US Low Temperature Plasma Summer School (v23)
University of Michigan
26-30 June 2023

Monday 26 June			
North University Building, Room 1528	08:00 - 08:20	Registration	
	08:20-08:30	Introduction to Summer School	Peter Bruggeman and Mark Kushner
	08:30-10:00	1-Introduction to Plasmas	Scott Baalrud University of Michigan
	10:00-10:30	*Break*	
	10:30-12:00	2-Low Pressure Plasmas	Uwe Czarnetzki Ruhr University
	12:00 - 13:30	*Lunch*	
North University Building, Room 1528	13:30-15:00	3-High Pressure Plasmas	Jose Lopez Seton Hall University
	15:00-15:30	*Break*	
	15:30-17:00	4-Magnetized Plasmas and Plasma Wave Interactions	Ken Hara Stanford University
Michigan Union, Anderson Room	17:30-19:30	*Poster Session and light dinner/refreshments*	List of poster presentations below
Tuesday 27 June			
North University Building, Room 1528	08:30-10:00	5-Plasma Kinetics and Reactions	Uwe Kortshagen University of Minnesota
	10:00-10:30	*Break*	
	10:30-12:00	6-Thermal Plasmas	Javad Mostaghimi University of Toronto
	12:00 - 13:30	*Lunch*	
North University Building, