

Gerard Lawler

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EDUCATION

2017 - present PhD in Physics (in progress) at **University of California, Los Angeles**
2016 - 2017 MS in Physics at **University of California, Los Angeles**
2015 - 2020 Coursework from **US Particle Accelerator School** (4 courses)
2012 - 2016 BA in Physics from **Boston University**

SUMMARY

Graduate student in physics specializing in the development of novel techniques for increasing electron photoinjector brightness particularly for reducing the size of free electron lasers (FELs). I have additional interest in light-matter interaction and radio-frequency engineering, especially in the context of micron to nanometer scale structures and their effects on field emission of electrons.

RESEARCH EXPERIENCE

Particle Beam Physics Laboratory (PBPL), UCLA

Aug 2016 - present

- Cryogenics design for RF cavity accelerator
- Pulsed power development in C and S band frequencies
- Laser optics and vacuum engineering for high harmonic generation experiment
- Teaching and management of up to 6 undergraduate research projects
- Plasmonic and beam dynamics simulations for surface studies involved in high harmonic generation
- Novel multipole magnet design
- Fabrication of nanoscale structures with anisotropic wet etches of silicon wafers

AEgIS Collaboration, CERN

2015 - 2016

- Antiproton beam dynamics simulations
- Ion optics design and manufacturing: incl. einzel lenses, hemispheric analyzers, and Penning traps

Center for Space Physics, BU

2012 - 2015

- Data mining and analysis for characterization of daily Martian ionosphere measurements
- semi-empirical modeling of peak electron density and total electron content of Martian ionosphere
- web design and maintenance of Mars International Reference Ionosphere (MIRI) website

PROJECTS

MOTHRA Laboratory

[Link to Webpage](#)

Commissioning of the new Multi-Objective Testing for High Gradient Radiofrequency Accelerators (MOTHRA) laboratory space on the site of the former UCLA cyclotron lab. The space includes a 30 in concrete bunker and associated laser clean room to perform studies relevant to the development of ultra high gradient RF accelerators and infrastructure development towards an ultra compact xray free electron laser. Site for CYBORG (CrYogenic Brightness-Optimized Radiofrequency Gun) beamline for photoemission and RF testing.

MITHRA Laboratory

[Link to Webpage](#)

Worked on development of an electron linear accelerator test facility located on UCLA's southwest campus in Westwood called MITHRA (Megavolt InTense High-gradient Research Accelerator (MITHRA)).

Beam Production and Cathode Development

[Read more](#)

Electrons used in linear accelerators are generated via materials known as cathodes. At PBPL we study emission physics from a theoretical perspective in order to study cathode behavior in order to improve beam brightness, current, and other figures of merit. Developed several concepts for higher brightness photo and field emission cathodes.

MIRI

[Link to Homepage](#)

The Mars International Reference Ionosphere (MIRI) is a semi empirical modeling reference for Martian ionosphere properties.

TEACHING EXPERIENCE

UCLA Department of Physics and Astronomy, *Teaching Assistant*

2019

- Upper division lab for physics majors
- Aided in curriculum redesign focusing more on scripting and data analysis with statistical software packages

Boston University Physics Department, *Learning Assistant*

2014 - 2015

- Ran discussions with graduate teaching assistant, and held independent office hours to assist students
- Taught introductory electromagnetism course for pre-medical students and advanced lab course for graduate students

Boston University Physics Department, , *Lab technician*

2012 - 2015

- Maintained physics demonstration stock room for department.
- Designed and created new demonstrations of physical phenomenon for classes and special events.

Museum of Science Boston, *SciCORE Intern*

2011

- Educated visitors and taught/interpreted exhibits for them.
- Designed exhibit displays and interpretations for use with the general public.
- Trained new staff and volunteers

PUBLICATIONS

Lawler, G.E., F. Bosco, et al. (Oct. 2022). "Cyborg Beamline Development Updates". In: *Proc. 5th Int. Particle Accel. Conf. (NAPAC'22)* (Albuquerque, NM, USA). International Particle Accelerator Conference 5. JACoW Publishing, Geneva, Switzerland, TUPA80, pp. 512–515. ISBN: 978-3-95450-232-5. DOI: [10.18429/JACoW-NAPAC2022-TUPA80](#).

Lawler, G.E., A. Fukasawa, Z. Li, A. Mostacci, et al. (Oct. 2022). "Design of a High-Power RF Breakdown Test for a Cryocooled C-Band Copper Structure". In: *Proc. 5th Int. Particle Accel. Conf. (NAPAC'22)* (Albuquerque, NM, USA). International Particle Accelerator Conference 5. JACoW Publishing, Geneva, Switzerland, TUPA81, pp. 516–518. ISBN: 978-3-95450-232-5. DOI: [10.18429/JACoW-NAPAC2022-TUPA81](#).

