AFOSR-TR- 84-0392

ANNUAL TECHNICAL REPORT

NONLINEAR WAVE PROPAGATION

AFOSR GRANT 78-3674-C

by

Mark J. Ablowitz

Department of Mathematics

and

Computer Science

Clarkson College of Technology

Potsdam, NY 13676

A1

84 05 15 243

PII Redacted

Change – effective 18 Mar 85

ADA141098

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE

REPORT DOCUMENTATION PAGE

1a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED	1b. RESTRICTIVE MARKINGS
2a. SECURITY CLASSIFICATION AUTHORITY	3. DISTRIBUTION/AVAILABILITY OF REPORT Approved for public release; distribution unlimited.
2b. DECLASSIFICATION/DOWNGRADING SCHEDULE	
4. PERFORMING ORGANIZATION REPORT NUMBER(S)	5. MONITORING ORGANIZATION REPORT NUMBER(S) AFOSR-TR- 84-0392
6a. NAME OF PERFORMING ORGANIZATION Clarkson College of Technology	6b. OFFICE SYMBOL (If applicable)
7a. NAME OF MONITORING ORGANIZATION Air Force Office of Scientific Research	
6c. ADDRESS (City, State and ZIP Code) Department of Mathematics & Computer Science Potsdam NY 13676	7b. ADDRESS (City, State and ZIP Code) Directorate of Mathematical & Information Sciences, Bolling AFB DC 20332
8a. NAME OF FUNDING/SPONSORING ORGANIZATION AFOSR	8b. OFFICE SYMBOL (If applicable) NM
9. PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER AFOSR-78-3674	
8c. ADDRESS (City, State and ZIP Code) Bolling AFB DC 20332	10. SOURCE OF FUNDING NOS. PROGRAM ELEMENT NO.: 61102F PROJECT NO.: 2304 TASK NO.: A4 WORK UNIT NO.:
11. TITLE (Include Security Classification) NONLINEAR WAVE PROPAGATION	
12. PERSONAL AUTHOR(S) Mark J. Ablowitz	
13a. TYPE OF REPORT ~~Interim~~ Final	13b. TIME COVERED FROM 1/10/82 TO 30/9/83
14. DATE OF REPORT (Yr., Mo., Day) 30 DEC 83	15. PAGE COUNT 47
16. SUPPLEMENTARY NOTATION 30 Dec 83	

17. COSATI CODES			18. SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
FIELD	GROUP	SUB. GR.	

19. ABSTRACT (Continue on reverse if necessary and identify by block number)

The essential point of view involved in this work is the continued study of certain fundamental features associated with the nonlinear wave propagation arising in and motivated by physical problems. The usefulness of the work is attested to by the varied applications, and wide areas of interest in physics, engineering and mathematics. The work accomplished involves wave propagation in fluid mechanics and nonlinear optics, multidimensional solitoins, multidimensional inverse problems, Painleve equations, long time asymptotic solutions, direct linearizations of certain nonlinear wave equations, DBAR problems, Riemann-Hilbert boundary value problems, etc.

20. DISTRIBUTION/AVAILABILITY OF ABSTRACT UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT. ☐ DTIC USERS ☐	21. ABSTRACT SECURITY CLASSIFICATION UNCLASSIFIED
22a. NAME OF RESPONSIBLE INDIVIDUAL Dr. Robert N. Buchal	22b. TELEPHONE NUMBER (Include Area Code) 767-4939
22c. OFFICE SYMBOL	

DD FORM 1473, 83 APR — EDITION OF 1 JAN 73 IS OBSOLETE.

A. Abstract

The essential point of view involved in this work is the continued study of certain fundamental features associated with the nonlinear wave propagation arising in and motivated by physical problems. The usefulness of the work is attested to by the varied applications, and wide areas of interest in physics, engineering and mathematics. The work accomplished involves wave propagation in fluid mechanics and nonlinear optics, multidimensional solitons, multidimensional inverse problems, Painlevé equations, long time asymptotic solutions, direct linearizations of certain nonlinear wave equations, DBAR problems, Riemann-Hilbert boundary value problems etc.

(1) Research Objectives

The continuing theme of the work performed under this grant has been the study of nonlinear wave propagation associated with physically significant systems. The work has important applications in fluid dynamics (e.g. long waves in stratified fluids), nonlinear optics (e.g. self-induced transparency, and self-focussing of light), and mathematical physics as well as important consequences in mathematics. Individuals working with me and hence partially associated with this grant include: Dr. Thanassios Fokas, Associate Professor of Mathematics and Computer Science, Dr. Adrian Nachman, Visiting Assistant Professor of Mathematics, Dr. Chris Cosgrove, Assistant Professor of Mathematics and Computer Science, Dr. Daniel Bar Yaacov, postdoctoral fellow in Mathematics and Computer Science and Mr. Ugurhan Mugan, graduate student in Mathematics and Computer Science. Attached please find the technical section of our recent proposal to A.F.O.S.R. In this proposal many of the main directions and results are outlined. Also attached please find the vitae of Ablowitz, Fokas, Nachman, Cosgrove and Bar Yaacov.

Areas of Study Include:

- Solutions of nonlinear multidimensional systems
- Inverse problems, especially in multidimensions
- DBAR methodology
- Riemann-Hilbert boundary value problems
- Solitons in multidimensional systems
- IST for nonlinear singular integro-differential equations; e.g. the Benjamin-Ono equation and the Intermediate Long Wave Equation
- Discrete IST and numerical simulations
- Long time asymptotic solutions of nonlinear evolution equations
- Painlevé equations
- Focussing singularities in nonlinear wave propagation
- Applications to surface waves, internal waves, shear flows, nonlinear optics, S.I.T., relativity etc.
- Direct linearizing methods for nonlinear evolution equations

Recent publications of M.J. Ablowitz supported by this research grant include the following:

1. **The Evolution of Multi-Phase Modes for Nonlinear Dispersive Waves, M.J. Ablowitz and D.J. Benney, Studies in Applied Mathematics, Vol. 49, p. 225, 1970.**
2. **Applications of Slowly Varying Nonlinear Dispersive Wave Theories, M.J. Ablowitz, Studies in Applied Mathematics, Vol. 50, p. 329, 1971.**
3. **Approximate Methods for Obtaining Multi-Phase Modes in Nonlinear Dispersive Wave Problems, M.J. Ablowitz, Studies in Applied Mathematics, Vol. 51, p. 17, 1972.**
4. **Semi-resonant Interactions and Frequency Dividers, M.J. Ablowitz, B.A. Funk and A.C. Newell, Studies in Applied Mathematics, Vol. 52, p. 51-74, 1973.**
5. **The Decay of the Continuous Spectrum for the Korteweg-deVries Equation, M.J. Ablowitz and A.C. Newell, Journal of Mathematical Physics, Vol. 14, p. 1277, 1973.**

6. Method of Solution for the Sine-Gordon Equation, M.J. Ablowitz, D.J. Kaup, A.C. Newell and H. Segur, Phys. Rev. Lett., 30, p. 1262, 1973.

7. Nonlinear Evolution Equations of Physical Significance, M.J. Ablowitz, D.J. Kaup, A.C. Newell and H. Segur, Phys. Rev. Lett., 31, p. 125, 1973.

8. Nonlinear Dispersive Waves and Multi-phase Modes, M.J. Ablowitz, Proc. of 1971 Summer Conference on Nonlinear Waves at Clarkson College, Editor: A.C. Newell, p. 127, 1974.

9. Coherent Pulse Propagation, A Dispersive Irreversible Phenomenon, M.J. Ablowitz, D.J. Kaup, and A.C. Newell, J. of Mathematical Phys., 11, p. 1852, 1974.

10.* The Inverse Scattering Transform-Fourier Analysis for Nonlinear Problems, M.J. Ablowitz, D.J. Kaup, A.C. Newell and H. Segur, Studies in Applied Mathematics, 53, p. 249, 1974.

11. Nonlinear Differential-Difference Equations, M.J. Ablowitz and J.F. Ladik, J. Mathematical Physics, 16, p. 598, 1975.

12. A Note on Resonance and Nonlinear Dispersive Waves, M.J. Ablowitz, Studies in Applied Mathematics, 54, p. 1, 1975.

13. The Inverse Scattering Transform-Semi-Infinite Interval, M.J. Ablowitz and H. Segur, J. Mathematical Physics, 16, p. 1054, 1975.

14. Resonantly Coupled Nonlinear Evolution Equations, M.J. Ablowitz and R. Haberman, J. Math. Phys., 16, p. 2301, 1975.

15. Nonlinear Evolution Equations - Two and Three Dimensions, M.J. Ablowitz R. Haberman, Phys. Rev. Lett., 35, p. 1185, 1975.

16. Asymptotic Evolution and Conservation Laws for the Nonlinear Schrodinger Equation I, H. Segur and M.J. Ablowitz, J. Math. Phys., 17, p. 710, 1976.

17. Nonlinear Differential-Difference Equations and Fourier Analysis, M.J. Ablowitz and J.F. Ladik, J. Math. Phys., 17, p. 1011, 1976.

18. A Nonlinear Difference Scheme and Inverse Scattering, M.J. Ablowitz and J.F. Ladik, Studies in Applied Math., 55, p. 213, 1976.

19. On the Solution of a Class of Nonlinear Partial Differential Equations, M.J. Ablowitz and J.F. Ladik, Studies in Applied Math., 57, pp. 1-12, 1977.

20. Nonlinear Evolution Equations - Continuous and Discrete, M.J. Ablowitz, SIAM Review, Vol. 19, No. 4, 1977.

21. Asymptotic Solutions of the Korteweg-deVries Equation, M.J. Ablowitz and H. Segur, Studies in Applied Math., 57, pp. 13-44, 1977.

*. This has been judged a citation classic by Current Contents (see Current Contents June 7, 1982, Vol. 13, No. 23).

22. Exact Linearization of a Painleve Transcendent, M.J. Ablowitz and H. Segur, Phys. Rev. Lett., Vol. 38, No. 20, p. 1103, 1977.

23. Solitons and Rational Solutions of Nonlinear Evolution Equations, J. Math. Phys., 19, pp. 2180-2186, 1977.

24. Lectures on the Inverse Scattering Transform, M.J. Ablowitz, Stud. in Appl. Math., 58, pp. 17-94, 1978.

25. The Inverse Scattering Transform - Continuous and Discrete and its Relationship with Painleve Transcendents, M.J. Ablowitz, Research Notes in Mathematics, 26, pp. 9-32, 1978, Pitman Publ.

26. Nonlinear Evolution Equations and Ordinary Differential Equations of Painleve Type, M.J. Ablowitz, A. Ramani and H. Segur, Lett. al Nuovo Cimento, 23, pp. 333-338, 1978.

27. Note on Miura's Transformation, M.J. Ablowitz, M.D. Kruskal and H. Segur, J. Math. Phys., 20, p. 999, 1979.

28. On the Evolution of Packets of Water Waves, M.J. Ablowitz, and H. Segur, J. Fluid Mech., 92, p. 691, 1979.

29. Explicit Solutions of Fisher's Equations for a Special Wave Speed, M.J. Ablowitz and A. Zeppetella, Bulletin of Math. Bio., Vol. 41, No. 6, pp. 835-840, 1979.

