

# Brian MacKie-Mason <[bmackiemason@anl.gov](mailto:bmackiemason@anl.gov)>

<http://brianmackiemason.com>

## EDUCATION

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- Doctor of Philosophy [Electrical Engineering](#) 2018  
[University of New Mexico](#), Advisor: Professor [Zhen Peng](#)  
[Novel Algorithms for Ultra Scale Electromagnetic Problems in the Supercomputing Era](#)
- Master of Science [Nuclear Engineering](#) 2013  
[University of Wisconsin-Madison](#)
- Bachelor of Science in Engineering [Nuclear Engineering](#) 2011  
[University of Michigan](#)

## JOURNAL PUBLICATIONS

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1. **B. MacKie-Mason** and Z. Peng, "Rapid Antenna Prototyping on Large Platforms via Data-Sparse Schur Complement," [Working].
2. **B. MacKie-Mason**, Y. Shao, A. Greenwood, and Z. Peng, "Supercomputing-Enabled First-Principles Analysis of Radio Wave Propagation in Urban Environments," *IEEE Transactions on Antennas and Propagation*, **66**, pp. 6606–6612 (2018). doi:[10.1109/TAP.2018.2874674](https://doi.org/10.1109/TAP.2018.2874674).
3. Z. Peng, R. Hiptmair, Y. Shao, **B. MacKie-Mason**, "Domain Decomposition Preconditioning for Surface Integral Equations in Solving Challenging Electromagnetic Scattering Problems," *IEEE Transactions on Antennas and Propagation*, **64**, pp. 210–223 (2016). doi:[10.1109/TAP.2015.2500908](https://doi.org/10.1109/TAP.2015.2500908).
4. **B. MacKie-Mason**, A. Greenwood, and Z. Peng, "Adaptive and Parallel Surface Integral Equation Solvers for Very Large-Scale Electromagnetic Modeling and Simulation (invited paper)," *Progress in Electromagnetics Research*, **154**, pp. 143–162 (2015). doi:[10.2528/PIER15113001](https://doi.org/10.2528/PIER15113001).

## CONFERENCE PUBLICATIONS

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1. Jon T. Kelley, **B. MacKie-Mason**, David A. Chamulak, Mark Martin, Kendall Crouch, Clifton C. Courtney, Ali E. Yilmaz, "Towards Quantifying the Effect of Material Uncertainty on RCS Predictions of Composite Targets," *IEEE International Conference on Wireless Information Technology and Systems (ICWITS) and Applied Computational Electromagnetics (ACES)*, Orlando, FL, May 20–24, 2024.
2. Jon Kelley, Kurt Norris, **Brian MacKie-Mason**, Brody Barton, David Chamulak, Scott Schaefer, Mark Martin, Kendall Crouch, Clifton Courtney, Ali Yilmaz, "Reproducible Measurements of "Fan Blades in a Pipe" CEM Benchmark", *45th Annual Meeting and Symposium of the Antenna Measurement Techniques Association (AMTA)*, Seattle, WA, October 8–13, 2023.
3. **B. MacKie-Mason**, J. T. Kelley, K. A. Norris, S. Schaefer, M. Martin, S. Cox, C. C. Courtney, D. A. Chamulak, A. E. Yilmaz, "On the Sensitivity of RCS to Manufacturing Defects in as-Built Camera Boxes with Voids", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*, Portland, OR, July 23–28, 2023. doi:<https://doi.org/10.1109/USNC-URSI52151.2023.10238329>.
4. J. T. Kelly, **B. MacKie-Mason**, K. A. Norris, B. Barton, D. A. Chamulak, S. Schaefer, M. Martin, S. Cox, C. C. Courtney, A. E. Yilmaz, "Using Camera Boxes to Build Reproducible CEM Benchmarks with Complex Ducts", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*, Portland, OR, July 23–28, 2023. doi:<https://doi.org/10.1109/USNC-URSI52151.2023.10237665>.

