January, 2008

DEBORAH ANN LEVIN

EDUCATION

State University of New York at Stony Brook, B. S., Chemistry, 1974

California Institute of Technology, Ph. D., Chemistry, 1979

Ph. D. Thesis: "Ab Initio Calculations of Processes in Low Energy Electron-Molecule Scattering," California Institute of Technology, June 1979, Thesis advisor, Prof. B. V. McKoy

EMPLOYMENT

July, 2007 – Present	Professor,
August, 2000–June 2007	Associate Professor Department of Aerospace Engineering The Pennsylvania State University University Park, PA 16802 (814) 865-6435 dalevin@psu.edu
May, 1998–Aug. 2000	Research Professor and lecturer, Department of Chemistry, George Washington University Washington, DC 20052
1979–May, 1998	Institute for Defense Analyses (IDA), Science & Technology and Systems Evaluation Divisions, Research Staff Member, Task Leader.

NARRATIVE STATEMENT

Dr. Deborah Levin joined the faculty of Penn State University as Associate

Professor in the Fall of 2000 following two years as a Research Professor at George Washington University and nineteen years as a research staff member at the Institute for Defense Analyses (IDA). She was promoted to Professor in July 2007. At IDA she began her research in modeling and simulation of chemically reacting, two-phase flows applied to the design of optical instruments for small rocket and satellite space experiments and post-mission data interpretation.

Since coming to Penn State, Dr. Levin has taught courses in Spacecraft Environmental Effects, an elective in the Department of Aerospace Engineering for seniors and graduate students, Mechanics of Fluids, a course for Engineering Science majors, Aerodynamics I and II, the junior year courses in incompressible and viscous and compressible flows for Aerospace Engineering majors, and the Physics of Gases for Aerospace and Mechanical Engineer graduate students that covers the kinetics, statistical mechanics, and quantum mechanics necessary to understand optical spectra of high-temperature flows. During her two years at GWU she taught General Chemistry, a course for science majors. She is currently supervising, two M.S. students, six Ph.D. students, and three postdoctoral fellows. She has graduated five MS and five Ph.D. students.

Dr. Levin's research combines topics in aerospace engineering and physical chemistry. Her research spans the general categories of modeling space experiments, space environments, microfluidics, micropropulsion, and plasma processes. The direct simulation Monte Carlo (DSMC) method is the primary gas dynamic technique used in her research to calculate nonequilibrium, transitional flows. In addition, different multi-scale approaches have been developed to extend the applicability to DSMC to near-continuum/continuum flows. Molecular dynamics is utilized to develop accurate physical, fine-grained models particularly for chemical reactions and two-phase cluster flows.

In the modeling of space experiments, her research has helped to quantitatively identify the electronically-excited NO_2 visible radiation as the dominant mechanism of spacecraft glow, as well as to numerically simulate OH and NH ultraviolet radiation observed from the Mir space station experiments. Using quasi-classical trajectory methods, she has been able to replace the usual DSMC semi-empirical chemical model with physically realistic collisional and chemical cross sections for selected chemical reactions with low-earth orbit reactive atomic oxygen. Her research has also extended the DSMC method to the modeling of homogeneous condensation in supersonic plume expansions, an important component of space-plume signatures as well as materials

processing. Her most recent project has involved modeling the high-altitude strongly ionized hypersonic flow and radiation from the Stardust Sample Return Capsule, the fastest vehicle to survive reentry into earth's atmosphere.

In addition, she has developed projects in applied research areas related to the modeling of MEMS microthruster propulsion device performance and materials survivability in atomic oxygen rich environments. Her first 3-D simulations of MEMS microthruster gas flows show that the gas-surface interaction model dominates the physics of these device flows and her first coupled DSMC and heat transfer calculations demonstrate that the thrust and nozzle survivability can be predicted for different material cooling strategies. Due to the multiple length scales in these problems, computationally more efficient forms of DSMC based on collision-limiter techniques have been developed. These approaches are being applied to the modeling of crack propagation in reinforced carbon-carbon materials used on the Shuttle wing leading edges and nose and charring ablator class of materials for planetary exploration.

