

CURRICULUM VITAE OF PROFESSOR M. LAKSHMANAN

1. Name and Designation

**Prof. M. LAKSHMANAN, Ph.D., D.Sc. (h.c.), F.N.A.Sc., F.A.Sc.,
F.N.A., FTWAS**



Professor of Eminence &
DST Ramanna Fellow/
DAE Raja Ramanna Fellow
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2. Date of Birth

25 March 1946

3. a) Marital Status
b) No. of Children

Married
Two

4. Area of Specialization

Theoretical/Mathematical Physics with
special reference to Nonlinear Dynamics:
(i) Solitons and (ii) Chaos

5. Academic Qualifications:

Course	Year	Subject	Class	University
B.Sc.	1966	Physics	First	Madras
M.Sc.	1969	Physics	First	Madras
Post M.Sc.	1970	Theoretical Physics	First Rank	Madras
Ph.D.	1974	Theoretical Physics	-----	Madras
D.Sc Honaris Causa	2009	Theoretical Physics	-----	University of Burdwan

* **Thesis : Dynamics of Certain Nonlinear Systems and Field Models**
Supervisor : Professor P.M. Mathews

6. Positions held

1. Professor of Eminence, Centre for Nonlinear Dynamics, Bharathidasan University since 1 July 2006
2. DST Ramanna Fellow since 1 July 2007
3. DAE-BRNS Raja Ramanna Fellow (2006-2007; 2011-)
4. Professor and Head, Department of Physics, Bharathidasan University, Tiruchirapalli (1994-2006); Head, Centre for Nonlinear Dynamics (1992-2006)
5. Professor of Physics, Bharathidasan University, Tiruchirapali, India (July 1984 onwards)
6. Honorary Professor, S.N. Bose National Centre for Basic Sciences, Calcutta (1989-94)
7. Reader in Physics, Bharathidasan University (1982-84).
8. Reader in Physics, University of Madras Autonomous Post- Graduate Centre, Tiruchirapalli – (1978-82).
9. Post-doctoral Fellow : University of Tuebingen, W.Germany (1976-77); Eindhoven University of Technology, Holland (1977-78).
10. Research Fellow/Research Assistant, University of Madras (1970-76).

7. Long Term Fellowships/Visiting Positions held Abroad

1. Japan Society for Promotion of Science Fellowship, Kyoto University, Kyoto, **Japan** (1984-85).
2. **Swedish** Natural Science Research Council Guest Scientist (1981, March-June).
3. Royal Society and Nuffield Foundation Bursary, University of Manchester Institute of Science and Technology, **U.K.** (1979-80).
4. Alexander von Humboldt Foundation Fellow, University of Tuebingen, (1976-77); Univ. of Hanover (1982, April-May), **W. Germany**.
5. Eindhoven University of Technology, **Holland** Post-doctoral Fellow (1977-78).

8. Short term Visiting Positions Abroad/Other Institutions

1. International Centre for Theoretical Physics, Trieste, **Italy** (May-Aug. 1975; April-June 1986).
2. Institute of Theoretical Physics, University of Utrecht, **Holland** (Aug-Oct. 1975).
3. NATO Advanced Study Institute, Banff, Alberta, **Canada** (Aug. 1980).

4. Department of Mathematics, University of Melbourne/University of Adelaide, **Australia** (Feb-March 1983).
5. Centro di Cultura A. Volta, Como, **Italy** (July 1988).
6. Fudan University, Shanghai, **China** (April 1989).
7. Department of Science and Technology-USSR Academy of Sciences Long Term Programme Visitor to **USSR** (July- Aug. 1990).
8. Indian National Science Academy-Polish Academy Exchange Programme Visitor to **Poland** (Jan/Feb.1991).
9. Indo-Greek Cultural Exchange Programme Visitor to **Greece** (July 1991).
10. Visiting Scientist at Indian Institute of Science, Bangalore (June 1976); Indian Institute of Technology Madras (Feb 1982).
11. Visiting Guest Professor, at the Department of Mathematics, Pondicherry University, Pondicherry May (1988).
12. Department of Science & Technology Theoretical Physics Seminar Circuit Speaker (Six times, 1989, 1991, 1993, 1995, 1999-2000) visiting institutions at Bombay, Ahmedabad, Bhubaneshwar, Calcutta, New Delhi, Kanpur, Hyderabad, etc..
13. INSA - Royal Society Visitor to **U.K.** during Sept.-Nov.1996.
14. Indo-Finnish Cultural Exchange Programme Visitor to University of Turku, **Finland**, November 1997.
15. Swedish Natural Science Research Council Visiting Scientist, University of Uppsala, **Sweden**, May 1999.
16. INSA-Royal Netherlands Academy Visitor **Holland**, Sept. 1999.
17. Invited Speaker in numerous conferences all around the world periodically.
18. Visitor to **Ukraine/Bulgaria**, 2001.
19. Visiting Scholar, Princeton University, **U.S.A.**, May-June 2002.
20. JSPS Invitation Fellow, Osaka City University, **Osaka, Japan** 1 October – 30 November 2002.
21. Visitor, Institute of Physics, University of Potsdam, **Germany** during November 2004
22. INSA-French Academy of Sciences Visitor to **France** during 14-28, March 2005
23. Visiting Scientist, Los Alamos National Laboratory, U.S.A., May-June 2006
24. JSPS Invitation Fellow, University of Tokyo, Japan 15 July 2006 – 15 September 2006
25. Visiting Scientist, Los Alamos National Laboratory, U.S.A., August –October 2007