5. A. Yilmaz, **B. MacKie-Mason**, S. Cox, C. Courtney and G. Burchuk, "On the Sensitivity of RCS to the Wall Conductivity of Highly-Conductive Structures with Voids", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*, Denver, CO, July 10–15, 2022. doi:[10.1109/AP-S/USNC-URSI47032.2022.9887308](https://doi.org/10.1109/AP-S/USNC-URSI47032.2022.9887308).
6. A. Yilmaz, E. Smith, S. Cox, **B. MacKie-Mason**, C. Courtney and G. Burchuk, "Camera Boxes: A Set of Complex Scattering Problems to Test EM Simulations and Measurements", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*, Denver, CO, July 10–15, 2022. doi:[10.1109/AP-S/USNC-URSI47032.2022.9887014](https://doi.org/10.1109/AP-S/USNC-URSI47032.2022.9887014).
7. A. Maicke, J. Kelley, **B. MacKie-Mason**, C. Courtney, S. Cox, D. Chamulak, G. Burchuk and A. Yilmaz, "A Benchmark Airplane Model with Ducts", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*, Denver, CO, July 10–15, 2022. doi:[10.1109/AP-S/USNC-URSI47032.2022.9887354](https://doi.org/10.1109/AP-S/USNC-URSI47032.2022.9887354).
8. S. Wang, **B. Mackie-Mason**, and Z. Peng, "Platform-Aware In-Situ Antenna and Metamaterial Analysis and Design," *International Review of Progress in Applied Computational Electromagnetics (ACES)*, Miami, Florida, USA, April 14–18, 2019. (Best Student Paper Award). <https://bit.ly/2VuzVgy>.
9. **B. MacKie-Mason** and Z. Peng, "Towards Real-time In-Situ Antenna Analysis and Design on Platforms of 1000 Wavelengths", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*, San Diego, CA, July 9–14, 2017. doi:[10.1109/APUSNCURSINRSM.2017.8072714](https://doi.org/10.1109/APUSNCURSINRSM.2017.8072714).
10. Z. Peng and **B. MacKie-Mason**, "High-Performance Surface Integral Equation Solvers Towards Extreme-Scale Electromagnetic Modeling and Simulation," *IEEE International Conference on Wireless Information Technology and Systems (ICWITS) and Applied Computational Electromagnetics (ACES)*, Honolulu, HI, 22–26, March 2016. doi:[10.1109/ROPACES.2016.7465365](https://doi.org/10.1109/ROPACES.2016.7465365).
11. **B. MacKie-Mason** and Z. Peng, "Adaptive, Scalable Domain Decomposition Methods for Surface Integral Equations," *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*, Vancouver, B.C., July 19–25, 2015. doi:[10.1109/APS.2015.7305220](https://doi.org/10.1109/APS.2015.7305220).

## CONTRIBUTED ABSTRACTS

1. Aaron Scheinberg, **B. MacKie-Mason**, S. Ethier, G. Chen, S. Slattery, R. Bird, E. D’Azevedo, CS Chang, et. al., "XGC", *Preparing Applications for Aurora at the Exascale Computing Project Annual Meeting*, Houston, TX, U.S.A. February 3–7, 2020. <https://bit.ly/2KsYdRV>
2. **B. MacKie-Mason** and XGC Team, "Early OpenMP Experience with Collision Kernel", *OpenMP BOF at the Exascale Computing Project Annual Meeting*, Houston, TX, U.S.A. February 3–7, 2020. <https://bit.ly/2zqN3uB>
3. **B. MacKie-Mason**, P. Velesko, R. Hager, C.-S. Chang, and T.J. Williams, "Application Study of Gyrokinetic PIC codes on Intel KNL architecture", *IXPUG Annual Fall Conference*, Hillsboro, OR, U.S.A. September 25–28, 2018. <https://goo.gl/iLGnTv>.
4. **B. MacKie-Mason** and Z. Peng, "Towards a Real-Time Solution of Extreme-Scale Electromagnetic Problems", *National Radio Science Meeting*, Boulder, CO, U.S.A., January 4–7, 2017. <https://goo.gl/bK4wms>.
5. **B. MacKie-Mason** and Z. Peng, "High-fidelity, High-performance Integral Equation Solver

- for Time-Harmonic Maxwell's Equations", *IEEE International Symposium on Antennas and Propagation & USNC/URSI National Radio Science Meeting*, Fajardo, Puerto Rico, U.S.A., June 26–July 1, 2016. <https://goo.gl/fgmgvk>.
6. Z. Peng and **B. MacKie-Mason**, "Integral equation discontinuous Galerkin methods for time harmonic electromagnetic wave problems," *International Review of Progress in Applied Computational Electromagnetics (ACES)*, Williamsburg, VA, March 22–26, 2015. <https://goo.gl/dkiyX>.

