# Northeastern University College of Engineering

#### John W. Cipolla, Jr.

Donald W. Smith Professor of Mechanical Engineering College of Engineering Distinguished Professor

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#### EDUCATION

BSME 1965, Drexel University
ScM 1967, Brown University
Thesis: A Kinetic Description of Cylindrical Heat Conduction
Advisor: T. F. Morse
PhD 1970, Brown University
Thesis: The Kinetic Theory of Gain in a Nearly-Free-Molecular Gas Laser Amplifier.
Advisor: T. F. Morse

#### **PROFESSIONAL APPOINTMENTS**

#### Northeastern University

Department of Mechanical Engineering 1971-1976 Assistant Professor 1976-1981 Associate Professor (tenured 1977) 1981-1995 Professor 1991-1995 Chairman

Department of Mechanical, Industrial and Manufacturing Engineering 1995-2003 Donald W. Smith Professor of Mechanical Engineering and Chairman

2003-2004 Vice Provost for Graduate Education

Department of Mechanical and Industrial Engineering 2004-present *Donald W. Smith Professor of Mechanical Engineering* 2007-present College of Engineering Distinguished Professor Interim Chair 2006-2007

**Politecnico di Milano**, Dipartimento di Matematica, Milano, Italy (Various periods 1986-1989) Collaborative research on kinetic theory of gases. Variational principles in unbounded curvilinear systems.

John W. Cipolla, Jr.

**Brown University**, Division of Engineering (Summer 1977; Sabbatical leave 1978-1979) Visiting Associate Professor (Research) Kinetic Theory of Radiating Gases; (Sabbatical leave 1985-1986), Visiting Professor (Research) Aerosol Deposition Processes.

**Max-Planck-Institut für Strömungsforschung**, Göttingen, West Germany: (1970-1971, Summer 1973) Research Associate. Research on kinetic theory of gases, variational principles, evaporation and condensation, polyatomic gases, rarefied radiating gases; (Summer 1975), Turbulence modelling)

**Università degli Studi di Milano**, Istituto di Scienze Fisiche, Milano, Italy. (1969-1970), NSF Postdoctoral Fellowship. Research on the kinetic theory of gases. Emphasis on variational principles and polyatomic gases. Kinetic theory of radiating gases.

**Boston University**, Department of Aerospace and Mechanical Engineering (Summer, Fall 1999) Sabbatical leave. Reading and research on microscale and nanoscale heat transfer.

# AWARDS

American Institute of Aeronautics and Astronautics *National Student Award* (Masters Division) 1967.

NSF Postdoctoral Fellowship, University of Milan, Italy, 1969-1970.

Dow Outstanding Young Faculty Award, ASEE Region I, 1977.

*Outstanding ME Faculty Member*, voted by the Northeastern University ME student body (1988 and 1990).

Fellow American Society of Mechanical Engineers, (1991).

# **PROFESSIONAL SOCIETY ACTIVITIES**

Member, American Society for Engineering Education (ASEE)

Member, Society of the Sigma Xi

Senior Member, Institute of Industrial Engineers (IIE) 1995-2004

Fellow, American Society of Mechanical Engineers (ASME)

ASME General Awards Committee, Region I representative 1996-2000, Chairman 2000-2003 ASME Committee on Honors, 2000-2003, 2004-2008. Vice Chair and Chair elect 2004-2008. Chair 2009-2011.

ASME Committee on Engineering Accreditation, 2005-2008. Secretary 2006, Interim Chair and Chair Elect 2007-2008. Chairman 2008-2009.

ASME Mechanical Engineering Department Heads Committee, National Committee Vice Chair 2001-2003, Chair 2003-2004.

Member ASME Board of Directors on Engineering Education, 2003-2005, 2007-2009. Organizing Committee 2004 ME Education Conference.

ABET/ASME Program Evaluator, 2000-present. EAC member 2009-2011.

## SPONSORED RESEARCH

*Thermal Processes in Optical Materials Fabrication: Aerosol Doping*, 6/90-9/92, \$75,000 (Principal Investigator) NSF.

