

## Peter J. Mardahl

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### Objective

I am not presently seeking employment. My diverse interests include plasma processing, numerical simulations of plasma, simulation code development, IC layout, and IC design, systems integration and system administration.

### Education

**Ph.D. Electrical Engineering and Computer Science,  
University of California, Berkeley, 2001.**

**M.S. Electrical Engineering and Computer Science,  
University of California, Berkeley, 1995.**

**B.S. with High Honors, Electrical Engineering and Computer Science,  
B.S. with High Honors, Nuclear Engineering,  
University of California, Berkeley, 1992.**

### Work Experience

**Air Force Research Laboratory  
Kirtland AFB, NM 87117**

**Physicist**

**June 2002 – present**

**Duties:** Scientific research in the field of PIC simulation of High Power Microwave devices.

**Supervisors:** Lt. Col. J. Mark DelGrande, Keith Cartwright

**Physics Department**

**Postdoctoral Researcher**

**University of California, Berkeley**

Physics Department, Berkeley CA 94720

**Jan. 7 2002 – Mar. 1 2002**

**Duties:** Conduct research in the field of laser plasma-interactions, maintain the Wurtele Group's Linux computers at UC Berkeley.

**Accomplishments:** Simulations of the effect of plasma fluctuations on laser focussing and amplification via the Raman backscatter instability, Simulations of the pi-pulse regime of the Raman backscatter amplification in progress.

**Supervisor:** Prof. J. Wurtele, (510) 486 6572.

**Physics Department**

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**Supervisor:** Prof. J. Wurtele, (510) 486 6572.

**Lawrence Berkeley National Labs**

**Graduate Student Research Assistant**

1 Cyclotron Road, Berkeley, CA 94720.

**October 2000 – Dec. 31, 2001**

**Duties:** Conduct research in the field of laser plasma-interactions, maintain the Wurtele Group's Linux computers at UC Berkeley.

**Accomplishments:** I enhanced parallel XOOPIIC to better handle laser-plasma interactions: certain approximations used previously proved insufficiently accurate. I also developed diagnostics to distinguish counter-propagating laser pulses in XOOPIIC, and developed a diagnostic for measuring the waist size of a laser pulse. I used the 1d and 2d versions of XOOPIIC to simulate laser amplification using the Raman backscatter interaction in plasma channels: this work forms the basis of the upcoming publication "Intense laser pulse amplification using Raman Backscatter in plasma

channels". I also used the 1d and 2d versions of the code to simulate plasma wakefields excited by laser pulses. I was the system administrator for the Wurtele Group's Linux computers, which involved purchasing computers, installing Linux, and maintaining them as well as answering user questions.

**Supervisor:** Prof. J. Wurtele, (510) 486 6572.

**EECS Department**

**University of California, Berkeley**

University of California, Berkeley, CA 94720.

**Graduate Student Research Assistant**

**June 1993 – Oct. 2000**

**Duties:** Conduct research in parallel PIC computing, microwave devices, and maintain the PTSG Group's Unix computers at UC Berkeley.

**Accomplishments:** I was one of the main participants in the development of the XOOPI C++ particle-in-cell code. I ported OOPIC to UNIX, applied XGRAFIX to make the X Windows GUI which formed XOOPI C, created the DADI-based electrostatic field solve for XOOPI C, improved the input file interpreter to understand arithmetic expressions and named variables as well as numerical constants, created the Equipotential boundary condition and several other boundary conditions, created numerous diagnostics in the XOOPI C code, parallelized the 2d version of XOOPI C, implemented bilinear current weighting and Langdon-Marder and Boris corrections, created a moving-window to simulate long models, designed and implemented parallel 2d XOOPI C, and created the dump/restore for both parallel and scalar XOOPI C. I updated the XES1 code and used it to study numerical heating, leading to my upcoming publication "Reducing numerical heating in 1-d PIC simulations". I used the XOOPI C code to study the Langdon-Marder and Boris corrections: this work is published in Computer Physics Communications. I also applied XOOPI C to the study of a Cerenkov maser and helped with the simulations of the Relativistic Klystron Oscillator high power microwave device. I was the system administrator since 1995 of the PTSG cluster of UNIX computers, which involved purchasing computers, installing OSs, maintaining security and the operating systems, seeing to backups, and meeting users' needs. I also created and maintained a CVS repository for XOOPI C code until the TechX corporation took that responsibility.

