Jacob Coty Stephens, Ph.D.

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Texas Tech University
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CURRENT POSITION

Texas Tech University — Lubbock, TX
Assistant Professor — September 2019 – Present

EDUCATION

Texas Tech University	PhD, Electrical Engineering	2015
Texas Tech University	MS, Electrical Engineering	2011
Texas Tech University	BS, Electrical Engineering	2011

CERTIFICATIONS

MIT – Kaufmann Teaching Program Certification — May 2018

RESEARCH EXPERIENCE

Massachusetts Institute of Technology — Cambridge, MA
Research Scientist — February 2018 – August 2019
Postdoctoral Research Associate — February 2016 – February 2018
My research at MIT involved the development of efficient high power THz and mm-wave sources with novel photonic structures and exploring their applications to low temperature plasma science. Independently, I am developing an improved understanding of fundamental kinetic phenomenon in low temperature plasmas based via Boltzmann equation based transport models.

Sandia National Laboratories — A
Graduate Student Scientist — May 2
Conducted research at SNL as a pulsed power engineer and plasma scientist for large scale, radiation effects testing efforts. This involved development of accurate power-flow models of the 10 MA Saturn accelerator and 18 MV HERMES III accelerator, as well as developing new concept designs for the revision of the Saturn accelerator. During this time, I held a DOE, Q-level security clearance. I have ongoing collaboration with Sandia, including co-authoring conference proceedings and periodically attending meetings in Albuquerque.

Texas Tech University – — Lubbock, TX
Center for Pulsed Power & Power Electronics
Senior Research Associate — May 2015 – January 2016
Graduate Research Associate — May 2010 – May 2015
Dissertation research involved the development and application of university-class pulsed power systems to study the equation-of-state and transport properties of dense, strongly coupled metal plasmas. During this time, I also developed intense VUV sources, and performed VUV/EUV spectroscopic measurements of low temperature plasmas, which included the first observation of photoionization capable EUV emission in developing low temperature plasmas.

TEACHING EXPERIENCE

Texas Tech University Lubbock, TX

Course Lecturer – Fundamentals of Electrical Engineering Fall 2015
Sophomore ECE course on circuit theory for electrical and computer engineering majors.

Guest Lecturer – Gaseous Electronics Fall 2015
Prepared and presented two lectures on the spectroscopy of low temperature plasmas and numerical modeling of low temperature plasmas for a graduate electrical engineering course.

Guest Lecturer – Introduction to Pulsed Power Spring 2015
Prepared and presented a two-part set of lectures on high power, transient voltage multipliers for a graduate electrical engineering course.

FELLOWSHIPS, AWARDS, AND AFFILIATIONS

Affiliations

LXCat Project Contributor May 2018 – Present
As a contributing member of the LXCat project, I oversee the development of educational tools for the low temperature plasma community. I also develop and contribute highly accurate kinetic tools for benchmarking electron-neutral cross-sections.

Eta Kappa Nu (EE Honor's Society) May 2009 – Present
IEEE Member August 2009 – Present
APS Member October 2013, May 2018 – Present

Fellowships

National Physical Sciences Consortium Fellowship September 2011 – May 2014
Doctoral Dissertation Fellowship September 2014 – May 2015

Awards

2013 IEEE Arthur Guenther International Pulsed Power Student Award June 2013

REFERENCES

Richard Temkin, Ph.D.
Senior Scientist, Dept. of Physics, Massachusetts Institute of Technology
Associate Director, Plasma Science & Fusion Center
Email: temkin@mit.edu
Phone: (617) 253-5528

Michael Shapiro, Ph.D.
Research Scientist, MIT Plasma Science & Fusion Center
Email: shapiro@psfc.mit.edu
Phone: (617) 253-8656

Kenneth Kreischer, Ph.D.
Program Manager, Northrop Grumman Corporation
Vacuum Electronics Research, Development, & Engineering
Email: kenneth.kreischer@ngc.com
Phone: (224) 625-4544