## POSTERS

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1. E. D'Azevedo, A. Scheinberg, M. Shephard, P. Worley, S. Sreepathi, **B. MacKie-Mason**, T.J. Williams, and the SciDAC HBPS XGC Team, "Performance Enhancements of XGC", *2019 Scientific Discovery through Advanced Computing Principal Investigator (PI) Meeting*, July 16–18, 2019. <https://bit.ly/3ayDYwC>
2. **B. MacKie-Mason** and XGC Team, "Performance Portability of XGC code at DOE supercomputing facilities", *DOE Performance, Portability and Productivity Annual Meeting*, Apr. 2–4, 2019. <https://bit.ly/2UHXMDa>.
3. **B. MacKie-Mason**, P. Veleko, R. Hager, C.-S. Chang, and T.J. Williams, "Performance Optimization of the XGC code on KNL architecture", *Annual Meeting of the APS Division of Plasma Physics*, Nov. 5–9, 2018. <https://goo.gl/wirgSu>.
4. **B. MacKie-Mason**, Z. Peng, and C. Kung, "Extreme Fidelity Computational Electromagnetic Analysis in the Supercomputer Era", *The International Conference for High Performance Computing, Networking, Storage and Analysis*, Salt Lake City, Utah, U.S.A., November 13–18, 2016. <https://goo.gl/jeQSKR>.
5. **B. MacKie-Mason**, W. Tang, "Modeling of laser-induced field emission", *Air Force Research Lab Annual Scholar Presentation*, Albuquerque, NM, July 2013. [Poster Unavailable].
6. **B. MacKie-Mason**, N. Lockwood, W. Tang, "Development of single-walled nanotube fiber cathode diagnostics", *Air Force Research Lab Annual Scholar Presentation*, Albuquerque, NM, July 2012. [Poster Unavailable].
7. **B. MacKie-Mason**, A. Greenwood, N. Lockwood, "Automated Testing of ICEPIC", *Air Force Research Lab Annual Scholar Presentation*, Albuquerque, NM, July 2011. [Poster Unavailable].

## OTHER

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1. **B. MacKie-Mason** and XGC Team, "Porting XGC to Aurora", *A21 Apps Working Group Meeting*, Argonne National Laboratory, IL, U.S.A., April 19, 2019. [Presentation Unavailable Until Aurora is Stood Up].
2. **B. MacKie-Mason**, "What Can KNL Do For You?", *CoPA Workshop on Deep-dive into XGC*, Princeton Plasma Physics Laboratory, NJ, U.S.A., Dec. 11–12, 2018. <https://bit.ly/2MH3OFT>.
3. **B. MacKie-Mason**, "What do I do?", *Argonne Computing Coffee & Code*, Argonne National Laboratory, IL, U.S.A., September 12, 2018. <https://goo.gl/AtWQSD>.
4. **B. MacKie-Mason** and Z. Peng, "Adaptive and parallel surface integral equation solvers for very large-scale electromagnetic modeling and simulation," *Electrical and Computer Engineering Student Paper Competition*, Albuquerque, NM, April 2016. <https://goo.gl/aK2KUn>.

## TECHNICAL SKILLS

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- **Academic:** Algorithm Development, High Performance Computing, Electromagnetic Analysis, Domain Decomposition Methods, Surface Integral Equation Methods, Scientific Computing, Particle-in-Cell
- **Languages:** Fortran, C/C++, MATLAB, Bash shell, Python
- **Programming Models:** MPI, OpenMP, (some) OpenACC
- **Software Packages:** ViSiT, CUBIT, KDevelop, SolidWorks (CAD), Intel VTUNE Amplifier
- (Well-known) **Research Codes:** Improved Concurrent Electromagnetic Particle-in-Cell (ICEPIC), X-Point Gyrokinetic Code
- **HPC Platforms:** Theta (ALCF), Cori-KNL (NERSC), JLSE (ALCF), Bebop (ANL), Mira (ALCF), Ulam (UNM), Summit (OLCF), Titan (OLCF), Excalibur (ARL), Topaz (ERDC)
- **$\mu$ Architectures:** Intel KNL, Intel's next generation

## RESEARCH EXPERIENCE

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**Staff Research Scientist, Computational Electromagnetics**

*January 2023 - Present*

**Senior Research Scientist, Computational Electromagnetics**

*April 2020 - Present*

[Lockheed Martin Aeronautics](#)

[Skunk Works](#)

**Kendall Crouch**

- Scientific Software Developer for 3D Method of Moments RCS Prediction Code
- PI for Domain Decomposition Methods
- TS Clearance

**Postdoctoral Appointee, Computational Plasma Physics**

*March 2018 - March 2020*

[Leadership Computing Facility](#)

[Argonne National Laboratory](#)

**Timothy J. Williams**

- Optimize XGC code for [Intel KNL architecture](#). 30% speed-up achieved on target kernel.
- Expert in electron push routine for XGC codebase. 70% of computational time.
- Investigate [portability and suitability](#) of XGC code for [Aurora](#).
- Present research findings at inter/national conferences and meetings.
- Argonne Training Program for Extreme-Scale Computing (ATPESC) 2019 participant.