*High Energy Laser Heating of Optical Fiber Preforms: Thermophoretic Deposition and Collapse,* 6/86-11/89, \$156,000 (Principal Investigator) NSF.

*Kinetic Theory Research on Droplet Growth and Evaporation*, 5/85-10/88 \$9,430 (Principal Investigator) NSF/INT.

*Theoretical Studies of Laser-Induced Buoyant and Thermophoretic Motion in Aerosols*, 3/83-8/86, \$160,948 (Principal Investigator) NSF.

Studies Relevant to the Interaction of Spacecraft with Plasmas, 10/78-9/80, \$155,000 (Co-Principal Investigator with M. B. Silevitch) AFOSR.

Multiple Nuclear Burst Modelling of Energetic Electron Injection into the Magnetosphere 6/74-9/77 \$83,500 (Co-Investigator with M. B. Silevitch and K. I. Golden) Air Force Geophysics Laboratory.

#### STUDENT ADVISING PhD Theses:

A. H. Hamdi (1978) *Electrostatic Discharge-Induced Fluid Flow* paper published in *Can J. Physics* **57**, 1758 (1979)

S. Ravikumar (1985) Thermal Radiation and Thermophoresis in Aerosols

L. Paz (1990) The Effects of Thermal Radiation on the Laser Enhanced MCVD Process

G. Jia (1991) Interactions of Radiation with Conduction, Convection and Thermophoresis (Co advised with Y. Yener)

J. Zhang (1995) Evaporation and Condensation in the Transition Regime of Kinetic Theory.

# PhD Committees:

S. Y. Tsai (1973) Theoretical Analysis of Agglomeration of Aerosols in Acoustic Fields A. Ray (1976) Mathematical Modelling and Digital Simulation of a Commercial Scale High Temperature Gas-Cooled Reactor (HTGR) Steam Power Plant

E. A. Ames (1981) Vacuum Pumping Properties of a High Voltage 60 Hz Crossed Field Discharge C. Y. Wang (1985) Some Model Problems in Laser-Enhanced MCVD (with T. F. Morse at Brown University)

D. DiGiovanni (1987) *Phosphorus Incorporation in Modified Chemical Vapor Deposition* (with T. F. Morse at Brown University)

I. Yannakis (1994) *Production of Nano-Scale Metal Oxide Particles in Flames: Theoretical and Computational Modeling* (with T. F. Morse at Brown University)

# **ME Degree Theses:**

A. H. Hamdi (1974) Laser-Induced Surface Vaporization into a Background Gas: A Kinetic Description
R. Goto (1985) A Numerical Design Procedure for Supersonic Turbine Buckets

## MS Theses:

Y. H. Lin (1974) Description and Fluid Modeling of Electrostatic Cooling

E. Addo (1975) Heat and Mass Fluxes in a Binary Mixture of a Vapor and a Non-Condensable Gas

D. Girardin (1983) One Dimensional Motion of an Absorbing Aerosol

N. Sreesing (1983) One Dimensional Unsteady Thermophoretic Motion

S. Ravikumar (1983) Finite Element Study of Laser Assisted Thermophoretic Deposition

L. Paz (1985) Thermophoretic Motion in a Heat Generating Aerosol in the Compressible Laminar Boundary Layer on a Flat Plate

R. Latham (1986) *The Effects of Internal Laser Heating on the Collapse Time of a Viscous Tube* (with T. F. Morse at Brown University)

T. S. Tse (1986) Interaction of Thermal Radiation and Thermophoresis in Aerosols (with Y. Yener) A. Bahlavouni (1987) An Investigation of Natural Convection Flows in Vertical Enclosures and Channels Employing a Non-Boussinesq Approach

J. McGrath (1988) Droplet Growth in a Binary Gas: A Theoretical Evaluation of Mass Flux and Heat Flux in the Slip Regime

H. Kornstein (1988) Liquid Nitrogen Flow at Critical Conditions

C. Hannon (1991) Aerosol Thermophoresis with Conduction and Radiation (with Y. Yener) Qin Zhang (1990) Poling of Optical Fibers: A Theoretical Study (with T. F. Morse at Brown University)

