**CURRICULUM VITAE: 22 November 2019.**

**Dr. N.D.Hari Dass, Fellow of National Academy of Sciences**

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**Marital Status** : Married.
**Nationality** : Indian.
**Date of Birth** : 25 September 1946.
**Present Position** :

[1] **Previous Positions(India):**

[a] Visiting Professor, Tata Institute for Fundamental Research(TIFR), Hyderabad, India(Jan 2015 - July 2019)
[b] Adjunct Professor, Chennai Mathematical Institute, India(Jan 2011 - Dec 2014.)
[c] Faculty, Centre for Quantum Information & Quantum Computing, Indian Institute of Science, Bangalore, India(June 2010 - July 2015.)
[d] Visiting Professor, Tata Institute for Fundamental Research(TIFR), Hyderabad, India(Jan-June 2014)
[e] DAE Raja Ramanna Professor, Centre for High Energy Physics, Indian Institute of Science, Bangalore( Sep 2007 - Dec 2010).
[f] Director, Poornaprajna Institute of Scientific Research, Bangalore ( Sep 2007 - Feb 2010)
[g] Senior Professor, Institute of Mathematical Sciences, Chennai (July 1986 - Sep 2006)

**Academic Qualifications**

[i] PhD ( Theoretical Physics), University of California at Santa Barbara, California, U.S.A, 1971.
[ii] M Sc ( Theoretical Physics ), Delhi University, Delhi, India, 1967.
[iii] B.Sc(Honours) in Physics, Delhi University, Delhi, India , 1965.

**Professional Record**

* Visiting Scientist, Niels Bohr Institute, Copenhagen, 1 June - 5 July, 2013.
* Visiting Professor, Utrecht University, 1 Jan - 29 Feb 2012.
* Visiting Professor, Hayama Center for Advanced Studies, Hayama, Japan ( 1 Oct '06 - 31 Mar '07).
* Visiting Professor, Spinoza Institute(Utrecht University), Netherlands (Sep - Nov 2002).
* Visiting Professor, Max Planck Institute for Physics, Munich, Germany ( July - Aug 1999).
* Monbusho Visiting Professor, KEK, Japan (Aug-Dec 1998).
* Monbusho Visiting Professor, KEK, Japan (Nov 1994-Nov 1995).
* Visiting Professor, Max Planck Institute for Physics, Munich, Germany(Sept-Oct 94).
* Visiting Scientist, Niels Bohr Institute, Copenhagen, Denmark(Oct-Nov 92).
* Visiting Professor, University of Stockholm, Sweden(Sept-Oct 92).
* Visiting Professor, University of Amsterdam, Netherlands (Jan 1991-Jan 1992).
* Visiting Professor, Utrecht University, Netherlands (Sept-Oct 1989).
* Scientist, NIKHEF, Section-H, Amsterdam, Netherlands (Jan 1983-June 1986).
* Scientific Associate, CERN, Geneva, Switzerland (Sept 1982-Dec 1982).
* Research Fellow, Niels Bohr Institute, Copenhagen, Denmark (Sept 1980-Sept 1982).
* Scientist, Raman Research Institute, Bangalore, India (July 1976-July 1980).
* Research Fellow, Niels Bohr Institute, Copenhagen, Denmark (Sept 1975-July 1976).
* Guest Scientist, Max-Planck Institut fur Physik und Astrophysik, Munchen, Germany (Sept 1973-Sept 1975).
* Research Associate and Adjunct Assistant Professor, University of California at Los Angeles, California, USA (Sept 1971-Sept 1973).
* Research Assistant, University of California at Santa Barbara, California, USA (June 1968-Sept 1971).

* Teaching Assistant, University of California at Santa Barbara, California, USA (Sept 1967-June 1968).