Dr. Levin serves the Pennsylvania State University with membership on several committees including those at the departmental and university levels. At the national level she continues to serve the profession primarily through her participation on the AIAA Plasmadynamics and Lasers Technical committee, involvement in conference organization and session chairing, and as a reviewer for various AIAA and APS journals. She supports DoD and NASA government agencies and industry through contracts and grants that rely on her expertise in modeling chemically reacting transitional flows.

PUBLICATIONS

1. Refereed Journal Publications:

P. M. Johnson and D. A. Levin, "A Dependence of Measured Phosphorescence Lifetimes upon Excitation Wavelength," *Molecular Photochemistry*, Vol. 6, p. 263, 1974.

D. A. Levin, T. N. Rescigno, and V. McKoy, "Discrete-Basis-Set Approach to the Minimum-Variance Method in Electron Scattering," *Physical Review A*, Vol. 16, p. 157, 1977.

D. A. Levin, A. W. Fliflet, M. Ma, and V. McKoy, "Gaussian Matrix Elements of the Free–Particle Green's Function," *Journal of Computational Physics*, Vol. 28, p. 416, 1978.

A. W. Fliflet, D. A. Levin, M. Ma, and V. McKoy, "Discrete-Basis-Set Calculations for e^--N_2 Scattering Cross Sections in the Static-exchange Approximation," *Physical Review A*, Vol. 17, p. 160, 1978.

D. A. Levin, A. W. Fliflet, and V. McKoy, "Low Energy Rotational and Vibrational-rotational Excitation Cross Sections for H_2 by Electron Impact," *Physical Review A*, Vol. 20, p. 491, 1979.

D. A. Levin, A. W. Fliflet, and V. McKoy, "Variationally Corrected Discrete Basis Set Calculation for e^--CO Scattering in the Static-Exchange Approximation," *Physical Review A*, Vol. 21, p. 1202, 1980.

S. N. Dixit, D. A. Levin, and B. V. McKoy, "Resonant Enhanced Multiphoton Ionization Studies in Atomic Oxygen," *Physical Review A*, Vol. 37, p. 4220, 1988.

D. A. Levin, R. J. Collins, and G. V. Candler, "Computations for Support Design of Measurements of Radiation from Low Velocity Shock Heated Air," *Journal of Thermophysics and Heat Transfer*, Vol. 5, p. 463, 1991.

C. T. Christou and D. A. Levin, "Analysis of Laser Backscattering from Solid Fuel Rocket Plumes," *AIAA Journal*, Vol. 29, No. 8, pp. 1259–1265, August 1991.

D. A. Levin, R. T. Loda, G. V. Candler, and C. Park, "Theory of Radiation from Low Velocity Heated Air," *Journal of Thermophysics and Heat Transfer*, Vol. 7, p. 269, 1993.

C. T. Christou, R. T. Loda, and D. A. Levin, "Simulation of Range- Resolved DIAL Measurements on In-Flight Rocket Plumes," *Journal of Thermophysics and Heat Transfer*, Vol. 7, p. 233, 1993.

P. W. Erdman, E. C. Zipf, P. Espy, C. Howlett, D. A. Levin, R. Loda, R. J. Collins, and G. V. Candler, "Flight Measurements of Low Velocity Bow Shock Ultraviolet Radiation," *Journal of Thermophysics and Heat Transfer* , Vol. 7, p. 37, 1993.

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P. W. Erdman, E. C. Zipf, P. Espy, C. Howlett, C. T. Christou, D. A. Levin, R. J. Collins, and G. V. Candler, "In-situ Measurements of UV Plume Radiation from the Bow Shock Ultraviolet 2 Rocket Flight," *Journal of Thermophysics and Heat Transfer*, Vol. 7, p. 704, 1993.

G. V. Candler, D. A. Levin, R. J. Collins, P. W. Erdman, E. Zipf, P. Espy, and C. Howlett, "Comparison of Theory with Plume Radiance Measurements from the Bow Shock Ultraviolet 2 Rocket Flight," *Journal of Thermophysics and Heat Transfer*, Vol. 7, p. 709, 1993.