I. Yannakis (1990) *Modeling the Thermophoretic Focusing of Aerosols* (with T. F. Morse at Brown University)

Jian Zhang (1991) Moment Simulation of Aerosol Evaporation in Laminar Tube Flow

## Senior Projects:

K. Tepper (1974) Steady Temperatures in a Laser Heated Solid

J. Pagliaccio (1980) RADEM

# UNIVERSITY SERVICE

# **Departmental Activities:**

Department of Mechanical Engineering

- Chairman 1991-1995 Responsible for academic and fiscal affairs of the department, including as many as 25 faculty, 8 staff and 17 graduate teaching assistants. Chaired Merit Review Committee, Graduate Committee, Tenure Committee. Initiated major renovation of undergraduate laboratory space in the department, some research laboratories and office space for 30 graduate students. Led departmental strategic planning effort. Initiated review of research infrastructure and laboratory needs in department. Managed downsizing of the departmental faculty and staff while maintaining teaching and research in the required full-time and part-time programs. Hired and mentored two minority faculty and one female faculty. Established career Development Committees for untenured faculty. Revised teaching loads for untenured faculty to enhance research productivity. Oversaw the preparation of ABET documentation (visited Fall 1995, 6 year accreditation awarded), internal self-study for periodic review of graduate programs (visited by combined external/internal review team Winter 1995).
- Head Thermofluids Division 1982-1990. Responsible for the overall planning and development of the division, consisting of nine full-time faculty, including curriculum and research development, textbook selection, recruitment of new faculty, faculty development, preparation of tenure and promotion dossiers, establishment of teaching loads for the division and staffing of courses in the part-time programs.
- Academic Policy Committee (1986-1991)
- Curriculum Study Group (1983-1985)
- Merit Review Committee (elected member, 1983-1984, 1990)
- Promotion Committee (elected member 1990-1991)

Department of Mechanical, Industrial and Manufacturing Engineering

- Chairman 1995-2003. Oversaw the planning and implementation of the merger of the department of Industrial Engineering and Information Systems into the Mechanical Engineering department in Spring 1995. Responsible for the academic and fiscal affairs of the merged department, currently including 25 faculty (16 ME and 9 IE), 9 staff and 33 graduate teaching assistants. A total departmental budget of \$4M. Total research increased substantially from previous years, now standing at approximately \$2M.
- Chair the Graduate Committee and oversaw the integration of the two graduate programs into one, including PhD requirements, qualifying examinations etc.
- Chair the Tenure committee.
- Chair the Merit Review Committee. Responsible for establishing uniform Merit guidelines across both groups in the merged department.
- Initiated the change of both ME and IE curricula to include a common second year and a common senior level design project course with the possibility of a manufacturing concentration in each.
- Established first Industrial Advisory Board for the department, planning and carrying out meetings.
- Prepared ABET documentation for intermediate visit for the Industrial Engineerign program in 1998. Three years accreditation awarded to next general review.
- Initiated and implemented planning for the Capstone Design Studio. Oversaw the development of proposals for external funding to two foundations (in collaboration with the Development office) and to NSF. Funding commitments totaled \$600,000 external and \$300,000 internal. Design Studio opened in Fall 1999.
- Awarded the New England Construction Council *Perini Award* for team development in the department.
- Initiated Assessment Committee for both the IE and ME programs. Developed Program Educational Objectives, in conjunction with Students, Faculty and the Industrial Advisory Board and Program Outcomes, as well as an assessment process for each. Prepared ABET Self Study report for Fall 2001 visit. Both programs awarded full accreditation.
- Department of Mechanical and Industrial Engineering
- Interim Chair Nov. 2006 to July 2007.