**Professional Honours**

• Gravity Foundation Honorable Mention for the essay *A new spin test for the equivalence principle*, 1976.
• Elected Fellow of the National Academy of Sciences, Allahabad(1998).
• Recipient of the DAE Raja Ramanna Professorship(2006 - 2010).
• Invited to deliver the Popli Memorial Lectures at St. Stephen's College, Delhi, November 2007.
• Invited speaker at the International Conference to mark 100 years of the Bohr Atom, 2013, organized by the Niels Bohr Archive and the Royal Danish Academy.
• Awarded the Vaidya-Raichaudhury Endowment Lecture of the Indian Association for General Relativity and Gravitation(IAGRG) for 2019..
• Recipient of the DAE-CVRaman distinguished lecturer for 2019.

**Other Professional Activities**

• I regularly referee papers for many National(Pramana) and International Journals(Quanta,Foundations of Physics) in Physics and Mathematics(Mathematical Reviews).

• I am on the editorial board of *Quanta*.

• I regularly guide bright young students and motivated teachers as part of the Indian Academies Summer Research Programme. I have frequently given talks to High School and College students on the fundamental issues of modern physics. I have lectured in many advance schools for PhD students.

• In Jan 2005 I organised a very succesful Workshop/school on parallel computing and cluster building which was attended by 60 participants from all over India. Details can be found at www.imsc.res.in/ parapp.

• I edited the special section *Quantum Measurements* in Current Science, Vol 109, Issue 11 (2015).

**Books Published**

* *The Principles of Thermodynamics*, published by CRC Press Ltd, ISBN 978-1-4665-1208-5, 2013.

**Teaching Experience**

* Graduate Teaching Assistant for Undergraduate and Graduate Courses, University of California at Santa Barbara (1967-1968)

* Have taught undergraduate courses regularly during 1971-73 at the University of California at Los Angeles. I was judged by the students to be among the top teachers at UCLA for both these years.

* Have taught a course on Lattice Gauge Theory as a part of the academic training programme of NIKHEF, Amsterdam, during 1984.

* Have lectured on Lattice Gauge Theory during the SERC summer school on High Energy Physics held at Shantiniketan, 1987.

* Have taught full fledged graduate level advanced courses on Differential Geometry(1986), Quantum Mechanics (1997,2003), Quantum Field Theory(1990,1991,1992,1999) and Elementary Particle Physics (2001) at the Institute of Mathematical Sciences.

* Regularly taught the Integrated MSc in Physics students of Mysore University, during 2007-2010.

* Taught a course on *Relativistic Quantum Mechanics* to IIIrd year BSc(Hons) students of Chennai Mathematical Institute(2005).

* Taught a specially designed course *Quantum Electrodynamics Off the Beaten Track* to IIIrd year BSc(Hons) students of the Chennai Mathematical Institute.

* Taught the graduate level course **HE392** on *Standard Model of Elementary Particle Physics* at Indian Institute of Science, Bangalore.

* Taught a two semester course *Thermodynamics & Statistical Mechanics* during Jan-Dec 2011 to BSc(Hons) students at the Chennai Mathematical Institute.

* Taught a one semester course on *Atomic and Molecular Physics* during Aug-Dec 2012 to BSc(Hons) students at the Chennai Mathematical Institute.

* Taught a one semester course on *General Relativity* during Aug-December 2013 to BSc(Hons) students at the Chennai Mathematical Institute.

* Taught a one semester course on *Classical Electrodynamics-II* during Jan-June 2014 to PhD students at the TIFR-Hyderabad.

* Taught a one semester course on *Classical Mechanics* during Aug-Dec 2014 to PhD students at the Chennai Mathematical Institute.

* Taught a one semester course on *Appreciating Field Theory* during Jan-June 2015 to PhD students at the TIFR-Hyderabad.

* Taught a one semester course on *Advanced Mathematical Physics* during July-Dec 2015 to PhD students at the TIFR-Hyderabad.

* Taught two one-semester courses on *Classical Electrodynamics-II* and *Quantum Mechanics-II* during Jan-July 2016 to PhD students at TIFR-Hyderabad.

* Taught a one-semester course on *Quantum Mechanics-II* during Jan-June 2017 to PhD students at TIFR-Hyderabad.

