**

**The Institute of Mathematical Sciences**

**Annual Report**  
**1983 1984**

**Madras - 600 113, India**

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## Introduction

In October 1983, Professor Alladi Ramakrishnan, the Founder - Director of the Institute of Mathematical Sciences, handed-over charge to Mr. T. D. Sundar Raj, I.A.S., Commissioner and Secretary to Government, Education Department, Government of Tamil Nadu and retired after having completed 60 years of age in August 1983. Prof. Alladi Ramakrishnan, served the Institute, as its Director, from its inception on January 3, 1962, for an uninterrupted period of 21 years. The spirit and ideals with which the Institute was founded continue to be the driving force for the scientists even today.

In February 1984, Prof. G. Rajasekaran (Professor of Physics, University of Madras) joined the Institute as its Joint Director.

Due to unavoidable circumstances, the Annual Report for the year 1983 could not be brought out and hence the present report incorporates the activities of the Institute, during the years 1983 and 1984.

The Primary activity of the Institute - viz. Creative research in Mathematical Sciences in pursuit of the aims and objectives of the Institute - continued uninterrupted during the years 1983 and 1984, with seminars as well as series of lectures both by the faculty members of the Institute and by visiting Scientists.

Prof. E. C. G. Sudarshan (Professor of physics, University of Texas at Austin, Texas, U.S.A.) took charge as the Director of the Institute in March 1984.

The Twenty-first Anniversary Symposium of the Institute entitled "MAT-SCIENCE 21" was inaugurated by His Excellency Mr. S. L. Khurana, Governor of Tamil Nadu, who delivered the Anniversary address on 29th January 1983. Mr. C. Subramaniam, Patron of the Institute, unveiled the portraits of the eminent Mathematical physicists Professor Hermann Weyl and Professor Eugene P. Wigner and spoke on his *Early Memories* which lead to the formation of the Institute in January 1962.

The Institute conducted a conference on *The Discrete and the Continuum in Physics*, at the Institution of Engineers, Mysore, from March 7-12, 1983 and a conference on *Probabilistic methods, Monte Carlo techniques and Applications*, at the Club House of the Hindustan Photo Films, Ootacamund, from September 15-20, 1983.

The Fourth *Number Theory* Conference of the Institute was conducted at the Club House of the Hindustan Photo Films, Ootacamund from January 5-10, 1984. The Conference was inaugurated by the distinguished Hungarian Mathematician, Professor P. Erdős, who headed a Hungarian delegation of four number theorists. Amongst

the other noteworthy number theorists who participated in this conference were Prof. H. Halberstam, from the University of Illinois, Champaign Urbana, Illinois, USA and Prof. H. E. Richert, from the University of Ulm, West Germany. The proceedings of this Conference edited by Dr. Krishnaswami Alladi will be published by Springer Verlag, and it is dedicated to Prof. P. Erdos on the occasion of his 70th Birthday.

The Board of Governors of the Institute has been reconstituted, in October 1983, with Dr. R. Ramanna, Chairman of the Atomic Energy Commission and Secretary to the Department of Atomic Energy, himself as a Member, with the tacit understanding and approval of the highest authorities in the country to upgrade and nurture the Institute to flourish as a National Centre of Excellence in Mathematical Sciences. Hon'ble Thiru C. Aranganayakam, Minister for Education, the Chairman of the Board and Mr. T. D. Sundar Raj, I.A.S., Commissioner and Secretary to Government, Education Department, are the representatives of the Government of Tamil Nadu. Besides the Director of the Institute, who is an Ex-Officio member of the Board, the other members are: Mr. Y. S. Das, Additional Secretary, Department of Atomic Energy, as the representatives of the Government of India, and Prof. K. R. Unni as a representative of the Academic Council of the Institute. During the period (November 1983 to March 1984) when Mr. T. D. Sundar Raj, I.A.S. was the Director of the Institute, the Board of Governors met on November 24, 1983 and February 22, 1984. After Prof. E. C. G. Sudarshan took charge as the Director of the Institute, the Board met on August 13, 1984 and December 18, 1984.

An allround expansion has been initiated by Prof. E. C. G. Sudarshan, from the middle of 1984, with increased aid from the Department of Atomic Energy, Government of India and the Government of Tamil Nadu. Additional land (2.5 Acres) opposite to the existing premises of the Institute in the Central Institutes of Technology Campus, has been allotted for the construction of a Guest House-cum-Student Hostel Complex, by the Government of Tamil Nadu. Three identical houses in a single compound have been rented, in the interim period from August 1984, to serve as a Guest House, a student Hostel, and as a residence for the Director, in Besant Nagar, about 5 Kms. from the Institute.

Professor C. S. Seshadri (Professor of Mathematics, Tata Institute of Fundamental Research, Bombay) is at the Institute from June 1984.

A search is now on to recruit new talent at the Faculty and the student levels from all parts of the country. Advertisements in all leading daily news papers were given and written and oral tests were conducted in July and October 1984, for the Junior Research Fellowships of the Institute. Of the 90 students (41 for Mathematics and 49 for Physics) who appeared for these tests, 7 students (3 for Mathematics and 4 for Physics) have been selected. The Junior Research Fellowship amount has been increased to Rs. 1000/- per month from October 1984.

Among the Visiting scientists to the Institute during 1983 and 1984 were : Prof. John Thompson Fields Medalist, Cambridge University, England, who visited the Institute and gave two seminars on *Finite Simple Groups*, in August 1984. Prof. S. Chandrasekar, Nobel Laureate and distinguished Service Professor at the University of Chicago, visited the Institute on November 2, 1984 and had a discussion with the academic group. Prof. T. Regge, University of Torino, Italy, visited the Institute on December 1 and gave a seminar on *Group Manifold Approach*.

An Honorary Degree of Science (Engineering) was conferred upon Prof. E. C. G. Sudarshan by the Faculty of Engineering of the Chalmers University of Technology, Gothenburg, Sweden, on May 25, 1984.

During the years 1983 and 1984, ten faculty members and four students participated in 22 International Conferences or Workshops. Participation in 11 International Conferences or Workshops was made possible with travel support from the Institute, while one faculty member obtained travel support from the Department of Science and Technology, Government of India, and another obtained support from the Indian National Science Academy-Royal Society of London exchange scientist programme (for 3 weeks). Also, seven faculty members and two students participated in 12 National Conferences within the Country.

To this Institute devoted to theoretical studies in Mathematical Sciences, the Library is the vital organ, catering to the needs of not only the members of the Institute but also those belonging to other Institutions in the city of Madras. The Library continued to expand with the addition of books and journals and at the end of 1984, the total number of volumes in the Library is approximately 20,000. Besides the 90 International journals on Mathematics and Physical Sciences which are subscribed for by the Institute, the Library is continuing to get 55 journals and Lecture Notes from leading research centres throughout the world, in exchange to the I.M.Sc. (Institute of Mathematical Sciences) Reports. A salient and attractive feature of this library is that the books and journals are always available for reference, due to its non-lending character. A preprint collection is maintained in the Library in order to facilitate a rapid exchange of ideas with Scientists at other leading research institutions like the Institute of Physics, PRL, SINP, Bhabha Atomic Research Centre, Madras University, Indian Institutes of Technology, TIFR, CERN, ICTP, LBL, SLAC, NORDITA, etc. On an average about 150 preprints are received every month. Recently, subscription to a few important daily newspapers has been initiated.

Madras-600 113  
Dec. 17, 1984.

E. C. G. SUDARSHAN  
*Director*

## **Aims and Objectives**

1. To create and provide an atmosphere and environment suitable for creative work and the pursuit of knowledge and advanced learning in the mathematical sciences for their own sake.
2. To promote and conduct research and original investigation of fundamental sciences in general with particular emphasis on Mathematics and Theoretical Physics.
3. To foster a rigorous mathematical discipline, to stimulate a zest for creative work and cultivate a spirit of intellectual collaboration among academic workers in fundamental sciences with particular emphasis on Mathematics and Theoretical Physics.
4. To arrange lectures, meetings, seminars and symposia in pursuance of its academic work for the diffusion of scientific knowledge.
5. To invite scientists in India and abroad actively engaged in creative work to deliver lectures and participate in academic activity.

## **Ph.D. Programme**

Facilities are available for postgraduate students to work for a Ph.D. degree under the guidance of the academic staff of the Institute in various faculties. Post doctoral and Junior research fellowships are awarded by the Institute.

The Standing Committee of the Inter-University Board of India and Ceylon at its meeting held in February 28, 1967 adopted a resolution recognising the Institute as a suitable centre for research work. In view of the above resolution the Institute is now recognised by the various Indian Universities as a centre for research for the Doctorate Degree in Theoretical Physics and Mathematics.

*Patron :*  
**Mr. C. SUBRAMANIAM**

## **Board of Governors**

### **Chairman**

**Hon'ble Mr. C. Aranganayakam**  
**Minister for Education**  
**Government of Tamil Nadu**

### **Members**

**Dr. R. Ramanna**  
**Chairman, Atomic Energy Commission and Secretary,**  
**Department of Atomic Energy**  
**Government of India**

**Mr. T. D. Sundar Raj, I.A.S.,**  
**Commissioner and Secretary to Government, Education Department**  
**Government of Tamil Nadu**

**Mr. Y. S. Das**  
**Additional Secretary to Government of India**  
**Department of Atomic Energy**

**Prof. E. C. G. Sudarshan**  
**Director**  
**The Institute of Mathematical Sciences**

**Prof. K. R. Unni**  
**The Institute of Mathematical Sciences**



# **Finance Committee**

## **Chairman**

**Mr. T. D. Sundar Raj, I.A.S.**  
**Commissioner and Secretary to Government, Education Department**  
**Government of Tamil Nadu**

## **Members**

**Mr. Y. S. Das**  
**Additional Secretary to Government of India**  
**Department of Atomic Energy**

**Mr. C. Ramachandran, I.A.S.**  
**Commissioner and Secretary to Finance**  
**Government of Tamil Nadu**

**Prof. E. C. G. Sudarshan**  
**Director**  
**The Institute of Mathematical Sciences**

**Mr. T. A. Lakshminarayanan**  
**Controller**  
**Bhabha Atomic Research Centre**

## Faculty Members

### Director

Prof. Sudarshan, E. C. G. (Physics)

### Joint Director

Prof. Rajasekaran, G. (Physics)

### Professors

Ranganathan, N. R. (Physics)

Santhanam, T. S. (Physics)

Seshadri, C. S.<sup>o</sup> (Mathematics)

Unni, K. R. (Mathematics)

Vasudevan, R. (Physics)

### Associate Professors

Alladi, Krishnaswami (Mathematics)

Mariwalla, K. H. (Physics)

Parthasarathy, R. (Physics)

Radhakrishnan, V. (Physics)

Shivamoggi, B. K. (Physics)

Sridhar, R. (Physics)

Srinivasa Rao, K. (Physics)

### Assistant Professor

Jagannathan, R. (Physics)

## Research Fellows

### Junior Research Fellows

Adhikari, S. D. (Mathematics)

Anthony, Anand, J. (Mathematics)

Balaji, V.\* (Mathematics)

Madivanane, S. (Physics)

Prem Kumar Yesudian, C. (Physics)

Radhakrishna Nair, B. S. (Physics)

Rajeswari, V. (Physics)

Shaji, N. (Physics)

Salai Dhavakodi, T. (Mathematics)

Venkatasatyanarayana, M. (Physics)

### Teacher Research Fellow

Srinivasan, J.\*\* (Physics)

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<sup>o</sup> Service on loan from Tata Institute of Fundamental Research, Bombay, from June 1984.