26. Invited Speaker in the Robin Bullough Memorial Meeting at University of Manchester, U.K. during 10-11, June 2009
27. Invited Speaker in the International Conference on “Nonlinear Evolution Equations and Dynamical Systems-2009” held at Isola Rossa, Sardinia, Italy during May 16-23, 2009
28. Invited Speaker in the SIAM Conference on “Nonlinear Waves and Coherent Structures (NW08)” was held at Rome (Italy), during 21-24 July 2008.
29. Invited Speaker at the International Conference on “Symmetry plus Integrability” held at the South Padre Island , Texas during June 10-14, 2011.
30. Invited Speaker at the Physcon-2011 conference held at Leon, Spain during September 4-8, 2011.

9. Academic Honours/Awards

1. University Grants Commission Career Award for Young Scientists (1980).
2. Raman Research Prize-Gold Medal, University of Madras (1980).
3. Best University Teacher Award (1984), Govt. of Tamil Nadu.
4. **S.S. Bhatnagar Prize in Physical Sciences (1989) (India's highest scientific prize).**
5. Member, National Board for Higher Mathematics (1989-92).
6. **Fellow of the Indian National Science Academy (1992).**
7. **Fellow of the Indian Academy of Sciences (1991).**
8. Fellow of the National Academy of Sciences, India (1989).
9. Prof. G. Sankaranarayanan Endowment Lecturer, Annamalai University (1991).
10. **Tamilnadu Scientists Award (TANSA) – 1993/94.**
11. **U.G.C. Hari Om Trust - Meghnad Saha Award in Theoretical Sciences (1990).**
12. Hari Om Ashram Prerit Shri Hari Vallabhdas Chunilal Shah Research Endowment Prize – 1996
13. **Dr. Biren Roy Memorial Lecture Award of INSA – 1998.**
14. **Foreign Member, Royal Academy of Sciences, Uppsala, Sweden (1999).**
15. Professor M.M. Thomas Endowment Lectureship Award, Bishop Moore College, Mavelikara (2001)
16. Awarded ICTP Senior Associate Fellowship, Trieste, Italy (2002-2008).

17. 76th Indian Science Congress Madurai Kamaraj University Distinguished Scientist Award (2004).

18. Dr. V. Shanmuga Sundaram Endowment Lectureship Award, Annamalai University (2005).

19. Professor Vishnu Vasudeva Narlikar Memorial Lecture Award of INSA - 2006 (Given in 2008) .

20. Goyal Prize in Physics 2005 (given in 2008) .

21. A.C. Banerjee Memorial Lecture Award of National Academy of Sciences -2007.

22. Conferred Doctor of Science (Honoris Causa) by University of Burdwan for outstanding contribution to Nonlinear Dynamics (2009).

23. Elected Fellow of the Academy of Sciences for the Developing World (FTWAS)- 2009.

10. Other Professional Activities

1. Member, Editorial Board, 1) International Journal of Bifurcation & Chaos (1991-); 2) Chaos, Solitons & Fractals (1993-2009); 3) Physics News (1994-96); 4) Journal of Nonlinear Mathematical Physics (1995 - 2010); 5) Guest Editor-in-Chief, Special issue on 'Solitons' of Chaos, Solitons & Fractals (1995); 6) Indian Journal of Physics (2002-04); 7) Proceedings of Royal Society of London A (2006 -); 8) Advances in Mathematical Physics (2009 -)

2. Reviewer in varied international journals of Theoretical/Mathematical Physics and Nonlinear Dynamics.

3. Organizer, SERC (DST) Winter School on 'Solitons' during Jan. 5-17, 1987 at Tiruchirapalli.

4. Local Secretary and Organizer of the 57th Annual Session of the National Academy of Sciences, India and the National Symposium on 'New Materials' held at Tiruchirapalli during Oct. 7-10, 1987.