* Taught a one-semester course on *Classical Electrodynamics-I* during the July-Dec 2017 to PhD students at TIFR-Hyderabads.'

* Taught a one-semester advanced course on *Quantum Thermodynamics* at TIFR-Hyderabad during Jan-June 2018.

* Taught a one-semester course on *Classical Mechanics* at TIFR-Hyderabad during July-Dec 2018.

* Taught a one-semester course on *Advanced Mathematical Physics* at TIFR-Hyderabad during Jan-June 2019.

**Some recent lectures in instructional schools/workshops**

* Gave a series of lectures on 'Quantum Measurements, Uncertainty Relations and Minimum Uncertainty' at the Summer School organized by the Centre for Quantum Information and Quantum Computing at IISc, Bangalore, May 2012.

* Gave a talk on 'Fault Tolerant Quantum Computing' at the National Seminar on Quantum Computers at Vellore Institute of Technology, Chennai Campus, 23 Feb 2013.

* Gave a set of three talks on 'How atoms reveal, and obscure, physics beyond that of their own formation' at the Karnataka Science and Technology Special Lectures for MSc students of Mysore University, 7-9 December 2015.

* Gave a set of lectures on 'Geometry and General Theory of Relativity' at University of Mysore, 31 July-4 August 2017.

* Gave a lecture on 'Introduction to quantum Measurements' at the Workshop on Quantum Foundations and Applications at IISER, Mohali, 17-19 October 2019.

* Gave a set of two lectures on Thermodynamics to B.Ed and MSc.Ed students at Regional Institute of Education, Mysore, during 24-25 October, 2019.

**Guiding Summer Students**

• I take particular interest in training undergraduate and MSc students to do original research. I have trained a very large number of summer students.

• At the Poornaprajna Institute of Scientific Research I organized two highly succesful Summer Schools for undergraduate students in Physics during the summers of 2008 and 2009.

**Computer Related Activities and Interests**

I have been working for over three decades in Lattice Gauge Theory which is a computer intensive area that numerically simulates challenging quantum field theory problems. I have been generating all the necessary programmes myself.

As part of the Xth Plan(2002-2007) activities of the Institute of Mathematical Sciences, Chennai, I undertook the challenging task of building a large scale Linux cluster for Lattice Gauge Theory Simulations. In a very short time and at fraction of the cost of supercomputers of similar performance, I have built a 288-CPU Linux cluster which has delivered a sustained performance of 1.002 Teraflops which made it **the second fastest supercomputer in India** and **the fastest in any academic/research institution** at that time of its commissioning. It was ranked 257th in the June 2004 list of Top 500 supercomputers of the world(www.top500.org) and 439th in the Nov 2004 list. It was the highest entry from a non-commercial organisation in India. It is still the only fully indigeneously built Indian Teraflop Supercomputer.

**Most Recent Research Activities**

[1] **Low energy theorems for gravitation:** In item [26] of my publications list, I had extended the low energy theorem techniques of Low, Weinberg and Schwinger to derive the Einstein quadrupole formula for gravitational radiation. As a byproduct, I had shown that Low's techniques when extended this way gave universal results for quadrupole radiation in electromagnetism too. With recent interest in the connection between such low energy theorems and the so called BMS(Bondi-Metzner-Sachs) symmetries, I am addressing the question of whether the gravitational octupole radiation is also universal.

Before this also, I had proved but not explicitly elaborated, interesting low energy theorems for parity violations in gravitation. These were discussed in item [17] but the proofs were not elaborated. There, two key results had been announced i.e i) the leading order terms in parity violations in gravitation induced by weak interactions are zero, and, ii) any evidence of fundamental parity violation in gravitation would invalidate general theory of relativity.

In view of their extreme importance, I am now formulating their detailed proofs on the one hand, and to verify them through explicit Feynman graph calculations on the other. Their implications for BMS invariance and related issues are also being investigated.