\* National Board for Higher Mathematics Fellow.

\*\* Part-time scholar, Department of Physics, A.M. Jain College, Madras.

## **Research Work**

The research carried out at the Institute of Mathematical Sciences has been broadly classified into various branches of Theoretical Physics and Mathematics. In this report, summaries of completed research work which has been published in journals in 1983 and 1984, or which has been submitted for publication is presented. Some of the research work has been presented at national and international conferences in the form of invited talks or contributed papers. Lists of publications in journals and in conference proceedings are presented.

The report on the research work regarding two of the faculty members is incomplete, due to their absence from the Institute on long term visiting assignments abroad since fall 1984.

### **ELEMENTARY PARTICLE PHYSICS**

#### **The recent single-tag two-photon experiments at PETRA and the issue of quark charges**

The recent PLUTO data of single tag 2-photon experiments indicating noticeable excess over the QCD prediction, have been analysed. It has been found that this excess and its  $Q^2$  dependence can be attributed to the presence of a colour-octet component in the electromagnetic current, thus signalling broken colour, provided the gluonmass parameter lies in the range of 150 - 350 MeV

(R. M. Godbole\*, T. Jayaraman\*, J. C. Pati\*, G. Rajasekaran and S. D. Rindani\*, Phys. Lett. **142B**, (1984) 91)

#### **Constant self-dual Abelian gauge fields and fermions in SU(2) gauge theory**

Fermion one-loop corrections to the effective action in a self-dual Abelian background field are calculated for an SU(2) gauge theory. It is found that these corrections for massless fermions tend to destabilize the vacuum. The quantitative and qualitative features of such corrections for the case of massive fermions are discussed.

(Daniel Kay\*, R. Parthasarathy and K. S. Viswanathan\*, Phys. Rev. **D28** (1983) 3116)

#### **Decays of weak bosons in the broken colour model**

Electroweak effects in electron-positron annihilation at high energies are studied in the model of integrally charged quarks (ICQ) with broken colour symmetry. Angular asymmetries as well as other phenomenological parameters are worked out, for possible confrontation with experiment.

(S. Lakshmibala\*, G. Rajasekaran and S. D. Rindani\*, submitted to Pramāna)

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\* External Collaborator.

## **On the classical solutions of SO(3) Gauge theory and 't Hooft-Polyakov Monopole**

It has been shown that the ansatz for the asymptotic ( $r \rightarrow \infty$ ) gauge fields by 't Hooft in the study of monopoles in SO(3) electroweak theory is not unique

(R. Parthasarathy, T. S. Santhanam and K. H. Mariwalla, submitted to Pramāna)

## **The ground state of an SU(2) gauge theory in a non-abelian background field**

The ground state in an SU(2) Yang-Mills theory using a constant nonabelian background field has been studied taking into account the gluon and quark one loop corrections to the classical energy density. The calculated energy density is found to be lower than that of the perturbative vacuum. The local minimum of the energy density is used to calculate the vacuum expectation value of the gluon condensate and the bag constant, which is found to be in reasonable agreement with the known estimates. The stability of this approximation has been studied.

(R. Parthasarathy, M Singer\* and K. S. Viswanathan,\* Can. J. Phys. 61 (1983) 1442)

## **Supersymmetric SU(2) Gauge theory in a Non-abelian background field**

A constant non-Abelian ansatz for the background field in a Yang-Mills theory has been used to calculate the quantum one-loop corrections to the effective energy density in a supersymmetric SU(2) gauge theory including matter fields. It is shown that there is a genuine reduction in the number of fermion flavours on going from ordinary to supersymmetric SU(2) theory. The supersymmetric SU(2) can accommodate only 6 fermion flavours. This reduction is due to the combined effect of supersymmetry and asymptotic freedom. Numerical values for the bag constant are obtained in a supersymmetric model. These are found to be in better agreement with the MIT values than a model based on ordinary SU(2) gauge theory.

(R. Parthasarathy, submitted to Phys. Rev. D)

## **Classical fields with vanishing colour currents**

It is shown that there are no non-trivial c-number solutions to models of colour confinement based on the constraint of vanishing quark currents, for colour SU(n) groups with  $n \geq 3$ .

(G. Rajasekaran, V. Srinivasan\* and M. S. Sriram\*, submitted to Pramāna)

### **An SU(3) model for electroweak unification**

A model of electroweak unification based on the group SU(3) has been found to reproduce the standard SU(2) and U(1) effective interactions with  $\sin^2 \theta_w = \frac{1}{4}$ . In this model none of the gauge bosons need acquire a large mass in order to suppress unwanted interactions.

(Mark Singer\*, R. Parthasarathy and K. S. Viswanathan\*, Phys. Lett. **125B** (1983) 63)

## **NUCLEAR PHYSICS**

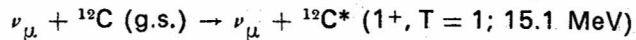
### **Recoil Polarization of $^{12}\text{C}$ (1+, T = 1; 15.1 MeV) in Neutrino neutral current interactions**

Cohen-Kurath wave functions have been used to obtain the numerical values of the average recoil polarization of  $^{12}\text{C}^*$  (1+, T = 1; 15.1 MeV) excited in neutrino neutral current interactions in  $^{12}\text{C}$ . It is found to be insensitive to the choice of the nuclear wave functions.

(R. Parthasarathy and C. Premkumar Yesudian, submitted to Phys. Lett. B)

### **Neutral current induced neutrino reactions in $^{12}\text{C}$**

The differential and total cross sections for the nuclear reaction.



are investigated for values of  $50 < E_\nu < 300 \text{ MeV}$ . An effective Hamiltonian for the above nuclear reaction is constructed from the neutrino-quark neutral-current weak interaction, by first constructing the neutrino-nucleon neutral current interaction and then using the impulse approximation along with the non-relativistic reduction procedure. The Weinberg-Salam model is the basis of the calculations. Detailed expressions for the differential cross-sections have been derived including the nucleon momentum-dependent terms and the numerical results obtained using the general 1p-shell wave functions of Cohen and Kurath. The sensitivity of the total cross sections to the nuclear models and to the Weinberg angle have been studied. The corresponding anti-neutrino reaction is also investigated. The ratio  $R \left( \sigma_T^\nu - \sigma_T^{\bar{\nu}} \right) / \left( \sigma_T^\nu + \sigma_T^{\bar{\nu}} \right)$  is found to be independent of the nuclear wave functions but very much sensitive to the Weinberg angle. Thus, this observable can be used to determine the free parameter  $\theta_w$  in a nuclear reaction, thereby complimenting the studies involving free nucleons. The recoil polarisation of the final nucleus  $^{12}\text{C}^*$  (1+; T = 1, 15.1 MeV) and its importance has also been studied.

(R. Parthasarathy and C. Premkumar Yesudian, to appear in Annals of Physics)

### **Quasi-free cluster knock-out reactions from ${}^6\text{Li}$ : $(\gamma, \pi^0 d)$ and $(\gamma, \pi^0 \alpha)$**

The pole model has been used to determine the  ${}^6\text{Li} - \alpha - d$  vertex constant from a study of the quasi-free cluster knock-out reactions:  $(e, e'd)$ ,  $(P, Pd)$ ,  $(e, e'\alpha)$  and  $(P, P\alpha)$  on  ${}^6\text{Li}$ , over a wide energy range. Then it is used to predict the cross sections for  $(\gamma, \pi^0 d)$  and  $(\gamma, \pi^0 \alpha)$  reactions on  ${}^6\text{Li}$ , for several photon energies, including the first pion-nucleon resonance region.

(K. Srinivasa Rao and V. S. Bhasin\*, submitted to Nucl. Phys)

### **Charged pion photoproduction from Nuclei**

Theoretical and experimental studies of pion photoproduction from nuclei have been prolific in recent years. The single-nucleon pion photoproduction amplitudes, the initial and final nuclear wave functions which fit other electromagnetic and weak processes, and the interaction of the outgoing pion with the residual nucleus through a pion-nucleus optical potential whose parameters are adjusted to the corresponding pion-nucleus scattering, are the three fundamental aspects of this complex reaction process. A review of the present state of art in the study of pion photoproduction from nuclei has been made.

(K. Srinivasa Rao, Nucl. Phys. and Solid State Phys. 26A, (1983) to appear)

## **CONDENSED MATTER**

### **On the Frohlich Decomposition and the condensate fraction in He II**

The method of extracting the Bose-Einstein condensate fraction in He II within the Frohlich decomposition scheme is revisited and a new simple formula for determining this fraction has been derived. Possible experimental and theoretical implications have been discussed.

(H. B. Ghassib\* and R. Sridhar, Phys. Letters 100A (1984) 198)

### **Biturcation of the solution of Onsager's Non-linear Integral Equation for Nematic Liquid Crystals**

The isotropic-nematic liquid crystalline phase transition is studied as the bifurcation of the solutions of Onsager's non-linear integral equation. The bifurcation points are located with the help of a theorem in the non-linear integral equation theory. These bifurcation points correspond to phase transitions. The first bifurcation point which corresponds to the isotropic-nematic phase transition gives the exact value of the critical density in terms of the microscopic parameters in agreement with the experiment. By Lyapunov-Schmidt method the bifurcation equation and an analytical solution valid in the neighbourhood of the critical point to any desired degree of accuracy has been obtained. The lowest approximation of this solution gives an expression for  $f(\mathbf{a})$ , the probability function for the molecular orientation, which is the same as that employed

by many authors in other models. Using the analytical solution obtained, the Frank elastic constants  $K_{11}$ ,  $K_{22}$ ,  $K_{33}$  for nematic liquid crystals have been expressed in terms of their microscopic parameters. The numerical values of these elastic constants computed are found to be in good agreement with the experimental data.

(V. Radhakrishnan, submitted to *Molecular Crystals and Liquid Crystals*)

### **Remarks on duality transformations in lattice spin systems**

This contribution deals with the  $\tau$ -continuum limit of anisotropic plane Ising lattice in arriving at the quantum dual Hamiltonian by a route different to that of Fradkin and Sussikind. One sees the necessity of effecting the exchange of coupling strengths in duality transformations. Construction prescribed by Savit's procedure to arrive at classical dual is also seen to imply this. Implication of this exchange feature is also discussed.

(N. R. Ranganathan and R. Vasudevan, *J. Phys. A: Math. Gen.* **17** (1984) 1143)

### **A new derivation of the structure factor and excitation spectrum of liquid He II**

Some results have been obtained on the basis of the assumption that single and two particle states saturate the frequency moment sum rules of  $S(k, \omega)$ . The method has been generalised to get a coupled set of integral equations so that the structure factor and the single particle excitation energy can be determined in a self-consistent manner.