5. Coorganizer, International Workshop on 'Nonlinear Evolution Equations: Integrability and Spectral Methods' held at Como, Italy during July 4-15, 1988.

6. Organizer, International Workshop on 'Symmetries and Singularity Structures of Nonlinear Dynamical Systems' at Tiruchirapalli, during Nov. 29-Dec. 2, 1989.

7. Organizer, NBHM Winter School on 'Analysis, Manifolds and Physics' held at Tiruchirapalli during Dec 20, 1992-Jan. 9, 1993.

8. Organizer, Winter School on "Integrable Systems and Low Dimensional Many Body Problems" held at Tiruchirapalli during Dec.18-23, 1995.

9. Organizer, Workshop on "Recent Developments in Chaotic Dynamics," Tiruchirapalli Dec. 9-13, 1996.

10. Organizer, International Conference on "Nonlinear Dynamics: Integrability and Chaos" to be held at Tiruchirapalli during February 12-16, 1998.

11. Invited Speaker/Given Plenary Lectures in Numerous International Conferences/Seminar all around the world.
12. Organizing Committee Member/Editor-in-Chief of Annual National Conferences on Nonlinear Systems & Dynamics (Kharagpur, 2004; Aligarh, 2005; Chennai 2006).
13. Local Organizer, 71st Annual Meeting of Indian Academy of Sciences at Trichy during November 11-13, 2005.
14. Organizing Committee Member of numerous other meetings in Nonlinear Dynamics inside and outside India.

11. Research Supervision:

Ph.D. dissertations completed	27
Working	4

12. Administrative Experience:

1. Dean, Faculty of Science, Bharathidasan University (2002-2005)
2. Head of the Department of Physics, Bharathidasan University (since 1994):
12 years
3. Head in-charge, Department of Physics, Bharathidasan University (1987-89) :
2 years
4. Head, Centre for Nonlinear Dynamics, Bharathidasan University (since 1992):
14 years
5. Member of the Syndicate, Bharathidasan University (1995-98)
6. Member of the Senate: 1987-89, since 1994
7. Member of the Standing Committee on Academic Affairs : 1993-99, 2003-
8. Convener, Disciplinary Committee, Bharathidasan University : 1995-98
9. Member, (i) Finance Committee, (ii) Staff Pattern Committee, (iii) Course Affiliation Committee, Bharathidasan University (1995-98)
10. Member, Various Committees on Course Affiliation to various Colleges/Inspection Commissions.
11. Member, Commission to evaluate the working of Cochin University of Science & Technology by the Govt. of Kerala.
12. Member, Steering Committee, State Level Entrance Examination (1996-98)
13. Chairman Board of Studies in Physics (PG); 1986-89, 1993-99, 2003-

14. Member Board of Studies in Physics, Pondicherry University, Alagappa University, Cochin University of Science & Technology, Madurai Kamaraj University, Manonmaniam Sundaranar University, University of Madras, St. Joseph's College, Seethalakshmi Ramaswamy College, Regional Engineering College, A.V.V.M. Sri Pushpam College, Poondi, A.V.C. College, Mayiladuthurai and so on at various times.
15. Member, Governing Board/Council, Bishop Heber College, Trichy, A.V.V.M. Sri Pushpam College, Poondi, Holy Cross College, Trichy, Nehru Memorial College, Puthanampatti, J.J. college, Pudukkottai
16. Member Academic Council, Regional Engineering College, St. Joseph's College, Trichy, etc.
17. Member, Selection Committees of University and College Teachers of various Universities in India and Indian Institute of Technology, Guwahati
18. Ph.D. and M. Phil. Thesis evaluation for various Universities in India and abroad
19. Member, C.S.I.R. Bhatnagar Award Selection Committee at various times
20. Member/Convener of C.S.I.R. National Level Entrance Test at various times
21. Member, National Board for Higher Mathematics (1989-92)
22. Member, Program Advisory Committee, Department of Science & Technology, Govt. of India (1996 onwards)
23. Member, Swarnajayanti Award Selection Committee of D.S.T. (1999-)
24. Member, Sectional Committee in Physical Sciences/Multidisciplinary Committee, etc. of Indian National Science Academy (1997-2000)
25. Member, TANSA Award Selection Committee (several years)
26. Convener, Madurai Local Chapter of the Indian National Science Academy, 2000-2003
27. Member, Council of Indian National Science Academy (2005-08)
28. Chairman, DST Expert Panel for Fast Track Scheme for Young Scientists in the area of Physical & Mathematical Sciences (2005-08; 2009 -)
29. Member, National Committee for International Union of Pure and Applied Physics (2007-2012)
30. Member, Inter-Academy Council Committee on DST-INSPIRE (2009)
31. Elected Council Member, Indian Academy of Sciences (2010-12).
32. Appointed Chairman, DST Fast Track Scheme for Young Scientists in Physics and Mathematical Science for 2009-11.