[2] **Magnetars from Strong Interactions:** With V. Soni I have proposed a model for the origin of ultra-high magnetic fields of the order of $10^{15}G$. found in Magnetars based on strong interaction phase transitions in the core. This model gives a very natural explanation for many puzzling behaviour of magnetars like the discrepancy between their spin-down and SNR ages, the fact that their magnetic fields do not decrease etc. We have identified some recently studied objects like J1846 which are in good agreement with the predictions of our model.

[3] **Numerical and analytical work on QCD-strings[97-98,101-104,106-108,111]:** a technique originally developed by Luscher and Weisz allows one to reduce variances to exponentially small values. We have developed a parallel version of this technique particularly suited to our KABRU cluster and done a very accurate study of the SU(3) QCD string in d=4.

We have been able to simulate this on the largest lattice (in physical scale) anywhere in the world. Our results have been reported at several International conferences. These have established several fundamental features about Yang-Mills flux tubes.

One of the striking results obtained by us through numerical simulations is that QCD flux tubes in $D = 3, 4$ with $SU(2), SU(3)$ gauge groups have the same dynamics as free Bosonic Strings. Luscher and Weisz had shown this to order $L^{-1}$ in string length, but we have established this to be true even to order $L^{-3}$.

My intense theoretical investigations into the problem have pointed to a very surprising result that a very large class of effective string theories may be *isospectral* to free bosonic string theory. This has attracted a lot of attention. Currently I am attempting to rederive these results, which were derived using CFT, from canonical QFT techniques. Being higher derivative theories new techniques are necessary to make further progress. I hope to get some definitive results soon.

[4] **Foundations of Quantum Mechanics:** With Tabish Qureshi [67], I showed that the protective measurements pioneered by Aharonov and others can not really provide any *Ontological* meaning even to the limited class of wavefunctions considered in that context. However, I have proposed new experiments based

on single-atom detection techniques to test a pragmatic interpretation of *Protective Measurements*. In another work I have shown that it is possible to give a *measurable statistical significance* to single unknown harmonic oscillator coherent states[85]. As a by-product I have given a new formulation of the no-cloning theorem for unknown harmonic oscillator coherent states[109,110].

Currently, I have undertaken a critical assessment of the so called *weak measurements*. In [123] I have shown that repeated weak measurements on a single copy are as invasive as projective measurements. In [127] I have shown that contrary to popular belief there is no advantage with weak measurements(over strong ) in testing Leggett-Garg inequalities. In [126], I have additionally shown that weak-value measurements are optimal in the sense of Wootters and Fields when post-selected states are mutually unbiased with respect to the pre-selected states. Yet another result announced there concerns the complex weak values as coordinates for the qubit state space(the space of density matrices). The metric has been computed and found to be conformally flat. Most recently, we have extended these results to arbitrary spins and have obtained explicit expressions for the Kaehler metrics in weak-value coordinates[136].

Additionally, I have several other results pertaining to foundational aspects of quantum measurements[89,90,91,115].

[5] **Modern perspectives on Noether's theorems:** With B. de Wit, S. Katmadas and Ivano Lodato, I am writing a comprehensive review that highlights the twin theorems of Emmy Noether, and their modern applications. The second of her theorems is relatively unfamiliar to both physicists and mathematicians. In this review we have elaborated how this second theorem has pivotal bearings for gauge theories, including the general theory of relativity, for such modern notions such as Witten's covariant phase spaces, and for some very recent applications of Wald entropies to the thermodynamics of supersymmetric black holes.

[6] **Non-equilibrium statistical mechanics of point vortex gas in two dimensions:** With Saikishan Suryanarayanan and Roddam Narasimha [117], I have investigated the mixing layer problem of fluid dynamics from the perspective of the statistical mechanics of two-dimensional point vortices. Through extensive numerical simulations motivated by analytical ideas, we have confirmed the expermentally established universality in a non-equilibrium domain, of a kind very different from universality in critical phenomena, as well as clear approach to equilibrium in the sense of Lundgren and Pointin, for late times. This work provides the statistical mechanical basis for a kind of turbulence, very different from

homogeneous and isotropic turbulence, where ordered structures actually play a dominant role.