# **Major College Committees:**

- ME Chairman Search Committee, Chairman (1989-1990)
- Math Curriculum Review Committee (1989)
- Dean's Advisory Committee on Tenure and Promotion (Chairman 1986-1987, member 1987-1988)
- Industrial Engineering and Information Systems, Department Chairman Review Committee (1987-1988)
- College Planning Group (1982-1984)
- Committee on Graduate Study in Engineering (1982-1984)
- Dean of Engineering Search Committee, Chairman (1979-1980)
- ME Chairman Search Committee (1980-1981)

# **Recent Selected University Service:**

• Graduate Council Review Committee for the Department of Mathematics (1987)

- Patent Committee (1986-1989)
- Committee on Priorities for Academic Affairs (1990-1991), Chairman, 1991-1992
- Academic Computer Advisory Committee (1990-1991)
- Financial Affairs Committee of the Faculty Senate, Recording Secretary (1991-1992)
- University Council on Research and Scholarship (presidential appointee), (1990-2000). Chaired panel to review science and engineering proposals for internal seed money grants. Winter 1999.
- Strategic Planning Steering Committee Chairman, (1992-1993). Worked with external consultants and the office of the Provost to conduct an institution-wide effort at strategic planning. Oversaw the activities of 10 university-wide Task Forces as well as the activities in each of the 7 colleges as they studied various issues and prepared reports. Helped lead the team in drafting the Strategic Plan *A Connected Community*. Presented the draft plan before nearly twenty groups on campus. Oversaw final draft and presented it to the faculty Senate for final voting. Plan accepted by the Board of Trustees with minor revisions March 25, 1994.
- Strategic Planning Implementation Advisory Committee, Chairman (1994-1995). Established priorities for phased implementation of key elements of the plan. Brought together various university groups to implement selected parts of the plan.
- Presidential Nominating Council, Elected by University Faculty (1995-1996). Worked as part of a 20 member group including Trustees, other faculty, staff, alumni and students to screen, interview and recommend applicants for the position of University President.
- Research Committee (Area of Emphasis) for the 1998 NEASC Re accreditation self-study. Co-Chair (1997-1998)
- NEASC Self Study Steering Committee 1997-1998.
- Chairman: Faculty Senate *Ad Hoc* Semester Calendar Committee, 2000. Final report accepted by faculty and administration. Transition to Semesters from quarters implemented in fall 2003.
- Vice Provost for Graduate Education: 2003-2004. Initiated change in process and policies for awarding financial aid. Initiated Strategic planning process for 21 PhD programs. Oversaw activities of the Graduate Council and Graduate Directors, including the New Program Committee, the Program Review Committee and the Executive Committee.
- Chairman: Faculty Senate Ad Hoc Committee on Faculty Suspension. 2008.
- Member: Faculty Senate *Ad Hoc* Committee on the Tenure Appeals Process. 2008-2009.
- Member: University Budget Model Task Force. 2008-2009.

## **Publications**

1. "Kinetic Description of Cylindrical Heat Conduction in a Polyatomic Gas" (with T. F. Morse), *Physics of Fluids*, **11**, 1929, (1968).

2. "Effect of Molecular Model and Boundary Conditions on Linearized Heat Transfer" (with C. Cercignani), in *Rarefied Gas Dynamics*, C. Cercignani and D. Dini, Eds., (Editrice Tecnico Scientifica, Pisa, Italy, 1971) Vol. II, p 767.

3. "Heat Transfer and Temperature Jump in a Polyatomic Gas", *Int. Journal of Heat and Mass Transfer*, **14**, 1599 (1971).

4. "Thermal Creep Slip with Arbitrary Accommodation at the Surface" (with S. K. Loyalka), *Physics of Fluids*, **14**, 1656 (1971).

5. "Kinetic Theory of an Optically Pumped Gas" (with T. F. Morse), *Physics of Fluids*, **14**, 1850(1971).

6. "A Note on the Role of the Branching Ratio in the Transfer of Resonance Radiation" (with J. J. Healy and T. F. Morse), *J. Quantitative Spectroscopy and Radiative Transfer*, **13**, 1219(1973).