30. Transverse Instability of One-Dimensional Transparent Optica Pulses in Resonant Media, M.J. Ablowitz and Y. Kodama, Phys. Lett., 70A, p. 83, 1979.

31. Two-dimensional Lumps in Nonlinear Dispersive Systems, J. Satsuma and M.J. Ablowitz, J. Math. Phys., 20, p. 1496, 1979.

32. Resonant Nonlinear Vibrations in Continuous Systems, M.J. Ablowitz, A. Askar, A.S. Cakmak, H. Engin, Int. J. Nonlinear Mechanics, Vol. 14, pp. 223-233, 1979.

33. Resonant Nonlinear Vibrations in Continuous Systems II, H. Engin, M.J. Ablowitz, A. Askar, A.S. Çakmak, Int. J. Nonlinear Mechanics, Vol. 14, pp. 235-246, 1979.

34. On Solutions to the Korteweg-deVries Equation, M.J. Ablowitz and H. Cornille, Phys. Lett., 72A, p. 277, 1979.

35. On an Internal Wave Describing a Stratified Fluid with Finite Depth, J. Satsuma, M.J. Ablowitz, Y. Kodama, Phys. Lett., 73A, No. 4, October, 1979.

36. Solitary Wave Collisions, M.J. Ablowitz, M.D. Kruskal, J.F. Ladik, SIAM J. Appl. Math., Vol. 36, No. 3, pp. 428-437, 1979.

37. Solitons, Solutions of Nonlinear Evolution Equations and the Inverse Scattering Transform, M.J. Ablowitz, Math. Methods & Appl. of Scatt. Theory, Eds. De Santo, Saenz and Zachary, Springer-Verlag, Vol. 130 Lect. Notes in Physics, 1980.

38. A Connection Between Nonlinear Evolution Equations and Ordinary Differential Equations of P-Type I, M.J. Ablowitz, A. Ramani and H. Segur, J. Math. Phys., 21, pp. 715-721, April, 1980.

39. A Connection Between Nonlinear Evolution Equations and Ordinary Differential Equations of P-Type II, M.J. Ablowitz, A. Ramani and H. Segur, J. Math. Phys., 21, pp. 1006-1015, May, 1980.

40. Transverse Instability of Breathers in Resonant Media, Y. Kodama and M.J. Ablowitz, J. Math. Phys., 21, pp. 921-931, 1980.

41. A Comparison Between Finite Element Methods and Spectral Methods as Applied to Bound State Problems, M. Duff, H. Rabitz, A. Askar, A. Cakmak and M.J. Ablowitz, J. Chem. Phys., 72 (3), pp. 1543-1559, 1980.

42. Long Internal Waves of Great Depth, M.J. Ablowitz and H. Segur, Stud. Appl. Math., Vol. 62, pp. 2149-262, 1980.

43. Solutions of an Internal Wave Equation Describing a Stratified Fluid with Finite Depth, J. Satsuma and M.J. Ablowitz, Proceedings of Nonlinear Partial Differential Equations in Engineering & Applied Science, edited by R.L. Sternberg, A.J. Kalinowki and J.S. Papadakis 397 (Marcel Dekker, Inc., New York, 1980).

44. Nonlinear Wave Propagation, M.J. Ablowitz, published in Encyclopedia of Physics, pp. 663-664, 1981.

45. Remarks on Nonlinear Evolution Equations and Ordinary Differential Equations of Painleve Type, by M.J. Ablowitz, Proc. Conf. on Solitons held in Kiev, U.S.S.R., September, 1979, as part of a Joint U.S. U.S.S.R. Academy of Sciences agreement, Physica 3D, 1 & 2, pp. 129-141 1981.

46. Finite Perturbations and Solutions of the Korteweg-deVries Equation, H. Airault and M.J. Ablowitz, C.R. Acad. Sc. Paris, 6292, pp. 279-281, 1981.

47. The Nonlinear Intermediate Long Wave Equation: Analysis and Method of Solution, Y. Kodama, J. Satsuma and M.J. Ablowitz, Phys. Rev. Lett., Vol. 46, 11, pp. 687-690, 1981.

48. Linearization of the KdV and Painleve II Equations, A.S. Fokas and M.J. Ablowitz, Phys. Rev. Lett., Vol. 47. No. 16, pp. 1096-1100, October, 1981.

49. Perturbations of Solitons and Solitary Waves, Y. Kodama and M.J. Ablowitz, Stud. Appl. Math., 64, pp. 225-245, 1981.

50. The Periodic Cubic Schrodinger Equation, Y.C. Ma and M.J. Ablowitz, Stud. Appl. Math., 65, pp. 113-158, 1981.

51. Remarks on Nonlinear Evolution Equations and the Inverse Scattering Transform, M.J. Ablowitz, Nonlinear Phen. in Physics & Biology, pp. 83-94 (Edited by R.H. Enns, B.L. Jones, R.M. Miura and S.S. Rangnekar, Plenum Publ. Corp., 1981).

52. Direct Linearization of the Korteweg-deVries Equation, A.S. Fokas and M.J. Ablowitz, AIP Conference Proceedings, No. 88, Mathematical Methods in Hydrodynamics and Integrability in Dynamical Systems, pp. 237-241, La Jolla Institute 1981, (edited by M. Tabor and Y.M. Treve).

53. A Direct Linearization Associated with the Benjamin-Ono Equation, M.J. Ablowitz and A.S. Fokas, AIP Conference Proceedings, No. 88, Mathematical Methods in Hydrodynamics and Integrability in Dynamical Systems, pp. 229-236, La Jolla Institute 1981, (edited by M. Tabor and Y.M. Treve).

54. A Significant, Coherent Nonlinear Phenomenon, M.J. Ablowitz and A.S. Fokas, Clarkson Innovations 1 (4) 1981.

55. Note on Asymptotic Solutions of the Korteweg-deVries Equation with Solitons, Stud. Appl. Math., 66, pp. 159-170, 1982.

56. Direct and Inverse Scattering Problems of Nonlinear Intermediate Long Wave Equations, Y. Kodama, M.J. Ablowitz and J. Satsuma, J. Math. Phys., Vol. 23, No. 4, pp. 564-576, 1982.

57. On the Periodic Intermediate Long Wave Equation, M.J. Ablowitz, A.S. Fokas, J. Satsuma and H. Segur, J. Phys. A, Math. Gen. 15, pp. 781-786, 1982.

58. On a Unified Approach to Transformations and Elementary Solutions of Painleve Equations, A.S. Fokas and M.J. Ablowitz, J. Math. Phys., 23, (11) 1982.

59. On the Inverse Scattering and Direct Linearizing Transforms for the Kadomtsev-Petviashili Equation, A.S. Fokas and M.J. Ablowitz, Phys. Lett., A 94, pp. 67, 1983.

60. The Direct Linearizing Transform and the Benjamin-Ono Equation, M.J. Ablowitz, A.S. Fokas and R.L. Anderson, Phys. Lett. A, 93, pp. 375, 1983.

61. The Inverse Scattering Transform for the Benjamin-Ono Equation - A Pivot to Multidimensional Problems, A.S. Fokas and M.J. Ablowitz, Stud. Appl. Math., 68, No. 1, 1983.

62. On a Backlund Transformation and Scattering Problem for the Modified Intermediate Long Wave Equation, J. Satsuma, T.R. Taha, M.J. Ablowitz, I.N.S. #12 preprint, 1982.

63. On Analytical and Numerical Aspects of Certain Nonlinear Evolution Equations, Part I: Analytical, T.R. Taha and M.J. Ablowitz, I.N.S. #14 preprint, 1982.

64. On Analytical & Numerical Aspects of Certain Nonlinear Evolution Equations, Part II: Numerical Nonlinear Schrodinger Equation, T.R. Taha and M.J. Ablowitz, I.N.S. #15 preprint, 1982.

65. On Analytical and Numerical Aspects of Certain Nonlinear Evolution Equations, Part III: Numerical, Korteweg-deVries Equation, T.R. Taha and M.J. Ablowitz, I.N.S. #16 preprint, 1982.

66. On the Inverse Scattering of the Time Dependent Schrodinger Equations and the Associated KPI Equation, A.S. Fokas and M.J. Ablowitz, to appear in Stud. in Appl. Math. I.N.S. #22 preprint, 1982.

67. On the Inverse Scattering Transform for the Kadomtsev-Petviashvili Equation, M.J. Ablowitz , D. Bar Yaacov and A.S. Fokas, to appear in Stud. in Appl. Math. I.N.S. #21 preprint, 1982.

68. Comments on the Inverse Scattering Transform and Related Nonlinear Evolution Equations, M.J. Ablowitz and A.S. Fokas, I.N.S. #25 preprint, to appear in the monograph: "Nonlinear Phenomena" ed. B. Wolf, December, 1982.

69. Lectures on the Inverse Scattering Transform for Multidimensional (2+1) Problems, A.S. Fokas and M.J. Ablowitz, I.N.S. #28 preprint, to appear in the monograph: "Nonlinear Phenomena" ed. B. Wolf, December, 1982.

70. On the Inverse Scattering Transform of Multidimensional Nonlinear Equations Related to First Order Systems in the Plane, A.S. Fokas and M.J. Ablowitz, I.N.S. #24, Submitted to J. Math. Phys., January 1983.

71. On the Limit from the Intermediate Long Wave Equation to the Benjamin-Ono Equation, P. Santini, M.J. Ablowitz and A.S. Fokas, I.N.S. #30 preprint, February, 1983, sub. to J. Math. Phys.

72. On a Method of Solution for a Class of Multidimensional Nonlinear Evolution Equations, A.S. Fokas and M.J. Ablowitz, Phys. Rev. Lett. Vol. 51, No. 1, pp. 7-10, July 1983.

73. On the Initial Value Problem of the Second Painleve Transcendent, A.S. Fokas and M.J. Ablowitz, I.N.S. #31, April 1983, to be publ. Comm. Math. Phys.

74. Direct Linearization of Certain Classes of Nonlinear Evolution Equations, P. Santi M.J. Ablowitz and A.S. Fokas.

75. Linear Operator and Conservation Laws for a Class of Nonlinear Integro-differenti Equations, I.N.S. #34, A. Degasperis and P. Santini.

76. Direct Linearization of a Class of Nonlinear Evolution Equations, I.N.S. #35, P. Santini, M.J. Ablowitz and A.S. Fokas.