**Research Assistant, Computational Electromagnetics**

*Fall 2013 - Spring 2018*

[Electrical and Computer Engineering](#)

[University of New Mexico](#)

**Professor Zhen Peng**

- Researched and developed a geometry-aware domain decomposition (GA-IE-DDM) method for the integral solution to extreme-scale, multi-scale electromagnetics problems.
- Developed tools to integrate many different solvers and post-processing techniques to aid in the solution of different types of antenna problems.
- Parallelized GA-IE-DDM in distributed memory environment for a scalable solution method to the Electric Field Integral Equation.
- Developed a model order reduction technique for solving electromagnetic radiation problems when many antennas are mounted on very large PEC platforms.

**Research Assistant, Computational Electromagnetics**

*June 2013 - August 2013*

[Air Force Research Lab](#)

[Directed Energy Directorate](#)

**Wilkin Tang**

- Designed and analyzed input decks for laser-induced field emission in ICEPIC.
- Participated in the improvement of computational tools available to the research group.
- Presented research at laboratory symposium to other research scientists.

**Research Assistant, Computational Electromagnetics**

*June 2012 - August 2012*

[Air Force Research Lab](#)

[Directed Energy Directorate](#)

**Nathaniel Lockwood**

- Designed diagnostics for field emission devices using simulation.
- Participated in the improvement of computational tools available to the research group.
- Presented research at laboratory symposium to other research scientists.

**Research Assistant, Computational Electromagnetics**

*May 2011 - August 2011*

[Air Force Research Lab](#)

[Directed Energy Directorate](#)

**Andrew Greenwood**

- Converted scripts from C-shell to Python for the ICEPIC test suite.
- Designed Monte Carlo collision plasma tests for the ICEPIC test suite.
- Presented poster at Directed Energy Conference, August 2011.
- Presented research at laboratory symposium to other research scientists.

**Lab Assistant, Nuclear Materials**

*May 2009 - August 2009*

[Nuclear Engineering & Radiological Sciences](#)

[University of Michigan](#)

**Professor Gary Was**

- Wrote MATLAB programs to smooth data and extract empirical modeling equations.
- Made schematic drawings of laboratory equipment using SolidWorks.
- Prepared for and attended lab group meetings.

**Undergraduate Research Assistant, Information Sciences**

*March 2008 - May 2009*

[School of Information](#)

[University of Michigan](#)

**Professor Yan Chen**

- Conducted human subject computer laboratory experiments.
- Studied trends of Facebook start-up using SQL.

**Lab Assistant, Information Sciences**

*March 2008 - May 2009*

[School of Information](#)

[University of Michigan](#)

**Professor Yan Chen**

- Assisted graduate students in their human subject computer laboratory experiments.
- Recruited subjects for experiments.
- Edited instructions for experiments.

**REU Student, Information Sciences**

*May 2008 - July 2008*

**School of Information**

**University of Michigan**

**Professor Yan Chen**

- Investigated trends of Facebook start-up (urTurn.com) using SQL.
- Made a research presentation on urTurn.com.
- Attended career training seminars.

**Lab Assistant**

*May 2007 - August 2007*

**Department of Chemistry**

**University of Michigan**

**Professor Penner-Hahn**

- Improved upon MATLAB algorithm that imaged microscopic worms.
- Assisted in series of experiments at Argonne National Laboratory.

**Lab Assistant**

*June 2006 - July 2006*

**Department of Biology**

**University of Michigan**

**Professor Sherman**

- Prepared ocean floor samples for discovery of possible bacteria strains.
- Assisted graduate students in preparing laboratory experiments.

## **TEACHING EXPERIENCE**

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**Graduate Teaching Assistant**

*August 2014 - December 2014*

**Department of Electrical & Computer Engineering**

**University of New Mexico**

- **ECE 561: Engineering Electrodynamics.** Provided selected lectures.
- **ECE 555: Foundations of Engineering Electromagnetics.** Provided selected lectures.
- **ECE 563: Computational Electromagnetics.** Provided selected lectures.
- **ECE 360: Introduction to Electromagnetics:**
  - Graded bi-weekly homework assignments.
  - Prepared and held weekly office hours.
  - Provided selected lectures.