7. "A Kinetic Theory of Evaporation and Condensation" (with H. Lang and S. K. Loyalka) in *Rarefied Gas Dynamics*, K. Karamcheti, Ed. (Academic Press, N.Y., 1974) p.179.

8. "Tensor Conductivity for Beam-Beam-Plasma Configuration" (with J. J. Garrity, K. I. Golden, and M. B. Silevitch) *Plasma Physics*, **16**, 116(1974).

9. "Kinetic Theory of Condensation and Evaporation II" (with H. Lang and S. K. Loyalka) *J. Chemical Physics*, **61** 69(1974).

10. "Temperature and Partial Pressure Jumps during Evaporation and Condensation of a Multicomponent Gas Mixture" (with H. Lang and S. K. Loyalka) in **Rarefied Gas Dynamics**, M. Becker and M. Fiebig, Eds. (DFVLR Press, Porz Wahn, West Germany, 1974) **Vol. 1**, p.F.4-1.

11 "Cross-Field Magnetosonic Two-Stream Instability" (with K. I. Golden) Canadian Journal of Physics, **10**, 1022(1975).

12. "Role of Streaming Plasma Instabilities in Parallel Shock Wave Structures" (with K. I. Golden) *Physics Letters*, **51A**, 251 (1975).

13. "Nuclear Burst Plasma Injection into the Magnetosphere with Resulting Spacecraft Charging" (with A. L. Pavel, K. I. Golden and M. B. Silevitch) in **Proceedings of the Spacecraft Charging Technology Conference Air Force Surveys in Geophysics** No. 364 (AFGL-TR-77-0051, C. P. Pike and R. R. Lovell, Eds., 24 February 1977, p. 167.

14. "Ion Cyclotron Beam Mode-Whistler Mode Plasma Instabilities and Their Role in Parallel Shock Wave Structures" (with K. I. Golden and M. B. Silevitch) *Physics of Fluids*, **20**, 82(1977).

15. "Eigenmode Description of the Hot Ion Cyclotron Beam Whistler Mode Instability in Parallel Shock Waves" (with K. I. Golden, Liu Chen, and M. B. Silevitch) *Physics of Fluids*, **20**, 58(1977).

16. "Analytical Study of the Time Dependent Spacecraft-Plasma Interaction" (with M. B. Silevitch) in **Spacecraft Charging Technology-1978**, R. C. Finke and C. P. Pike, Eds., NASA Conf. Pub. 2071, AFGL-TR-79-0082, 1979, p. 197.

17. "Kinetic Effects in an Optically Excited Gas" (with T. F. Morse) J. Quantitative Spectroscopy and Radiative Transfer, **22**, 365(1979).

18. "On the Temporal Development of a Plasma Sheath" (with M. B. Silevitch), *Journal of Plasma Physics*, **25**, 373(1981).

19. "Laser Modification of Thermophoretic Deposition", (with T. F. Morse) J. Colloid and Interface Sci., **97**(1984)137.

20. "Laser Enhanced Thermophoretic Deposition" (with T. F. Morse), in **Proceedings of the Third Symposium on Lasers and Applications**, Edited by H. D. Bist and J. S. Goela, (Tata McGraw-Hill Publishing Limited, New Delhi, 1984) p.438.

21. "Laser-Induced Buoyancy and Forced Convection in Vertical Tubes", (with T. F. Morse, D. DiGiovanni, and C. Y. Wang), in **Natural Convection: Fundamentals and Applications,** edited by S. Kakac, W. Aung and R. Viskanta, (Hemisphere Publishing Corp., N.Y., 1985) p.1118.

22. "Laser Induced Natural Convection and Thermophoresis", (with T. F. Morse and C. Y. Wang), *J. Heat Transfer*, **107**, (1985)161.

23. "Laser Induced Thermophoresis and Particulate Deposition Efficiency", (with T. F. Morse and C. Y. Wang), *J. Heat Transfer*, **107**, (1985) 155.