Renewal of Research Funding

Submitted to

Air Force Office of Scientific Research

Nonlinear Wave Propagation

Principal Investigator

Mark J. Ablowitz

Professor of Mathematics

and

Computer Science

Clarkson College of Technology

Potsdam, New York 13676

Phone: Office: 315-268-2395

Home: 315-265-4877

Index

0. Forward

The main purpose for the continuation of this reasearch funding is to support the work presently being carried out by Professor Mark J. Ablowitz, and his associates, in the Mathematics and Computer Science Department at Clarkson College of Technology. The principal investigator has been working in the general area of nonlinear wave propagation for over ten years. The scope of the work is broad, although it has as its principal focus the understudying of nonlinear phenomena connected with the wave propagation which arise in physical problems. In recent years significant breakthroughs have been made and this area of research is of current interest to mathematicians, physicists, and engineers alike. During past years the active research funds allowed us to support Dr. Thanassios Fokas, Dr. Chris Cosgrove, Dr. J. Satsuma, Dr. A. Nakamura and Dr. D. Bar Yaacov as collaborative faculty and postdoctoral Research Associates at Clarkson. All of these people have expertise in this field of research and have been valuable assets to our research program.

The proposal is divided as follows. In the first section an abstract of the research is given. In the second section we give a report of current and proposed research. The third section gives references; the fourth section contains curriculum vitaes of the principal investigator and his close associates, and the fifth section contains a proposed budget for two years.

1. Abstract

In recent years important advances in the study of nonlinear wave phenomena have occurred. These advances have allowed researchers to begin to understand some of the fundamental building blocks associated with nonlinear waves as well as being able to obtain solutions to a number of nonlinear evolution equations. We feel that it is important to recognize that these studies are generi in nature and apply to numerous physical problems. Examples are the propagation o1 long waves in stratified fluids, self-focussing in nonlinear optics, self-induced transparency, water waves, plasma physics, relativity etc.

In the period of time mentioned above, both approximate and exact methods of solution to problems of physical significance have emerged. Especially significant amongst the exact methods of analysis is what we shall refer to as the Inverse Scattering Transform and the associated concept of the soliton. This method has found applications to physics, engineering and mathematics alike. The results already obtained, and the wide ranging interest in these problems have motivated our work. In this proposal we discuss some of the research problems which we are particularly interested in.

2. Current and Proposed Research

Since this research began to be supported by the Air Force Office of Scientific Research, we have actively studied a number of problems in nonlinear wave theory. In what follows we shall list some of the areas which we have studied along with the principal results and future directions.

(a) Development of the Multidimensional Inverse Scattering Transform.

During the past year we have made important progress. Namely we have developed a viable technique to effect the Inverse Scattering Transform (I.S.T.) for a class of physically interesting nonlinear evolution equations in "two plus one dimensions".

Special cases include:

(i) The Kadomtsev-Petviashvili equation:

$$(u_t+6uu_x+u_{xxx})_x + \sigma_1 u_{yy} = 0, \quad \sigma_1 = \pm 1 \qquad (1)$$

(ii) The Davey-Stewartson equation:

$$iA_t-\sigma_1 A_{xx}+A_{yy} = \sigma_2 A|A|^2+2\sigma_1\sigma_2\Phi A$$

$$\sigma_1\Phi_{xx}+\Phi_{yy} = -(|A|^2)_{xx} \quad , \sigma_1=\pm 1, \ \sigma_2=\pm 1 \qquad (2)$$

(iii) The 3-Wave Interaction equations:

$$u_{it}+c_{ix}u_{ix}+c_{iy}u_{iy} = \gamma_i u_j u_k, \qquad (3)$$

$i,j,k = 1,2,3$ permuted, c_{ix}, c_{iy}, γ_i are constant.

These equations arise in a number of physical problems e.g. water waves, internal waves, plasma physics etc. (see for example Ref.1-4). Recently we have shown [5,6,7] that there is a broad extension of the well known ideas in one plus one dimensions which has allowed us to solve these systems. It should, of course, be noted that some earlier work, especially related to equations (1) [8] and equation (3) [9] had been undertaken. However general procedures to handle these as well as other two plus one dimensional equations were not developed, nor were the Lump type solutions (i.e. multidimensional solitons, decaying in all direction incorporated into the analysis.

Our methods show how Riemann-Hilbert boundary value methods and an associ ed technique, the so-called "$\bar{\partial}$" DBAR method, can be used to formulate integral equations which serve to linearize and thereby solve the associated nonlinear evolution equations. We are able to capture the lump solitons and give them a spectral characterization. Previously the special soliton solutions, outside the framework of the initial value problem, had been found [10] by direct methods.

It is our opinion that this new work is significant, for it shows that (a) a class of multidimensional nonlinear wave problems can indeed be solved via I.S.T. (b) a number of new methods and concepts have emerged during this study. I the future we intend to consider other physically interesting multidimensional problems, develop an even broader theory, and tackle certain "three plus one dimensional" nonlinear wave equations.

(b) A Class of Physically Significant Singular Nonlinear Integro-Differential Equations.

Recently we have applied the I.S.T. to a class of nonlinear singular integro-differential equations. One particular physical application is long internal gravity waves in a stratified fluid. In fact there have been a number o recent discoveries of soliton type phenomena for internal waves in the ocean. These studies have been reported in Scientific American [11], Physics Today [12] and the New York Times [13]. However both the way in which it arises, and the relevant mathematics strongly suggest that many other applications will be found as well. In fact it has been shown that there are applications to shear flow problems [14].

The specific equation we have considered is:

$$u_t+2uu_x+T(u_{xx})+\frac{1}{\delta}u_x = 0 \tag{4}$$

where

$$T(u) = \fint_{-\infty}^{\infty}\left(-\frac{1}{2\delta}\right)\coth\left(\frac{x-\xi}{2\delta}\right)u(\xi)d\xi.$$

$\fint_{-\infty}^{\infty}$ represents the principal value integral and δ is a parameter. References [15,16] discuss the derivation of (4) in the context of internal waves. As $\delta\to 0$ we have the KdV equation

$$u_t+2uu_x+\frac{\delta}{3}u_{xxx} = 0, \tag{5}$$

whereas if $\delta\to\infty$ we have the so-called Benjamin-Ono equation

$$u_t+2uu_x+H(u_{xx}) = 0, \tag{6}$$

where $H(u) = \frac{1}{\pi}\fint_{-\infty}^{\infty}\frac{u(\xi)}{\xi-x}d\xi$ is the Hilbert transform of u.

Thus equation (4) contains as limiting forms both the KdV and Benjamin-Ono equations. The fact that (4) has multisoliton solutions ([17,18]) suggested to us that indeed (4) may be solvable by the Inverse Scattering Transform (I.S.T.). In fact w[illegible] ve found [19], [20] a Bäcklund Transformation, a generalized Miura Transformati[illegible] [illegible]n and rational solutions, interesting dynamical systems and a <u>new type of s[illegible] problem</u>. This scattering problem is given by the equat[illegible]

$$i\psi_x^+ + (u-\lambda)\psi^+ = u\psi^- \tag{7}$$

where u satisfies equation (1), and $\psi^{\pm}$ are the boundary values of a function analytic in the strips $o<\text{Im}x<2\delta$ for ψ^{+}, $-2\delta<\text{Im}x<o$ for ψ^{-}, and periodically extended. Specifically, equation (4) is a differential Riemann-Hilbert problem. When λ,μ are given by

$$\lambda = -k\coth 2k\delta, \qquad \mu = k\,\text{cosech}\,2k\delta,$$

and $\psi^{-}(x) = \psi^{+}(x+2i\delta)$ (by periodicity) we find that in the limit we have the Schrödinger scattering problem

$$\psi_{xx}+(k^2+u/\delta)\psi = 0 \qquad (8)$$

which is the linear scattering problem associated with the KdV equation (2).

Despite the fact that (7) is a totally new type of scattering problem we were nevertheless able to develop [21] the necessary I.S.T. Viewed as a Riemann-Hilbert boundary problem (7) bears many similarities to the I.S.T. associated with the classical Korteweg-deVries equation, i.e. the I.S.T. reduces to solving a Riemann-Hilbert problem with a "shift". A certain discrete symmetry relation yields this shift. On the other hand when $\delta\to\infty$ we have just shown [22] that the Riemann-Hilbert problem becomes nonlocal. Specifically the discrete symmetry relation becomes continuous, and this gives rise to the nonlocality of the Riemann problem. Moreover we have been able to demonstrate how one can find the solution of the Benjamin-Ono equation ($\delta\to\infty$) by taking the suitable limit of the intermediate equation (δ finite) [23]. It is significant to note that the Benjamin-Ono equation bears many similarities to the multidimensional problem, especially the Kadomtsev-Petviashvili equation. We discuss many of these ideas in recent review papers [24].

Finally, it should be pointed out that we feel that there are other significant nonlinear singular integro-differential evolution equations which should fall into similar categories such as those discussed above. One such example is the so-called Modified Intermediate Long Wave equation. This equation is related to

(4) via a Miura Transformation [25]. We shall continue to investigate such possibilities in the future.

(c) Transverse Instability of One Dimensional Transparent Optical Pulses in Resonant Media.

It is well known that ultrashort optical pulses may propagate coherently without attenuation in certain resonant media [26,27]. This phenomena is commonly referred to as Self-Induced Tranparency (S.I.T.) and has been intensively studied experimentally, numerically, and analytically by numerous researchers, motivated at least in part, by significant potential applications. From a mathematical point of view the one dimensional equations of S.I.T are very special. Namely, it has been shown that these equations can be fully integrated by the use of the Inverse Scattering Transform [28,29]. Specifically, the above analysis has shown that arbitrary initial values break up into a sequence of coherent pulses, which do not decay as they propagate, plus radiation which rapidly attentuates. These coherent pulses are referred to as solitons.

There are various types of solitons [26,27]; e.g. "2π pulses" ("hyperbolic secant pulses"), "$o\pi$ pulses" ("breathers") etc. In our paper, "Transverse Instability of One-Dimensional Transparent Optical Pulses in Resonant Media", [30] we have shown analytically, that the 2π pulse is, in fact, unstable to certain transverse variations (i.e. multidimensional perturbations). These results are consistent with numerical and experimental studies on the transverse effects in S.I.T. [31,32]. The latter work has shown that transverse variations can lead to frequency-amplitude modulations and in some cases self-focussing filaments. Similarly in [33] we have recently been able to show that the breather solution ($o\pi$ pulse) is also unstable to long transverse perturbations. Mathematically speaking, this work was difficult because the earlier analysis had to be much further developed. We point out that this analytical stability calculation is on a mode which is much more complicated than a permanent travelling wave (i.e. a simple soliton 2π pulse). In the future we wish to examine the stability of a double pole solution (i.e. a limiting form of a breather solution just before it breaks up into a two soliton state) as well as attempting to more fully understand both the properties of the two dimensional model, as well as looking for multi-dimensional soliton solutions in analogy with the lump solutions discussed in (a) above.

(d) Perturbations of Solitons and Solitary Waves.

The above work on transverse stability of solitons in S.I.T. led us naturally to the problem of adding general weak perturbations to equations which admit solitons or solitary waves as special solutions (both in one and more than one dimension). Some of the mathematical machinery was already in place due to the work done in part (b) described above. We have found [34] that, generally speaking, such perturbation problems can be successfully handled by more or less well known perturbation methods. We have compared our results to some of those in the literatu which employ the Inverse Scattering Transform (see for example [35-37]. One advantage of our technique is, that it also applies to problems which are not necessa integrable and hence I.S.T. will not apply.