(R. Sridhar and A. Shanthi, LT-17, Eds. U. Eckern, A. Schmid, W. Weber and H. Wuhl, Elsevier Science Publishers (1984) 1203).

### **Role of two-phonon excitations in the inelastic scattering of neutrons from He II**

The suggestion that the multi-excitation component of the dynamic structure function is dominated by the two-phonon mode has been analysed on the basis of a model for the two-particle excitations resulting in a qualitative fit to the experimental data. A better agreement is anticipated if a physically relevant potential is employed and higher (three or more) correlations are also considered.

(R. Sridhar and A. Shanthi, *Phys. Lett.* **93A** (1983) 198)

### **A remark on the temperature dependence of the structure factor and excitation energy of a quantum liquid**

The simple assumption that a single mode saturates the sum rules leads to a non-linear integral equation for the structure factor  $S(k)$  and excitation energy  $\nu(k)$ . The integral equation for  $S(k)$  is strikingly similar to that obtained by Mihara and Puff while that of  $\nu(k)$  yields corrections to the already known temperature dependence of velocity of sound.

(R. Sridhar, *Phys. Lett.* **98A** (1983) 441).

## **A comment on an integral equation for the structure factor of superfluid $^4\text{He}$ .**

The recently proposed linear integral equation for the structure factor of superfluid  $^4\text{He}$  by Sridhar and Vasudevan has been generalised so as to include the diffuse nature of the two-particle excitation spectrum.

(R. Sridhar, Acta. Phys. Polonica **A64** (1983) 115)

## **Spin-Polarized Hydrogen**

Recently a great deal of attention has been given to the study of metastable states of matter arising from the polarization of electronic spins of the atoms. In this context spin polarized atomic hydrogen is being studied in detail. The production and storage of atomic hydrogen in bulk quantities itself is a problem of great technological importance. The exothermicity of the recombination of two hydrogen atoms is expected to be of great significance.

Theoretically it is of great interest because of the fact that when cooled below  $T_c$  it is expected to form a new state of matter—a superfluid quantum gas. The weak interatomic potential (compared to superfluid Helium) and the large interatomic separation (one order of magnitude larger than the spacing in Helium-4) in the spin polarized atomic hydrogen allow one to consider it as a weakly interacting Bose gas. Actually it is an ideal testing ground for Bogoliubov like theories.

In this review the following problems of theoretical importance have been discussed :

- (i) the possible decay mechanisms
- (ii) determination of the critical temperature taking into account the inhomogeneous stabilising magnetic field.
- (iii) calculation of the density distribution
- (iv) study of magnetization compression and thermal leakage
- (v) collective excitations, the effect of spin dependent pair correlation functions.

(R. Sridhar, Nucl. Phys. and Solid State Phys. **26A** (1983) to appear)

## **GROUP THEORY AND APPLICATIONS**

### **A unified description of the representations of the graded Lie algebra $\text{Gsl}(2)$**

Indecomposable representations of the graded Lie algebra  $\text{Gsl}(2)$  have been analyzed in detail. The study of the irreducible representations (finite - and infinite - dimensional) have been shown to be intimately related to the study of these indecomposable representations.

(Bruno Gruber\*, T. S. Santhanam and Raj Wilson\*, J. Math. Phys. **25** (1984) 1253)



### **Indecomposable representations for para-Bose algebra**

A general study of the representations of the graded Lie algebra of para-Bose oscillators has been made. Besides realizing the standard representations, some interesting indecomposable (not fully reducible) representations have also been found.

(B. Gruber\* and T. S. Santhanam, J. Math. Phys. **24**. (1983) 1032)

### **On projective representations of finite Abelian groups**

A simple procedure of obtaining all the inequivalent irreducible projective matrix representations of any finite Abelian group has been given.

(R. Jagannathan, to appear in Proceedings of the IV Number Theory Conference, Institute of Mathematical Sciences, Madras, Ed K. Alladi, Lecture Notes in Mathematics, Springer-Verlag, 1984)

### **Indecomposable representations of some Lie and graded Lie algebras**

The study of the representations in the space of universal enveloping algebra reveals that the irreducible representations of Lie or graded Lie algebras appear as representations induced on the quotient space of indecomposable representations. This aspect has been demonstrated in the case of the algebra of parabose oscillators—a prototype version of a graded Lie algebra. A unified treatment of the representations of  $Gsl(2)$  is also given.

(T. S. Santhanam, Lecture Notes in physics, Springer-Verlag, 1984)

### **Indecomposable representations of the graded Lie algebra $Ospl(2,1)$**

Representations of the graded Lie algebra  $Ospl(2,1)$  have been studied in the space of its universal enveloping algebra. Extremal vectors have been explicitly constructed and a study of the invariant subspaces made.

(T. S. Santhanam and S. Madivanane, Proc. of the International Conference on Differential Geometric methods in theoretical Physics, 1984, to appear)

## **QUANTUM MECHANICS AND QUANTUM OPTICS**

### **Finite-dimensional quantum mechanics of a particle – III : The Weylian quantum mechanics of confined quarks**

It has been shown that a finite-dimensional analog of Weyl's formulation of quantum kinematics of a physical system through irreducible Abelian groups of unitary ray

rotations in system space offers many possibilities for the quantum mechanics of confined particles and the recently developed framework of such Weylian finite-dimensional quantum mechanics, due to the author and collaborators, has been expanded with a view to account for the various characteristics of quark physics

(R. Jagannathan, *Int. J. Theor. Phys.* **22** (1983) 1105)

### **A note on the relation between q-algebras without interaction and Weyl commutation relations**

It has been shown that the quantum mechanics defined by Kuryshkin's q-algebras without interaction is the same quantum mechanics in finite dimensions of Santhanam.

(S. Madivanane and M. Venkata Satyanarayana, *Lett. al Nuo. Cim.* **40** (1984) 19).

### **Impossibility of squeezed coherent states for a para-Bose oscillator**

It has been shown that squeezed coherent states do not exist for the para-Bose oscillator.

(T. S. Santhanam and M. Venkata Satyanarayana, *Phys. Rev. D*, to appear)

### **Special Topics in the Quantum Theory of Angular Momentum**

Two special topics in the quantum theory of angular momentum are discussed. They are: (i) the relationship between the coupling and recoupling coefficients (for two and three angular momenta, respectively) and sets of generalized hypergeometric functions of unit argument; and (ii) the 'non-trivial' or polynomial zeros of angular momentum coefficients and their classification.

(K. Srinivasa Rao, *Pramāna*, to be published)

### **On the polynomial zeros of Clebsch-Gordan and Racah coefficients**

It has been shown that the symbolic binomial expansions for the Clebsch-Gordan and Racah coefficients are exact for  $n = 1$  (where  $n + 1$  indicates the number of terms in the series expansion). When exact, these binomial forms reveal polynomial zeros of degree one, which are trivial structure zeros, hitherto considered as 'non-trivial' zeros, along with polynomial zeros of degree  $\geq 2$ .

(K. Srinivasa Rao and V. Rajeswari, *J. Phys. A: Math. and Gen.* **17A** (1984) L243).

### **An identity satisfied by the harmonic oscillator brackets**

An identity satisfied by the harmonic oscillator (Talmi-Moshinsky) brackets has been derived from two equivalent methods for evaluating an Integral often encountered in cluster model studies.

(K. Srinivasa Rao, *Int. J. for Theor. Phys.* to appear)

## **Realization of First Order Optical Systems using thin Lenses**

A first order optical system has been investigated in full generality within the context of wave optics by reducing the problem to a study of the ray transfer matrices. The simplest such systems correspond to axially symmetric propagation. Realization of such systems by centrally located lenses separated by finite distances has been studied. It has been shown that, contrary to the commonly held view, the set of first order systems that can be realized using axially symmetric thin lenses exhausts the entire  $SL(2,R)$  group; at most three lenses are needed to realize any element of this group. In particular, inverse of free propagation has been so realized. Among anisotropic systems it has again been shown that every element of the lens group  $Sp(4, R)$  can be realized using a finite number of thin lenses.

(E. C. G. Sudarshan, N. Mukunda\* and R. Simon\*, submitted to J. Optical Society).

## **Generalised Coherent states and generalised squeezed coherent states**

Roy and Virendra Singh showed that the harmonic oscillator possesses an infinite string of exact shape-preserving coherent wave packet states  $|n, \alpha\rangle$  having classical motion. It has been shown that the states  $|n, \alpha\rangle$  could be obtained from the coherent state  $|\alpha\rangle$  and it has also been shown how a coherent state  $|\alpha\rangle$  could be expanded in the basis of  $|n, \alpha\rangle$ 's. Further the possibility of 'squeezing' the state  $|n\rangle$  is investigated and the 'generalised squeezed coherent states' obtained. The squeezed coherent states for the displaced oscillator are defined. The physical meaning of squeezing is pointed out.

(M. Venkata Satyanarayana, submitted to Phys. Rev. D)

## **PROBABILITY THEORY, STOCHASTIC PROCESSES AND APPLICATIONS**

### **The Stochastic non-linear equations and order of scattering**

Non-linear stochastic equations, especially of the generalised Riccati type, arising in many situations in physics and engineering were solved using the tool of order of scattering technique. This is a great improvement over the earlier methods used by Adomian and others. The new method, at each stage of computation, sums up a set of an infinite class of diagrams not covered by the earlier methods.

(G. Adomian\* and R. Vasudevan, J. of Math. and Phys. Sciences 18 (1984) to appear)

### **A stochastic approach to inverse scattering in Geophysical layers**

A method has been proposed to analyse the stochastic profile of the geophysical layers (Gopillaud layers) from the response or sequence of responses obtained by input impulses,

like seismic explosions. The reflected and transmitted amplitudes provide the data from which the inverse determination can be done using various techniques including potential determination methods from phase shifts. These ideas are adumbrated.

(G. Adomian\* and R. Vasudevan, Math. Modelling an Int. J. 5 (1984) to appear)

### **On some new concepts in probability theory**

The concepts 'disparity', 'activity' and 'duality' introduced in the study of some stochastic processes by Ramakrishnan have been discussed. Also an outline of the probabilistic aspects of the formalism of the Weylian finite-dimensional quantum mechanics developed by the author and collaborators as a candidate for the physics of permanently confined particles has been given.

(R. Jagannathan, Proceedings of the Winter School on Stochastic Processes - Formalism and Applications, University of Hyderabad, Eds. G. S. Agarwal and S. Dattagupta, Lecture Notes in Physics, 184 (1983) 54 Springer-Verlag)

### **Combinants, Bell polynomials and Applications**

The concept of combinants introduced in the formulation of the generating function for probabilities is analysed, demonstrating the fact that they play the same role in computing cumulants as probabilities do in computing moments. The mathematical framework of Bell polynomials is used to relate combinants and probabilities. The effective use of combinants in branching processes is brought out. Also the coupled differential equations governing the combinants yield direct coupled equations for cumulants. The concept of mixed combinants has been developed.

(R. Vasudevan, P. R. Vittal\* and K. V. Parthasarathy\*, J. Phys. A: Math. Gen. 17 (1984) 989)

### **Basic concepts in the theory of stochastic processes and introduction to Markov processes**

Various concepts of Markov processes and the various tools employed in the study and analysis of stochastic processes are dealt with.