24. "Laser Enhancement of Thermophoretic Deposition Processes", (with T. F. Morse, C. Y. Wang, and D. DiGiovanni), *J. Lightwave Technology*, **LT-4**, (1986) 151.

25. "Thermophoresis in an Absorbing Aerosol", (with T. F. Morse), J. Aerosol Science, **18**, (1987) 245.

26. "On the Choice of Trial Functions in Integro-Differential Variational Principles of Transport Theory" (with S. K. Loyalka), *Nuclear Science and Engineering*, **99**, 118(1988)

27. "Transition Regime Droplet Growth and Evaporation: An Integro-Differential Variational Approach" (with S. K. Loyalka) in *Rarefied Gas Dynamics* (AIAA, 1989)

28. "Theoretical Modeling of the Incorporation of Phosphorus Doping in the MCVD Process", (with D. DiGiovanni and T. F. Morse), *J. American Ceramic Society*, **71**, 914 (1988).

30. "The Effect of Sintering on Dopant Incorporation in Modified Chemical Vapor Deposition" (with T. F. Morse and D. DiGiovanni), *J. Lightwave Technology*, **22**, 657, (1991).

31. "Radiation between Two Concentric Spheres Separated by a Participating Medium" (with Y. Yener and G. Jia), J. Quantitative Spectroscopy and Radiative Transfer, **46**, 11, (1991).

32. "Thermophoresis of a Radiating Aerosol in Laminar Boundary Layer Flow" (with Y. Yener and G. Jia), *J. Thermophysics and Heat Transfer*, **6**, 476, (1992).

33. "Thermophoresis of a Radiating Aerosol in Thermally Developing Poiseuille Flow", (with Y.

Yener and G. Jia) International J. Heat and Mass Transfer, 35, 3265, (1992).

# **Conference Presentations**

1. ``Kinetic Theory of Heat Transfer'' (with T. F. Morse), APS Fluid Dynamics Division Meeting, November 1966.

2. ``Kinetic Theory of Zero Field Gain in a Gaseous Laser'', (with T. F. Morse), *Symposium on Kinetic Equations*, Cornell University, July 1969. Abstract published in **Kinetic Equations**, edited by R. L. Liboff and N. Rostoker, (Gordon and Breach, N. Y., 1971) p. 253.

3. The Effect of Molecular Model and Boundary Conditions on Linearised Heat Transfer'' (with C. Cercignani), *Seventh International Symposium on Rarefied Gas Dynamics*, Pisa, Italy, July 1970. (paper published in Symposium Proceedings).

4. "The Free Molecular Velocity Distributions of an Optically Excited Gas" (with T. F. Morse), *Symposium on the Interdisciplinary Aspects of Transport Theory*, Oxford University, September, 1970. (Abstract published in *J. Quant. Spectr. and Rad. Trans.*, **11**, 1023 (1971)).

5. ``Thermal Creep Slip with Arbitrary Accommodation at the Surface'' (with S. K. Loyalka) *German Physical Society Meeting*, Munster, West Germany, March, 1971.

6. ``Kinetic Theory of an Optically Pumped Gas'' (with T. F. Morse) *Eighth International Symposium on Rarefied Gas Dynamics*, Stanford University, July 1972.

7. ``Kinetic Theory of Evaporation and Condensation'' (with S. K. Loyalka and H. Lang) *Eighth International Symposium on Rarefied Gas Dynamics*, Stanford University, July 1972. (Paper published in Symposium proceedings).

8. ``Temperature and Partial Pressure Jumps During Evaporation and Condensation'' (with S. K. Loyalka and H. Lang) *Ninth International Symposium on Rarefied Gas Dynamics*, Göttingen, West Germany, July 1974. (Paper published in symposium proceedings).

9. "The Transition from Kinetic- to Diffusion-Dominated Mass Flux during Phase Change" *APS Fluid Dynamics Division Meeting*, University of Maryland, November 1975. (Abstract published in **Bull. APS Series II**, **20**, 1438 (1975).