Our analysis, shows in some detail, that there is quite different phenomena occurring in different regions of space. Namely near the peak of the soliton, we have adiabatic motion of the soliton (or solitary wave). Away from the soliton a linear W.K.B. theory applies. The results are asymptotically matched in order to obtain a uniformly valid theory. To our knowledge this theory is the first such uniformly valid calculation of a perturbation of a soliton or solitary wave. Previous theories were valid in limited regions of space only.

By examining other equations admitting solitary wave solutions (i.e. ones which are not solvable by I.S.T.) we believe that we have discovered a new class of equations which have focussing singularities, (namely, equations which have certain solutions which are "nice" initially, but blow up in a finite time).

For example, we have discovered evidence that strongly indicates that the following equation is in this class:

$$u_t+u^p u_x+u_{xxx} = 0 \qquad (9)$$

for p>4. We hope to continue to investigate such questions in the future. These questions are of both mathematical and physical interest.

(e) On a linearization of the Korteweg-deVries (KdV) and Painlevé II (P_{II}) Equations

Recently we have discovered an alternative linear integral equation which, in principle, allows one to capture a far larger class of solutions to KdV than does the Gel'fand-Levitan equation. Specifically we have shown by direct calculation that if $\phi(k;x,t)$ solves

$$\phi(k;x,t)+ie^{i(kx+k^3t)}\int_L \frac{\phi(\ell;x,t)}{\ell+k}d\lambda(k) = e^{i(kx+k^3t)}, \qquad (10)$$

where $d\lambda(k)$, L are an appropriate measure and contour respectively then

$$u(x,t) = -\frac{\partial}{\partial x}\int_L \phi(k,x,t)d\lambda(k) \qquad (11)$$

satisfies KdV:

$$u_t+6uu_x+u_{xxx} = 0 \qquad (12)$$

In our paper [38] we (a) give a direct proof of the above facts; (b) for a special contour and measure we show how the Gel'fand-Levitan equation may be recovered as a special case; For this contour/measure such an integral equation had been recently discovered in the context of pure scattering - inverse scattering theory (see for example [39]). (c) Characterize a three parameter family of solutions to the self-similar o.d.e. associated with KdV which may be directly related to the second Painlevé Transcendent (P_{II}): (We note that the Gel'fand-Levitan-Marchenko equation associated with P_{II} only characterizes a one parameter family of solutions). In order to carry out (c) we had to investigate a concrete singular integral equation in which the contour L consists of 5 rays all passing thru the origin. The analysis requires the full power (and some extensions) of the classical theory of singular integral equations [40-42].

It should be remarked that (i) the integral equation (10) applies to potentials of the Schrödinger equation, even without the application to KdV or P_{II}; (ii) the motivation for developing such an integral equation originates from the concept of summing perturbation series [43,44]. (iii) Recently Flaschka and Newell [45] considered P_{II} via monodromy theory. In their work they derive a formal system of linear singular integral equations for the general solution of P_{II}. However the highly nontrivial question of existence of solutions was left open. How their work and ours relate is a question which we have been investigating. (iv) The linear version of KdV: $u_t+u_{xxx} = 0$ is solved in full generality as a special case. Some future directions are: (a) Investigation of the full generality of the solutions of KdV via this new formulation. (b) Development of similar types of integral equations for other nonlinear evolution equations, as well as ones which relate to natural "equilibrium" states for KdV, other than the zero (or vacuum) state.

(c) Compare this direct linearization to the direct Riemann-Hilbert method of Zakharov and Shabat [46].

(f) A Connection Between Nonlinear Evolution Equations and Certain Nonlinear O.D.E.'s of Painlevé type.

The development of the inverse scattering transform (I.S.T.) has shown that certain nonlinear evolution equations possess a number of remarkable properties including the existence of solitons, an infinite set of conservation laws, an explic set of action angle variables, etc. We have noted in [47] that there is a connectic between these nonlinear partial differential equations (PDE's) solvable by I.S.T. and nonlinear ordinary differential equations (ODE's) without movable critical point (Some definitions: a critical point is a branch point or an essential singularity in the solution of the ODE. It is movable if its location in the complex plane depends on the constants of integration of the ODE. A family of solutions of the ODE without movable critical points has the P-property; here P stands for Painlevé.) In [48-50] we have announced and developed a number of results which indicate that this connection to ODE's of P-type is yet another remarkable property of these special nonlinear PDE's. We have conjectured that:

> Every nonlinear ODE obtained by a similarity reduction of a nonlinear PDE of I.S.T. class is, perhaps after a transformation of variables, of P-type.

Here we refer to a nonlinear PDE as being in the I.S.T. class if nontrivial solutions of the PDE can be found by solving a linear integral equation of the Gel'fand-Levitan-Marchenko form. No general proof of this conjecture is available yet, but we have proven a more restricted result in this direction. It is known that under scaling transformations certain nonlinear PDE's of I.S.T. class reduce to ODE's. Moreover, the solutions of these ODE's may be obtained by solving linear integral equations. We have shown that every such family of solutions has the P-property.

We note that the conjecture in its strongest form relates to ODE's obtained from equations solved <u>directly</u> by I.S.T. There are many examples of equations solved only indirectly by I.S.T.; the sine-Gordon equation is one of the best known examples. An ODE obtained from an equation solved indirectly by I.S.T. need not be of P-type, but it may be related through a transformation to an ODE that is.

One consequence of this conjecture is an explicit test of whether or not a given PDE may be of I.S.T. class; namely, reduce it to an ODE, and determine whether the ODE is of P-type. To this end, we identify certain necessary conditions that an ODE must satisfy to be of P-type and describe an explicit algorithm to determine whether an ODE meets these necessary conditions.

We have exploited this connection in order to develop both solutions and asymptotic connection formulae to some of the classical transcendents of Painlevé [51] as well as others. The method which we have given in order to determine if an ODE is of P type is a useful device for determining the integrability of an ODE. For example in [52] using this method we have derived a new explicit solution for the traveling waves of Fisher's equation. Indeed this method, which was also used successfully in classical problems [53] has seen a recent revival of interest (for example see [54-56]).

In the future we intend to consider the following problems:

(1) The complete connection formulae (i.e. the global connection of asymptotic states) for the interesting Painlevé equations associated with linear Gel'fand-Levitan'Marchenko equations. It should also be mentioned that some other important work has already been accomplished in this direction (see for example [57],[58]).

(2) To prove that the ODE's which we have derived, in fact satisfy the property; i.e. that they have no movable essential singularities, regardless of initial conditions.

(3) To develop solutions to these ODE's which correspond to general initial conditions. In this regard we shall reconsider the recent work of Flaschka and Newell [45] especially in relation to the work discussed earlier in this proposal [see ref. 38].

(4) Study the connection between the Bäcklund transformations developed in the Russian literature (the reader may wish to see the review [59] as well as the articles by Fokas [60] and Fokas and Ablowitz [61]) and their connection to I.S.T. and monodromy preserving deformations. We have very recently made progress in this direction.

(g) Discrete I.S.T. and Numerical Schemes.

It is significant that many of the concepts related to the inverse scattering theory apply to suitably discretized nonlinear evolutions equations; for example the Toda lattice, and discrete nonlinear Schrödinger equation (see for example [62], [63]). It is of interest to ask whether one can solve partial difference equations (i.e. numerical schemes) by inverse scattering. An obvious application is to numerical simulations. We have succeeded in analytical developing such schemes [64]. These schemes can be shown to converge to a given nonlinear P.D.E. (which itself is solvable by inverse scattering) in the continuous limit. Moreover they have the nice property that they are neutrally stable, have exact soliton solutions and possess an infinite number of conserved quantities. Recently we have compared the practical numerical simulation of a given nonlinear P.D.E. (e.g. cubic nonlinear Schrödinger or KdV) using traditional methods, with our newly developed schemes. Our schemes have proven to be extremely strong.

The results are compiled in a sequence of recent papers [65-67]. In the future, we hope to continue to assess the usefulness of various numerical schemes on important model nonlinear problems.

CURRICULUM VITAE

Mark Jay Ablowitz
68 Elm Street
Potsdam, New York

PII Redacted

[redacted]

Office Phone: 315-268-2365
315-268-2375

[redacted]

EDUCATIONAL DATA:

B.S.,	1967	University of Rochester, Rochester, N.Y. Mechanical Engineering
Ph.D.,	1971	Massachusetts Institute of Technology Cambridge, Massachusetts Mathematics

EXPERIENCE:

Instructor, Summer Session, M.I.T., 1970
Teaching Assistant in Mathematics, M.I.T., 1967-1971
Assistant Professor of Mathematics, Clarkson College of Technology, 1971-75
Associate Professor of Mathematics, Clarkson College of Technology, 1975-76
Visiting Professor of Applied Mathematics, Princeton University, 1977-78
Professor of Mathematics, Clarkson College of Technology, 1976-79
Professor and Chairman, Department of Mathematics and Computer Science, Clarkson College of Technology, 1979-present.

AWARDS:

Sloan Foundation Fellowship 1975-1977
Clarkson Graham Research Award 1976
John Simon Guggenheim Foundation Fellowship, 1984

BOOKS:

Solitons and the Inverse Scattering Transform, with H. Segur; published by SIAM Studies in Applied Mathematics, 1981.

PUBLICATIONS:

1. The Evolution of Multi-Phase Modes for Nonlinear Dispersive Waves, M.J. Ablowitz and D.J. Benney, Studies in Applied Mathematics, Vol. 49, p. 225, 1970.

2. Applications of Slowly Varying Nonlinear Dispersive Wave Theories, M.J. Ablowitz, Studies in Applied Mathematics, Vol. 50, p. 329, 1971.

3. Approximate Methods for Obtaining Multi-Phase Modes in Nonlinear Dispersive Wave Problems, M.J. Ablowitz, Studies in Applied Mathematics, Vol. 51, p. 17, 1972.

4. Semi-resonant Interactions and Frequency Dividers, M.J. Ablowitz, B.A. Funk and A.C. Newell, Studies in Applied Mathematics, Vol. 52, p. 51-74, 1973.

5. The Decay of the Continuous Spectrum for the Korteweg-deVries Equation, M.J. Ablowitz and A.C. Newell, Journal of Mathematical Physics, Vol. 14, p. 1277, 1973.

6. Method of Solution for the Sine-Gordon Equation, M.J. Ablowitz, D.J. Kaup, A.C. Newell and H. Segur, Phys. Rev. Lett., 30, p. 1262, 1973.

7. Nonlinear Evolution Equations of Physical Significance, M.J. Ablowitz, D.J. Kaup, A.C. Newell and H. Segur, Phys. Rev. Lett., 31, p. 125, 1973.

8. Nonlinear Dispersive Waves and Multi-phase Modes, M.J. Ablowitz, Proc. of 1971 Summer Conference on Nonlinear Waves at Clarkson College, Editor: A.C. Newell, p. 127, 1974.