(R. Vasudevan, Proceedings of the Winter School on Stochastic Processes Formalism and Applications, Univ. of Hyderabad, Eds. G. S. Agarwal and S. Dattagupta, Lecture notes in physics 184 (1983) 2, Springer-Verlag)

## **Stochastic Differential equations**

Two types of stochastic calculi, viz. the Ito and the Stratonovic methods in analysing systems with additive and multiplicative noise are dealt with. The comparisons and evaluation of these types of integrations in the context of physical problems have been analysed.

(R. Vasudevan, Proceedings of the Winter School on Stochastic Processes-Formalism and Applications, Univ. of Hyderabad, Eds. G. S. Agarwal and S. Dattagupta, Lecture notes in physics **184** (1983) 37 Springer-Verlag)

## **Storage problems in continuous time with random inputs and random outputs and deterministic release**

The first passage problems lead to great insights regarding different threshold studies in storage, inventory, biological and environmental systems. A model of a dam with both random inputs and outputs along with deterministic exponential release has been treated for the first time using imbedding methods and inventing novel types of densities. Third order equations for the Laplace transform of the densities and closed form solutions have been obtained. Situations of overflow and emptiness are investigated and solutions, in terms of known functions, have been obtained.

(R. Vasudevan and P. R. Vittal\*, J. of Applied Math. and Computation, (1984) to appear)

## **Fluctuation-Dissipation Relations in the presence of multiplicative Noise**

This work analyses the modifications warranted in the fluctuation-dissipation relations when a multiplicative noise is present in the Langevin equation modelling the dynamics of a system. Concepts relating to Stratonovic and Ito type stochastic integration method have been employed in arriving at modifications of the first as well as the second fluctuation-dissipation theorems.

(R. Vasudevan and K. V. Parthasarathy\*, submitted to the J. of Transport Theory and Statistical Physics)

## **PLASMA PHYSICS**

### **Resistive instabilities in a plasma**

Instabilities produced by finite-resistivity effects in a plasma are of great interest in connection with research in fusion devices, solar flares and geomagnetic substorms. The physical mechanism of this instability is elucidated and in particular, the tendencies in the system towards the instability and the tendencies opposing it, if any, are identified.

As an illustration, the example of the so called gravitational interchange mode wherein a plasma with the statistically stable vertical density gradient is situated in a vertical gravitational field and a sheared horizontal magnetic field is considered. The physical picture developed is expected to be useful in sorting out phenomena that appear when more subtle properties of the resistive modes in a plasma are considered.

(B. K. Shivamoggi, submitted to European Journal of Physics)

### **Modulational instability of a finite-amplitude Alfvén wave**

A finite-amplitude plane-polarized Alfvén wave is shown to undergo a modulational instability consequent to its trapping in density cavities which are created by the ponderomotive force associated with the Alfvén wave. The instability arises when the density cavity travels at subsonic speeds.

(B. K. Shivamoggi, submitted for publication to Astrophysics and Space Science)

### **Parametric excitation of circularly polarized waves**

Parametric excitation by a modulating magnetic field of circularly-polarized waves propagating along the magnetic field have been considered.

(B. K. Shivamoggi, submitted to Czechoslovak Journal of Physics)

### **Driven magnetic field reconnection**

The boundaries of a plasma in a magnetostatic equilibrium with a magnetic null surface inside the plasma are perturbed at a rate fast compared with even the hydromagnetic evolution rate. The ensuing adjustments in the plasma and the magnetic field threading through it are investigated.

(B. K. Shivamoggi, submitted for publication in Physica Scripta)

### **Tearing - mode instability in a compressible plasma**

The tearing - mode instability of a sheet pinch in a compressible plasma has been investigated. The treatment is analytical. The compressibility effects, as a first approximation, are assumed to be small and are described as a correction to the standard FKR theory. The compressibility effects, when assumed small, are found to become important only in the thin resistive layer near the magnetic neutral surface. The results show that compressibility effects stabilize the tearing modes. This result may have some relevance to the observed stability of current sheets for prolonged times in the laboratory.

(B. K. Shivamoggi, submitted for publication in Physics of Fluids)

### **Evolution of current sheets near a hyperbolic magnetic neutral point : Effect of plasma density variation**

A nearly exact solution of the magnetohydrodynamic equations for a time-dependent, two-dimensional flow of a compressible plasma of finite conductivity in a hyperbolic magnetic field has been obtained. This solution predicts that the current sheet at the neutral point evolves more rapidly when the plasma density builds up locally around the magnetic neutral point.

(B. K. Shivamoggi, submitted to the Physics of Fluids)

### **Relativistic non - linear plasma waves**

An intense electromagnetic wave nonlinearly propagating in a plasma gets coupled to a Langmuir wave in the plasma in the relativistic case. A generalised perturbation theory is proposed for this system of coupled waves. This theory allows for both amplitude and phase modulations of the coupled waves and can therefore, successfully, deal with internal resonances if they arise in the system in question. This theory also recovers results of the known special cases in the appropriate limit, and provides insight into the nature of quasi-longitudinal waves in the relativistic case.

(B. K. Shivamoggi, submitted to the Journal of Plasma Physics)

### **Modulational stability of ion acoustic waves**

Karpman's mechanism is explored for the modulational instability of ion-acoustic waves on interaction with a slow plasma motion. The latter are found to be modulationally stable unlike the Langmuir waves.

(B. K. Shivamoggi, submitted for publication to the Canadian Journal of Physics)

### **Non-linear electrostatic ion - cyclotron waves**

The non - linear effects on electrostatic ion-cyclotron waves travelling perpendicular to the applied magnetic field in a cold-ion and hot-electron plasma are investigated. The method of strained parameters is used to develop a special solution which represents purely periodic waves with the non-linear effects showing up as an amplitude dependent frequency shift and multiperiodicity.

(B. K. Shivamoggi, submitted for publication in Fizika - Yugoslavia)

## **MOLECULAR SPECTROSCOPY**

### **On the application of perturbation theory for the calculation of molecular constants from isotopic frequency shifts**

It has been shown that the first order perturbation theory can be used to evaluate reasonably well the molecular constants from data on isotopic frequency shifts if the

off-diagonal elements of the relevant matrices are not neglected as is usually done. Numerical calculations for non-linear symmetrical  $XY_2$  molecules have been reported in support of the theory.

(N. Subramanian\*, R. Srinivasamoorthy\* and R. Jagannathan, Indian J. Pure and Appl. Phys. **21** (1983) 731)

#### **Molecular constants using isotopic frequency shifts**

Vibrational constants of some symmetrical  $XY_3$ ,  $XY_4$  and  $XY_6$ ;  $XYZ$  and  $XY_2Z$  molecules have been computed using a method, based on first order perturbation theory and isotopic frequency shifts, developed in an earlier paper by the authors.

(N. Subramanian\*, R. Srinivasamoorthy\*, G. A. Savari Raj\* and R. Jagannathan, Proc. National Conf. Vibrational Spectroscopy, Madras (1983) 74)

#### **On the use of root location theorems for matrices in the problem of determination of molecular force constants**

It has been shown that root location theorems for matrices can be effectively used in the problem of determination of molecular force constants. As an example a parametric method of evaluation of these constants has been developed for molecules, with Wilson's F and G matrices involving only one and two dimensional blocks, using isotopic frequency shifts or frequencies and coriolis coupling constants. Numerical examples have been provided and generalization to higher dimensional problems has been briefly discussed.

(N. Subramanian\*, R. Srinivasamoorthy\*, G. A. Savari Raj\* and R. Jagannathan, Indian J. Phys. **58B** (1984) 349)

## **SPECIAL THEORY OF RELATIVITY**

#### **A Note on the Lorentz transformation in three dimensions**

A derivation of the Lorentz transformation for one dimensional space, due to Ramakrishnan, has been generalized for the case of three dimensional space.

(R. Jagannathan, J. Math. Anal. Appl. **94** (1983) 242)

#### **Further unnoticed symmetries in special relativity**

In an earlier paper attention was drawn to some unnoticed symmetries in the special theory of relativity revealed through a quantity called bias,  $B = [(c-v)/(c+v)]^{1/2}$  where  $c$  is the velocity of light and  $v$ , the velocity of a "particle". Another symmetry called towards and away (TA) symmetry which follows naturally from the theory has been pointed out.

(Ramakrishnan, Alladi, J. Math. Anal. and Appl. **94** (1983) 237)



## GENERAL

### Ten Fundamental Problems and their solutions

A summary of the formulation and solution of ten fundamental, familiar but unsolved problems in the fields of Quantum Mechanics, Relativity and probability is recorded.

(Ramakrishnan, Alladi, J. Madras University 46B (1983) 72).

## MATHEMATICS

Dr. Krishnaswami Alladi gave a course of two lectures on "Sieve Methods" in December 1983. He gave a course of five lectures in "Number Theory" in February-March, 1984, and another course of four lectures on special topics in Number theory.

Prof. C. S. Seshadri has started an extensive course of lectures (three per week), intended as an introduction to diverse aspects of "Modern Geometry", from Nov. 15, 1984. Prof. K. R. Unni, has started a course of lectures (three per week), on "Analysis" from Dec. 3, 1984.

### Srinivasa Ramanujan and the Creation of Probabilistic Number Theory

In 1917 the Indian mathematician, Srinivasa Ramanujan, wrote a joint paper with G. H. Hardy on the number of prime factors of an integer. Nearly two decades passed before the full significance of this paper was realised and it eventually led to the creation of Probabilistic Number Theory. The important foundational ideas in this subject starting with the original paper of Hardy and Ramanujan are described and the researches in the area have been summarised.

(Krishnaswami Alladi, J. Madras University 46B (1983) 17)

### Line Bundles on Schubert Varieties

The normality of Schubert varieties in the generalized flag variety, associated to a semi-simple algebraic group, was proved.

(C. S. Seshadri, submitted to the proceedings of the TIFR Colloquium on Vector Bundles, 1984.)

## Participation in International Conferences

Dr. Krishnaswami Alladi gave invited talks at special sessions on Number theory at the annual meeting of the American Mathematical Society in Denver, Colorado in January 1983 and at the regional meeting of the American Mathematical Society in Norman, Oklahoma, in March 1983 - during his stay at the University of Texas at Austin as a Visiting Associate Professor. In December 1983, as a delegate of the Institute, he participated in the West Coast Number Theory Conference at Asilomar, California, which was dedicated to the memory of Prof. E. G. Straus and delivered two talks on his research work. He participated in the Conference on Analytic Number Theory and Diophantine problems, held at the Oklahoma State University, Still Water, from June 24 to July 3, 1984, with travel support given by the Department of Science and Technology, New Delhi, and gave a talk at a special session. He participated in a meeting of the American Mathematical Society, on "Diophantine problems, Diophantine approximations and transcendency", held at Bowdoin College, Brunswick, Maine, from July 15-21, 1984.