P. W. Erdman, E. C. Zipf, P. Espy, C. Howlett, D. Levin, R. Collins, and G. Candler, "Measurements of Ultraviolet Radiation from a 5 km/sec Bow Shock," *Journal of Thermophysics and Heat Transfer*, Vol. 8, p. 441, 1994.

D. Levin, G. Candler, R. Collins, P. Erdman, E. Zipf, and C. Howlett, "Examination of Theory for the Bow Shock Ultraviolet Rocket Experiments–I," *Journal of Thermophysics and Heat Transfer*, Vol. 8, p. 447, 1994.

D. Levin, M. Braunstein, G. Candler, R. Collins, and G. Smith, "Examination of Theory for Bow Shock Ultraviolet Rocket Experiments–II," *Journal of Thermophysics and Heat Transfer*, Vol. 8, p. 453, 1994.

D. Levin, G. Candler, R. Collins, C. Howlett, and E. Whiting, "Comparison of Theory with Atomic Oxygen 130.4 nm Radiation Data from the Bow Shock Ultraviolet 2 Rocket Flight," *Journal of Thermophysics and Heat Transfer*, Vol. 9, p. 629, 1995.

I. Boyd, G. Candler, and D. Levin, "Dissociation Modeling in Low Density Hypersonic Flows of Air," *Physics of Fluids*, Vol. 7, p. 1757, 1995.

D. Levin, R. Collins, G. Candler, M. Wright, and P. Erdman, "Examination of OH Ultraviolet Radiation from Shock-Heated Air," *Journal of Thermophysics and Heat Transfer*, Vol. 10, p. 200, 1996.

D. Levin, I. Boyd, and K. Kossi, "Ultraviolet Radiation From The Hydroxyl Radical: A Diagnostic In Rarefied Flows," *Proceedings of the International Symposium on Rarefied Gas Dynamics*, Beijing, China, pp. 651–656, August 19–24, 1996.

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R. Collins, D. Levin, and V. Dogra, "A Reexamination of the Atmospheric Explorer Data Using the DSMC Technique," *21st Rarefied Gas Dynamics Meeting*, Marseilles, France, pp. 665–672, July 1998.

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D. Levin, G. Candler, and C. Limbaugh, "Multi-spectral Radiance from a Hypersonic Slender Body," *Journal of Thermophysics and Heat Transfer,* Vol. 14, No. 2, pp.237–243, April–June 2000.

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C. M. Benson, S. F. Gimelshein, D. A. Levin, and A. Montaser, "Simulation of Droplet Heating and Desolvation in an Inductively Coupled Plasma–Part I," *Spectrochimica Acta*, Part B, Vol. 56, pp. 1097–1112, 2001.

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S. F. Gimelshein, D. A. Levin, J .A. Drakes, G. F. Karabadzhak, Y. Plastinin, "Modeling of Ultraviolet Radiation in Steady and Transient High-Altitude Plume Flows," *Journal of Thermophysics and Heat Transfer*, Vol. 16, No. 1, pp. 58–67, January-March 2002.

A. Alexeenko, D. Levin, S. Gimelshein, R. Collins, G. Markelov, "Numerical Simulation of High–Temperature Gas Flows in a Millimeter–Scale Thruster," *Journal of Thermophysics and Heat Transfer*, Vol. 16, No. 1, pp. 10–16, January-March 2002.

S. Gimelshein, A. A. Alexeenko, and D. Levin, "Modeling of the Interaction of a Side Jet with a Rarefied Atmosphere," *Journal of Spacecraft and Rockets*, Vol. 39, No. 2, pp. 168–176, March-April 2002.

S. F. Gimelshein, D. A. Levin, and R. J. Collins, "Modeling of Infrared Radiation in a Space Transportation System Environment," *AIAA Journal*, Vol. 40, No. 4, pp.781–790, April 2002.

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A. Alexeenko, D. Levin, S. Gimelshein, R. Collins, and B. Reed, "Numerical Modeling of Axisymmetric and Three–Dimensional Flows in MEMS Nozzles," *AIAA Journal*, Vol. 40, Number 5, pp. 897–904, May 2002**.**

N. E. Gimelshein, S. Gimelshein, and D. Levin, "Vibrational Relaxation Rates in the Direct Simulate Monte Carlo Method," *Physics of Fluids*, Vol. 14, No. 12, pp. 4452–4455, December 2002.