9. Coherent Pulse Propagation, A Dispersive Irreversible Phenomenon, M.J. Ablowitz, D.J. Kaup, and A.C. Newell, J. of Mathematical Phys., 11, p. 1852, 1974.

10.* The Inverse Scattering Transform-Fourier Analysis for Nonlinear Problems, M.J. Ablowitz, D.J. Kaup, A.C. Newell and H. Segur, Studies in Applied Mathematics, 53, p. 249, 1974.

11. Nonlinear Differential-Difference Equations, M.J. Ablowitz and J.F. Ladik, J. Mathematical Physics, 16, p. 598, 1975.

12. A Note on Resonance and Nonlinear Dispersive Waves, M.J. Ablowitz, Studies in Applied Mathematics, 54, p. 1, 1975.

13. The Inverse Scattering Transform-Semi-Infinite Interval, M.J. Ablowitz and H. Segur, J. Mathematical Physics, 16, p. 1054, 1975.

14. Resonantly Coupled Nonlinear Evolution Equations, M.J. Ablowitz and R. Haberman, J. Math. Phys., 16, p. 2301, 1975.

15. Nonlinear Evolution Equations - Two and Three Dimensions, M.J. Ablowitz R. Haberman, Phys. Rev. Lett., 35, p. 1185, 1975.

* This has been judged a citation classic by Current Contents (see Current Contents June 7, 1982, Vol. 13, No. 23).

16. Asymptotic Evolution and Conservation Laws for the Nonlinear Schrodinger Equation I, H. Segur and M.J. Ablowitz, J. Math. Phys., 17, p. 710, 1976.

17. Nonlinear Differential-Difference Equations and Fourier Analysis, M.J. Ablowitz and J.F. Ladik, J. Math. Phys., 17, p. 1011, 1976.

18. A Nonlinear Difference Scheme and Inverse Scattering, M.J. Ablowitz and J.F. Ladik, Studies in Applied Math., 55, p. 213, 1976.

19. On the Solution of a Class of Nonlinear Partial Differential Equations, M.J. Ablowitz and J.F. Ladik, Studies in Applied Math., 57, pp. 1-12, 1977.

20. Nonlinear Evolution Equations - Continuous and Discrete, M.J. Ablowitz, SIAM Review, Vol. 19, No. 4, 1977.

21. Asymptotic Solutions of the Korteweg-deVries Equation, M.J. Ablowitz and H. Segur, Studies in Applied Math., 57, pp. 13-44, 1977.

22. Exact Linearization of a Painleve Transcendent, M.J. Ablowitz and H. Segur, Phys. Rev. Lett., Vol. 38, No. 20, p. 1103, 1977.

23. Solitons and Rational Solutions of Nonlinear Evolution Equations, J. Math. Phys., 19, pp. 2180-2186, 1977.

24. Lectures on the Inverse Scattering Transform, M.J. Ablowitz, Stud. in Appl. Math., 58, pp. 17-94, 1978.

25. The Inverse Scattering Transform - Continuous and Discrete and its Relationship with Painleve Transcendents, M.J. Ablowitz, Research Notes in Mathematics, 26, pp. 9-32, 1978, Pitman Publ.

26. Nonlinear Evolution Equations and Ordinary Differential Equations of Painleve Type, M.J. Ablowitz, A. Ramani and H. Segur, Lett. al Nuovo Cimento, 23, pp. 333-338, 1978.

27. Note on Miura's Transformation, M.J. Ablowitz, M.D. Kruskal and H. Segur, J. Math. Phys., 20, p. 999, 1979.

28. On the Evolution of Packets of Water Waves, M.J. Ablowitz, and H. Segur, J. Fluid Mech., 92, p. 691, 1979.

29. Explicit Solutions of Fisher's Equations for a Special Wave Speed, M.J. Ablowitz and A. Zeppetella, Bulletin of Math. Bio., Vol. 41, No. 6, pp. 835-840, 1979.

30. Transverse Instability of One-Dimensional Transparent Optica Pulses in Resonant Media, M.J. Ablowitz and Y. Kodama, Phys. Lett., 70A, p. 83, 1979.

31. Two-dimensional Lumps in Nonlinear Dispersive Systems, J. Satsuma and M.J. Ablowitz, J. Math. Phys., 20, p. 1496, 1979.

32. Resonant Nonlinear Vibrations in Continuous Systems, M.J. Ablowitz, A. Askar, A.S. Cakmak, H. Engin, Int. J. Nonlinear Mechanics, Vol. 14, pp. 223-233, 1979.

33. Resonant Nonlinear Vibrations in Continuous Systems II, H. Engin, M.J. Ablowitz, A. Askar, A.S. Cakmak, Int. J. Nonlinear Mechanics, Vol. 14, pp. 235-246, 1979.

34. On Solutions to the Korteweg-deVries Equation, M.J. Ablowitz and H. Cornille, Phys. Lett., 72A, p. 277, 1979.

35. On an Internal Wave Describing a Stratified Fluid with Finite Depth, J. Satsuma, M.J. Ablowitz, Y. Kodama, Phys. Lett., 73A, No. 4, October, 1979.

36. Solitary Wave Collisions, M.J. Ablowitz, M.D. Kruskal, J.F. Ladik, SIAM J. Appl. Math., Vol. 36, No. 3, pp. 428-437, 1979.

37. Solitons, Solutions of Nonlinear Evolution Equations and the Inverse Scattering Transform, M.J. Ablowitz, Math. Methods & Appl. of Scatt. Theory, Eds. De Santo, Saenz and Zachary, Springer-Verlag, Vol. 130 Lect. Notes in Physics, 1980.

38. A Connection Between Nonlinear Evolution Equations and Ordinary Differential Equations of P-Type I, M.J. Ablowitz, A. Ramani and H. Segur, J. Math. Phys., 21, pp. 715-721, April, 1980.

39. A Connection Between Nonlinear Evolution Equations and Ordinary Differential Equations of P-Type II, M.J. Ablowitz, A. Ramani and H. Segur, J. Math. Phys., 21, pp. 1006-1015, May, 1980.

40. Transverse Instability of Breathers in Resonant Media, Y. Kodama and M.J. Ablowitz, J. Math. Phys., 21, pp. 921-931, 1980.

41. A Comparison Between Finite Element Methods and Spectral Methods as Applied to Bound State Problems, M. Duff, H. Rabitz, A. Askar, A. Cakmak and M.J. Ablowitz, J. Chem. Phys., 72 (3), pp. 1543-1559, 1980.

42. Long Internal Waves of Great Depth, M.J. Ablowitz and H. Segur, Stud. Appl. Math., Vol. 62, pp. 2149-262, 1980.

43. Solutions of an Internal Wave Equation Describing a Stratified Fluid with Finite Depth, J. Satsuma and M.J. Ablowitz, Proceedings of Nonlinear Partial Differential Equations in Engineering & Applied Science, edited by R.L. Sternberg, A.J. Kalinowki and J.S. Papadakis 397 (Marcel Dekker, Inc., New York, 1980).

44. Nonlinear Wave Propagation, M.J. Ablowitz, published in Encyclopedia of Physics, pp. 663-664, 1981.

45. Remarks on Nonlinear Evolution Equations and Ordinary Differential Equations of Painleve Type, by M.J. Ablowitz, Proc. Conf. on Solitons held in Kiev, U.S.S.R., September, 1979, as part of a Joint U.S. U.S.S.R. Academy of Sciences agreement, Physica 3D, 1 & 2, pp. 129-141 1981.

46. Finite Perturbations and Solutions of the Korteweg-deVries Equation, H. Airault and M.J. Ablowitz, C.R. Acad. Sc. Paris, 6292, pp. 279-281, 1981.

47. The Nonlinear Intermediate Long Wave Equation: Analysis and Method of Solution, Y. Kodama, J. Satsuma and M.J. Ablowitz, Phys. Rev. Lett., Vol. 46, 11, pp. 687-690, 1981.

48. Linearization of the KdV and Painleve II Equations, A.S. Fokas and M.J. Ablowitz, Phys. Rev. Lett., Vol. 47. No. 16, pp. 1096-1100, October, 1981.

49. Perturbations of Solitons and Solitary Waves, Y. Kodama and M.J. Ablowitz, Stud. Appl. Math., 64, pp. 225-245, 1981.

50. The Periodic Cubic Schrodinger Equation, Y.C. Ma and M.J. Ablowitz, Stud. Appl. Math., 65, pp. 113-158, 1981.

51. Remarks on Nonlinear Evolution Equations and the Inverse Scattering Transform, M.J. Ablowitz, Nonlinear Phen. in Physics & Biology, pp. 83-94 (Edited by R.H. Enns, B.L. Jones, R.M. Miura and S.S. Rangnekar, Plenum Publ. Corp., 1981).

52. Direct Linearization of the Korteweg-deVries Equation, A.S. Fokas and M.J. Ablowitz, AIP Conference Proceedings, No. 88, Mathematical Methods in Hydrodynamics and Integrability in Dynamical Systems, pp. 237-241, La Jolla Institute 1981, (edited by M. Tabor and Y.M. Treve).

53. A Direct Linearization Associated with the Benjamin-Ono Equation, M.J. Ablowitz and A.S. Fokas, AIP Conference Proceedings, No. 88, Mathematical Methods in Hydrodynamics and Integrability in Dynamical Systems, pp. 229-236, La Jolla Institute 1981, (edited by M. Tabor and Y.M. Treve).

54. A Significant, Coherent Nonlinear Phenomenon, M.J. Ablowitz and A.S. Fokas, Clarkson Innovations 1 (4) 1981.

55. Note on Asymptotic Solutions of the Korteweg-deVries Equation with Solitons, Stud. Appl. Math., 66, pp. 159-170, 1982.

56. Direct and Inverse Scattering Problems of Nonlinear Intermediate Long Wave Equations, Y. Kodama, M.J. Ablowitz and J. Satsuma, J. Math. Phys., Vol. 23, No. 4, pp. 564-576, 1982.

57. On the Periodic Intermediate Long Wave Equation, M.J. Ablowitz, A.S. Fokas, J. Satsuma and H. Ségur, J. Phys. A, Math. Gen. 15, pp. 781-786, 1982.

58. On a Unified Approach to Transformations and Elementary Solutions of Painleve Equations, A.S. Fokas and M.J. Ablowitz, J. Math. Phys., 23, (11) 1982.

59. On the Inverse Scattering and Direct Linearizing Transforms for the Kadomtsev-Petviashili Equation, A.S. Fokas and M.J. Ablowitz, Phys. Lett., A 94, pp. 67, 1983.

60. The Direct Linearizing Transform and the Benjamin-Ono Equation, M.J. Ablowitz, A.S. Fokas and R.L. Anderson, Phys. Lett. A, 93, pp. 375, 1983.

61. The Inverse Scattering Transform for the Benjamin-Ono Equation - A Pivot to Multidimensional Problems, A.S. Fokas and M.J. Ablowitz, Stud. Appl. Math., 68, No. 1, 1983.