Dr. K. H. Mariwalla, as delegate of the Institute, participated and delivered lectures on "Black Hole Interiors" and on "Curvature copies" in the III International Mathematical Physics Workshop and NUPP Summer School, at Adelaide, from February 9-19, 1983. He participated in the National Conference of the New Zealand Institute of Physics held at the University of Auckland, from May 10-13, 1983.

Prof N. R. Ranganathan, as a delegate of the Institute, participated and gave a lecture in the III Int. Workshop on Mathematical Physics and NUPP Summer School, held at the University of Adelaide, Australia, from February 9-19, 1983. He participated in the XIII International Conference on Stochastic processes and their Applications, held at Varanasi, from December 17-23, 1983.

Professor Alladi Ramakrishnan, as a delegate of the Institute, participated in the American Mathematical Society Summer Research Conference on *Probability and Differential Equations*, held at Boulder, Colorado, USA from July 24-30, 1983.

Dr. R. Sridhar, as a delegate of the Institute, participated in the 75th Jubilee Conference on Helium - 4, held at the University of St. Andrews, Scotland, from August 1 to 5, 1983. He participated in the research workshop on condensed matter, during his stay at the International Centre for Theoretical Physics, Trieste, Italy (August 9 to September 13, 1983) and delivered a lecture on *Two-particle correlations in liquid He-4*. He participated as a delegate of the Institute, in the 17th International Conference on Low Temperature Physics (LT-17) held at the University of Karlsruhe, West Germany, from

August 15 to 22, 1984. He participated in the International workshop on condensed matter physics, at the International Centre for Theoretical Physics, Trieste, Italy, from August 29 to September 12, 1984.

Prof. T. S. Santhanam participated and gave an invited talk in the XII International Colloquium on Group theoretical methods in physics, held at the International centre for theoretical physics, Trieste, Italy, in September 1983. He participated in the XII International Conference on differential geometric methods in theoretical physics, held at Clausthal, West Germany, from August 30 - September 2, 1983. As a delegate of the Institute, he participated and gave an invited talk in the XIII International Conference on Differential Geometric methods in Theoretical Physics, held at Shamen, Bulgaria from August 20-26, 1984.

Prof. G. Rajasekaran participated and chaired a session in the Topical Conference on *Flavour Mixing in Weak Interactions*, held at Erice, Italy from March 4-11, 1984. He participated and gave an invited talk at the International Symposium on Theoretical Physics to celebrate the Diamond Jubilee of Bose Statistics, held at the Indian Institute of Science, Bangalore from November 19 - December 1, 1984.

Dr. B. K. Shivamoggi, as delegate of the Institute, participated in the International Conference on Plasma Physics held at Lousanne, Switzerland, from June 27 to July 3, 1984.

Dr. K. Srinivasa Rao participated and chaired a session at the 4th International Conference on Clustering Aspects of Nuclear Structure and Nuclear Reactions, held at Chester, from July 23-27, 1984, as an exchange scientist sponsored by the Indian National Science Academy and the Royal Society of London. As a delegate of the Institute, he participated in the International Conference on Nuclear Physics held at Bhabha Atomic Research Center, Bombay from December 27-31, 1984.

Prof. E. C. G. Sudarshan participated in the *International Conference on 50 years of weak Interactions*, held at Racine, Wisconsin, from May 29 to June 8, 1984. His paper entitled, *Origin of the Universal V-A theory*, in collaboration with Prof. R. E. Marshak - reviewing the circumstances under which the V-A theory of Weak Interactions, due to Sudarshan and Marshak, was discovered and the crucial role it played in the development of the Electro-weak theory - was presented at this Conference by Prof. Marshak. He inaugurated and gave an invited talk at the International Symposium on Theoretical Physics to celebrate the Diamond Jubilee of Bose Statistics, held at the Indian Institute of Science, Bangalore, from November 19 - December 1, 1984. Mr. M. Venkata Satyanarayana also participated in this Symposium.

Mr. J. Srinivasan and Miss. V. Rajeswari, participated in the International Conference on Nuclear Physics held at Bhabha Atomic Research Centre, Bombay, from December 27-31, 1984.

## Participation in National Conferences

Prof. R. Vasudevan participated in the Fifth National Symposium on Radiation Physics held at Calcutta from November 21 to 24, 1983 and delivered an invited lecture on *New formalism of transport of polarized light*.

Dr. K. Srinivasa Rao, Dr. R. Sridhar, Miss A. Shanthi and Mr. J. Srinivasan, participated in the Nuclear Physics and Solid State Physics Symposium, organised under the auspices of the Department of Atomic Energy, Government of India, at the University of Mysore, from December 22 to 27, 1983. Dr. K. Srinivasa Rao and Dr. R. Sridhar delivered invited talks on *Pion Photoproduction from nuclei* and *Spin polarized hydrogen*, respectively, at this symposium.

Dr. B. K. Shivamoggi delivered an invited talk on *Spectral theory of hydromagnetic turbulence* at the one-day *Dr. S. Chandrasekhar* symposium held at Indian Institute of Technology, Madras on October 27, 1983.

Dr. S. S. Lakshmi participated in the Indian Mathematical Society meeting held at Indian Institute of Technology, Madras from December 27 to 29, 1983.

Prof. E. C. G. Sudarshan inaugurated and delivered an invited talk at the Silver Jubilee Workshop on Recent advances in Theoretical Physics, held at the Indian Institute of Technology, Kanpur from December 5-15, 1984. He gave an invited talk at the working conference on Social and Philosophical implications of Artificial Intelligence held at New Delhi, from December 21-22, 1984.

Prof. G. Rajasekaran, presented a general review talk at the IAEA meeting of South-East and South Asian countries held at the Reactor Research Centre, Kalpakkam, in March 1984. He participated and gave a lecture in the Workshop on 'Gauge theories, Gravitation and the Early Universe' held at the Physical Research Laboratory, Ahmedabad, in November 1984. He participated and gave a series of lectures in the workshop on 'Recent advances in theoretical physics', held at the Indian Institute of Technology, Kanpur, in December 1984.

Dr. R. Parthasarathy chaired a session and gave a lecture in the workshop on 'Recent advances in theoretical physics', held at the Indian Institute of Technology, Kanpur, in December 1984.

## Visiting Assignments

Alladi, Krishnaswami, Visiting Associate Professor, Univ. of Texas at Austin, U.S.A. till August 1983 (from October 1981). During this period he visited and delivered seminars on his research work at the South West Texas State Univ. in San Marcos, Texas, at Oklahoma State Univ. in Still Water, Oklahoma, at the Univ. of Ulm and the Univ. of Frankfurt in West Germany. In December 1983, he visited the Univ. of California at Los Angeles and gave a colloquium at the Univ. of Hawaii in Honolulu. He visited the Univ. of Texas at Austin, from July 4-14, 1984. He is now a Visiting Associate Professor at the Univ. of Hawaii, Honolulu, for 9 months from August 25, 1984.

Mariwalla, K. H. was a Visiting Professor at La Trobe University, Bundoora, Victoria, from February 20 - April 29, 1983 and from May 18-23, 1983. During that period he gave a course of four lectures on "Complementarity and Coherence", and a Course of ten lectures on "Structures in Mechanics and Quantization problem". He visited the Australian National University, Canberra (May 16-18, 1983) and gave lectures on "Curvature Copies" and on "Structures in Mechanics". He visited Canterbury University, Christchurch, New Zealand, from April 29 - May 10, 1983 and gave two lectures on "Structures of Mechanics". He was at the Waikato University, New Zealand (May 3-14, 1983) and gave a seminar on "Black Hole interiors".

Parthasarathy, R. Visiting Associate Professor, Simon Frazer University, Burnaby, Canada, till July 1983 (from September 1981).

Rajasekaran, G. visited the Institute of Theoretical Physics of the University of Naples, Italy, for a week in March 1984.

Ranganathan, N. R. gave seminars at the La Trobe University, Bundoora, Victoria, University of Tasmania, Hobart, Australian National University, Canberra and the Univ. of New South Wales, Sydney, during Feb.- March 1983. He visited and lectured at the Mehta Research Institute for Mathematics, Allahabad, on December 22, 1983.

Santhanam, T. S., Visiting Professor at the Southern Illinois University, Carbondale, Illinois, U.S.A. till July 15, 1983 (from September 1982). During this period, he visited the Centre for Particle Theory at the University of Texas, Austin (May 12 - 19, 1983) and delivered lectures at the City College of the City University of New York, the University of Rochester and visited the McGill University, Montreal (May 20 - June 8). He was a Guest Scientist at the Int. Centre for Theor. Phys., Trieste, Italy,

for one month (July-August 1983) and a Guest Professor at the Physikalisches Institut der Universität Bonn, Bonn, for one month (August - September 1983).

Shivamoggi, B. K. is at present a Visiting Associate Professor at the University of Central Florida, Orlando, for 9 months, from September 1, 1984.

Sridhar, R., Visiting Scientist, Institute of Physics, Bhubaneswar, for one week in November 1984.

Srinivasa Rao, K., Visiting Scientist, Centre for Theoretical Studies, Indian Institute of Science, Bangalore, for one month (March - April 1984), Visiting Scientist, Institute of Physics, Bhubaneswar, for one week in July 1984. He visited U.K. for 3 weeks, from July 21 - August 12, 1984, as an exchange scientist sponsored by the Indian National Science Academy and the Royal Society of London. During this period, he visited the University of Manchester, Daresbury Laboratory and the Oxford University where he delivered lectures and had discussions. Alexander von Humboldt Foundation Fellow at the Institute for Theoretical Nuclear Physics, University of Bonn, Bonn, for 2 months. (August 13 - October 14, 1984).

Sudarshan, E. C. G., Professor of Physics, University of Texas, Austin, Texas, (March-July, 1984, September 18 - October 9, 1984). During this period he was a Visiting Professor for one month at the Instituto di Fisica Teorica, Napoli, Italy (May-June 1984) and a Visiting Professor for one month at the Chalmers University of Technology, Gothenburg, Sweden (June-July 1984).