33. Member, Inter Academy Panel on DST INSPIRE Program.

34. Member, Science Panel, Indian Academy of Sciences (2009-11).

13. List of candidates guided/guiding for Ph.D. thesis and their present positions

I. Candidates who have completed Ph.D. thesis & their present positions:

S.No.	Name of the Ph.D. Scholar	Title of the thesis & Year	Present Position of the Scholar
1.	P. Kaliappan	Studies on the Invariances & Symmetries of Certain Nonlinear Evolution Equations (1981)	Professor of Mathematics NGM College, Pollachi (Deceased)
2.	M. Daniel	Nonlinear Excitations in the Heisenberg Ferromagnetic Spin Chain (1983)	Professor and Chair, School of Physics, Bharathidasan University Tiruchirapalli
3.	K.M. Tamizhmani	Geometrical, Group Theoretical and Singularity Structure Aspects of Certain Nonlinear Partial Differential Equations (1986)	Professor, Department of Mathematics, Pondicherry University, Pondicherry
4.	R. Sahadevan	Painleve Analysis and Integrability of Certain Coupled Nonlinear Oscillators (1987)	Professor, Ramanujam Institute for Advanced Study in Mathematics, University of Madras, Chennai
5.	S. Ganesan	Studies on Certain Nonlinear Diffusive Systems (1988)	Professor, Govt. College of Technology Coimbatore
6.	K. Porsezian	On the Nonlinear Dynamics of the Discrete and Continuum Spin Systems (1991)	Professor and Head, Department of Physics, Pondicherry University, Pondicherry
7.	S.Rajasekar	Bifurcation and Chaos in Certain Dissipative Nonlinear Dynamical Systems (1992)	Professor, Department of Physics, Bharathidasan University, Tiruchirapalli
8.	K. Ganesan	Classical and Quantum Chaos of the Hydrogen Atom in a Generalized van der Waals Potential (1993)	Professor, Department of Computer Science, Vellore Institute of Technology, Vellore
9.	S. Parthasarathy	On the Analytic Structure and Chaotic Dynamics of Certain Damped Driven Nonlinear Oscillators (1993)	Reader & Head, Department of Bio-informatics, Bharathidasan University, Tiruchirapalli
10.	K. Murali	Bifurcation, Controlling and Synchronization of Certain Nonlinear Electronic Circuits	Assistant Professor, Anna University, Chennai
11.	M. Senthilvelan	Lie Symmetries and Integrability of Certain Nonlinear Dynamical Systems (1996)	Lecturer, Centre for Nonlinear Dynamics, Bharathidasan University Tiruchirapalli

12.	R. Radha	Localized Coherent Structures in (2+1) Dimensional Soliton Systems (1996)	Lecturer, Govt. College for Women, Kumbakonam
13.	R. Radhakrishnan	Exact Coupled Optical Solitons in Fibers (1998)	Lecturer, Jamal Mohamed College, Trichy
14.	P. Muruganandam	Spatio-temporal Dynamics of Certain Discrete and Continuous Nonlinear Systems (2000)	Lecturer, Department of Physics, Bharathidasan University
15.	A. Venkatesan	Dynamics of Certain Periodically and Quasiperiodically Driven Nonlinear Oscillators: Bifurcations, Chaos and Strange Nonchaos (2000)	Lecturer, Nehru Memorial College, Puthanampatti
16.	N. Athavan	Quantum Mechanics of Two-Centre Coulomb Problem (2002)	Lecturer, Govt. Arts College, Ariyalur
17.	T. Kanna	Optical Soliton Propagation in Nonlinear Media (2003)	Lecturer, Bishop Heber College, Trichy
18.	S. Vijayalakshmi	Geometry of Spin Systems (2004)	Lecturer, Govt. Arts College, Coimbatore
19.	K. Thamilmaran	Chaos, Hyperchaos and Synchronization of Chaos (2005)	Reader, Centre for Nonlinear Dynamics, Bharathidasan University
20.	P. Palaniyandi	Controlling and Synchronization of Chaos (2006)	Lecturer, Nehru Memorial College, Puthanampatti
21.	P.S. Bindu	Symmetries, Integrability and Dynamics of certain Diffusive, dispersive and Dissipative types nonlinear physical models (2007)	Lecturer, Lady Doak College, Madurai
22.	C. Senthil Kumar	Periodic and Localized Solutions of (2+1) Dimensional Integrable Systems (2007)	Lecturer, Vivekananda university, Salem
23.	D.V. Senthilkumar	Chaotic Synchronizations and their Transitions in Nonlinear Time-delay Systems (2007)	Alexander von Humboldt post doctoral fellow, potsdam university, Germany
24.	V.K. Chandrasekar	Integrability and Linearization of Nonlinear Dynamical Systems and Applications (2007/2009)	Scientist, Centre for Nonlinear Dynamics
25.	S. Rajendran	Nonlinear dynamics of Bose-Einstein condensates with time varying control parameters (2011)	Senior Research Fellow, DST, Centre for Nonlinear Dynamics
26.	R. Gladwin Pradeep	Integrability and Nonlocal Connections of Nonlinear finite dimensional systems (2011)	Senior Research Fellow DST, Centre for Nonlinear Dynamics
27.	M. Vijayajayanthi	Collision Dynamics of Bright and dark optical solitons in (1+1) and (2+1) dimensional	Senior Research Fellow DST, Centre for Nonlinear Dynamics