PUBLICATIONS

Peer Reviewed, First Author / Solo Author

1) J. Stephens, "A Multi-Term, Multi-Harmonic Boltzmann Equation Model for Kinetic Behavior in Intense Microwave and Terahertz Excited Low Temperature Plasmas", Phys. Plasmas, **25**, 103502 (2018).
2) J. Stephens, "A Multi-Term Boltzmann Equation Benchmark of Electron-Argon Cross-Sections in Low Temperature Plasma Environments", J. Phys. D: Appl. Phys. **51**, 125203 (2018).
3) J. Stephens, M. Abide, A. Fierro, A. Neuber, "Practical considerations for modeling streamer discharges in air with radiation transport", Plasma Sources Sci. Technol. **27**, 075007 (2018).
4) J. Stephens, A. Fierro, S. Beeson, G. Laity, D. Trienekens, R.P. Joshi, J. Dickens, A. Neuber, "Photoionization capable, extreme and vacuum ultraviolet emission in developing low temperature plasmas in air", Plasma Sources Sci. Technol. **25**, 025024 (2016).
5) J. Stephens, A. Fierro, D. Trienekens, J. Dickens, A. Neuber, "Optimizing drive parameters of a 121.6 nm source", Plasma Sources Sci. Technol. **24**, 015013 (2015).
6) J. Stephens, A. Fierro, B. Walls, J. Dickens, A. Neuber, "Nanosecond, repetitively pulsed microdischarge vacuum ultraviolet source" Appl. Phys. Lett. **104**, 074105 (2014).
7) J. Stephens, A. Fierro, J. Dickens, A. Neuber, "Influence of VUV illumination on breakdown mechanics: pre-ionization, direct photoionization, and discharge initiation" J. Phys. D: Appl. Phys. **47**, 325501 (2014).
8) J. Stephens, J. Dickens, A. Neuber, "Semiempirical wide-range conductivity model with exploding wire verification", Phys. Rev. E. **89**, 053102 (2014).
9) J. Stephens, A. Fierro, J. Dickens, A. Neuber, "Temporally resolved electron density of a nanosecond, repetitively pulsed microdischarge" J. Phys. D: Appl. Phys. **47**, 465205 (2014).
10) J. Stephens, A. Fierro, J. Dickens, A. Neuber, "Micrometer-resolution high speed imaging of pulsed microdischarge ignition", IEEE Trans. Plasma Sci. **42**, 2652 (2014).
11) J. Stephens, A. Neuber, "Exploding Wire Experiments and Theory for Metal Conductivity Evaluation in the Sub-eV Regime", Phys. Rev. E **86**, 066409 (2012).
12) J. Stephens, S. Beeson, J. Dickens, A. Neuber, "Charged Electret Deposition for the Manipulation of High Power Microwave Flashover Delay Times", Phys. Plasmas **19**, 112111 (2012).
13) J. Stephens, A. Neuber, "Electric Field Enhanced Conductivity in Strongly Coupled Dense Metal Plasma," Phys. Plasmas **19**, 060702 (2012).
14) J. Stephens, A. Neuber, M. Kristiansen, "Experimental and Theoretical Evaluation of Surface Coated Exploding Wires", Phys. Plasmas **19**, 032702 (2012).
15) J. Stephens, W. Mischke, A. Neuber, "The Impact of Wire Environment on Electro-Explosive Fuse Performance", IEEE Trans. Plasma Sci., **40**, pp. 2517-2522 (2012).

Peer Reviewed, Co-Author

16) J.F. Picard, S.C. Schaub, G. Rosenzweig, J.C. Stephens, M.A. Shapiro, R.J. Temkin, "Laser-Driven Semiconductor Switch for Generating Nanosecond Pulses from a Megawatt Gyrotron", accepted for publication in *Applied Physics Letters*.
17) S. Feathers, J. Stephens, A. Neuber, "550-W Ultraviolet Exciplex Source for Pulsed Power Applications", IEEE Trans. Plasma Sci., **47**, 508, (2019).
18) X. Lu, J.C. Stephens, I. Mastovsky, M.A. Shapiro, R.J. Temkin, "High Power Long Pulse Microwave Generation from a Metamaterial Structure with Reverse Symmetry", *Phys. Plasmas*, **25**, 023102 (2018).
19) A.V. Soane, M.A. Shapiro, J. Stephens, R.J. Temkin "Theory of Linear and Nonlinear Gain in a Gyroamplifier Using a Confocal Waveguide" IEEE Trans. Plasma Sci., **45**, 2438, (2017).
20) D. Trienekens, J. Stephens, A. Fierro, J. Dickens, A. Neuber, "Time-discretized extreme and vacuum ultraviolet spectroscopy of spark discharges in air, N_2, and O_2", J. Phys. D: Appl. Phys. **49**, 035201 (2016).
21) A. Fierro, J. Stephens, S. Beeson, J. Dickens, A. Neuber, "Discrete photon implementation for plasma simulations" Phys. Plasmas **23**, 013506 (2016).