**Other Continuing Research Interests**

[1] Foundations of Quantum Statistical Mechanics: With Sathiapalan and Kalyanarama, I have addressed the conceptual issues involved in the apparent transition of a pure state into a microcanonical distribution state. This is a quantum mechanical version of the Boltzmann H-theorem. Soon after the birth of quantum mechanics, von Neumann had addressed this issue in detail, and had proposed a quantum version of coarse graining. In [82], we have made some progress on this foundational issue with a different picture of quantum mechanical coarse graining than that of von Neumann. There are still many open issues.

[2] Numerical Simulations of Dual Lattice Gauge Theories: I have been working over the last few years in numerically implementing a proposal by Anishetty et al for a dual formulation of lattice gauge theories. This is a problem of a Markov process on constrained spaces.I have solved the problem of finding ergodic moves that never leave the constrained surface. Currently I am trying to resolve some difficulties related to an apparent lack of positivity of the Boltzmann weights. This work would also have immediate bearings on Regge-Ponzano formulation of Quantum Gravity.

[3] Further Experimental Tests for Parity and Time Reversal Violation in Gravitation: Nearly two decades ago I had proposed some simple tests for P and T violations in Gravitation. Recently, several groups have started looking for these effects using NMR-techniques. I am currently studying the use of laser cooled atom traps for the same purpose.

[4] Asymptotically free extensions of the standard model: over the last few years we have investigated the stability of asymptotically free gauge theories with fermions against inclusion of scalars. We have found a class of such theories. Surprisingly these theories naturally satisfy a variety of stringent restrictions imposed by Flavour changing neutral currents, precision electroweak parameters etc. There are many interesting phenomenological implications of these models to higgs Physics.

[5] Applications of Graph Theory to the problems of Dynamical Triangulations of Random Surfaces: I have proved an exact mapping between the problem of the partition function of a bosonic string in arbitrary dimensions regularised by dynamical triangulations and the probability distribution of the complexity of 3-regular simple graphs (completed; manuscript under preparation).

[6] Gauge Dependence in Matrix Models : I have investigated the possible gauge dependence in Matrix models of Superstrings.This work was motivated by the findings of Kawai et al whereby they found block-block interactions in IIB Matrix models to be in agreement with IIB supergravity theories.But these being off-shell quantities depend on gauge choice in general.The general problem of gauge dependence was studied by establishing Nielsen-like Identities.The issue of gauge independent effective actions within these models has also been studied.

[7] Quantum Electrodynamics Without Gauge-potentials: I have shown how QED can be reformulated in an elegant manner without ever introducing vector potentials and consequently without the need for gauge fixing(completed; manuscript under preparation. Presented at the International Symposium on Foundations of Quantum Theory at TIFR, 1997).

**Some of my most important works(in chronological order)**

[1] In 1971,immediately after my PhD I showed how to obtain, in closed form, the expression for the effective lagrangean for the interaction of photons with *odd* number of pions. This is equivalent to the so called *Wess-Zumino consistency conditions* but obtained completely independently and in a new way. The full significance of this result was realised by Witten and others nearly 15 years later.

[2] In the period 1972-1975 I, along with Schwinger's Source Theory group at UCLA, developed elegant and powerful nonperturbative methods to treat Quantum electrodynamic processes in very strong magnetic fields. Even to this day this body of work is used extensively to treat a variety of problems of astrophysical interest, particularly pulsars.

[3] In 1974 a pulsar in a binary system was discovered for the first time. The general relativistic effects in this system were the strongest ever measured. I was the first to predict in detail the effects of *Gravitational Spin Precession* in such systems thereby providing a completely new test of Einstein's General Theory of Relativity. I was also the first to provide a completely classical derivation, based on Schwinger's Source Theory, of this effect when the mass of the spinning body is comparable to that of its companion. It is of immense gratification to me that radio astronomers Hotan, Bailes and Ord have observed these effects 30 years later, in the *world year of physics* 2005.