**Supervisor:** Prof. C.K. Birdsall, (510) 643-6631.

**EECS Department**

**University of California, Berkeley**

University of California, Berkeley, CA 94720.

**Graduate Student Teaching Assistant**

**August 1992 – May 1993**

**Duties:** Run the day-to-day operations of the EECS 40I self-paced circuits class, provide help to students, administer weekly tests, and supervise the other teaching assistants for the class.

**Accomplishments:** In addition to carrying out my basic duties satisfactorily, I updated and organized the archive of student mastery tests, which was in a state of disarray at the beginning of the course.

**Supervisor:** Prof. Richard S. Muller, (510) 643-6690.

**Honors and Scholarships**

Chancellor's Scholarship, University of California, Berkeley, 1998-1992.

Institute of Nuclear Power Operations Scholarship 1991-1992.

Graduated with High Honors, University of California, Berkeley undergrad.

**Course Work**

Plasma Theory A & B	Applied EM Theory A & B
Digital ICs	Num. Sol. of Diff. Equations A & B
Plasma Computational Phys.	Partially Ionized Plasmas
Process and Design ICs	Numerical Analysis
Advanced Digital ICs	Solid State Devices
Circuit theory	Nonlinear circuits
Thermodynamics	Quantum mechanics
Nuc. Reactor Theory	Intro. Nuc. Physics
Vector Calculus	Linear Algebra
Calculus	Physics-mechanics, EM

## Research

Parallelization of a 2D3v electromagnetic PIC plasma simulation code  
Simulations of a Cerenkov Maser  
Study of Marder and Boris corrections to EM PIC simulations  
Study of numerical heating in a 1-dimensional PIC code  
Simulation of laser-plasma interactions using XOOPIC, for wakefield accelerators and for laser pulse compression via transient Raman backscatter

## Technical and Computer Skills

**Electrical Engineering:** Laser-plasma simulations using XOOPIC, high energy microwave device simulations using XOOPIC, circuit simulation via SPICE, IC layout using MAGIC, electromagnetics, plasma physics, IC manufacture in a 1 micron mini lab, semiconductor device physics, linear and nonlinear circuit theory, circuit design.

**Applied math:** Numerical analysis, numerical solution of PDEs and ODEs.

**Nuclear Engineering:** Reactor theory, heat transfer, thermodynamics, material science, nuclear physics, plasma physics, quantum mechanics.

**Computer and programming:** Proficient in C and C++  
Familiar with Java, Python, Perl, Pascal, Fortran, Scheme, HTML

**Development tools:** CVS, make, gdb, gcc/g++.

**UNIX tools:** csh, awk, emacs.

I am one of the principal developers of the XOOPIC code, written in C++, in collaboration with many programmers. I was responsible for the parallelization of XOOPIC using MPI.

## International Skills

**Languages:** Spoken and written English; some Spanish.

**Citizenship:** USA

## Publications

### Journal Articles

Mardahl, P.J.; Verboncoeur, J.P., "Charge conservation in electromagnetic PIC codes; spectral comparison of Boris/DADI and Langdon-Marder methods." *Computer Physics Communications*, Nov. 1997, vol.106, (no.3):219-29.

Bruhwiller, D.L.; Giacone, R.E.; Cary, J.R.; Verboncoeur, J.P.; Mardahl, P.J.; Esaray, E.; Leemans, W., "Particle-in-cell simulations of plasma accelerators and electron-neutral collisions." *Physical Review Special Topics-Accelerators and Beams*, Oct. 2001, vol.4, (no.10).

### Book Chapters

J.W. Luginsland, T.A. Antonsen, Jr., J.P. Verboncoeur, R.W. Lemke, L. Ludeking, P.M. Mardahl, A.T. Lin, Y.Y. Lau, and J.D. Blahovec, Jr., "Parallel PIC", in "Advances in High Power Microwave Sources and Technologies", ed. R.J. Barker, and E. Schamiloglu, IEEE Press, New York, N.Y., 376-437 (2001).