- Lawler, G.E., A. Fukasawa, N. Majernik, J.R. Parsons, et al. (July 2022). “CrYogenic Brightness-Optimized Radiofrequency Gun (CYBORG)”. In: *Proc. IPAC’22* (Bangkok, Thailand). International Particle Accelerator Conference 13. JACoW Publishing, Geneva, Switzerland, THPOST046, pp. 2544–2547. ISBN: 978-3-95450-227-1. DOI: [10.18429/JACoW-IPAC2022-THPOST046](https://doi.org/10.18429/JACoW-IPAC2022-THPOST046).
- Lawler, G.E., A. Fukasawa, N. Majernik, and J.B. Rosenzweig (July 2022). “Temperature Dependent Effects on RF Surface Resistivity”. In: *Proc. IPAC’22* (Bangkok, Thailand). International Particle Accelerator Conference 13. JACoW Publishing, Geneva, Switzerland, THPOST045, pp. 2540–2543. ISBN: 978-3-95450-227-1. DOI: [10.18429/JACoW-IPAC2022-THPOST045](https://doi.org/10.18429/JACoW-IPAC2022-THPOST045).
- Lawler, G.E., N. Majernik, J.I. Mann, N. Montanez, et al. (Oct. 2022). “Development of Nanopatterned Strong Field Emission Cathodes”. In: *Proc. 5th Int. Particle Accel. Conf. (NAPAC’22)* (Albuquerque, NM, USA). International Particle Accelerator Conference 5. JACoW Publishing, Geneva, Switzerland, THYD5, pp. 863–865. ISBN: 978-3-95450-232-5. DOI: [10.18429/JACoW-NAPAC2022-THYD5](https://doi.org/10.18429/JACoW-NAPAC2022-THYD5).
- Lawler, G.E., N. Majernik, J.I. Mann, N.E. Montanez, et al. (July 2022). “Emittance Measurements of Nanoblade-Enhanced High Field Cathode”. In: *Proc. IPAC’22* (Bangkok, Thailand). International Particle Accelerator Conference 13. JACoW Publishing, Geneva, Switzerland, MOPOMS033, pp. 709–712. ISBN: 978-3-95450-227-1. DOI: [10.18429/JACoW-IPAC2022-MOPOMS033](https://doi.org/10.18429/JACoW-IPAC2022-MOPOMS033).
- Mann, J.I., T. Arias, S.S. Karkare, et al. (Oct. 2022). “Simulations of Nanoblade Cathode Emissions with Image Charge Trapping for Yield and Brightness Analyses”. In: *Proc. 5th Int. Particle Accel. Conf. (NAPAC’22)* (Albuquerque, NM, USA). International Particle Accelerator Conference 5. JACoW Publishing, Geneva, Switzerland, TUPA86, pp. 535–538. ISBN: 978-3-95450-232-5. DOI: [10.18429/JACoW-NAPAC2022-TUPA86](https://doi.org/10.18429/JACoW-NAPAC2022-TUPA86).
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- Parsons, J.R. et al. (July 2022). “Temperature Dependent Effects on Quality Factor in C-band RF Cavities”. In: *Proc. IPAC’22* (Bangkok, Thailand). International Particle Accelerator Conference 13. JACoW Publishing, Geneva, Switzerland, THPOTK027, pp. 2826–2828. ISBN: 978-3-95450-227-1. DOI: [10.18429/JACoW-IPAC2022-THPOTK027](https://doi.org/10.18429/JACoW-IPAC2022-THPOTK027).
- Sakai, Y. et al. (July 2022). “Introduction of Westwood Linear Accelerator Test Facility in University of California Los Angeles”. In: *Proc. IPAC’22* (Bangkok, Thailand). International Particle Accelerator Conference 13. JACoW Publishing, Geneva, Switzerland, TUPOPT035, pp. 1085–1088. ISBN: 978-3-95450-227-1. DOI: [10.18429/JACoW-IPAC2022-TUPOPT035](https://doi.org/10.18429/JACoW-IPAC2022-TUPOPT035).
- Wang, B. et al. (July 2022). “Simulations of Laser Field Emission from Nanostructures with Image Charge Trapping and Band Structure Transitions”. In: *Proc. IPAC’22* (Bangkok, Thailand). International Particle Accelerator Conference 13. JACoW Publishing, Geneva, Switzerland, MOPOMS036, pp. 717–720. ISBN: 978-3-95450-227-1. DOI: [10.18429/JACoW-IPAC2022-MOPOMS036](https://doi.org/10.18429/JACoW-IPAC2022-MOPOMS036).
- Fukasawa, A. et al. (Aug. 2021). “Advanced Photoinjector Development at the UCLA SAMURAI Laboratory”. In: *Proc. IPAC’21* (Campinas, SP, Brazil). International Particle Accelerator Conference 12. JACoW Publishing, Geneva, Switzerland, WEPAB056, pp. 2728–2731. ISBN: 978-3-95450-214-1. DOI: [10.18429/JACoW-IPAC2021-WEPAB056](https://doi.org/10.18429/JACoW-IPAC2021-WEPAB056).
- Lawler, G.E., A. Fukasawa, Z. Li, N. Majernik, et al. (Aug. 2021). “RF Testbed for Cryogenic Photoemission Studies”. In: *Proc. IPAC’21* (Campinas, SP, Brazil). International Particle Accelerator Conference