[4] In 1975 I proposed a number of experimental tests for Quantum Effects in Gravitation, in particular for possible parity violations. Due to enormous strides in experimental techniques the effects I predicted are now being seriously investigated.

It will require further refinements in sensitivities by about an order of magnitude to probe the effects at levels anticipated by me. A positive result would mean that Einstein's general theory of relativity would not hold at the level of elementary particles.

[5] No-go theorems for de Sitter Cosmology: in a work (item [41] of the complete list of publications) that has received focussed attention from all the leading string theorists including E. Witten(hep-th/0106109), J. Polchinski and others we proved the impossibility of an accelerated universe in a number of superstring and supergravity theories. With the observation that our universe is indeed accelerating, our work has led to hectic activity and citation for our article published in 1987 has increased from initial of about 10 in a decade to 160 at present.

[6] Some years ago Sharatchandra et al had given an alternative formulation i.e dual formulation of Lattice Gauge Theories. Realising this alternative formulation in numerical simulation was a major challenge. I succeeded in setting up the structures and algorithms necessary for this. Though this was a major step many conceptual issues still remain unresolved. Items [71,75-76].

[7] Infrared effects of Goldstone Bosons: Goldstone bosons pervade all branches of physics from soft condensed matter physics to string theory. After many years of hard work we have given a uniform treatment and new insights into the singular behaviour associated with Goldstone bosons. Some of our predictions have been confirmed by International groups through very precise numerical simulations.

[8] Quantum Measurement theory: this continues to be a deep and unsolved problem in physics. Over the last decade I have been continually working on this class of problems and have elucidated in depth the nature of adiabatic (protective) measurements as well as given new prescriptions for Quantum Tomography. These results are potentially of importance to Quantum Computing also. See items [67],[72],[80],[85],[88-91] of the list of publications.

[9] Extending asymptotically free theories to include scalars and to construct phenomenologically viable alternatives to the standard model. After many years of research this problem has been settled. See items [64],[65],[73] and [81] in the publications list.

[10] Foundations of Quantum Statistical Mechanics: starting from first principles we have shown how a pure state of a quantum many body system evolves into a state that is indistinguishable from a microcanonical distribution when only macroscopic observables are used to probe the system. This is equivalent to the quantum version of the H-theorem.

[11] String formation in gauge theories: the Superstring theories of the present had their origin in the proposal that strongly interacting particles(hadrons) are states of excitations of a string. In 2002 Luscher and Weisz through numerical simulations based on a very powerful algorithm due to them showed that strings are formed between quarks and antiquarks. There has been some controversy as to the exact scale and nature of the string formation. Using our Teraflop computer KABRU and adopting the Luscher-Weisz algorithm for parallel implementation on KABRU we have done these studies on much larger lattices than anyone before and we have clearly established that string formation happens only close to 1fm and that it is a Nambu-Goto string.

[11] To explain the results of these numerical simulations I, along with my collaborators Peter Matlock and Yashas Bharadwaj have systematically developed the so called Polchinski-Strominger Effective String Theories and proved a number of very major results. The latest of such results is the striking demonstration that all such theories have the same spectrum as free bosonic string theories.

[12] Magnetars from Strong Interactions: With V. Soni I have proposed a model for the origin of ultra-high magnetic fields of the order of $10^{15}G$. found in Magnetars based on strong interaction phase transitions in the core. This model gives a very natural explanation for many puzzling behaviour of magnetars like the discrepancy between their spin-down and SNR ages, the fact that their magnetic fields do not decrease etc. We have identified some recently studied objects like J1846 which are in good agreement with the predictions of our model.

[13] Quantum Trajectories: I have carefully investigated the issues arising from repeated weak measurements on a *single* copy motivated by the foundational question as to whether states of single copy have any measurable significance. I had, in 2014, showed that repeated weak measurements on a single copy increasingly resemble strong measurements. Recently, with Rutvij Bhavsar we can put these claims on a much stronger mathematical footing.