Peer Reviewed, Submitted for publication

1) F. Liu, L. Nie, X. Lu, J. Stephens, K. Ostrikov, "Vacuum-free vacuum ultraviolet: Atmospheric plasma VUV photon emission for photo-dynamic science and technology", submitted for review in *Applied Physics Review*.

Peer Reviewed, In preparation

2) Jacob C. Stephens, Guy Rosenzweig, John C. Tucek, Mark A. Basten, Kenneth E. Kreischer, Michael A. Shapiro, Richard J. Temkin, "A Sub-Terahertz Photonic Crystal Based Amplifier"
3) L. Pitchford, *et al.* (international collaboration with the LXCat team) "Comparisons of sets of electron–neutral scattering cross sections and swarm parameters in noble gases: Carbon Dioxide"
4) L. Pitchford, *et al.* (international collaboration with the LXCat team) "Comparisons of sets of electron–neutral scattering cross sections and swarm parameters: Hydrogen and Deuterium"

Conference Presentations and Manuscripts

1) Oral presentation for the 2018 IEEE International Conference on Plasma Science

   Jacob C. Stephens, "Exploring Electron Kinetics in RF and Microwave Discharges Using a Non-Stationary, Multi-Term Boltzmann Equation Model" Proc. Of the 2018 IEEE International Conference on Plasma Science, June 24-28, 2018 in Denver, CO, USA.
2) Poster presentation for the 2018 IEEE International Conference on Plasma Science

   Jacob C. Stephens, Michael A. Shapiro, Richard J. Temkin, "Progress on the Fabrication and Test of an Extended Interaction Klystron with a New

Photonic Bandgap Topology" Proc. Of the 2018 IEEE International Conference on Plasma Science, June 24-28, 2018 in Denver, CO, USA.

3) Poster presentation and authored manuscript for the 2018 IEEE International Vacuum Electronics Conference

   Jacob C. Stephens, Guy Rosenzweig, John C. Tucek, Mark A. Basten, Kenneth E. Kreischer, Michael A. Shapiro, Richard J. Temkin, "Design and Test of a W-band Photonic Bandgap Extended Interaction Klystron Amplifier" Proc. Of the 2018 IEEE International Vacuum Electronics Conference, April 24-26, 2018 in Monterey, CA, USA.

4) Co-authored oral presentation and manuscript for the 2018 IEEE International Vacuum Electronics Conference

   Xueying Lu, Jacob C Stephens, Ivan Mastovsky, Michael A Shapiro, Richard J Temkin, "High Power Microwave Generation by Cherenkov-Cyclotron Instability in a Metamaterial Structure with Negative Group Velocity" Proc. Of the 2018 IEEE International Vacuum Electronics Conference, April 24-26, 2018 in Monterey, CA, USA.

5) Poster presentation at the 2017 IEEE International Conference on Plasma Science

   Jacob C. Stephens, Michael A. Shapiro, Richard J. Temkin, "Design of a 250 GHz Photonic Bandgap Extended Interaction Klystron" Proc. Of the 2017 IEEE International Conference on Plasma Science, May 21-25, 2017 in Atlantic City, NJ, USA.

6) Co-authored oral presentation at the 2017 IEEE International Conference on Plasma Science

   G. Rosenzweig, J.C. Stephens, Michael A. Shapiro, Richard J. Temkin, "Design of Oversized TWTs with Photonic Band-Gap Structures" Proc. Of the 2017 IEEE International Conference on Plasma Science, May 21-25, 2017 in Atlantic City, NJ, USA.

7) Oral presentation and authored manuscript for the 2017 IEEE International Vacuum Electronics Conference

   Jacob C. Stephens, Guy Rosenzweig, John C. Tucek, Mark A. Basten, Kenneth E. Kreischer, Michael A. Shapiro, Richard J. Temkin, "Design of a 94 GHz Photonic Bandgap Based Extended Interaction Klystron Amplifier" Proc. Of the 2017 IEEE International Vacuum Electronics Conference, April 24-26, 2017 in London, UK.