12. JACoW Publishing, Geneva, Switzerland, WEPAB096, pp. 2810–2813. ISBN: 978-3-95450-214-1. DOI: [10.18429/JACoW-IPAC2021-WEPAB096](https://doi.org/10.18429/JACoW-IPAC2021-WEPAB096).
- Lawler, G.E., J.I. Mann, et al. (Aug. 2021). “Initial Nanoblade-Enhanced Laser-Induced Cathode Emission Measurements”. In: *Proc. IPAC’21* (Campinas, SP, Brazil). International Particle Accelerator Conference 12. JACoW Publishing, Geneva, Switzerland, WEPAB097, pp. 2814–2817. ISBN: 978-3-95450-214-1. DOI: [10.18429/JACoW-IPAC2021-WEPAB097](https://doi.org/10.18429/JACoW-IPAC2021-WEPAB097).
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- Mann, J.I., T. Arias, G.E. Lawler, et al. (Aug. 2021). “Simulations of Nanoblade-Enhanced Laser-Induced Cathode Emissions and Analyses of Yield, MTE, and Brightness”. In: *Proc. IPAC’21* (Campinas, SP, Brazil). International Particle Accelerator Conference 12. JACoW Publishing, Geneva, Switzerland, WEPAB147, pp. 2957–2960. ISBN: 978-3-95450-214-1. DOI: [10.18429/JACoW-IPAC2021-WEPAB147](https://doi.org/10.18429/JACoW-IPAC2021-WEPAB147).
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- Shao, Y.Z. et al. (Aug. 2021). “Tapered Modular Quadrupole Magnet to Reduce Higher-Order Optical Aberrations”. In: *Proc. IPAC’21* (Campinas, SP, Brazil). International Particle Accelerator Conference 12. JACoW Publishing, Geneva, Switzerland, THPAB328, pp. 4429–4431. ISBN: 978-3-95450-214-1. DOI: [10.18429/JACoW-IPAC2021-THPAB328](https://doi.org/10.18429/JACoW-IPAC2021-THPAB328).
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- Lawler, Gerard et al. (2019). “Electron Diagnostics for Extreme High Brightness Nano-Blade Field Emission Cathodes”. In: *Instruments* 3.4. ISSN: 2410-390X. DOI: <https://doi.org/10.3390/instruments3040057>.

- Mann, Joshua et al. (2019). “1D Quantum Simulations of Electron Rescattering with Metallic Nanoblades”. In: *Instruments* 3.4. ISSN: 2410-390X. DOI: [10.3390/instruments3040059](https://doi.org/10.3390/instruments3040059).
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- Rosenzweig, J.B., A. Cahill, et al. (2018). “Ultra-high brightness electron beams from very-high field cryogenic radiofrequency photocathode sources”. In: *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 909. 3rd European Advanced Accelerator Concepts workshop (EAAC2017), pp. 224–228. ISSN: 0168-9002. DOI: <https://doi.org/10.1016/j.nima.2018.01.061>.
- Rosenzweig, J.B., F. Filippi, et al. (2018). “Adiabatic plasma lens experiments at SPARC”. In: *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 909. 3rd European Advanced Accelerator Concepts workshop (EAAC2017), pp. 471–475. ISSN: 0168-9002. DOI: <https://doi.org/10.1016/j.nima.2018.02.016>.
- Roussel, R., G. Andonian, M. Conde, et al. (2018). “Measurement of transformer ratio from ramped beams in the blowout regime”. In: *Nuclear Instruments and Methods in Physics Research Section A: Accelerators, Spectrometers, Detectors and Associated Equipment* 909. 3rd European Advanced Accelerator Concepts workshop (EAAC2017), pp. 130–133. ISSN: 0168-9002. DOI: <https://doi.org/10.1016/j.nima.2018.02.002>.
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- Mendillo, M et al. (2015). “The equivalent slab thickness of Mars’ ionosphere: Implications for thermospheric temperature”. In: *Geophysical Research Letters* 42.9, pp. 3560–3568. DOI: <https://doi.org/10.1002/2015GL063096>.
- Mendillo, Michael et al. (2013). “A new semiempirical model of the peak electron density of the Martian ionosphere”. In: *Geophysical Research Letters* 40.20, pp. 5361–5365. DOI: <https://doi.org/10.1002/2013GL057631>.

