

MICHAEL D. LITOS

Curriculum Vitae, February 2021

Address: 390 UCB, Boulder, CO 80309 \diamond **Phone:** 303-492-6453 \diamond **Email:** michael.litos@colorado.edu

EMPLOYMENT

University of Colorado Boulder Assistant Professor, Department of Physics	<i>Sep. 2016 - Present</i>
SLAC National Accelerator Laboratory Associate Staff Scientist	<i>Nov. 2014 - Aug. 2016</i>
SLAC National Accelerator Laboratory Postdoctoral Research Associate	<i>July 2010 - Oct. 2014</i>

EDUCATION

Boston University Doctor of Philosophy: Physics	<i>July 2003 - May 2010</i>
Michigan State University Bachelor of Science: Physics; Additional Major: East Asian Studies (Japanese)	<i>Sep. 1998 - June 2003</i>

RESEARCH HIGHLIGHTS

University of Colorado Boulder

Assistant Professor, 2016 – Present

- Collaborator in 10 experiments related to plasma wakefield acceleration at the upcoming FACET-II facility at SLAC National Lab, commissioning in Spring 2021.
- Principle investigator for 3 experiments planned for FACET-II: Beam Emittance Preservation in a Plasma Wakefield Accelerator; Hard Focusing with a Thin Plasma Lens; Experimental Demonstration of an Ion Channel Laser.
- Developed comprehensive theory for transverse beam dynamics in plasma wakefield accelerators.
- Developed new laser-reliant techniques to generate advanced plasma sources for use in plasma wakefield acceleration.
- Developed novel plasma diagnostic schemes for wakefield accelerator plasma sources.
- Developed underdense plasma lens for use with high-energy electron beams that can produce the strongest possible focusing in vacuum.
- Developed new ultrafast photonic diagnostic (electro-optic sampling beam position monitor) for relativistic electron beams.
- Developed physics case for the first experimental demonstration of an ion channel laser, which is a plasma-based analog of the free electron laser.

SLAC National Accelerator Laboratory

Associate Staff Scientist: 2014 – 2016

Postdoctoral Research Associate: 2010 – 2014, Supervisor: Dr. Mark Hogan

- Participated in planning, coordination, execution, and analysis for nearly all experiments carried out at the Facility for Advanced Accelerator Experimental Tests (FACET) at SLAC National Accelerator Laboratory over the full lifetime of the facility, 2011-2016.

- Demonstrated high-gradient, high-efficiency plasma wakefield acceleration for the first time. First author of corresponding publication in Nature, which was featured on the cover of the issue.
- Achieved still-standing record for greatest electron beam acceleration in a plasma-based accelerator (9 GeV energy gain in 1.3 meters). First author of corresponding publication.
- Discovered new regime of plasma wakefield acceleration for positron beams.
- Demonstrated multiple beam injection techniques, including beam ionization injection and laser ionization injection.
- Demonstrated hollow-channel plasma wakefield accelerator using positron bunches and measurement of the transverse wakefields contained therein.
- Measured electromagnetic field structure inside a plasma wakefield accelerator.
- Demonstrated high-gradient plasma wakefield acceleration in a high-ionization threshold gas.
- Measured long-range force acting on an electron beam passing near a neutral plasma column.

Boston University

Graduate Research Assistant: 2003 – 2010, Supervisor: Prof. Ed Kearns

- Member of the Super-Kamiokande and T2K collaborations. Participated in neutrino oscillation and nucleon decay analysis in addition to detector hardware and software upgrades.
- Developed Geant-4 simulation of a proposed near detector for T2K.
- Performed first search for dinucleon decay into charged kaons using Super-K data and established the standing limit for R-Parity violating, $\Delta B = 2$ decay process $pp \rightarrow K^+K^+$.
- Built and utilized first algorithm to identify and locate multiple particle vertices for a single event in a water Cherenkov detector.
- Performed first multi-variate analysis of Cherenkov detector data using a boosted decision tree.
- Designed, built, and installed detector monitor hardware at Super-K.
- Assisted with water Cherenkov detector upgrade for SK-III at Super-K.