62. On a Backlund Transformation and Scattering Problem for the Modified Intermediate Long Wave Equation, J. Satsuma, T.R. Taha, M.J. Ablowitz, I.N.S. #12 preprint, 1982.

63. On Analytical and Numerical Aspects of Certain Nonlinear Evolution Equations, Part I: Analytical, T.R. Taha and M.J. Ablowitz, I.N.S. #14 preprint, 1982.

64. On Analytical & Numerical Aspects of Certain Nonlinear Evolution Equations, Part II: Numerical Nonlinear Schrodinger Equation, T.R. Taha and M.J. Ablowitz, I.N.S. #15 preprint, 1982.

65. On Analytical and Numerical Aspects of Certain Nonlinear Evolution Equations, Part III: Numerical, Korteweg-deVries Equation, T.R. Taha and M.J. Ablowitz, I.N.S. #16 preprint, 1982.

66. On the Inverse Scattering of the Time Dependent Schrodinger Equations and the Associated KPI Equation, A.S. Fokas and M.J. Ablowitz, to appear in Stud. in Appl. Math. I.N.S. #22 preprint, 1982.

67. On the Inverse Scattering Transform for the Kadomtsev-Petviashvili Equation, M.J. Ablowitz , D. Bar Yaacov and A.S. Fokas, to appear in Stud. in Appl. Math. I.N.S. #21 preprint, 1982.

68. Comments on the Inverse Scattering Transform and Related Nonlinear Evolution Equations, M.J. Ablowitz and A.S. Fokas, I.N.S. #25 preprint, to appear in the monograph: "Nonlinear Phenomena" ed. B. Wolf, December, 1982.

69. Lectures on the Inverse Scattering Transform for Multidimensional (2+1) Problems, A.S. Fokas and M.J. Ablowitz, I.N.S. #28 preprint, to appear in the monograph: "Nonlinear Phenomena" ed. B. Wolf, December, 1982.

70. On the Inverse Scattering Transform of Multidimensional Nonlinear Equations Related to First Order Systems in the Plane, A.S. Fokas and M.J. Ablowitz, I.N.S. #24, Submitted to J. Math. Phys., January 1983.

71. On the Limit from the Intermediate Long Wave Equation to the Benjamin-Ono Equation, P. Santini, M.J. Ablowitz and A.S. Fokas, I.N.S. #30 preprint, February, 1983, sub. to J. Math. Phys.

72. On a Method of Solution for a Class of Multidimensional Nonlinear Evolution Equations, A.S. Fokas and M.J. Ablowitz, Phys. Rev. Lett. Vol. 51, No. 1, pp. 7-10, July 1983.

73. On the Initial Value Problem of the Second Painleve Transcendent, A.S. Fokas and M.J. Ablowitz, I.N.S. #31, April 1983, to be publ. Comm. Math. Phys.

NONTECHNICAL ARTICLES:

Soviet and U.S. Ties in Science, New York Times, August, 1980.

GRANTS:

National Science Foundation, Mathematics Section	1972 - present 1972-73: P.I. M.J. Ablowitz, A.C. Newell. 1973-76: P.I. M.J. Ablowitz, D.J. Kaup, A.C. Newell, H. Segur. 1977-81: P.I. M.J. Ablowitz, D.J. Kaup, A.C. Newell 1982-83: P.I. M.J. Ablowitz, A.S. Fokas, D.J. Kaup.
Present Amount: $52,200.	
Office of Naval Research, Mathematics Division	1978 - present 1978-81: P.I. M.J. Ablowitz, D.J. Kaup, A.C. Newell. 1982-83: P.I. M.J. Ablowitz, A.S. Fokas.
Present Amount: $42,200.	
Air Force Office of Scientific Research, Mathematics Division, Present Amount: $57,475.	1978 - present P.I. M.J. Ablowitz.

Sloan Fellowship: 1975-1977.

John Simon Guggenheim Fellowship: 1984.

INVITED PRESENTATIONS:

Rensselaer Polytechnic Institute, Mathematics Department, May, 1972.

American Mathematical Society Summer Conference on Nonlinear Wave Motion, Clarkson College of Technology, July, 1972.

Applied Mathematics Summer Seminar, Dartmouth College, August, 1972. Sponsored by the Office of Naval Research, Mathematics Branch.

Massachusetts Institute of Technology, Mathematics Department, December, 1973.

Rensselaer Polytechnic Institute, Mathematics Department, March, 1974.

Invited Speaker: SIAM Fall Meeting on Nonlinear Wave Propagation, October, 1974.

Joint Seminar: University of Chicago-Northwestern University, November, 1974.

Rockefeller University, December, 1974.

McGill University, Mathematics Department, November, 1975.

Princeton University, Applied Mathematics Department, January, 1976.

University of Pittsburgh, Mathematics Department, March, 1976.

Massachusetts Institute of Technology, Mathematics Department, 10 Lectures on Nonlinear Wave Propagation, April-May, 1976.

University of Chicago, Geophysics Department, May, 1976.

University of Denver, Mathematics Department, May, 1976.

Nihon University, Physics Department, Tokyo, Japan, July, 1976.

Nagoya University Plasma Physics Institute, Najoya, Japan, July, 1976

Kyoto University, Physics Department, Kyoto, Japan, July, 1976.

Ritsumeikan University, Mathematics and Physics Departments, Kyoto, Japan, July, 1976.

Osaka University, Mechanical Engineering Department, Osaka, Japan, July, 1976.

University of Rochester, Mathematics Department, April, 1977.

University of Rome, Mathematics Department, Rome, Italy, June, 1977.

Los Alamos Labs, Albuquerque, New Mexico, November, 1977.

Denver University, Mathematics Department, November, 1977.

New York University, Mathematics Department, February, 1978.

Princeton University, Applied Mathematics Department, April, 1978.

International Quantum Electrodynamic Conference, Atlanta, GA, May, 1978.

Princeton University, Plasma Physics Lab, May, 1978.

Syracuse University, A.M.S. Meeting, invited speaker, October, 1978.

Naval Research Laboratory, Fluid and Numerical Computations Group, December, 1978.

Physics Group, C.N.R.S. Saclay, France, December, 1978.

S.U.N.Y. Buffalo, Mathematics Department, April, 1979.

Catholic University, Conference on Inverse Scattering, invited speaker, May, 1979.

University of Rhode Island, Conference on Nonlinear Partial Differential Equations, June, 1979.

International Conference on Solitons, Jadwisin, Poland, August, 1979.

International Conference on Soliton Theory, Kiev, U.S.S.R., Part of a Joint U.S. - U.S.S.R. Academy of Sciences agreement, September, 1979.

New York University, Courant Institute of Mathematical Sciences, December, 1979.

Columbia University, Dept. of Mathematics, February, 1979.

Workshop on Nonlinear Evolution Equations and Dynamical Systems, Chania, Crete, July 9-23, 1980.

Remarks on Nonlinear Evolution Equations and the Inverse Scattering Transform, Banff Conference, Banff Alberta, Canada, August, 1980.

Brown University, Providence, Rhode Island, October, 1980.

University of Montreal, November, 1980.

University of Michigan, November, 1980.

Georgia Institute of Technology, December, 1980.

Washington, D.C., December, 1980.

York University, Toronto, Canada, March, 1981.

Workshop on Nonlinear Evolution Equations, Solitons and Spectral Methods, August 24-29, 1981, Trieste, Italy.

Workshop on Mathematical Methods in Hydrodynamics and Integrability in Related Dynamical Systems, La Jolla Institute, La Jolla, California, December 7-9, 1981.

York University, Physics Department, March, 1982.

Yale University, Mathematics Department, March, 1982.

Princeton University, Applied Mathematics Program, April, 1982.

Columbia University, Program in Applied Mathematics, April, 1982.

Solitons '82, Scott Russell Centenary Conference and Workshop, Edinburgh, Scotland, August, 1982.

Cornell University, Ithaca, NY, Wave Phenomena, Twenty-Fifth Annual Meeting of the Society for Natural Philosophy, September 22-25, 1982.

School and Workshop, "Nonlinear Phenomena", November 29-December 17, 1982, Oaxtapec, Mexico.

Cornell University, Ithaca, NY, April 21, 1983.

S.U.N.Y. at Stony Brook, Department of Theoretical Physics, April 22-25, 1983.

2nd Workshop on Nonlinear Evolution Equations and Dynamical Systems Orthodox Academy of Crete, Chania, Crete, August 13-28, 1983.

2nd International Workshop on Nonlinear and Turbulent Processes in Physics, Kiev, USSR, October 10-25, 1983.

TEACHING CREDENTIALS:

Courses Taught

Elementary Calculus
Differential Equations
Advanced Calculus for Engineers
Modern Managerial Mathematics
Introduction to Numberical Analysis
Approximatin Methods of Applied Mathematics
Nonlinear Wave Motion
Elementary Analysis
Asymptotic and Perturbation Methods
Methods of Applied Mathematics - Complex Analysis, Partial Differential Equations, vector Calculus, etc.

Teaching Evaluation

I have been rated by students on a scale of 5. The average is approximately 4.5.

Ph.D. STUDENTS:

J.F. Ladik, Nonlinear Differential - Difference Equations, June, 1975, Clarkson College.

Y.C. Ma, Studies of the Cubic Schrodinger Equations, Princeton University, 1977. I was an informal advisor and reader of the thesis.

A. Ramani, On O.D.E.'s of Painleve Type, Princeton University, 1979. I was an informal advisor and reader of the thesis.

Y. Kodama, Perturbation and Stability Problems in Nonlinear Waves. Ph.D. 1979, Clarkson College.

T. Taha, Numerical and Analytical Aspects of Nonlinear Evolution Equations. Ph.D. 1982, Clarkson College.

P. Santini, Aspects of the Theory for Multidimensional Nonlinear Partial Differential Equations Solvable via the Inverse Scattering Transform. Ph.D. expected June, 1983.

POSTDOCTORAL ASSOCIATES:

J. Satsuma, General Education, Miyazaki Medical College, Kiyotake, Miyazaki 889-16, Japan. January 1979 - September 1980.

Y. Kodama, Clarkson College of Technology, Department of Mathematics and Computer Science, Potsdam, August 1979-July 1980.

A. Nakamura, Osaka University of Foreign Study, Osaka, Japan, August 1980 - March 1982.

D. Bar Yaacov, Yale University, Department of Mathematics, New Haven, Connecticut. September 1982 - June 1984.

MASTER'S STUDENTS:

Benjamin Funk, June 1972

COMMITTEES:

(a) National

National Science Foundation Postdoctoral Fellowships in Mathematical Sciences, 1978 - 1982.

Conference Board on Mathematical Sciences, Regional Conferences Panel, 1979, 1980.

Co-director, Organizer of Joint U.S. - U.S.S.R. Academy of Sciences Meeting Held in Kiev, U.S.S.R., September, 1979.

(b) Clarkson College

Computer Science Committee of the Mathematics Department, 1971-1973.

Undergraduate Committee of the Mathematics Department, 1972-1974.

Graduate Committee of the Mathematics Department of 1974-1978.