SKILLS

Programming	Python, C/C++, JAVA, Fortran, IDL, Matlab, Mathematica, LaTeX
Other Software	HFSS, CST, SolidWorks, Lumerical, IDL, ROOT, Matlab, Mathematica, LabVIEW
Operating Systems	Linux (Ubuntu, CentOS, Debian), Windows
Nanofabrication	Photomask layout and write, spin coating, photolithography, sputtering, plasma-enhanced chemical vapor deposition
Electronics	Microcontrollers, signal processing, robotics, fast electronics

STUDENT ADVISING

Sean O’Tool, *UCLA Undergraduate*

Jan 2023 - present

Cryogenic material testing for cathode plugs in high gradient RF photoguns.

Jake Parsons, *UCLA Post-Bac Researcher*

Jan 2021 - Jan 2023

Developed cryogenic testing infrastructure and Cband RF power infrastructure at UCLA Mothra laboratory. Several proceedings contributions authored and publication in progress.

Nathan Montanez, *UCLA Undergraduate*

Jan 2022 - present

Trained in nanofabrication procedures in coordination with UCLA Nanolab. Data analysis of nanoblade cathode measurements. Developed additional calibration tests for diagnostics. Developing nanofabrication recipe modifications.

Arathi Suraj, *UCLA Undergraduate*

Jan 2021 - 2022

Developed testing infrastructure for novel solenoid development and assisted in development of novel solenoid magnets for electron beam diagnostics in UCLA Mothra laboratory.

Oliver Shao, *UCLA Undergraduate*

2019-2020

Performed high frequency cavity simulations using HFSS and magnet simulation of novel pole shape leading to conference proceedings contribution.

Victor Yu, *UCLA Undergraduate*

Jan 2018 - 2021

Trained in nanofabrication procedures in coordination with UCLA Nanolab. Manufactured several generations of nanoblade patterned field emission cathodes for characterisation diagnostics. Developed electron beam diagnostics for nanoblade cathodes. Developed two novel cathodes based on AMO techniques leading to multiple provisional patents.

River Robles, *UCLA Undergraduate*

Jan 2018 - 2020

Trained in nanofabrication procedures in coordination with UCLA Nanolab. Manufactured several generations of nanoblade patterned field emission cathodes for characterisation diagnostics.

Yumeng Zhuang, *UCLA Undergraduate*

2018-2019

Ran beam dynamics simulations using C++ library Ion Beam Simulator and designed beam optics and diagnostic elements for low energy ($< 1\text{keV}$) electrons from novel cathodes.

Kunal Sanwalka, *UCLA Undergraduate*

2017 - 2019

Ran beam dynamics simulations using GPT and designed beam optics and diagnostic elements for low energy ($< 1\text{keV}$) electrons from novel cathodes.

CONFERENCES AND WORKSHOPS

LCWS23, Contributed Talk

2023

Title: *Application of CrYogenic Brightness-Optimized Radiofrequency Gun (CYBGORG) for Future Collider Studies*

IPAC23, Poster Talk

2023

Title: *Effects of Bulk Material Properties on RF Surface Resistivity*

IPAC23, Poster Talk

2023

Title: *Temperature Stability in CrYogenic Brightness-Optimized Radiofrequency Gun (CYBORG)*

IPAC23, Poster Talk

2023

Title: *Novel Fabrication Methods and Geometries of Nanoblade Cathodes*

MeVArc22, Contributed Talk

2022

Title: *High Gradient CrYogenic Brightness-Optimized Radiofrequency Gun (CYBORG) Test Bed*