II. Candidates who are working for their Ph.D. thesis:

28.	Ishaq Ahamed	Time Series Analysis	Lecturer, Jamal Mohamed College, Trichy
29.	R. Suresh	Synchronization in Time-delay Systems	Senior Research Fellow DST, Centre for Nonlinear Dynamics
30.	A. Durga Devi	Integrable Systems	Senior Research Fellow DST, Centre for Nonlinear Dynamics
31	B. Subash	Nonlinear Spin Systems	Junior Research Fellow DST, Centre for Nonlinear Dynamics

14. List of Sponsored Research Projects:

S. No	Title of the Project	Duration	Amount Rupees in lakhs	Granting Agency
1.	Nonlinear Wave Propagation in Ferromagnets	1979-82	2.0	INSA
2.	Biological Oscillators	1980-83	3.0	CSIR
3.	Differential Geometry of Soliton Systems	1980-83	2.5	UGC
4.	Nonlinear Dynamics (Career Award)	1980-83	2.5	UGC
5.	Nonlinear Excitations in Magnetic Materials	1985-89	3.0	DST
6.	Solitons	1986-89	3.0	DST
7.	Classical and Quantum Chaos in Rydberg Atoms in External Field	1990-94	4.0	CSIR
8.	Nonlinear Dynamics of Magnetic Systems: Coherent and Chaotic Structures	1990-95	6.25	DST
9.	Symmetry, Singularity Structure and Bifurcation Aspects of Certain Nonlinear Differential Equations	1994-97	2.0	DAE

10.	Establishment of a Nonlinear Dynamics Unit	1995-2002	83.0	DST
11.	Nonlinear Differential Equations of Diffusive Type : Spatio Temporal Patterns Bifurcation and Chaos	1998-2001	5.0	DAE
12.	Optical Soliton Interactions in Birefringent Fibers	2002-2005	12.0	CSIR
13.	Integrability and Nonintegrability of Nonlinear Differential Equations: Role of Symmetries and Singularity Structures	2001-2004	7.2	DAE
14.	Establishment of a Nonlinear Dynamics Unit – Phase II	2002-2007	100.12	DST
15.	DAE Project “Spatio-temporal Patterns and Localized Structures in Nonlinear Schrodinger Family of Equations in (2+1) Dimensions	2004-2007	13.0	DAE
16.	Library Grant to the Centre for Nonlinear Dynamics	From the year 1990 onwards. Annual Grant	4.30 per year	DAE (NBHM)
17.	DST Ramanna Fellowship Grant	2007-2010	40.2	DST
18.	Establishment of a Nonlinear Dynamics Unit – Phase III	2008-2013	284.00	DST
19.	DST Ramanna Fellowship project	2011-2014	33	DST

15. List of Publications:

1. Papers published in International Journals	270
2. Proceedings/General Articles	31
3. Books Published by International Publishers	9

16. A DETAILED DESCRIPTION OF SCIENTIFIC CONTRIBUTIONS OF PROF. M. LAKSHMANAN

Professor M. Lakshmanan has been one of the most versatile research workers in the field of Nonlinear Dynamics today at the international level and has contributed to the field extensively. Particularly very few people have contributed to both the fields of Solitons and Chaos, which are major constituents of Nonlinear Dynamics, on equal footing as Prof. Lakshmanan has done. His many faceted research works have enriched the subject considerably and contributed to the advancement of the general theory of solitons, integrable systems, magnetic and optical solitons, classical chaos including bifurcations, controlling, synchronization and secure communications as well as quantum chaos and spatiotemporal patterns. Further, Dr. Lakshmanan has single handedly built an active research group of international standard in Nonlinear Dynamics and established a Centre for Nonlinear Dynamics at Bharathidasan University, Tiruchirapalli, India. These contributions are well documented in the write up "A Short Resume of Professor M. Lakshmanan's Scientific Contributions" by M. Daniel, K. M. Tamizhmani and R. Sahadevan in their edited book "Nonlinear Dynamics : Integrability and Chaos", Narosa Publishing House, New Delhi (2000); Also see "Nonlinear Dynamics", M. Daniel and S. Rajasekar (Ed), Narosa, New Delhi (2009).