10. ``Low Frequency Two-Stream Instabilities and their Rôle in Shock Structure'' (with M. B. Silevitch and K. I. Golden) *APS Plasma Physics Division Meeting*, November 1976. (Abstract published in **Bull. APS**, October 1976).

11. ``Analytical Study of the Time-Dependent Spacecraft-Plasma Interaction'' (with M. B. Silevitch) *Second Spacecraft Charging Technology Conference*, Colorado Springs, CO. November, 1978. (Paper published in Conference Proceedings).

12. "Study of Dynamic Solid Body- Plasma Interaction" (with M. B. Silevitch) Spring Meeting of the APS, Washington DC, April 1979. (Abstract published in **Bull. APS**, March, 1979).

13. ``Laser Modification of Thermophoretic Deposition'' (with T. F. Morse) US Congress of Applied Mechanics, Cornell University, July 1982.

14. ``Heat Transfer and Thermophoresis in an Absorbing Aerosol'' (with T. F. Morse) 21<sup>st</sup> National Heat Transfer Conference, Seattle, WA, July 24-27, 1983. (ASME Paper **83-HT-55**.

15. ``Laser Induced Natural Convection and Thermophoresis", (with T. F. Morse and C. Y. Wang) *21<sup>st</sup> National Heat Transfer Conference*, Seattle, WA, July 24-27, 1983. Paper published in **Interfacial Transport Phenomena**, Edited by J. C. Chen and G. S. Bankoff (ASME, 1983)p. 13.

16. ``Laser Induced Thermophoresis and Particulate Deposition Efficiency" (with T. F. Morse and C. Y. Wang) *21st National Heat Transfer Conference*, July 24-27, 1983. Paper published in **Interfacial Transport Phenomena**, Edited by J. C. Chen and G. S. Bankoff (ASME, 1983) p.21.

17. ``Laser Induced Thermophoresis in Aerosols'' (with T. F. Morse), US Army Chemical Systems Laboratory, *Scientific Conference on Obscuration and Aerosol Research*, Edgewood, MD, June 20-24, 1983.

18. ``One Dimensional Unsteady Thermophoretic Motion'', (with T. F. Morse, D. Girardin and N. Sreesing), ASME Winter Annual Meeting, Boston, MA, November 13-18, 1983. Paper published in Transport Phenomena in Materials Processing, PED-Vol 10, HTD-Vol 29, Edited by M. M. Chen, J. Mazumder, and C. L. Tucker, III. 1983 p.31.

19. "New Results of Laser Aerosol Interaction" US Army Chemical Research and Development Center, *Scientific Conference on Obscuration and Aerosol Research*, Edgewood MD, June 26-29, 1984.

20. ``Laser Induced Buoyancy and Forced Convection in Vertical Tubes'' (with T. F. Morse), invited paper presented at *NATO Advanced Study Institute on Natural Convection*, Cesme (Izmir) Turkey, July 15-27, 1984.

21. ``Thermophoretic Transport in Laminar Tube Flow of an Absorbing Aerosol'', (with T. F. Morse and S. Ravikumar), *ASME Winter Annual Meeting*, New Orleans LA, December 9-14, 1984. (ASME Paper **84-WA/HT-44**).

22. ``Thermophoresis of a Heat Generating Aerosol in a Compressible Boundary Layer'' (with T. F. Morse and L. Paz), *38<sup>th</sup> Annual Meeting of the APS Division of Fluid Dynamics*, Tucson, AZ, November 24-26, 1985.

23. ``Laser Enhanced Thermophoretic Deposition'' (with T. F. Morse, D. DiGiovanni, C. Gregory, and S. Ravikumar), 2<sup>nd</sup> International Aerosol Conference, Berlin (West), September 22-26, 1986. Paper published in **Aerosols: Formation and Reactivity**, (Pergamon, Oxford, England, 1986) p.968.