- [ECE 131: Programming Fundamentals:](#)
  - Graded bi-weekly homework assignments.
  - Prepared for and held weekly office hours.

**Graduate Teaching Assistant, [EMA 201: Statics](#)**

*January 2012 - May 2013*

[Department of Engineering Physics](#)

[University of Wisconsin-Madison](#)

- Prepared and taught two or three hours of discussion section each week.
- Held weekly office hours.
- Graded tests and assignments.
- Participated in bi-weekly planning sessions with other teaching assistants and lead instructor.

**Teaching Assistant, Calculus**

*September 2006 - January 2007*

[Department of Mathematics](#)

[Pioneer High School, Ann Arbor](#)

**Laurie Hochrein**

- Graded extra credit assignments.
- Taught lessons on selected topics.
- Answered student questions.

**Math Tutor**

*January 2006 - May 2006*

- Provided tutoring for two middle school students in mathematics.
- Developed curriculum for tutoring sessions.

## **PROFESSIONAL SERVICE**

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[Margaret Butler Review Committee](#)

*March 2019*

[INCITE Computational Readiness Review Committee](#)

*2019*

**Career Mentoring to High School Students**

*2018-19*

[International Journal of Antennas and Propagation](#)

*Reviewer*

[Waves in Random and Complex Media](#)

*Reviewer*

## **PROFESSIONAL SOCIETIES**

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[IEEE](#)

*2015 - 2018*

[SIAM](#)

*2016 - 2018*

[APS](#)

*2018 - 2019*

## **CLEARANCES**

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[Department of Defense Secret](#)

*2012-2022*

## **AWARDS & HONORS**

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- [UNM Leadership and Involvement Award](#), 2018.
- [GPSA President's Award for Innovative Leadership](#), 2017.
- [ECE Outstanding Graduate Student](#), 2017.
- [Who's Who](#) Among American Colleges & Universities, 2017.
- [ECE GSA Student Paper Competition – Journal Paper Section](#), 3rd prize, 2016.
- [Eagle Scout](#), February 2007.
- Michigan Peace Prize, January 2007.

## **OTHER EXPERIENCE**

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### **UNM GPSA**

*Fall 2015 - May 2018*

- GPSA Alternate Representative to [Student Fee Review Board](#) (July 2017 - May 2018)
- [Department of ECE Delegate](#) (August 2015 - May 2016, August 2016 - May 2017)
- [GPSA Finance Committee](#) Member (August 2016 - May 2017)
- GPSA Representative to [Information Technology Committee](#) (August 2015 - May 2016)
- [Legislative Steering Committee](#) Member-at-large (February 2016 - May 2016)
- Organized first annual department-wide student paper competition.
- Helped arrange for a regular meeting room within the department.

### **UNM ECE Graduate Student Association (GSA)**

*Fall 2015 - May 2017*

- ECE GSA [Vice-President](#) (June 2016 - May 2017)
- ECE GSA [Volunteer Member](#) (August 2015 - May 2016)

### **Alpha Sigma Phi**

*Fall 2007 - Present*

- [Grand Chapter Advisor](#) (November 2012 - May 2013)
- [Financial Advisor](#) (November 2012 - August 2014)
- [Brotherhood Development Director](#) (January 2011 - April 2011)
- [Philanthropy Director](#) (January 2009 - December 2010)
- [Treasurer](#) (January 2008 - December 2009)

### **Study Abroad in Argentina**

*June 2010 - August 2010*

- Attained an intermediate working knowledge of spoken and written Spanish.
- Gained extensive practice in intercultural interactions.

### **MPowered Entrepreneurship**

*September 2009 - December 2009*

- Member of team that planned Global Entrepreneurship week.
- Recruited entrants for 1000 Pitches contest.
- Promoted the philosophy of entrepreneurship throughout campus.

### **Youth Group of First United Methodist**

*September 2001 - June 2007*

- Leader within a high school team that raised \$50,000 to build a church in Bulgaria.
- Part of team that won Michigan Peace Prize (2007) for filming a documentary on religious diversity.
- Participated in multiple service mission trips, including three international locations.



**Boy Scouts of America***September 2000 - June 2007*

- Completed an Eagle Scout Service Project.
- Held various leadership positions, including Senior Patrol Leader.
- Participated in outdoor adventure activities with the Venture Patrol.
- Attended the 2001 National Scout Jamboree.
- Completed 25 skills-based merit badges.