In the early days of his scientific career, Professor Lakshmanan (along with his Ph.D. thesis supervisor Prof. P.M. Mathews, University of Madras, India) had shown that relativistically moving objects can have apparent speeds that may exceed the velocity of light [1] (For a laudatory review see "News and Views" column of Nature 241, 423-24 (1973) by Prof. W.H. McCrea), which was able to explain the motion of certain quasars and found applications in high speed photography. His studies on the nonlinear excitations in ϕ^4 field theories [2] constitute one of the earliest significant contributions to the topic. His invention of a unique nonpolynomial oscillator [5] exhibiting amplitude dependent simple harmonic motions, the generalization of which leads to quantum mechanically solvable $SU(2) \times SU(2)$ chiral Lagrangian nonpolynomial models [10], had been used by Prof. P.W. Higgs (J. Phys. A 12, 309 (1979)) in his studies on quantum integrable constrained systems which is considered to be a precursor to the field of quantum groups.

In 1977, Professor Lakshmanan had made one of his outstanding contributions to Nonlinear Dynamics by proving that the continuum Heisenberg ferromagnetic spin system (this paper about has more than 300 citations) is a completely integrable soliton system [14], thereby leading to the notion of magnetic solitons. Since then Professor Lakshmanan's activities in Nonlinear Dynamics have touched many important topics of contemporary interest in integrable systems and chaotic dynamics as pointed out below briefly.

1. **THEORY OF SOLITONS AND INTEGRABILITY** : Professor Lakshmanan had over the years contributed significantly to the theory of solitons by bringing out the differential geometric connections, various symmetry aspects including Lie and Lie-Backlund symmetries, singularity structure behaviour and solution structures associated with soliton possessing nonlinear evolution equations. In particular he had shown how several physically important soliton equations in (1+1) and (2+1) dimensions are connected to the nonlinear dynamics of moving space curves [17, 21, 30, 34, 53,239] and moving surfaces [139, 176] and how they are related to spin systems [138,192]. These studies

have also identified new integrable inhomogeneous equations [30,53,71] and brought out the connection with linear spectral problems, conservation laws, soliton solutions and integrability [224, 231, 233, 240, 243, 244].

2. **SYMMETRIES AND SINGULARITY STRUCTURES** : Professor Lakshmanan and his students were the earliest to identify the connection between soliton equations, associated Lie symmetries [131, 140] and Painleve transcendental equations [24, 31, 40]. Further detailed analysis of generalized Lie-Bäcklund symmetries have brought out their close connection with complete integrability of soliton systems along with identification of perturbed hierarchy of integrable soliton systems [38, 43, 52]. Combining Painleve singularity structure analysis with Hirota bilinearization method, Prof. Lakshmanan and his students have successfully obtained multisoliton solutions for several (1+1) dimensional systems [57, 63, 101, 114, 115, 122] AND exponentially localized dromion solutions in (2+1) dimensions [106, 120, 126]. Very recently they have also identified a novel method to solve (2+1) dimensional integrable nonlinear evolution equations [185, 196, 213, 216, 217] based on these connections.
3. **FINITE DIMENSIONAL INTEGRABLE SYSTEMS** : Classification of integrable finite dimensional systems [50, 60, 190], including coupled nonlinear oscillators, based on Painleve singularity structure analysis and existence of generalized symmetries [89,225,226] were made and new integrable systems identified by Professor Lakshmanan and his students. Very recently they have proposed [173, 180, 181, 188, 190, 191, 193, 214, 215, 219, 221, 234] a fundamentally new method of isolating, identifying and solving integrable nonlinear systems of finite order, in terms of what is known as generalized modified Prolle-Singer approach, and showed how a large class of new integrable systems can be identified, their integrals of motion and explicit solutions obtained. Generalized linearization [188, 219] procedures have also been proposed with exciting further potentialities. A nonlocal transformation method to identify integrable nonlinear systems have been proposed [193, 241]. Amplitude independent isochronous oscillations in nonlinear systems have been identified [187, 218, 236]. Nonstandard Hamiltonian structures in dissipative dynamical systems have been pointed out [200,221], which includes the damped harmonic oscillator [200].
4. **NONLINEAR EXCITATIONS IN MAGNETIC SPIN SYSTEMS** : Starting from the above mentioned seminal contribution that the isotropic continuum ferromagnetic spin system [14] is a completely integrable solitonic system, Professor Lakshmanan and coworkers have opened up new avenues of research in nonlinear magnetic spin dynamics. The radially symmetric Heisenberg spin chain was shown to be equivalent to a generalized nonlocal nonlinear Schrödinger equation and higher dimensional spin systems were shown to take an analysable form [33] in terms of stereographic variables. The effect of Landau-Gilbert damping was shown to be formally a complex sealing of time of the undamped spin chain [49]. Using such an approach localized magnetic excitations in higher spatial dimensions [109, 138] and spatio temporal patterns arising due to Suhl's instability [179, 192] were identified. Spin torque effect in nanoferrromagnets in terms of generalized Landau-Lifshitz-Gilbert equation was explained [212,230] and dynamic and static excitations in classical discrete anisotropic Heisenberg spin chain were obtained [209].