TEACHING, ACADEMIC, AND SUPERVISION ACTIVITIES

Courses Taught at the University of Colorado Boulder:

Semester	Course Number	Course Title
2016 Fall	PHYS 3300 (lab instr.)	Intro to Electronics Lab
2017 Spring	PHYS 2170 (lecturer)	Gen. Physics III: Intro to Modern Physics
2017 Fall	PHYS 2170 (lecturer)	Gen. Physics III: Intro to Modern Physics
2018 Spring	PHYS 2020 (backup)	Gen. Physics II: Elec. and Magnetism (Non-Majors)
2018 Fall	PHYS 4150 (lecturer)	Intro to Plasma Physics
2019 Spring	PHYS 2020 (lecturer)	Gen. Physics II: Elec. and Magnetism (Non-Majors)
2020 Spring	PHYS 2170 (lecturer)	Gen. Physics III: Intro to Modern Physics
2020 Fall	PHYS 1115 (lecturer)	Gen. Physics I: Classical Mechanics (Majors)
2021 Spring	PHYS 5150 (lecturer)	Graduate Plasma Physics I

Courses Taught at the United States Particle Accelerator School:

Session	Role	Course Title
2016 Jan. Session	Co-Instructor	Particle-Driven Wakefield Accelerators
2020 Jan. Session	Co-Instructor	Particle-Driven Wakefield Accelerators

Student Research Supervision

- Current academic and research supervisor to four physics Ph.D. graduate students.
- Served as research supervisor for five undergraduate and post-bachelor research assistants.
- Two undergraduates graduated with honors based on research conducted under my supervision.

PROFESSIONAL SERVICE ACTIVITIES

Departmental Committee Work

Participant in various committees within the Physics Department at the University of Colorado Boulder.

Research Center Administration

Associate Director of the Center for Integrated Plasma Studies, May 2017 - present.

Professional Society Memberships

American Physical Society 2010 - present; *IEEE* 2018 - present.

Journal Referee Work

Refereed manuscripts for the following journals: *Nature*; *Nature Physics*; *Nature Scientific Reports*; *Physical Review Letters*; *Physical Review E*; *Physical Review Accelerators and Beams*; *IEEE Proceedings*.

Grant Proposal Review

Reviewed the following types of research grant proposals for the US DOE Office of Science, 2016 – present: *SBIR Phase 1 and 2*; *High Energy Physics*; *High Energy Density Laboratory Plasma Physics*; *Accelerator Stewardship*; *Early Career Award*.

Participated in comparative review panel for the US DOE Office of Science for *Accelerator Stewardship* research grant applications in 2018.

Reviewed a research grant proposal for the Agence Nationale de la Recherche (France) in 2019.

Conference Organization

Organizing committee member for *Physics and Applications for High Brightness Beams Workshop 2019*, Crete, Greece, April 8-12, 2019.

Organizing committee member for *Advanced Accelerator Concepts Workshop 2018*, Breckenridge, CO, Aug. 12-17, 2018. Obtained \$17k student support grant through NSF.

Working Group Leader for *Advanced Accelerator Concepts Workshop: Beam-Driven Plasma Wakefield Acceleration Working Group*, Washington, D.C., July 31-Aug. 5, 2016.

Working Group Leader for *Laser and Plasma Accelerator Workshop: Beam-Driven Plasma Wakefield Acceleration Working Group*, Goa, India, Sep. 2-6, 2013.

Research Funding Roadmap Workshops

First author and coordinator of white paper submitted to The National Academy of Sciences, Engineering, and Medicine for the Plasma 2020 Decadal Assessment, entitled “*Survey of Particle Beam-Driven Plasma Wakefield Acceleration Research*”. Submitted March 8, 2019.

Invited Participant at U.S. Department of Energy Workshop: “*Workshop to Chart a Roadmap for Advanced Accelerators*”, Washington, D.C., Feb. 2-3, 2016.

GRANTS AND AWARDS

PI: \$650k Early Career Award grant from NSF 2021-2025, “*CAREER: Coherent Radiation Production in an Ion Channel Laser*”.

PI: \$220k grant from NSF-DOE 2018-2020, “*High-Speed, High-Resolution Diagnostic System for a Plasma Wakefield Accelerator*”.

PI: \$1.1M grant from US DOE Office of Science 2017-2020, “*Plasma Source Development for Beam Emittance Preservation in a Plasma Wakefield Accelerator*”.

PI: \$1.15M grant from US DOE Office of Science 2020-2024, “*Emittance Preservation in a Plasma Wakefield Accelerator, Hard Focusing with a Thin Plasma Lens, and Demonstration of an Ion Channel Laser*”.