24. ``Aerosol Thermophoresis and Radiative Transfer'', (with Y. Yener and T. S. Tse), 24<sup>th</sup> National Heat Transfer Conference, Pittsburgh PA, August 9-12, 1987. Paper published in **Fundamentals and Applications of Radiation Heat Transfer**, **HTD-Vol 72**, Edited by A. M. Smith and T. F. Smith, p. 59.

25. ``Laser Enhanced Thermophoresis in Vertical Tube Flows'' (with T. F. Morse and C. Y. Wang), *ASME Winter Annual Meeting*, Boston MA, December 13-18, 1987. Paper published in **Convective Transport**, **HTD-VOL 82**, Edited by Y. Jaluria, R. S. Figliola, and M. Kaviany, p.9.

26. "Phosphorus Incorporation in Modified Chemical Vapor Deposition" (with T. F. Morse and

D. DiGiovanni), 11<sup>th</sup> Conference on Optical Fiber Communication, New Orleans, LA, January 25-28, 1988. (Abstract published in **OFC88 Technical Digest**, p.108).

27. ``Transition Regime Droplet Growth and Evaporation: An Integrodifferential Variational Approach'', (with S. K. Loyalka) *Sixteenth International Symposium on Rarefied Gas Dynamics*, Pasadena, CA July, 1988. (Paper published in Symposium Proceedings).

28. ``Aerosol Delivery of Non-Volatile Dopants in the MCVD System'', (with T. F. Morse, R. Laoulache, and P. Charilaou), *AIChE Annual Meeting*, Washington DC, December 1988.

29. ``The Effects of Radiation on Particle Deposition in MCVD: The Optically Thin Case'', (with T. F. Morse and L. P. Paz), Presented at the *1989 Annual Heat Transfer Conference*, Philadelphia PA, August 1989. (Paper published in Conference Proceedings).

30. ``Aerosol Thermophoresis with Conduction and Radiation'', (with C. Hannon and Y. Yener) Presented at the *1989 Annual Heat Transfer Conference*, Philadelphia, PA, August 1989. (Paper published in Conference Proceedings).

31. "Radiative Transfer Between Two Concentric Spheres Separated by a Participating Medium" (with G. Jia and Y. Yener), *Tenth Brazilian Congress of Mechanical Engineering*, Rio de Janeiro, December 1989. (Paper published in Congress proceedings).

32. "Simultaneous Radiation and Conduction Between Two Concentric Spheres Separated by a Participating Medium", (with G. Jia and Y. Yener) *International Heat Transfer Conference, August 20-24, 1990*, Jerusalem, Israel. Paper published in **Heat Transfer 1990**, Edited by G. Hetsroni (Hemisphere, NY, 1990) Vol 5, pp 439-444.

33. "Thermophoretic Focussing in Optical Materials Processing", (with I. Yannakis and T. F. Morse). Presented at the *International Symposium on Manufacturing and Materials Processing*, August 1990, Dubrovnik, Yugoslavia. Paper published in symposium proceedings, edited by W. Aung, (Begell House, NY, 1997), Vol 2, pp 795-809.

34. "Interaction of Radiation and Convection in Laminar Boundary Layer Flow over a Flat Plate", (with G. Jia and Y. Yener). Presented at the *27<sup>th</sup> National Heat Transfer Conference*, July 28-31, 1991, Minneapolis MN.

35. "Thermophoresis of a Radiating Aerosol in a Thermally Developing Poiseuille Flow" (with G. Jia and Y. Yener). Presented at the *10<sup>th</sup> Annual Meeting of the American Association for Aerosol Research*, Traverse City MI, October 8-11, 1991.

36. "Multicomponent Droplet Evaporation in the Slip Regime" (with J. Zhang and T. F. Morse). Presented at the *11<sup>th</sup> Annual Meeting of the American Association for Aerosol Research*, San Francisco, CA, October 12-16, 1992.

37. "Thermophoresis of Radiating Aerosols" (with Y. Yener). Presented at the *First International Symposium on Radiative Transfer*. Paper published in symposium proceedings (Begell House, NY, 1996) pp334-351.