Research Committee of Clarkson College, 1977.

Tenure Committee of Clarkson College, 1978.

Faculty Senator of Clarkson College, 1978.

PROFESSIONAL AFFILIATIONS:

Tau Beta Pi, Engineering Honor Society
Sigma Xi
Society of Industrial and Appl. Math.
Math Association of America
American Mathematical Society

BIOGRAPHICAL LISTINGS:

Who's Who in Education
Who's Who in the East
Probably others

CONSULTING EXPERIENCE:

Polaroid Corporation: Numerical Computation of Fluid Flow. Mission Research Corporation, Washington, DC: Nonlinear Wave Theory.

EDITORIAL BOARDS:

Editorial Board: Studies in Applied Mathematics 1983 -
SIAM Journal in Applied Mathematics 1983 -

Associate Editor: Journal of Mathematical Physics: 1976-1979.

Journal/Grant Reviewing:
- Physical Review
- Phys. Rev. Lett.
- J. Math. Phys.
- S.I.A.M.
  - J. of Applied Mathematics
  - J. on Math. Analysis
- Studies in Applied Mathematics
- J. Fluid Mechanics
- Phys. of Fluids
- N.S.F. Grants - Math
- Nat. Acad. Sci. - Grants for U.S. Army
- A.F.O.S.R. Research Grants

REFERENCES:

1. Professor V. Barcilon
   Professor of Applied
   Mathematics & Geophysics
   University of Chicago
   Chicago, IL 60637

2. Professor D.J. Benney
   Professor of Mathematics
   Massachusetts Institute of Technology
   Cambridge, MA 02139
   Thesis Advisor

3. Professor M. Kac
   University of So. California
   Department of Mathematics
   Los Angeles, CA 90007

4. Professor M.D. Kruskal
Professor & Director of the
Applied Mathematics Program
Princeton University
Fine Hall
Princeton, NJ 08540

5. Professor Peter Lax
Courant Institute of
Mathematical Sciences
251 Mercer St.
New York, NY 10012

6. Professor Henry McKean
Courant Institute of
Mathematical Sciences
251 Mercer St.
New York, NY 10012

RESUME

DANIEL BAR YAACOV

OFFICE ADDRESS:

Department of Mathematics
and Computer Science
Clarkson College of Technology
Potsdam, New York 13676
Tel: (315) 268-2372

[PII Redacted]

[redacted]

[redacted]

JOB OBJECTIVE: To obtain a university faculty position in the field of mathematics.

EDUCATION:

Yale University	9/77-8/82	Ph.D.
The Hebrew University of Jerusalem	9/74-6/77	B.Sc.

DISSERTATION TITLE: Analytic Properties of scattering and Inverse Scattering for First Order Systems.

DISSERTATION ADVISOR: Professor Richard Beals.

PUBLICATIONS: On the Inverse Scattering Transform for the Kadomtsev-Petviashvili Equation, with M.J. Ablowitz and A.S. Fokas, to appear in Studies in Applied Mathematics.

TEACHING EXPERIENCE: I have taught most of the courses in the calculus sequence at Yale during the past three years.

HONORS:

Dean's List, The Hebrew University, 1975-77

University Fellow, Yale, 1977-81

REFERENCES: Professors: R. Beals, R.R. Coifman, and

Yale University
Department of Mathematics
Box 2155 Yale Station
New Haven, CT. 06520

Professor M.J. Ablowitz
Department of Mathematics
Clarkson College
Potsdam, N.Y. 13676

CURRICULUM VITAE

PII Redacted

Christopher M. Cosgrove

[redacted]

1967: Higher School Certificate. Gained first place in Mathematics in N.S.W.

1967: First place in N.S.W. School Mathematics Competition (a 3-hour exam consisting of six challenging problems accessible to high school students).

1968: Awarded Barker Scholarship no. III, Horner Exhibition, and T.G. Room Medal for gaining first place in Mathematics in H.S.C.

1968-71: Four-year B.Sc. (Honours) course at University of Sydney majoring in Pure Mathematics. Principal subjects were Pure Mathematics, Applied Mathematics, and Physics. Degree conferred April 1972.

1971: Gained first place and four individual question prizes in the Sydney University Mathematical Scoeity (SUMS) Annual Problem Competition. (This is a nationwide competition open to undergraduate students; it consists of ten very difficult problems bordering on original research in some cases).

1972-June 1979: Employed as Tutor in Applied Mathematics at University of Sydney. Full-time 1972, 1978-9; part-time 1973-7.

1973: Fourth-year honours course in Applied Mathematics (non-degree). Gained High Distinction (equivalent to good 1st Class Honours in B.Sc. degree course).

1974-78: Candidate for Ph.D. degree in General Relativity. Supervisor: Edward D. Fackerell. Thesis topic: "Generation of exact solutions of the stationary axisymmetric vacuum gravitational field equations." Four publications. Thesis submitted for examination February 9, 1979. Degree conferred Nov. 1979.

1979: Invited to give papers at two conferences in honour of the birth of Albert Einstein: Einstein Centenary Sumer School on Gravitational Radiation and Collapsed Objects, Perth, Western Australia, 22-31 January 1979; The Second Marcel Grossmann Meeting on the Recent Developments of General Relativity, Trieste, Italy, 5-11 July 1979.

July 1979-June 1980: Employed as Research Associate in Physics with William Kinnersley at Montana State University.

July 1980-June 1982: Richard Chace Tolman Fellow in Theoretical Astrophysics at California Institute of Technology (awarded on the basis of an international competition).

July 1982-present: Assistant Professor of Mathematics at Clarkson College of Technology.

LIST OF PUBLICATIONS

1. "New family of exact stationary axisymmetric gravitational fields generalizing the Tomimatsu-Sato solutions", J. Phys. A. Math. Gen. 10, 1481-1524, (September 1977).

2. "Limits of the generalized Tomimatsu-Sato gravitational fields," J. Phys. A: Math. Gen. 10, 2093-2105 (December 1977).

3. "A new formulation of the field equations for the stationary axisymmetric vacuum gravitational field I. General theory," J. Phys. A: Math. Gen. 11, 2389-2404 (December 1978).

4. "A new formulation of the field equations for the stationary axisymmetric vacuum gravitational field II. Separable solutions," J. Phys. A: Math. Gen. 11, 2405-30 (December 1978).

5. "Stationary axisymmetric gravitational fields: an asymptotic flatness preserving transformation," article in Gravitational Radiation, Collapsed Objects, and Exact Solutions, Proceedings of the Einstein Centenary Summer School, Perth, 1979, edited by C. Edwards, Lecture Notes in Physics 124 (Berlin, New York: Springer-Verlag, 1980), pp. 444-53.

6. "Continuous groups and Backlund transformations generating asymptotically flat solutions," article in Proceedings of the Second Marcel Grossmann Meeting on General Relativity, Trieste, 1979, edited by R. Ruffini (Amsterdam, New York, Oxford: North Holland Publishing Company, 1982), pp. 287-99.

7. "Relationships between the group-theoretic and soliton-theoretic techniques for generating stationary axisymmetric gravitational solutions," J. Math. Phys. 21, 2417-47 (September 1980).

8. "Eigenvalues of the Chandrasekhar-Page Angular Functions," by K.G. Suffern, E.D. Fackerell, and C.M. Cosgrove, J. Math. Phys. 23, p. 1350 (May 1982).

9. "Bäcklund transformations in the Hauser-Ernst formalism for stationary axisymmetric spacetimes," J. Math. Phys. 22, 2624-39 (November 1981).

10. "Relationship between the inverse scattering techniques of Belinskii-Zakharov and Hauser-Ernst in general relativity," J. Math. Phys. 23, 615-33 (April 1982).

CURRICULUM VITAE

A.I. Nachman
27 1/2 Lawrence Avenue
Potsdam, NY 13676
(315) 268-2376 (Office)
(315) 265-6862 (Home)

PII Redacted

[redacted]

EDUCATION:

1971-1974 McGill University - B.Sc. (Honors Math.) 1974
1974-1979 Princeton University - M.A. (Analysis) 1976
Ph.D. (P.D.E.) 1980

Doctoral Thesis Advisor: Charles Fefferman

SCHOLARSHIPS & HONORS:

1972-1974	J.W. McConnel Scholarship	- McGill University
1973-1974	Anne Molson Scholarship	- McGill University
1974	First Class Honors in Math.	- McGill University
1974	Anne Molson Gold Medal	- McGill University
1979-1981	J.W. Gibbs Instructor	- Yale University
1982-1983	Lilly Fellow	- University of Rochester

PRESENT POSITION:

Visiting Assistant Professor - Department of Mathematics and Computer Science, Clarkson College of Technology, Potsdam, NY 13676

TEACHING EXPERIENCE:

- 11 semesters Calculus at Princeton U., Yale U. and U. of Rochester
- undergraduate courses in Linear Algebra, Ordinary Differential Equations and Partial Differential Equations.
- a graduate course on Hyperbolic Differential Equations at Yale U.
- a graduate course on Pseudodifferential Operators at U. of Rochester
- a one year seminar on Solitons and Inverse Scattering at U. of Rochester

PUBLICATIONS:

The Wave Equation on the Heisenberg Group-Comm. in P.D.E., 7(6), 675-714, (1982)

REFERENCES:

Professor Richard Beals	Dept. of Math., Yale University
Professor Charles Fefferman	Dept. of Math., Princeton University
Professor Elias Stein	Dept. of Math., Princeton University

LANGUAGES:

English, French, German, Roumanian.

V I T A E

ATHANASSIOS S. FOKAS

PII Redacted

[redacted]

1971:	Graduated from high school, Athens, Greece
1972:	Paddington Technical College, London "General Certificate of Education"
1972-75:	Department of Aeronautics, Imperial College, University of London, London, England
	Degree: B.Sc. 1975, with first class honors, also awarded the "Governors" Prize in Aeronautics: for 1975, for being the best student in the final year of the Aeronautics.
1975-79:	Department of Applied Mathematics, California Institute of Technology, Pasadena
	Degree: Ph.D. June 1979 (supervisor: P.A. Lagerstrom)
1979-80:	Saul Kaplun Research Fellow in Applied Mathematics, Caltech
1980-82:	Assistant Professor, Clarkson College
June - August, 1981:	Visiting Professor, Universitat Paderborn, West Germany
1983:	Associate Professor, Clarkson College

PUBLICATIONS:

1. Ph.D. Thesis: "Invariants, Lie-Bäcklund Operators, and Backlund Transformations", Caltech 1979.

2. D. S. Cohen, A. S. Fokas, P. A. Lagerstrom: Proof of Some Asymptotic Results for a Model Equation for Low Reynolds Number Flow, SIAM J. Appl. Math., 35, July 1978.

3. A. S. Fokas: Group Theoretical Aspects of Constants of Motion and Separable Solutions in Classical Mechanics, J. Math. Anal. Applic., 68, 347, April 1979.

4. A. S. Fokas, P. A. Lagerstrom: Quadratic and Cubic Invariants in Classical Mechanics, J. Math. Anal. Appl., 74, 342, (1980).