\$17k grant from NSF 2018, “*Student Participation Support for 2018 Advanced Accelerator Concepts Workshop*”. Used for student support at the AAC 2018 workshop in Breckenridge, CO.

Breakthrough Prize in Fundamental Physics 2016 (Super-Kamiokande and T2K Collaborations).

Okemos Education Foundation Distinguished Alumni Award 2016.

SELECTED INVITED PRESENTATIONS

1. FACET-II Science Workshop 2019, “*Tailored Plasma Sources for Emittance Preservation in PWFA and High-Brightness Plasma-Injected Beams*”, SLAC Nat’l Lab, Menlo Park, CA, Oct. 30, 2019.
2. Scientific Meeting of the Royal Society: Directions in particle beam-driven plasma wakefield acceleration, “*Beam Quality Preservation Challenges and Strategies*”, Kavli Royal Society Centre, Chicheley Hall, Newport Pagnell, UK, June 4-5, 2018.
3. Fermilab Workshop on Megawatt Rings & IOTA/FAST, “*Plasma Beam Modulator and Afterburner at FAST*”, Fermi National Accelerator Laboratory, Batavia, IL, May 7-10, 2018.
4. LOA Physics Seminar, “*Plasma Wakefield Acceleration Experiments at FACET*”, Laboratoire d’Optique Appliquée, Palaiseau, France, July 17, 2017.
5. CU Boulder Physics Colloquium, “*Plasma Wakefield Acceleration: Surfing on a Wave of Plasma*”, University of Colorado Boulder, Boulder, CO, Feb. 25, 2016.
6. American Physical Society Department of Particles and Fields Meeting, “*High Efficiency Acceleration of an Electron Beam in a Plasma Wakefield Accelerator*”, University of Michigan, Ann Arbor, MI, Aug. 7, 2015.
7. Laser and Plasma Accelerators Workshop 2015, “*Latest Results from FACET*”, Guadeloupe, France, May 13, 2015.
8. Advanced Accelerators and Concepts Workshop, “*High Efficiency, High Gradient PWFA at FACET*”, San Jose, CA, July 14, 2014 [plenary session].
9. Boston University High Energy Physics Departmental Seminar, “*Plasma Wakefield Acceleration: Not your parents’ particle accelerator*”, Boston University, Boston, MA, Apr. 11, 2014.
10. North American Particle Accelerator Conference, “*Plasma Wakefield Acceleration Results from the FACET Project*”, Pasadena, CA, Oct. 3, 2013.

SELECTED PUBLICATIONS

Underlined names represent CU graduate students under my supervision.

1. K. Hunt-Stone, R. Ariniello, C. E. Doss, J. R. Cary, and **M. D. Litos**, “Electro-optic sampling beam position monitor for relativistic electron beams”, *Physical Review Accelerators and Beams* (accepted 2021)
2. S. Archana, et al., “Extremely Dense Gamma-Ray Pulses in Electron Beam-Multifoil Collisions”, *Physical Review Letters* 126 064801 (2020)
3. R. Zgadzaj, et al., “Dissipation of electron-beam-driven plasma wakes”, *Nature Communications* 11 4753 (2020)
4. C. Doss, et al., “Laser-ionized, beam-driven, underdense, passive thin plasma lens”, *Physical Review Accelerators and Beams* 22 111001 (2019)
5. A. Deng, O. Karger, et al., “Generation and acceleration of electron bunches from a plasma photocathode”, *Nature Physics* 1745-2481, doi: 10.1038/s41567-019-0610-9 (2019)
6. R. Ariniello, C. E. Doss, K. Hunt-Stone, J. R. Cary, and **M. D. Litos**, “Transverse beam dynamics in a plasma density ramp”, *Physical Review Accelerators and Beams* 22 041304 (2019)
7. **M. Litos**, R. Ariniello, C. Doss, K. Hunt-Stone, and J. R. Cary, “Beam emittance preservation using Gaussian density ramps in a beam-driven plasma wakefield accelerator”, *Philosophical Transactions of the Royal Society A* 377 20180181 (2019)
8. ALLEGRO Collaboration, “Towards an Advanced Linear International Collider”, arXiv:1901.10370v2 (2019)
9. C. Lindstrom, et al., “Measurements of transverse wakefields induced by a misaligned positron bunch in a hollow channel plasma wakefield accelerator”, *Physical Review Letters* 120 124802 (2018)
10. **M. Litos**, R. Ariniello, C. Doss, K. Hunt-Stone, and J. R. Cary, “Experimental Opportunities for the Ion Channel Laser”, *Proceedings of the 2018 IEEE Advanced Accelerator Concepts Workshop* (2018)
11. C. Joshi, et al. “Plasma wakefield acceleration experiments at FACET-II”, *Plasma Physics and Controlled Fusion* 60 034001 (2018)
12. A. Doche, et al., “Acceleration of a trailing positron bunch in a plasma wakefield accelerator”, *Scientific Reports* 7 14180 (2017)
13. N. Vafaei-Najafabadi, et al., “Limitation on the accelerating gradient of a wakefield excited by an ultrarelativistic electron beam in rubidium plasma”, *Physical Review Special Topics: Accelerators and Beams* 1212 030004 (2017)
14. **M. Litos** and C. Jing, “Summary report of working group 4: Beam-driven acceleration”, *Proceedings of the 17th Advanced Accelerator Concepts Workshop* (2017)
15. S. Gessner, et al., “Demonstration of a positron beam-driven hollow channel plasma wakefield accelerator”, *Nature Communications* 7 11785 (2016)
16. S. Corde, et al., “High-field plasma acceleration in a high-ionization potential gas”, *Nature Communications* 7 11898 (2016)
17. C. Clayton, et al., “Self-mapping the longitudinal field structure of a nonlinear plasma accelerator cavity”, *Nature Communications* 7 12483 (2016)
18. E. Adli, et al., “Long-range attraction of an ultrarelativistic electron beam by a column of neutral plasma”, *New Journal of Physics* 18 103013 (2016)
19. S. Corde, et al., “Multi-gigaelectronvolt acceleration of a positron Beam in a self-loaded plasma wakefield”, *Nature* 524 442-445 (2015)