## Publications in Journals

- Adomian, G.\* and Vasudevan, R. "The stochastic non-linear equations and order of scattering", J. of Math. and Phys. Sciences **18** (1984).
- Adomian, G.\* and Vasudevan, R. "A stochastic approach to inverse scattering in geophysical layers", Mathematical Modelling an Int. J., **5** (1984)
- Alladi, Krishnaswami., "Moments of additive functions and the sequence of shifted primes", J. London Math. Soc. (to appear)
- Alladi, Krishnaswami., "Srinivasa Ramanujan and the creation of Probabilistic Number Theory", J. Madras Univ. **46B** (1983) 17
- Bohr, H.\* and Rajasekaran, G. "Large-N gauge theory of loops and strings-I" Phys. Rev. (to appear)
- Bohr, H.\* and Rajasekaran, G. "Large-N gauge theory of loops and strings-II" Phys. Rev. (to appear)
- Ghassib, H. B.\* and Sridhar, R. "On the Frohlich decomposition and the condensate fraction in He II," Phys. Lett. **100A** (1984) 198
- Godbole, R. M.\*, Jayaraman, T.\*, Pati, J. C.\*, Rajasekaran, G. and Rindani, S. D.\* "The recent single-tag two-photon experiments at PETRA and the issue of quark charges", Phys. Lett. **142B** (1984) 91
- Gruber, B.\* and Santhanam, T. S., "Indecomposable representations of para-Bose algebra", J. Math. Phys. **24** (1983) 1032
- Gruber, B.\*, Wilson Raj\* and Santhanam, T. S., "A unified approach to the representation theory of the graded algebra  $Gsl(2)$ ", J. Math. Phys. **25** (1984) 1253
- Jagannathan, R., "A note on the Lorentz transformation in three dimensions" J. Math. Anal. Appl., **94** (1983) 242
- Jagannathan, R., "Finite-dimensional quantum mechanics of a particle-III: the Weylian quantum mechanics of Confined quarks", Int. J. of Theor. Phys. **22** (1983) 1105
- Kay, Daniel\*, Parthasarathy, R. and Viswanathan, K. S.\*, "Constant selfdual Abelian gauge fields and fermions in  $SU(2)$  gauge theory", Phys. Rev. **28D** (1983) 3116
- Lakshmi, S. S., "An alternative definition of local connectedness in bitopological spaces", J. Indian Inst. Sci. (to appear)

- Lakshmi Bai, V., and Seshadri, C. S., 'Singular Locus of a Schubert Variety', *Bull. of Am. Math. Soc.* **11** (1984) 363.
- Lakshmi Bai, V., and Seshadri, C. S., 'Geometry of  $G/P - V$ ', *J. of Algebra* (to appear)
- Parthasarathy, R., Singer, M.\* and Viswanathan, K. S.\*, "The ground state of an  $SU(2)$  gauge theory in a non-abelian background field", *Canadian J. Phys.*, **61** (1983) 1442
- Ramakrishnan, Alladi., "Further unnoticed symmetries in special relativity", *J. Math. Anal. Appl.*, **94** (1983) 237
- Ramakrishnan, Alladi., "Ten fundamental problems and their solutions", *J. Madras University*, **46B** (1983) 72
- Ranganathan, N. R. and Vasudevan, R., "Remarks on duality transformations in lattice spin systems", *J. Phys. A: Math. Gen.* **17** (1984) 1143
- Santhanam, T. S. and Satyanarayana, M. V., "Squeezed coherent states of parabose oscillators", *Phys. Rev. D* (to appear)
- Shivamoggi, B. K., "Magnetohydrodynamic properties near a X-type magnetic neutral line", *J. Plasma Phys.* (to appear)
- Singer, Mark\*, Parthasarathy, R. and Viswanathan, K. S.\*, "An  $SU(3)$  model for electro-weak unification", *Phys. Lett.* **125B** (1983) 63
- Sridhar, R. and Shanthi, A., "Role of two phonon excitations in the inelastic scattering of neutrons from He II", *Phys. Lett.* **93A** (1983) 198.
- Sridhar, R., "A comment on an integral equation for the structure factor of superfluid  $^4\text{He}$ ", *Acta Phys. Polonica* **64A** (1983) 115
- Sridhar, R., "A remark on the temperature dependence of the structure factor and excitation energy of a quantum liquid", *Phys. Lett.* **98A** (1983) 441.
- Srinivasa Rao, K. and Rajeswari, V., "On the polynomial zeros of 3-j and 6-j symbols", *J. Phys. A: Math. and Gen.* **17A** (1984) L243
- Srinivasa Rao, K., "An identity satisfied by the harmonic oscillator brackets", *Int. J. of Theor. Phys.* (1984) (to appear)
- Srinivasa Rao, K., "Report on the Fourth International Conference on Clustering aspects of nuclear structure and nuclear reactions", *Phys. News*, **15** (1984)
- Srinivasa Rao, K., "Special topics in the Wigner-Recah algebra in Quantum Theory", *Pramāna* (to appear)
- Srinivasa Rao, K., "Query No. 287", *Am. Math. Soc. Notices* **30** (1983) 598
- Srinivasa Rao, K. and Rajeswari, V. "Response", *Am. Math. Soc. Notices* **31** (1984) 165



- Subramanian, N.\*, Srinivasamoorthy, R.\*, Savari Raj, G. A.\* Jagannathan, R., "On the use of root location theorems for matrices in the problem of determination of molecular force constants", Indian J. Phys. **58B** (1984) 349.
- Subramanian N.\*, Srinivasamoorthy, R.\* and Jagannathan, R., "On the application of perturbation theory for the calculation of molecular constants from isotopic frequency shifts", Indian J. of Pure Appl. Phys., **21** (1983) 731.
- Sudarshan, E. C. G., "Quantum Measurement and Dynamical Maps", Contribution to honour Yu'val Ne'eman on his 60th Birthday (1984) - Festschrift
- Vasudevan, R., Vittal, P. R.\* and Parthasarathy, K. V.\* "Combinants, Bell polynomials and applications", J. Phys. A: Gen. Math. **17** (1984) 989.
- Vasudevan, R., and Vittal, P. R.\*, "Storage problems in continuous time with random inputs and random outputs and deterministic release", J. of Applied Maths. and Computation (1984) (to appear)

## **Contributed papers, Invited talks in Conference proceedings**

- Alladi, Krishnaswami, "The monotonicity principle for the sieve", Lecture Notes in Mathematics, Springer-Verlag, Ed. K. Alladi (1984) to appear.
- Alladi, Krishnaswami, "A new application of the Sieve to probabilistic number theory", Proc. of the Conf. on Analytic Number Theory, Austin, Texas (1983).
- Jagannathan, R., "On some new concepts in probability theory", Lecture Notes in Phys., Eds. G. S. Agarwal and S. Dattagupta, Springer-Verlag **184** (1983) 54.
- Jagannathan, R., "On projective representations of finite Abelian groups", Lecture Notes in Maths, Springer-Verlag, Ed. K. Alladi (1984) to appear.
- Rajasekaran, G., "Grand Unified theories", Proc. of the High Energy Phys. Symp., Mysore (1984) 1.
- Rajasekaran, G., "Magnetic monopoles," Proc. of the 30th Ann. Symp. of the Saha Institute of Nuclear Physics, Calcutta (1984).
- Santhanam, T. S., "Indecomposable representations of some Lie and graded Lie algebras", Lecture Notes in Phys., Springer-Verlag (1984).
- Santhanam, T. S. and Madivanane, S., "Indecomposable representations of the graded algebra  $Ospl(2, 1)$ ", Proc. of the Int. Conf. on Differential Geometric Methods in Theor. Phys., Bulgaria (1984) to appear.
- Sheshadri, C. S., 'Line Bundles on Schubert Varieties', submitted to the Proc. of the T.I.F.R. Colloquium on Vector Bundles (1984).
- Sridhar, R., "Spin polarized Hydrogen", Nucl. Phys. and Solid State Phys. (India) **26A** (1983).
- Sridhar, R. and Shanthi, A., "Pressure dependent study of the neutron scattering intensities from liquid He II", Nucl. Phys. and Solid State Phys. (India) **26C** (1983).
- Sridhar, R. and Shanthi A., Proc. of the 17th Int. Symp. on Low Temp. Phys. (L-17), Karlsruhe, Elsevier Science Pub. (1984) 1203.
- Sridhar, R., "Analysis of two - phonon excitations in liquid He II", Proc. of the 75th Jubilee Conf. on Helium-4, St. Andrews, Scotland, Ed. J. G. M. Armitage, World Scientific, Singapore (1983).

- Srinivasa Rao, K., "Charged pion photoproduction from nuclei", Nucl. Phys. and Solid State Phys. (India) **26A** (1983).
- Srinivasa Rao, K. and Srinivasan, J., "The root mean square radius of  ${}^7\text{Li}$ ", Nucl. Phys. and Solid State Phys. (India) **26B** (1983).
- Srinivasa Rao, K. and Srinivasan, J., "Photodisintegration of  ${}^7\text{Li}$ ", Nucl. Phys. and Solid State Phys. (India) **26B** (1983).
- Srinivasa Rao, K., "An identity for the harmonic oscillator brackets", Contributed papers. 4th Int. Conf. on clustering Aspects of Nucl. Structure and Nucl. Reactions, Chester (1984) 123.
- Srinivasa Rao, K., Sridhar, R. and Srinivasan, J., "Charge form factor of  ${}^6\text{Li}$  and  ${}^7\text{Li}$ ", Contributed papers, 4th Int. Conf. on Clustering Aspects of Nucl. Structure and Nucl. Reactions, Chester (1984) 125.
- Srinivasa Rao, K. and Srinivasan, J., "Photodisintegration of  ${}^6\text{Li}$  and  ${}^7\text{Li}$ ", Contributed papers, 4th Int. Conf. on Clustering Aspects of Nucl. Structure and Nucl. Reactions, Chester (1984) 127.
- Srinivasa Rao, K. and Bhasin, V. S., "Quasi-free cluster knock-out reactions from  ${}^6\text{Li}$ ", Contributed papers, 4th Int. Conf. on Clustering Aspects of Nucl. Structure and Nucl. Reactions, Chester (1984) 247.
- Srinivasa Rao, K. and Rajeswari, V., " $\pi^-/\pi^+$  ratio for pion photoproduction from nuclei", Proc. of Int. Conf. on Nucl. Phys., Bombay (1984).
- Subramanian, N.,\* Srinivasamoorthy, R.,\* Savari Raj, G. A.\* and Jagannathan, R., "Molecular constants using isotopic frequency shifts", Proc. of Nat. Conf. on Vibrational Spectroscopy, M.I.T., Madras (1983) 74.
- Vasudevan, R., "New formalisms of transport of polarized light", 5th Nat. Symp. on Radiation Physics, Calcutta (1983).
- Vasudevan, R., "Basic concepts in the theory of stochastic processes and introduction to Markov processes", Lecture Notes in Phys., Eds. G. S. Agarwal and S. Dattagupta, Springer-Verlag **184** (1983) 2.
- Vasudevan, R., "Stochastic differential equations", Lecture Notes in Phys., Eds. G. S. Agarwal and S. Dattagupta Springer-Verlag (1983) 37.

## **Seminars at the Institute**

Raghavan, R. S. - Bell Laboratories, USA

The Quest for massive neutrino (7.1.83)

Rao, Y. S. T. - North Eastern Hill University, Shillong

Quantum Mechanical Barrier Penetration with Dissipation (18.1.83)

Vladimirov, Y. S. - Steklov Institute of Mathematics, USSR

Mathematical problems in Modern Mathematical Physics (28.1.83)

Rozanov, J. A. - Steklov Institute of Mathematics, USSR

New Development in the theory of Random Process (28.1.83)

Pal, B. K. - Himachal Pradesh University, Simla

High Energy Physics and Unification of Forces - I, II and III - three lectures

(5.2.83 - 9.2.83)

Ramamoorthy, V. S. - BARC, Bombay

Fission Barrier heights some open problems (14.2.83)

Computer simulation of small quantum systems as applied to nuclear collisions (15.2.83)

Pandya, S. P. - PRL, Ahmedabad

Structure of Transitional Nucleii (17.3.83)

Mitra, A. N. - Delhi University, Delhi

The Three-Body Problem : a Perspective (28.3.83)

The Three-neutron Problem (30-3-83)

Raghavan, T. E. S. - University of Illinois at Chicago, USA

Stochastic Games (20.5.83)

Vasudevan, R. I.M.Sc.