5. **OPTICAL SOLITON INTERACTIONS AND BEC SOLITONS** : The dynamics of optical solitons in multimode fibers and photorefractive materials are governed by coupled nonlinear Schrodinger equations. Prof. Lakshmanan and his coworkers have brought out the remarkable fact that the underlying solitons undergo novel shape changing/intensity redistribution collisions [135, 153, 156, 160] corresponding to generalized linear fractional transformations. Such a possibility leads to the construction of various logic gates [164] including the universal NAND gates, through purely light-light collisions leading to the exciting possibility of all optical computers atleast in a theoretical sense in homogeneous bulk media. Very recently, Prof. Lakshmanan and his coworkers [189,204,206] have shown the remarkable fact that in multi component mixed signs of focusing and defocusing type nonlinear coefficients, signal amplification can be identified through exact shape changing soliton collisions which can become singular if certain conditions on initial conditions are violated. Higher dimensional (2+1) NLS equations of specific types also exhibit such properties [217,220]. Very many interesting solitonic structures in Bose-Einstein condensates under different conditions have been brought out [198, 224, 233, 244].
6. **BIFURCATIONS AND CHAOS** : Professor Lakshmanan and his students have brought out the detailed bifurcation routes and chaotic structures in a wide variety of nonlinear oscillators ranging from Bonhoeffer – van der Pol [64, 65], double –well Duffing-van der Pol [98, 137] , Josephson junction [72] and Fitz-Hugh-Nagumo [100, 134] oscillators, spin systems [81] to velocity-dependent nonpolynomial oscillators [130], etc. Existence, characterization and classification of various types of strange non-chaotic attractors (SNAs) in quasi- periodically forced systems [142, 149] have been demonstrated in a number of physically interesting systems. New transitions and mechanisms involving different routes such as Torus bubbling, type III intermittency, and subharmonic instability bifurcations for SNAs have been identified [149,155] in addition to the standard routes such as Heagy-Hammel, fractalization and type-I intermittency routes. Novel bifurcation routes with hyperchaotic attractors in time delay systems have also been identified [186, 195,198,209,212]. Experimental realizations [193,214] of many of these bifurcations and chaos aspects have also been made. Dynamics of several time delay systems have been elucidated and also experimentally demonstrated [313].
7. **NONLINEAR ELECTRONIC CIRCUITS** : With Murali and Chua, Prof. Lakshmanan had introduced [103, 108] the simplest nonlinear dissipative chaotic circuit (MLC circuit) as a paradigmic model for non-autonomous nonlinear dynamical systems, which is a simple nonlinear generalization of the standard series RLC circuit. A simple variant MLC circuit [152, 163] which is a generalization of the parallel RLC circuit had also been introduced. These two circuits admit almost all known bifurcations routes to chaos and can be investigated experimentally, numerically and analytically. Various other analog circuits like modified canonical Chua circuit [168] and negative conductance circuit [177,214] have also been studied for their bifurcations and chaos scenario. These circuits have been playing a pivotal role in various studies of chaotic dynamics including bifurcations, chaos, controlling and synchronization.
8. **CONTROLLING AND SYNCHRONIZATION OF CHAOS** : Various algorithms for controlling of chaos by feedback and nonfeedback methods have been critically evaluated by Lakshmanan and his group and new algorithms such as application of constant and