**List of Publications**

[1] Axial Vector Divergences and the Reactions $\gamma\gamma \to$ Pions (with R. Aviv and R.F. Sawyer), Phys.Rev.Lett 26 (1971) 591.

[2] Gauge Invariance, Chiral Symmetry, and $\gamma\gamma \to$ odd number of soft pions, Phys. Rev D (1972) 1542.

[3] Gauge Invariance, Chiral Symmetry, and the decay $\eta^0 \to \pi^0\gamma\gamma$, Phys.Rev D (1973) 1548.

[4] Some Comments on the $\eta \to 3\pi$ Problem (with R.N.Madan), Nuovo Cimento Letters 7:3 (1973) 117.

[5] Compton Scattering in External Magnetic Fields-I Spin Zero Charged Particles (with K.A.Milton and L.L.De Raad), Phys.Rev D9 (1974) 1041.

[6] Compton Scattering in External Magnetic Fields-II Spin 1/2 Charged Particles (with K.A.Milton, W.Y.Tsai and L.L.De Raad), Phys.Rev D10 (1974) 299.

[7] Parity Violating Compton Amplitude in Unified Theories of Weak and Electromagnetism(with M.Bace), Annals of Physics 94:2 (1975)

[8] Compton Scattering in Strong External Electromagnetic Fields in the Proceedings of the International Symposium on the Role of Magnetic Fields in Physics and Astrophysics (New York Academy of Sciences, 1975)

[9] The New Binary Pulsar and the Observation of Gravitational Spin Precession (with V.Radhakrishnan), Astrophys.Letters 16 (1975)135.

[10] The Hulse-Taylor Pulsar and Gravitational Spin Precession in the Proceedings of the First Marcel Grossmann Meeting on General Relativity (1975)

[11] The Gravitational Two Body Problem-A Source Theory Viewpoint (with C.F. Cho), Annals of Physics 96:2 (1976)

[12] Calculation of Parity Violating Part of the Compton Amplitude (with Kwang Je Kim), Nucl.Phys B113 (1976) 336.

[13] Equivalence Principle, Stress Tensor and the Long Range Behaviour of Gravitational Interactions (with C.F.Cho), Phys.Rev D (1976) 2511.

[14] Tests for C, P, T-Nonconservation in Gravitation, Phys.Rev.Lett 36 (1976) 393.

[15] New Spin Test for the Equivalence Principle, J.Gen.Rel. and Gravitation 8 (1977) 89.

[16] Photon Decay into Neutrinoes in a Strong Magnetic Field (with K.A.Milton and L.L.De Raad), Phys.Rev D14 (1976) 3326.

[17] Experimental Tests for Some Quantum Effects in Gravitation, Annals of Physics 107:1-2 (1977) 337.

[18] On Supersymmetry, in the Proceedings of the Fourth High Energy Physics Symposium 1978 (eds.S.N.Ganguli and P.K.Malhotra)

[19] Quantum Dynamics of Black Holes, in "Gravitation, Quanta and the Universe"- Proceedings of the Einstein Centenary Symposium (eds.A.R. Prasanna and C.V. Vishveswara, Wiley Eastern Ltd. 1980)

[20] Alternative Searches for Parity Violation in Atomic Physics (with A.R.P. Rau), Phys.Lett B89 (1980) 375.

[21] Feynman Graph Derivation of Einstein Quadrupole Formula (with V.Soni), J.Phys. A15 (1982) 473.

[22] Strong Magnetic Fields, in "Quantum Electrodynamics of Strong Fields" - Proceedings of the NATO-ASI Meeting on Strong Fields (Ed.W.Greiner, Plenum Press 1983)

[23] Calculations in the Weak and Crossover Regions of SU(2) Lattice Gauge Theory (with J.Greensite, T.H.Hansson and P.G.Lauwers), Phys.Lett B105 (1981) 201.