NAPAC22, Invited Contributed Talk	2022
Title: <i>Development of Nanopatterned Strong Field Emission Cathodes</i>	
NAPAC22, Poster Talk	2022
Title: <i>Cyborg Beamline Development Updates</i>	
NAPAC22, Poster Talk	2022
Title: <i>Design of a High-Power RF Breakdown Test for a Cryocooled C-Band Copper Structure</i>	
NAPAC22, Poster Talk	2022
Title: <i>Nanopatterned Cathodes</i>	
IPAC22, Poster Talk	2022
Title: <i>Emittance Measurements of Nanoblade-Enhanced High Field Cathode</i>	
IPAC22, Poster Talk	2022
Title: <i>Introduction of Westwood Linear Accelerator Test Facility in University of California Los Angeles</i>	
IPAC22, Poster Talk	2022
Title: <i>Temperature Dependent Effects on RF Surface Resistivity</i>	
IPAC22, Poster Talk	2022
Title: <i>CrYogenic Brightness-Optimized Radiofrequency Gun (CYBORG)</i>	
IPAC22, Poster Talk	2022
Title: <i>Temperature Dependent Effects on Quality Factor in C-band RF Cavities</i>	
HG22, Invited Talk	2022
Title: <i>UCLA Breakdown & HG Research Updates</i>	
HG22, Invited Talk	2022
Title: <i>CrYogenic Brightness-Optimized Radiofrequency Gun (CYBORG)</i>	
IPAC21, Poster Talk	2021
Title: <i>RF Testbed for Cryogenic Photoemission Studies</i>	
IPAC21, Poster Talk	2021
Title: <i>Initial Nanoblade-Enhanced Laser-Induced Cathode Emission Measurements</i>	
IPAC21, Poster Talk	2021
Title: <i>Cryogenic Component and Material Testing for Compact Electron Beamlines</i>	
USPAS20 Winter Session	2020
Course Title: <i>Particle Driven Wakefield Accelerators; High Brightness Electron Injectors and Applications</i>	
2019 NSF STC Professional Development Workshop	2019
Student representative for NSF Center for Bright Beams	
Canadian-American-Mexican Graduate Student Physics Conference, Poster Talk	2019
Title: <i>Electron Diagnostics for Extreme High Brightness Nano-Blade Field Emission Cathode</i>	
Physics and Applications of High Brightness Beams Workshop	2019
Title: <i>Electron Diagnostics for Extreme High Brightness Nano-Blade Field Emission Cathode</i>	

USPAS18 Winter Session	2019
Course Title: <i>Advanced Accelerator Physics</i>	
Joint-US-CERN-Japan-Russia International Accelerator School	2017
Topic <i>RF Technologies</i>	
APS April Meeting	2017
Title <i>Generating a Reduced-energy Antiproton beam using Channeling Electrostatic elements (GRACE)</i>	
USPAS16 Summer Session	2016
Course Title: <i>Self-Consistent Simulations of Beam and Plasma Systems; Unifying Physics of Accelerators, Lasers and Plasma Synergy and Bridges</i>	
USPAS15 Summer Session	2015
Course Title: <i>Fundamentals of Accelerator Physics and Technology with Simulations and Measurements Lab</i>	

PROFESSIONAL ORGANIZATION

2018-present	IEEE , Nuclear and Plasma Sciences Society; Photonics Society; Young Professionals
2018-present	SPIE
2016-present	APS , Physics of Beams (DPB); Plasma Physics (DPP); Physics and Society (FPS); Laser Science (DLS); International Physics (FIP); Industrial and Applied Physics (FIAP); Graduate Student Affairs (FGSA); Far West Section (FWS); Early Career Scientists (FECS)

OTHER ACTIVITIES

NSF CBB Grad-to-Grad , <i>Chair</i>	2020 - present
Chaired graduate student dialogue meetings for NSF Center for Bright Beams in order to facilitate inter-university dialogue.	
MIPA Program , <i>Mentor</i>	2020
UCLA Exploring Your Universe , <i>Booth Leader</i>	2019 - present
Designed demonstration of scientific principles of particle accelerators using electrostatic spark generator. Organized and led team of volunteer educators at annual event with hundreds of elementary school aged children and other science enthusiasts.	
UCLA Astronomy Live! , <i>Educator</i>	2019
IEEE Try Engineering Together , <i>Mentor</i>	2019 - 2020
Correspondence between 3rd grade mentee as part of elementary school educational curriculum. Discussed engineering principles and reviewed age appropriate articles with supervision of elementary school instructor	
PRISM Program , <i>Mentor</i>	2015 - 2016
BU Chapter of Society of Physics Students (SPS) , <i>Co-President</i>	2014 - 2016
FIRST Robotics Team 125 Ask an Engineer , <i>Volunteer</i>	2012
FIRST Robotics Team 125 , <i>Co-Captain</i>	2011 - 2012

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