Combinants Bell Polynomials (28.5.83)

Ranganathan, N. R. - I.M.Sc.

Broken Ergodicity and its implications for Physical System (8.7.83)

Sridhar, R. - I.M.Sc.

Two-Particle Excitations in Liquid He - II (27.7.83)

Parthasarathy, R. - I.M.Sc.

The Ground State in Yang-Mills Theory (19-8-83)

Subba Rao, M. V. - University of Alberta, Canada  
Topics in Number Theory (25.8.83)

Erwin Fenyves - University of Texas at Dallas, USA  
Proton Decay Experiments (25.8.83)

Jain, P. L. - University of Buffalo, USA  
Nuclear Collisions of Uranium at One GeV Per Nucleon (5.9.83)

Nanda, V. C. - Punjab University, Chandigarh  
Integral Matrices (30.9.83)

Madivanane, S. - I.M.Sc.  
A Note on General Involutorial Transformations (10.10.83)

Venkata Satyanarayana, M. - I.M.Sc.  
A Remark on Angular Momentum Coherent States (12.10.83)

Rajasekaran, G. - I.M.Sc.  
Baryons as Solitons (19.10.83)

Kilambi, S. - Universite de Montreal, Canada  
Recent Progress in Nonassociative Banach Algebras - six lectures - (3.11.83 to  
22.11.83)

Shivamoggi, B. K. - I.M.Sc.  
Tearing Mode Instabilities in Plasmas (9.11.83)

Vasudevan, R. - I.M.Sc.  
Radiative Transfer (14.11.83)

Venkata Satyanarayana, M. - I.M.Sc.  
Kuryshkin's Q-Algebras and Weyl Quantization (14.11.83)

Ranganathan, N. R. - I.M.Sc.  
Supersymmetry and Theory of Disordered Physical Systems (17.11.84)

Sridhar, R. - I.M.Sc.  
Spin Polarized Hydrogen (28.11.83)

Krishnaswami Alladi - I.M.Sc.  
Sieve Methods - two lectures (1.12.83. and 31.12.83)

Ranganathan, N. R. - I.M.Sc.  
Supersymmetry and Theory of Disordered Physical Systems - three lectures (3.12.83 to  
9.12.83)

Sridhar, R. - I.M.Sc.  
Spin-Polarized Hydrogen (7.12.83)

- Landsberg, P. T. - University of Sussex, UK  
Thermodynamics Approach to Statistical Mean (15.12.83)
- Rao, Y. S. T. - North-Eastern University, Shillong  
Anamalon Behaviour in Heavy Ion Reactions (19.12.83)
- Hironari Miyazawa - University of Tokyo, Japan  
Aharanov - Bohm Effect (28.12.83)
- Kleibner, F. C. - University of Melbourne, Australia  
Concepts in Branching Processes (29.12.83)
- Halberstam, H. - University of Illinois at Urbana, USA  
Sieve Methods (30.12.83)
- Sathpathy, L. - Institute of Physics, Bhubaneswar  
The Generalized Hugenholtz - Vanhove Theorem and a New  
Mass relation infinite Nucleii (30.12.83)
- Heini Halberstam - University of Illinois at Urbana, USA  
Sieve Methods (2.1.84)
- Carl Pomerance - University of Georgia, USA  
How to factor a number (2.1.84)
- Sos, V. T. - Hungarian Academy of Sciences, Budapest  
Irregularities of partitions, uniform distribution and Ramsey theory (13.1.84)
- Sarkozy, A. - Hungarian Academy of Sciences, Budapest  
Sums of Integers having small Prime Factors (13.1.84)
- Richert, H. E. - University of Ulm, West Germany  
Sieve Methods (18.1.84)
- Paul Erdos - Hungarian Academy of Sciences, Budapest  
Problems and results in Number Theory (18.1.84)
- Halberstam, H. - University of Illinois at Urbana, USA  
Sieve Methods (19.1.84)
- Pal, B. K. - Himachal Pradesh University, Simla  
Supergravity, Unification of Forces (20.1.84)
- Bruce C. Berndt - University of Illinois at Urbana, USA  
Selected results from Ramanujan's note books (20.1.84)  
Ramanujan and continued fractions (21.1.84)
- Parthasarathy, R. - I.M.Sc.  
Kalaza-Klein Theory (23.1.84)

**Ranganathan, N. R. - I.M.Sc.**

**Supersymmetry and Theory of Disordered Physical Systems - two lectures (24.1.84 and 28.1.84)**

**Choquet Bruhat - University of Paris, France**

**Global Solutions of Yang-Mills Equations (31.1.84)**

**Krishnaswami Alladi - I.M.Sc.**

**Number Theory - five lectures (3.2.84 to 3.3.84)**

**Rajaraman, A. - Structural Engineering Research Centre, Madras**

**Microprocessors and Mini Computers (24.2.84)**

**Shivamoggi, B. K. - I.M.Sc.**

**Relativistic Nonlinear Plasma Waves (7.3.84)**

**Krishnaswami Alladi - I.M.Sc.**

**Identities for basic series (9.3.84)**

**Applications of Basic series to Partitions (17.3.84)**

**Extensions of Eulers's Theorem on Partitions (24.3.84)**

**On a partition problem of Sylvester (31.3.84)**

**Parthasarathy, R. - I.M.Sc.**

**On a Class of Solutions to  $SU(2)$  A Yang-Mills Theory and Confinement (22.3.84)**

**Seetharaman, M. - University of Madras, Madras**

**Higher Order JKWB Approximation for Radian Problems (23.3.84)**

**Rajasekaran, G. - I.M.Sc.**

**Flavour Mixing in Weak Interactions (29.3.84)**

**Balram Rajpur - University of Tennessee at Knoxville**

**Spectral Representation of Semi-stable Processes (2.4.84)**

**Srinivasa Rao, K. - I.M.Sc.**

**Course of lectures on Nuclear Theory (11.4.84)**

**Rajasekaran, G. - I.M.Sc.**

**Magnetic Monopoles in Broken-Colour QCD (18.4.84)**

**Vasudevan, R. - I.M.Sc.**

**Random Impulses and Hyperfine Interactions (18.4.84)**

**Jagannathan, R. - I.M.Sc.**

**Finite Dimensional Quantum Mechanics - Gudder's Model (25.4.84)**

**Santhanam, T. S. - I.M.Sc.**

**The Problem of Generations in Unified Gauge Theories (25.4.84)**

- Sridhar, R. - I.M.Sc.  
Spin-Polarized Hydrogen (25.4.84)
- Balakrishnan, V. - IIT, Madras  
Anomalous Diffusion in One Dimension (28.4.84)
- Shivamoggi, B. K. - I.M.Sc.  
Integrability of Hamiltonian Systems (30.4.84)
- Rajaraman, R. - Centre for Theoretical Studies, Bangalore  
Fractional Charge in Field Theory and Polymer Physics (2.5.84)
- Jagannathan, R. - I.M.Sc.  
On the Entropic Formulation of Uncertainty for Quantum Measurements (3.5.84)
- Sridhar, R. - I.M.Sc.  
Spin Polarized Hydrogen (3.5.84)
- Rajasekaran, G. - I.M.Sc.  
New unexpected phenomena in high energy experiments (10.5.84)
- Parthasarathy, R. - I.M.Sc.  
Neutrino neutral-current excitation of  $^{12}\text{C}^*$  ( $1^+$ ;  $T=1$ ; 15.1 MeV) (10.5.84)
- Pasupathy, J. - Centre for Theoretical Studies, Bangalore  
Cosmological Consequences of Identifying the (2.2) with Canonical Higgs Boson (11.5.84)
- Mani, H. S. - IIT, Kanpur  
Static Properties of Baryons in Skyrme Model (15.5.84)
- Vasudevan, R. - I.M.Sc.  
One Dimensional Competing Ising Model (17.5.84)
- Raghunathan, K. - TIFR, Bombay  
Parity Violation in  $\text{C}_s$  Atom (17.5.84)
- Govindarajan, T. R. - Loyola College, Madras  
Supersymmetric  $\text{SU}(2)_L \times \text{SU}(2)_R \times \text{U}(1)_{B-L}$  Model (18.5.84)
- Ramachandran, R. - IIT, Kanpur  
Composite Model with Supersymmetry (21-5-84)
- Waghmare, Y. R. - IIT, Kanpur  
Nuclear Structure Studies Using Elementary Particles as Probe - three lectures (22.5.84 to 24.5.84)  
Classical and Semi-Classical Prescriptions to the Fusion of Heavy Ions - three lectures (28.5.84 to 30.5.84)
- Athreya, K. - Iowa State University, USA  
Discounted Branching Random Walks (1.6.84)



- Srinivasa Rao, K. - I.M.Sc.  
Pion Double Charge Exchange Scattering (17.5.84)
- Ranganathan, S. R. - Royal Military College Kingston, Canada  
Atomic Dynamic of Dense Gases (4.6.84)
- Bruch Rothschild - University of California at Los Angeles, USA  
Recent Results and Problems in Ramsey Theory (4.6.84)  
Triangulations of the Convex Hull of a Set of n-Points (5.6.84)
- Parthasarathy, R. - I.M.Sc.  
Kaluza-Klein Theory in  $(4+n)$  Dimensions (8.6.84)
- Vasudevan, R. - Defence Research Development Organisation, Bangalore  
Scope of Applications of Computers in Defence (13.6.84)
- Singh, L. P. - Utkal University, Bhubaneswar  
Path Integral Formulation of The Theory of Loops and Strings (14.6.84)  
Physical Aspects of Multi-Monopole Solutions (15.6.84)
- Srinivasan, V. - Central University, Hyderabad  
Supersymmetric Formulation of Stochastic Quantization (25.6.84)  
Chiral Anomaly and Quantized Hall Effect (29.6.84)
- Joshipura, A. S. - IIT, Kanpur  
Supersymmetric Model Building (3.7.84)
- Behera, S. N. - Institute of Physics, Bhubaneswar  
Theory of Raman Scattering in layered-charge density wave (CDW) and Compounds  
(5.7.84)  
Phonon Response of a System undergoing CDW and Superconducting transitions  
(9.7.84)  
A Field theoretic model for first order structural phase transition (12.7.84)
- Madivanane, S. - I.M.Sc.  
Realization of the Basic Representations of the Euclidean Lie Algebra - I - from a  
Physicist's point of View (6.7.84)
- Santhanam, T. S. - I.M.Sc.  
Superalgebra, supertableau etc. (12.7.84 and 19.7.84)
- Madivanane, S. - IMSc.  
A New Formula for characters - I (20.7.84)
- Shivamoggi, B. K. - I.M.Sc.  
Highlights of ICPP 1984 (23.7.84)  
Highlights of ICPP 1984 - III (24.7.84)
- Rajasekaran, G. - I.M.Sc.  
Fields with Vanishing Colour Currents (26.7.84)