8) Co-authored presentation at the 2017 IEEE International Pulsed Power Conference

   N. Joseph, E. Holman, D.Kirschner, B. Lewis, J. Lott, J. Stephens, K. Struve, R. Thomas, "Characterization of Individual Pulsed Power Modules on the Saturn Accelerator", Proc. Of the 2017 IEEE Pulsed Power Conference, June 18-22, 2017, Brighton, UK.

9) Co-authored presentation and manuscript at the 2017 International Workshop on Multipactor, Corona, and Passive Intermodulation

   S. Lin, Y. Li, C. Liu, J. Stephens, "Improved Stationary Statistical Theory for Multipactor", Proc. of the 2017 International Workshop on Multipactor,

Corona, and Passive Intermodulation, April 5-7, 2017, Noordijk, The Netherlands.

10) Oral presentation at the 2016 IEEE International Conference on Plasma Science

J. Stephens, A. Neuber, "Photoionization in developing low temperature plasma streamer discharges in air" Proc. of the 2016 IEEE International Conference on Plasma Science, June 19-23, 2016 in Banff, Canada.

11) Co-authored presentation and manuscript at the 2016 IEEE International Conference on Plasma Science

S. Feathers, J. Stephens, A. Neuber, "Characterization of a UV discharge source for pulsed power applications" Proc. Of the 2016 IEEE International Conference on Plasma Science, June 19-23, 2016 in Banff, Canada.

12) Oral presentation at the 2015 IEEE International Conference on Plasma Science

J.C. Stephens, A. Fierro, S. Beeson, J. Dickens, A. Neuber, " Photoionization Relevant Extreme and Vacuum Ultraviolet Emission from Developing Low Temperature Plasmas in Air", Proc. of the 2015 IEEE International Conference on Plasma Science May 24-28, 2015 in Belek, Antalya, Turkey

13) Oral presentation at the 2015 IEEE International Conference on Plasma Science

J. Stephens, D. Mauch, S. Feathers, J. Mankowski, J. Dickens, A. Neuber, "Nanosecond, Pulsed Microdischarge UV and VUV Sources", Proc. of the 2015 IEEE International Conference on Plasma Science May 24-28, 2015 in Belek, Antalya, Turkey

14) Invited Presentation: Oral presentation at the 2015 IEEE International Pulsed Power Conference

J. Stephens, A. Fierro, S. Beeson, J. Dickens, A. Neuber, "Experimental Observation of Photoionization Relevant Emission from Developing Low Temperature Plasmas in Air", Proc. of the 2015 IEEE Pulsed Power Conference, May 31 – June 4, 2015 in Austin, TX, USA.

15) Oral presentation at the 2015 IEEE International Pulsed Power Conference

J. Stephens, D. Mauch, S. Feathers, J. Mankowski, J. Dickens, A. Neuber, "Nanosecond Pulsed UV Excimer Microdischarges for Photoconductive Switch Triggering", Proc. of the 2015 IEEE Pulsed Power Conference, May 31 – June 4, 2015 in Austin, TX, USA.

16) Oral presentation at the 2015 IEEE International Pulsed Power Conference

J. Stephens, J. Dickens, A. Neuber, "Exploding wires for nanosecond timescale, compact high power current interruption", Proc. of the 2015 IEEE Pulsed Power Conference, May 31 – June 4, 2015 in Austin, TX, USA.

17) Presented poster for the 2015 IEEE Pulsed Power Conference

J. Stephens, C. Hicks, J. Dickens, A. Neuber, W. Carey, O. Bergen "Generation of Intense Shockwaves in Air Using Exploding Wires", Proc. of the 2015 IEEE Pulsed Power Conference, May 31 – June 4, 2015 in Austin, TX, USA.

18) Co-authored presentation and manuscript for the 2015 IEEE Pulsed Power Conference

S. Feathers, A. Fierro, S. Beeson, J. Stephens, A. Neuber, "Fundamental Investigation of Microsecond Breakdown near a High Permittivity Dielectric"

Proc. of the 2015 IEEE Pulsed Power Conference, May 31 – June 4, 2015 in Austin, TX, USA.