5. A. S. Fokas, P. A. Lagerstrom: On the Use of Lie-Bäcklund Operators in Quantum Mechanics, J. Math. Anal. Appl., 74, 342, (1980)

6. A. S. Fokas: Lie-Bäcklund Theory of Separation of Variables and Conservation Laws in Classical and Quantum Mechanics, Invited Lecture given at the International Joint IUTAM/IMU Symposium "Group Theoretical Methods in Mechanics", August 25-29, 1978, Novosibirsk, U.S.S.R. Published in Proceedings of Symposium.

7. A. S. Fokas, R. L. Anderson: Group Theoretical Nature of Bäcklund Transformations, Letters in Math. Phys., 3, 117 (1979).

8. A. S. Fokas: Generalized Symmetries and Constants of Motion of Evolution Equations, Letters in Math., Phys. 3, 467 (1979).

9. A. S. Fokas: A Symmetry Approach to Exactly Solvable Evolution Equations, J. of Math. Physics, 21, 1318, (1980).

10. A. S. Fokas, B. Fuchssteiner: On the Structure of Symplectic Operators and Hereditary Symmetries, Lettere Al Nuovo Cimento, 28, 299 (1980).

11. A. S. Fokas, B. Fuchssteiner: Bäcklund Transformations for Hereditary Symmetries, Nonlinear Analysis, TMA 5, 423 (1981).

12. B. Fuchssteiner, A. S. Fokas: Symplectic Structures, their Bäcklund Transformations and Hereditary Symmetries, Physica 4D, 47, (1981).

13. Y. C. Yortsos, A. S. Fokas: An Analytical Solution for Linear Waterflood Including the Effects of Capillary Pressure, Society of Petroleum Engineers of AIME, SPE 9407, (1980).

14. A. S. Fokas, Y. C. Yortsos: On the Exactly Solvable Equation

$$S_t = {(\beta S + \gamma)^{-2} S_x}_x + \alpha(\beta S + \gamma)^{-2} S_x$$

Occurring in Two-Phase Flow in Porous Media, SIAM J. Appl. Math. 42 (2), 318 (1982).

15. A. S. Fokas, Y. C. Yortsos: The Transformation Properties of the Sixth Painlevé Equation and One-Parameter Families of Solutions, Lettere Al Nuovo Cimento 30, 539 (1981).

16. A. S. Fokas, M. J. Ablowitz, On a Unified Approach to Transformations and Elementary Solutions of Painlevé Equations, J. Math. Phys. 23, (11) (1982).

17. A. S. Fokas, M. J. Ablowitz: On a Linearization of the Korteweg-deVries and Painlevé II Equations, Phys. Rev. Lett., 47 (6), 1096 (1981).

18. M. J. Ablowitz, A. S. Fokas, J. Satsuma, H. Segur: On the Periodic Intermediate Long Wave Equations, J. Phys. A 15, 781 (1982).

19. A. S. Fokas, B. Fuchssteiner: The Hierarchy of the Benjamin-Ono Equation, Phys. Lett. 86A, 341 (1981).

20. A. S. Fokas, R. L. Anderson: On the Use of Isospectral Eigenvalue Problems for Obtaining Hereditary Symmetries for Hamiltonian Systems, J. of Math. Phys. 23 (6), 1066 (1982).

21. R. L. Anderson, A. S. Fokas: Comments on the Symmetry Structure of Bi-Hamiltonian Systems, Published in the Proceedings of the International Symposium on Selected Topics in Quantum Field Theory and Math. Physics, June 14-19, 1981, Bechyne' Castle, Czechoslovakia.

22. M. J. Ablowitz, A. S. Fokas: The Soliton - A Significant, Coherent Nonlinear Phenomenon, Clarkson Innovations 1 (4) (1981).

23. A. S. Fokas and M. J. Ablowitz: Direct Linearizations of the Korteweg-deVries Equation, Presented at the Workshop on Mathematical Methods in Hydrodynamics and Integrability in Related Dynamical Systems, La Jolla, CA, December 7-9, 1981, AIP Conference Proceedings No. 88, edit. by M. Tabor and M. Treve. Mathematical Methods in Hydrodynamics and Integrability in Dynamical Systems, pp. 237-241.

24. M. J. Ablowitz and A. S. Fokas: A Direct Linearization Associated with the Benjamin-Ono Equation, Presented at the Workshop on Mathematical Methods in Hydrodynamics and Integrability in Related Dynamical Systems, La Jolla, CA, December 7-9, 1981, AIP Conference Proceedings No. 88, edit. by M. Tabor and M. Treve. Mathematical Methods in Hydrodynamics and Integrability in Dynamical Systems, pp. 229-236.

25. M. J. Ablowitz, A. S. Fokas and R. L. Anderson: The Direct Linearizing Transform and the Benjamin-Ono Equation, Phys. Lett. A. 93, 375 (1983).

26. A. S. Fokas and M. J. Ablowitz: On the Inverse Scattering and Direct Linearizing Transforms for the Kadomtsev-Petviashvili Equation, Phys. Lett. A., 94, 67 (1983).

27. A. S. Fokas and M. J. Ablowitz: The Inverse Scattering Transform for the Benjamin-Ono Equation - A Pivot to Multidimensional Problems, Stud. Appl. Math. 68, 1 (1983).

28. A. S. Fokas and M. J. Ablowitz, On the Inverse Scattering of the Time Dependent Schrödinger Equations and the Associated KPI Equation, to appear in Stud. in Appl. Math.

29. M. J. Ablowitz, D. Bar Yaacov, and A. S. Fokas, On the Inverse Scattering Transform for the Kadomtsev-Petviashvili Equation, to appear in Stud. in Appl. Math., INS #21.

30. A. S. Fokas, On the Inverse Scattering of First Order Systems in the Plane Related to Nonlinear Multidimensional Equations, Phys. Rev. Lett. Vol. 51, No. 1, 3-6, July, 1983.

31. M. J. Ablowitz and A. S. Fokas, Comments on the Inverse Scattering Transform and Related Nonlinear Evolution Equations, I.N.S. #25 preprint, to appear in the monograph: "Nonlinear Phenomena" ed. B. Wolf, December, 1982.

32. A. S. Fokas and M. J. Ablowitz, Lectures on the Inverse Scattering Transform for Multidimensional (2+1) Problems, I.N.S. #28 preprint, to appear in the monograph: "Nonlinear Phenomena" ed. B. Wolf, December, 1982.

33. A. S. Fokas and M. J. Ablowitz, On the Inverse Scattering Transform of Multidimensional Nonlinear Equations Related to First Order Systems in the Plane, I.N.S. #24, sub. to J. Math. Phys., January, 1983.

34. A. S. Fokas, On the Inverse Scattering Transform in Two Spatial and One Temporal Dimensions, I.N.S. #26 preprint, February, 1983, to appear in the monograph "Advances in Nonlinear Waves" ed. A.C. Newell.

35. P. Santini, M. J. Ablowitz and A. S. Fokas, On the Limit from the Intermediate Long Wave Equation to the Benjamin-Ono Equation, I.N.S. #30 preprint, February, 1983, to appear J. Math. Phys.

36. A. S. Fokas and M. J. Ablowitz, On a Method of Solution for a Class of Multi-Dimensional Nonlinear Evolution Equations, Phys. Rev. Lett., Vol. 51, No. 1, pp. 7-10 July, 1983.

37. A. S. Fokas and M. J. Ablowitz, On the Initial Value Problem of the Second Painlevé Transcendent, I.N.S. #31, April 1983, to be published Comm. Math. Phys.

Participation in National and International Conferences

The author has been invited and has given lectures in the following conferences:

1. Joint IUTAM/IMU Symposium "Group Theoretical Methods in Mechanics", August 25-29, 1978, Novosibirsk, U.S.S.R.

2. Workshop on Nonlinear Equations, July 29 - August 10, 1979, Potsdam, New York.

3. Workshop on Nonlinear Evolution Equations and Dynamical Systems, July 9-23, 1980, Crete, Greece.

4. Workshop on Nonlinear Evolution Equations, Soliton and Spectral Methods, Trieste, Italy, August 24-29, 1981.

5. Workshop on Mathematical Methods in Hydrodynamics and Integrability in Related Dynamical Systems, La Jolla, CA, December 7-9, 1981.

6. Scott Russell Centenary Conference, Edinburgh, Scotland, August 22-27, 1982.

7. Twenty-Fifth Annual Meeting of the Society for Natural Philosophy, Cornell University, Ithaca, N.Y. September 22-25, 1982.

8. School and Workshop, "Nonlinear Phenomena", November 29 - December 17, 1982, Qaxtapec, Mexico, (the author gave a series of five invited lectures).

9. 2nd Workshop on Nonlinear Evolution Equations and Dynamical Systems, Chania, Crete, Greece, August 9-25th, 1983.

10. 2nd International Workshop on Nonlinear and Turbulent Processes in Physics, Kiev, USSR, October 14-22, 1983.

<u>Colloquia and Seminars Given</u>

1. "Applications of Lie-Bäcklund Symmetries", UCLA, Los Angeles, January 1979.

2. "Lie-Bäcklund Operators and Exactly Solvable Evolution Equations", California Institute of Technology, February 1979.

3. "A Symmetry Approach to Exactly Solvable Evolution Equations", Courant Institute of Mathematical Sciences, February 1980.

4. "Hereditary Operators and their Applications", Clarkson College of Technology, February 1980.

5. "One-Parameter Families of Solutions of the Sixth Painlevé Equation", University of Georgia, June 1980.

6. "Linearization of the Korteweg-deVries and Painlevé II Equations", Clarkson College of Technology, May 1981.

7. "Linearization of the Korteweg-deVries and Painlevé II Equations, University of Georgia, October 1981.

8. "Linearization of the Korteweg-deVries and Painlevé II Equations, Courant Institute of Mathematical Sciences, New York University, November 1981.

9. "Linearization of the Korteweg-deVries and Painlevé II Equations, Princeton University, November 1981.

10. "Linearizations of Korteweg-deVries, Painlevé II and Benjamin-Ono Equation, California Institute of Technology, December 1981.

11. "The Inverse Scattering of the Kadomtsev-Petviashvili Equation, Yale University, March 1982.

12. "Multidimensional Inverse Scattering Transform", University of Georgia, October 1982.

13. "The Inverse Scattering Transform in Multidimensions, Stanford University, November, 1982.

14. "Solitons and the Inverse Scattering Transform in Multidimensions", Massachusetts Institute of Technology, April, 1982.

15. "Solitons and the Inverse Scattering Transform in Multidimensions", Harvard, April, 1983.

16. "Solitons and the Inverse Scattering Transform in Multidimensions", State University of New York at Stony Brook, April, 1983.

<u>Contract Awards:</u>

1982- : National Science Foundation, Mathematics Section.
P.I. M.J. Ablowitz, A.S. Fokas, D.J. Kaup.

1982- : Office of Naval Research, Mathematics Division.
P.I. M.J. Ablowitz, A.S. Fokas.