### Journal Articles in Preparation

P.J. Mardahl, K. Cartwright, J.P. Verboncoeur, "Reducing numerical heating in 1-d PIC simulations", Submitted to *Computer Physics Communications*

P.J. Mardahl, J.P. Verboncoeur, "A methodology for parallel PIC", to be submitted to *Computer Physics Communications* in early 2002.

P.J. Mardahl, H.J. Lee, G. Penn, J.S. Wurtele, "Intense laser pulse amplification using Raman Backscatter in plasma channels", submitted Physics Letters A, Jan. 2002.

### Conference Papers

D. Dimitrov, D. Bruhwiler, W. Leemans, E. Esaray, P. Catravas, C. Toth, B. Shadwick, J. Cary, R. Giacone, J. Verboncoeur, and P. Mardahl, "Particle-in-Cell Simulations of Gas Ionization by Short Intense Laser Pulses", Bull. Am. Phys. Soc. 46 (2001).

R.E. Giacone, J.R. Cary, D. Bruhwiler, E. Esaray, W.P. Leemans, B.A. Shadwick, P. Mardahl, and J.P. Verboncoeur, "Quality Particle Beams by Laser Injection into Plasma Accelerators using Colliding Pulses", Bull. Am. Phys. Soc. 46 (2001).

Bruhwiler, D.L.; Giacone, R.; Cary, J.R.; Verboncoeur, J.P.; Mardahl, P.J.; Esaray, E.; Leemans, W., "Modeling beam-driven and laser-driven plasma wakefield accelerators with XOOPIC." (Advanced Accelerator Concepts. Ninth Workshop, Sante Fe, NM, USA, 10-16 June 2000). AIP Conference Proceedings, 2001 (no.569):591-604.

Mardahl, P.J.; Verboncoeur, J.P.; Birdsall, C.K.; Hall, C. "Progress on a 3D particle-in-cell model of a W-band klystron." IN: ICOPS 2000. IEEE Conference Record - Abstracts. 27th IEEE International Conference on Plasma Science (Cat. No.00CH37087). (ICOPS 2000. IEEE Conference Record - Abstracts. 27th IEEE International Conference on Plasma Science (Cat. No.00CH37087)ICOPS 2000. IEEE Conference Record - Abstracts. 27th IEEE International Conference on Plasma Science, New Orleans, LA, USA, 4-7 June 2000). Piscataway, NJ, USA: IEEE, 2000. p. 102.

Mardahl, P.; Verboncoeur, J.P.; Birdsall, C.K. "Simulations of dielectric Cerenkov masers at moderate to high power." IN: IEEE Conference Record - Abstracts. 1996 IEEE International Conference on Plasma Science (Cat. No.96CH35939). (IEEE Conference Record - Abstracts. 1996 IEEE International Conference on Plasma Science (Cat. No.96CH35939)IEEE Conference Record - Abstracts. 1996 IEEE International Conference on Plasma Science, Boston, MA, USA, 3-5 June 1996). New York, NY, USA: IEEE, 1996. p. 256.

Verboncoeur, J.P.; Mardahl, P.J.; Cartwright, K.L.; Birdsall, C.K. "Simulation of pulse shortening in a relativistic klystron oscillator." IN: IEEE Conference Record - Abstracts. 1996 IEEE International Conference on Plasma Science (Cat. No.96CH35939). (IEEE Conference Record - Abstracts. 1996 IEEE International Conference on Plasma Science (Cat. No.96CH35939)IEEE Conference Record - Abstracts. 1996 IEEE International Conference on Plasma Science, Boston, MA, USA, 3-5 June 1996). New York, NY, USA: IEEE, 1996. p. 291-2.

Mardahl, P.; Verboncoeur, J.; Birdsall, C.K. "A spectral comparison of two methods of removing errors in Gauss' law in a 2-dimensional PIC plasma simulation." IN: IEEE Conference Record - Abstracts. 1995 IEEE International Conference on Plasma Science (Cat. No.95CH35796). (IEEE Conference Record - Abstracts. 1995 IEEE International Conference on Plasma Science (Cat. No.95CH35796)International Conference on Plasma Science (papers in summary form only received), Madison, WI, USA, 5-8 June 1995). New York, NY, USA: IEEE, 1995. p. 244.

### References

Available on request.