20. **M. Litos**, et al., “9 GeV energy gain in a beam-driven plasma wakefield accelerator”, *Plasma Physics and Controlled Fusion* 58 034017 (2015)
21. **M. Litos**, et al., “High-efficiency acceleration of an electron beam in a plasma wakefield accelerator”, *Nature* 515 92-95 (2014) [cover feature]
22. N. Vafaei-Najafabadi, et al., “Beam loading by distributed injection of electrons in a plasma wakefield accelerator”, *Physical Review Letters* 112 025001 (2014)
23. S. Green, et al., “Laser ionized preformed plasma at FACET”, *Plasma Physics and Controlled Fusion* 56 084011 (2014)
24. **M. Litos**, et al. (Super-Kamiokande Collaboration), “Search for dinucleon decay into kaons in Super-Kamiokande”, *Physical Review Letters* 112 131803 (2014) [corresponding author]
25. K. Abe, et al. (Super-Kamiokande Collaboration), “Search for nucleon decay via $n \rightarrow \bar{\nu}\pi^0$ and $p \rightarrow \bar{\nu}\pi^+$ ”, *Physical Review Letters* 113 121802 (2014)
26. **M. Litos**, et al., “Evaluation of temporal diagnostic techniques for two-bunch FACET beam”, PAC 2011 Proceedings, MOP242 (2011)
27. G. Mitsuka, et al. (Super-Kamiokande Collaboration), “Study of non-standard neutrino interactions with atmospheric neutrino data in Super-Kamiokande I and II”, *Physical Review D* 84 113008 (2011)
28. K. Abe, et al. (T2K Collaboration), “Indication of electron neutrino appearance from an accelerator-produced muon neutrino beam”, *Physical Review Letters* 107 041801 (2011)
29. R. Wendell, et al. (Super-Kamiokande Collaboration), “Atmospheric neutrino oscillation analysis with subleading effects in Super-Kamiokande I, II, and III”, *Physical Review D* 81 092004 (2010)
30. H. Nishino, et al. (Super-Kamiokande Collaboration), “Search for proton decay via $p \rightarrow e^+\pi^0$ in a large water Cherenkov detector”, *Physical Review Letters* 102 141801 (2009)
31. M. Fechner, et al. (Super-Kamiokande Collaboration), “Kinematic reconstruction of atmospheric neutrino events in a large water Cherenkov detector with proton identification”, *Physical Review D* 79 112010 (2009)
32. K. Abe, et al. (Super-Kamiokande Collaboration), “Measurement of atmospheric neutrino flux consistent with tau neutrino appearance”, *Physical Review Letters* 97 171801 (2006)