19) Co-authored presentation and manuscript for the 2015 IEEE Pulsed Power Conference

N.R. Joseph, M.E. Savage, J.C. Stephens, B.A. Lewis, J.A. Lott, R.D. Thomas, "Enhancements to the Short Pulsed Nanosecond X-Radiator (SPHINX) Pulsed Power System" Proc. of the 2015 IEEE Pulsed Power Conference, May 31 – June 4, 2015 in Austin, TX, USA.

20) Oral presentation at the 2014 IEEE International Conference on Plasma Science

J. Stephens, A. Fierro, J. Dickens, A. Neuber, "Pulsed microdischarge, 121.6 nm VUV source with 40 watt peak power", Proc. of the 2014 IEEE International Conference on Plasma Science, May 25 – 29, 2014 in Washington D.C., USA.

21) Oral presentation at the 2014 IEEE International Conference on Plasma Science

J. Stephens, D. Ryberg, J. Dickens, A. Neuber, "Optimization of shock intensities generated by high current exploding wires", Proc. of the 2014 IEEE International Conference on Plasma Science, May 25 – 29, 2014 in Washington D.C., USA.

22) Oral presentation at the 2013 APS Gaseous Electronics Conference

J. Stephens, A. Fierro, J. Dickens, A. Neuber, "A short pulse, high rep-rate microdischarge VUV source", Proc. of the 2013 APS Gaseous Electronics Conference, September 30-October 4, 2013 in Princeton, New Jersey, USA.

23) Presented poster for the 2013 Pulsed Power and Plasma Sciences Conference

J. Stephens, J. Dickens, A. Neuber, "Development of a Pulsed Micro Hollow Cathode Discharge Array", Proc. of the 2013 IEEE Pulsed Power and Plasma Sciences Conference, June 16-21, 2013 in San Francisco, California, USA.

24) Oral presentation and authored manuscript for the 2013 Pulsed Power and Plasma Sciences Conference

J. Stephens, J. Dickens, A. Neuber, "Hydrodynamic and Magnetohydrodynamic Modeling of Exploding Wires in Opening Switch Type Operation", Proc. of the 2013 IEEE Pulsed Power and Plasma Sciences Conference, June 16-21, 2013 in San Francisco, California, USA.

25) Oral presentation and authored manuscript for the 2012 Megagauss Magnetic Field Generation and Related Topics Conference

J. Stephens, A. Neuber, M. Kristiansen, "Simulation of an Exploding Wire Opening Switch", Proc. of the 2012 IEEE International Megagauss Magnetic Field Generation and Related Topics Conference, October 14-19, 2012 in Wailea, Hawaii, USA.

26) Oral presentation and authored manuscript for the 2012 IEEE Power Modulator and High Voltage Conference

J. Stephens, A. Neuber, J. Dickens, M. Kristiansen, "Experimentation and Simulation of High Current Density Surface Coated Electro-Explosive Fuses", Proc. of the 2012 IEEE International Power Modulator and High Voltage Conference, June 3-7, 2012 in San Diego, California, USA.

27) Co-Authored invited presentation for the 2012 International Conference on Plasma Science

A.A. Neuber, J. C. Stephens, C. Lynn, J. Walter, J. Dickens, M. Kristiansen, “Stand-Alone Pulsed Power Generator for HPM Generation” Proc. of the 2012 IEEE International Conference on Plasma Science, July 8-12, 2012, in Edinburgh, United Kingdom.

28) Presented poster and authored manuscript for the 2011 IEEE International Pulsed Power Conference

J. Stephens, A. Neuber, J. Dickens, M. Kristiansen, “Compact Electro-Explosive Fuse Optimization for a Helical Flux Compression Generator”, Proc. of the 2011 IEEE International Pulsed Power Conference, pg. 517-522, June 19-23, 2011 in Chicago, Illinois, USA.

29) Co-Authored manuscript for the 2010 Power Modulator and High Voltage Conference

C. Davis, A. Neuber, J. Stephens, A. Young, J. Dickens, M. Kristiansen, “Optimizing Wire Parameters in Exploding Wire Arrays", Proc. Of the 2010 Power Modulator and High Voltage Conference, pg. 549-552, May 23-May 27, 2010 in Atlanta, Georgia, USA.