pulsed external forces and external noise have been suggested for controlling chaos [92, 110, 128]. Very recently with his student Palaniyandi, Prof. Lakshmanan [178, 182] had proposed a potentially very effective technique for estimation of control parameters and flow functions from chaotic time series data using control algorithms. Along with Murali, he had introduced several effective techniques [93, 104, 110, 127] such as one way coupling, compounding chaotic signals, etc. to study synchronization of chaos, transmission of analog and digital chaotic signals [133, 141], possible secure communication by multistep parameter modulation [154, 202] and so on. Very recently Senthilkumar and Lakshmanan [174, 183, 199, 203, 208, 211, 223, 225] have demonstrated the notion of different kinds of synchronization scenario such as complete, anticipatory, lag, oscillating, phase synchronizations in time delay systems. Along with Senthilkumar and Kurths, Prof. M. Lakshmanan had introduced the notion of phase in nonphase coherent hyperchaotic attractors modeled by time delay systems and studied phase synchronization in these systems [194, 208, 210]. Prof. Lakshmanan and his students have also demonstrated size induced instability [184] of synchronization manifolds in arrays of coupled nonlinear oscillators and electronic circuits and emergence of different kinds of spatio-temporal patterns [147, 207, 246] in them as a function of system size. Time delay induced synchronization and chaotic phase synchronization in such systems have been classified [225, 238, 242, 248]. Notion of mass synchronization of pathological states [245], globally clustered chimeras [235] and event related desynchronization/synchronization [228, 249] have been elucidated.

9. **QUANTUM CHAOS** : With K. Nakamura, Prof. Lakshmanan had shown [59] that for quantum bound systems whose classical versions are nonintegrable, coupled dynamical equations for energy levels and eigenfunctions with the nonintegrability parameter taken as 'time' are equivalent to a completely integrable Calogero-Moser system in (1+1) dimensions with internal complex vector space. This then allows one to develop analytical formalism for energy level distributions associated with nonintegrable and chaotic systems [90]. Quantum chaotic dynamics associated with hydrogenlike Rydberg atoms in external van der Waals type interaction [74, 84, 95] have been extensively analysed by Lakshmanan and his student Ganesan to explain the behaviour of such systems. Extensive analysis of quassiclassical dynamics associated with two center Coulomb problems [157-159] using generalized JWKB approximations had revealed the intricate properties of these systems jointly with Athavan (Ph.D. student), N. Fröman and P.O. Fröman.

Professor M. Lakshmanan has well over 270 research publications encompassing these works and has also published important reviews [257-273] and books in Nonlinear Dynamics by reputed publishers [305-313]. All these works are very well cited in the literature. He has guided about 25 students for their Ph.D. degrees. Professor Lakshmanan is well recognized nationally and internationally. He is a recipient of the India's highest scientific prize, namely S.S. Bhatnagar Prize in Physical Sciences (1989), besides several other prizes. He is an elected Fellow of all the three Indian Academies of Sciences and is also an elected Fellow/Foreign Member of Royal Society of Sciences, Uppsala, Sweden and a Fellow of the Academy of Sciences of the Developing World (TWAS). He is a recipient of several prestigious Fellowships like Alexander von Humboldt Fellowship (1976-77), Japan Society for Promotion of Science Fellowship (1984-85), JSPS Invitation Fellowships in 2002 and 2006 and Royal Society Nuffield Foundation Bursary Fellowship (1979-80), and held Visiting Scientist positions in various

countries. He was also a Senior Associate of the International Centre for Theoretical Physics, Trieste, Italy (2002-07). He is also serving/has served as a member of the Editorial Boards of prestigious journals such as Proceedings of the Royal Society London A, International Journal of Bifurcations & Chaos (World Scientific), Chaos, Solitons and Fractals (Pergamon) and Journal of Nonlinear Mathematical Physics (Lulea University, Sweden), Advances in Mathematical Physics, etc. Finally, over the years, Professor Lakshmanan had established thriving collaborative programs with established scientists around the world including Professors Martin Kruskal (Solitons), Leon Chua (Nonlinear Circuits), Robin Bullough (Solitons), Juergen Kurths (Chaos) and K. Nakamura (Quantum Chaos/Magnetic Systems) for the benefit of both sides.

Finally, one must also note that Professor Lakshmanan had done yeoman service to the cause of theoretical physics and in particular Nonlinear Dynamics in India and elsewhere by developing the Centre for Nonlinear Dynamics to international level from scratch at a remote place Tiruchirapalli in southern India. The facilities at the Centre have been availed by a large number of scientists all over the country and abroad. Professor Lakshmanan is revered as a father figure in Nonlinear Dynamics by fellow scientists in India. As a token of appreciation his former and present students, colleagues and collaborators organized a very successful International Conference on “Recent Development in Nonlinear Dynamics” in honour of Professor Lakshmanan during February 13-16, 2008 at Tiruchirapalli. The proceedings of the Conference is published by Narosa Publishers, New Delhi.

NOTE: NUMBERS IN PARANTHESIS IN THE ABOVE WRITE UP CORRESPOND TO THE SERIAL NUMBERS IN THE COMPLETE LIST OF PUBLICATIONS OF PROF. MUTHUSAMY LAKSHMANAN