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C. Benson, D. A. Levin, S. F. Gimelshein, and A. Montaser, "A Kinetic Model for Simulation of Aerosol Droplets in High-Temperature Environments," *Journal of Thermophysics and Heat Transfer*, July-August 2004, Vol. 41, No. 4, pp. 582-591.

S. Gimelshein, D. A. Levin, and A. A. Alexeenko, "Modeling of Chemically Reacting Flows from a Side-jet at High Altitudes," *Journal of Spacecraft and Rockets*, July-August 2004, Vol. 41, No. 4, pp. 582-591.

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T. Ozawa, D. Fedosov, D. Levin, and S. Gimelshein, "Use of Quasiclassical Trajectory Methods in the Modeling of OH Production Mechanisms in DSMC," *Journal of Thermophysics and Heat Transfer*, April-June 2005, Vol. 19, No. 2, pp. 235-244.

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Z. Li, J. Zhong, and D. Levin, "Advanced MD Condensation Models for Modeling Water Expansions into Vacuum Conditions," DSMC07 Conference in Santa Fe, New Mexico, September 30-October 3, 2007.

E. Titov and D. Levin" DSMC and Collision Limiter Forms for Modeling Supersonic Nozzle and Channel Flows," DSMC07 Conference in Santa Fe, New Mexico, September 30-October 3, 2007.

S. Gratiy, A. Walker, D. Levin, D. Goldstein, P. Varghese, L. Trafton, B. Larignon, "Modeling of SO_2 IR Radiation in 19 micron from the Sublimation Atmosphere of Io," Planetary Atmospheres 2007 (PATM 2007), Nov. 6-7, Greenbelt Marriot Hotel, Greenbelt, Md.

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I. Boyd, J. Zhong, D. Levin, and P. Jenniskens, "Flow and Radiation Analyses for Stardust Entry at High Altitude," 46th AIAA Aerospace Sciences Meeting, January 7-10, 2009, Reno, Nevada, AIAA Paper No. 2008-1215.

DEBORAH ANN LEVIN

AWARDS

AIAA Certificate of Merit for the purpose of promoting technical and scientific excellence presented to D. A. Levin and S. F. Gimelshein, for the outstanding paper titled, "Modeling of OH Vibrational Distributions Using Molecular Dynamics with Direct Simulation Monte Carlo Method," 35th AIAA Thermophysics Conference, Anaheim, California, June 12, 2001.

2006 Penn State Engineering Society Outstanding Research Award.

PROFESSIONAL ACTIVITIES

1. Member of the AIAA and the Plasmadynamics and Lasers Technical Committee and present chair (June 2007-May2009). AIAA Associate Fellow, January 2004.
2. Associate editor and reviewer for the *Journal of Thermophysics and Heat Transfer*, *AIAA Journal*, the *Journal of Spacecraft and Rockets*, and *Physics of Fluids*, ASME, International Mechanical Engineering Congress and Exposition, New Orleans, Louisiana, November 17–22, 2002.
3. Participation in the Jet Propulsion Laboratory's New Millennium Program's Space Technology 7 (ST7) system validation flight experiment program's pre-phase A study team for Aerocapture, January 18, 2001.
4. Participation as deputy science team leader for the Skipper Satellite, launched in December 1995. The satellite project was a fully integrated endeavor between American and Russian scientists and engineers. The position involved supervising the development of science instrument scripts, computer software to automate script development, data analyses, and the integration of the science objectives into the mission. In coordination with researchers from Cornell and the University of Minnesota, participation included the preparation of pre-flight radiance predictions.
5. Organizer and Chair of the Plasmadynamics and Lasers Technical Committee Sessions for the AIAA 36th Aerospace Sciences Meeting, January 1998. Session chair for various Aerospace Sciences Meetings, Thermophysics, and Plasmadynamics Conferences.
6. Organizer and session chair for the 2002 International Symposium of Rarefied Gas Dynamics Meeting, Whistler, Canada.