[24] On the Theory of Direct Pair Production by Accelerated Charges, Nucl.Phys B197 (1982) 399.

[25] Some Comments on the Effect of Diffuse Gamma Radiation on Pulsars (NBI-HE-81-35)

[26] On Applications of Low Energy Theorems for Gravitational Radiation (NBI-HE-81-45)

[27] Some Approximate Calculations in SU(2) Lattice Mean Field Theory (with P.G. Lauwers), Nucl.Phys B210 FS 6 (1982) 388.

[28] The Phase Structure of $SU(N)/Z_N \otimes SU(N)/Z_N$ Spin Systems in Two Dimensions(with A.Patkos and F.Deak), Nucl.Phys B205 FS 5(1982) 414.

[29] Variational Study of the Critical Properties: The Spectrum and Phase Structure of the XY-Model(with A.Patkos), Nucl.Phys B210 FS 6(1982) 529.

[30] Improved Variational Estimates for the Mass Gap in the Two Dimensional XY-Model(with A.Patkos), Phys.Lett B119 (1982) 391.

[31] An Analytic Variational Study of the Phase Structure of Compact QED on the Lattice(with A.Patkos and P.G.Lauwers), Phys.Lett B124(1983) 387.

[32] Variational Investigations of Euclidean SU(2) Lattice Gauge Theory (with P.G. Lauwers and A. Patkos), Phys.Lett. B130(1983) 292.

[33] On the Presence of Lower Dimensional Confinement Mechanisms in 4-d SU(2) Gauge Theory (with A. Patkos and P.G. Lauwers), Phys.Lett. B136(1984) 395.

[34] On the Details of the Variational Investigations of SU(2) Euclidean Lattice Gauge Theories(with P.G. Lauwers), Nucl.Phys. B235 FS 11(1984) 535.

[35] Variational Study of $Z_2$ Lattice Gauge Theories (NIKHEF-1982) with P.G. Lauwers.

[36] Lattice Theory for Nonspecialists(NIKHEF 11/1984) -lectures given under the academic training programme( subsequently enlarged into a self contained monograph on Lattice Theory to be published by DST-SERC).

[37] On the Analytical Evaluation of the Partition Function of an Unit-hypercube in 4 Dimensions(this contains the mathematical techniques that led to the solution of the variational problem for 4-d gauge theories). NIKHEF 12/1984

[38] Variational Estimate of the Mass Gap for SU(2) Euclidean Lattice Gauge Theories-NIKHEF 13/1984.

[39] Field Theories on Lattice in Pramana(1985)

[40] On the QCD Effective Action for Pions and Vector Mesons (with M.F.L. Golterman), Nucl.Phys. B277(1986) 739.

[41] Residual Supersymmetry of Compactified d=10 Supergravity(with B.de Wit and D.J.Smit), Nucl.Phys. B283(1987) 165.

[42] On Neutrinoes from SN1987a (with D. Indumathi, A.S. Joshipura and M.V.N. Murthy), Current Science 56(1987) 575.

[43] Observational Cosmology, in "Gravitation, Quantum Fields and Superstrings", Proceedings of the UGC Instructional Conference(eds. P.M. Mathews, G. Rajasekaran and M.S. Sriram, World Scientific, Singapore, 1988).

[44] Supernova 1987a and its Implications to Neutrino Physics(with D. Indumathi, A.S. Joshipura and M.V.N. Murthy), DAE Symposium on Nuclear Physics, Vol 30A(1987) 238.

[45] The Statistical Mechanics-Particle Physics Correspondence, in "Recent Developments in Theoretical Physics", eds. E.C.G. Sudarshan, K. Srinivasa Rao and R. Sridhar(World Scientific, Singapore, 1988).

[46] Aspects of Unitarity in String Theories, in the Proceedings of the DST workshop on Particle Physics-Superstring Theory, eds. H.S. Mani and R. Ramachandran(World Scientific, Singapore, 1988).

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