- Raghunathan, M. S. - TIFR, Bombay  
 Groups Generated by Reflections I (24.7.1984)  
 Groups Generated by Reflections II (25.7.1984)  
 Loop Groups and Affine Weyl Groups (26.7.84)
- Bhama Srinivasan, - University of Illinois at Chicago, U.S.A.  
 Representations of Finite Classical Groups (25.7.1984)
- Rhama Venkataraman -  
 The Canonical Ensemble Redefined with a Quadratic Term in the Hamiltonian  
 (3.17.1984)
- Varadhan, S. R. S. - Courant Institute of Mathematical Sciences, New York  
 Function Space Integrals and applications - I (1.8,1984)  
 Function Space Integrals and applications - II (2.8.1984)
- Mariwalla, K. H. - I.M.Sc.  
 Symmetries of Nth order ordinary differential Equations and applications (3.8.1984)
- Kulkarni, R. S. - Indiana University, U.S.A.  
 Topological aspects of Kleinian groups (7.8.1984)  
 An analogue of the Riemann mapping theorem for Lorentz matrices (8.8.1984)
- Sinha, K. P. - Centre for Theoretical Studies, Banlore  
 Jahn-Teller Polarons and Superconducting Properties of Some Systems (10.8.1984)
- John Thompson - Cambridge University, England  
 Finite Simple Groups (11.8.1984 and 13.8.1984)
- Tata, K. - University of Texas at Austin, U.S.A.  
 Seeing Super Symmetry (14.8.1984)
- Murthy, M. K. - TIFR, Bombay  
 Local Solvability for Linear Partial Differential Operators (14.8.1984)
- Baskaran, G. - International Centre for Theoretical Physics, Trieste, Italy  
 Quantum Hall Effect in 2 Dimensions (14.8.1984)
- Kalpana Kallianpur - University of Texas at Austin, U.S.A.  
 Testing the Triple Gauge Couplings of the Weinberg-Salam Theory (16.8.1984)
- Xerxes Tata - University of Oregon, U.S.A. and CERN, Geneva  
 Hot Supersymmetry (16.8.1984)
- Pasupathy, J. - Centre for Theoretical Studies, Bangalore  
 (2.2) as the Higgs particle (28.8.1984)
- Balachandran, A. P. - Syracuse University, U.S.A.  
 Fractional Charges and Magnetic Monopoles (31.8.1984)

Mukunda, N. - Centre for Theoretical Studies, Bangalore  
Magnetic Monopoles (4.9.1984)

Balasubramanian, R. - TIFR, Bombay  
Recent Progress in Analytic Number Theory - Waring's Problem (5.9.1984)  
Class Number Problem (6.9.1984)  
Riemann Zeta Function (10.9.1984)

Parthasarathy, R. - I.M.Sc.  
Kaluza-Klein Theory - An Elementary Introduction (15.9.1984)

Sridhar, R. - I.M.Sc.  
A Bird's Eye View - LT17 (21.9.1984)

Naik, P. C. - Institute of Physics, Bhubaneswar  
Long-Range Interaction between Spins (26.9.1984)  
Analogue of Aharonov-Bohm Effect in Spin Gauge Theory (27-9-1984)  
Spontaneous Symmetry breaking in Large N theories (28.9.1984)

Sreekantan, B. V. - TIFR, Bombay  
High Energy Astronomies (28.9.1984)

Santhanam, T. S. - I.M.Sc.  
A brief report on the International Conference on differential geometric methods in  
Theoretical Physics held in Shumen, Bulgaria from 20-26 Aug. 84 (5.10.1984)

Misra, S. P. - Institute of Physics, Bhubaneswar  
Super Gravity I (15.10.1984)  
Super Gravity II (16.10.1984)  
Super Gravity III (18.10.1984)

Gopal Prasad - TIFR, Bombay  
Anisotropic groups over local and global fields (19.10.1984)  
The Kneser-Tits problems (22.10.1984)

Pradhan, T. - Institute of Physics, Bhubaneswar  
Lie Group for Supersymmetry and a boson-fermion Wave Equation (22.10.1984)  
Gravito-magnetic field and its experimental test (24.10.1984)

Yajnik, A. Urjit - Center for Particle Theory Austin, U.S.A.  
Vortices and Monopoles to Save Inflation? (25.10.1984)

Joshiyura, A. S. - Saurashtra University, Gujarat  
Composite Models and  $N=2$  Susy (2.11.1984)  
 $Su(2)$ ,  $xu(1)$  Breaking in Supergravity Models (7.11.1984)

Sridhar, R. - I.M.Sc.  
Some recent results on the temperature dependence of the structure factor and  
excitation spectrum in Liquid He II (8.11.1984)

Singh, J. P. - Indian Institute of Technology, Kanpur  
Dynamical Symmetry Breaking - I (5.11.1984)  
Dynamical Symmetry Breaking - II (6.11.1984)

Eliezer, C. J. - Latrobe University, Australia  
With Mathematics And With Universities: A Long Love Affair (9.11.1984)

Basu, S. K. - Moscow University, U.S.S.R.  
Quantization procedure based on Probability Operator (13.11.1984)

Parida, M. K. - Sambalpur University, Sambalpur  
A New Approach to Left-Right Symmetry breaking in Unified Gauge Theories  
(13.11.1984)

A search for low right-handed mass scale in  $SU(8)_L \times SU(8)_R$   
Grand unification and super gravity models (15.11.1984)

Mahapatra, B. P. - Sambalpur University, Burla  
Possible Evidence for purely power suppressed correction to Scaling  
Violations - I (14.11.1984)

Possible Evidence for purely power suppressed correction to Scaling  
Violations - II (16.11.1984)

Radhakrishnan, V. - I.M.Sc.  
Phase transitions of Liquid Crystals (15.11.1984)

Seshadri, C. S. - I.M.Sc.  
Course of lectures on Geometry (15.11.1984)

Chaturvedi, S. - University of Hyderabad, Hyderabad  
Stochastic Quantization (16.11.1984)

Panchapakesan, S. - Southern Illinois University, Carbondale, U.S.A.  
Locally Optimal Subset Selection Rules (28.11.1984)

Unni, K. R. - I.M.Sc.  
Course of lectures on Analysis (1.12.1984)

Regge, T. - University of Turin, Italy  
Group Manifold approach (1.12.1984)

Morandi, G. - Universite di Modena, Italy  
Spontaneous Symmetry Breaking in Many Body Systems (7.12.1984)

Marmo, G. - Universita di Napoli, Italy  
When do the equations of motion determine their Lagrangian description uniquely?  
(Inverse Problem) (7.12.1984)

**Radhakrishnan, V. - I.M.Sc.  
Super Conducting Devices (11.12.84)**

**Mariwalla, K. H. - I.M.Sc.  
Addled Ado on Action Ambiguities (12.12.84)**

**Rohit Parikh - City University of New York  
Modal Logic (18.12.84)  
Dynamic Logic (19.12.84)  
Logic of knowledge (20.12.84)**

**Vigier, Jean-Dierre - Inst. Henri Poincare, France  
Wave Particle Duality and the Principle of complementarity (15.12.84)  
Statistical interpretation of quantum mechanics (17.12.84)**

**Hari Dass, N. D. - Raman Res. Inst., Bangalore  
Lattice Gauge Theories - I & II (18.12.84 & 19.12.84)**

**Mahajan, S. M. - Physical Research Lab., Ahmedabad  
Introduction to Fusion (19.12.84)  
Alfven waves in confined plasma (20.12.84)**

**Kapoor, A. K. - University of Hyderabad, Hyderabad  
Hamiltonian Path Integrals (20.12.84)  
Exact Path Integration (21.12.84)**

**Viswanathan, K. S. - Simon Fraser Univ., Canada  
Alternate Kaluza - Klein Theories of Gravity and Supergravity - I (26.12.84)**

**Viswanathan, K. S. - Simon Fraser Univ., Canada  
Alternate Kaluza - Klein Theories of Gravity and Supergravity - II (27.12.84)**

**Sakita, B. - City College of the City Univ. of New York  
Stochastic Quantization (27.12.84)  
Large "N" Baryons and strong coupling (29.12.84)**

## **Library**

During the year 1983, 515 books and bound volumes of periodicals were added to the library. During the year 1984 (till November) 295 books and bound volumes of periodicals were added to the library.

Assistance was provided in obtaining books, journals and technical materials for the members of the faculty and students for their research work from the libraries of Indian Institute of Technology, University of Madras, Engineering College, A.C. College of Technology, Reactor Research Centre at Kalpakkam and the Tata Institute of Fundamental Research at Bombay, on an Inter-Library loan basis. Similar help was also rendered on a reciprocal basis, to other Institutions, thereby strengthening the spirit of cooperation with them.

The Library got as a gift, the back volumes (Vol. 1 to 7) of the Fibonacci Quarterly, from Dr. H. V. Krishna, Professor of Mathematics, Manipal Institute of Technology, Manipal.

A Kilburn 1600 MR plain paper copier was acquired for the Institute and is at present housed in the Library.

## **Administrative Staff**

<b>Mr. K. S. Santhanagopalan</b>	<b>Librarian</b>
<b>Mr. R. Jayaraman</b>	<b>Office Superintendent</b>
<b>Mr. S. Krishnan</b>	<b>Accountant</b>
<b>Mr. A. R. Balakrishnan</b>	<b>U.D. Typist</b>
<b>Mr. P. Chellakrishnan*</b>	<b>Typist</b>
<b>Mr. R. Ganapathy</b>	<b>P.A. to Director</b>
<b>Miss. M. Gayatri*</b>	<b>Temporary Typist</b>
<b>Mr. N. S. Sampath</b>	<b>U.D. Typist</b>
<b>Mr. T. V. Vasudevan*</b>	<b>Temporary Typist</b>
<b>Mr. G. Venkatesan</b>	<b>Junior Library Assistant</b>
<b>Mr. K. Chellakutty</b>	<b>Van Driver</b>
<b>Mr. G. Nithyanandam*</b>	<b>Car Driver</b>
<b>Mr. D. Varadarajan</b>	<b>Despatch Clerk</b>
<b>Mr. S. Muthusigamani**</b>	<b>Attender</b>
<b>Mr. M. Gangan</b>	<b>Attender</b>
<b>Mr. P. Govindan</b>	<b>Skilled Attender</b>
<b>Mr. G. Elumalai</b>	<b>Gardener</b>
<b>Mr. V. Jayaraman</b>	<b>Caretaker</b>
<b>Mr. M. Kanniappan</b>	<b>Gardener</b>
<b>Mr. M. Munuswamy</b>	<b>Peon</b>
<b>Mr. T. R. Narayanan</b>	<b>Caretaker-cum-cook</b>
<b>Mr. M. Selvaraj</b>	<b>Sweeper</b>
<b>Mr. T. Venugopal</b>	<b>Watchman</b>
<b>Mr. J. Balakrishnan*</b>	<b>Library helper</b>
<b>Mr. V. Parthiban*</b>	<b>Library helper</b>
<b>Mr. C. Rajendran*</b>	<b>Cleaner</b>
<b>Mr. E. Murthy*</b>	<b>Watchman</b>
<b>Mr. A. Murugesan*</b>	<b>Hostel-cum-Guest House Cook</b>

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\* Temporary staff.

\*\* On leave.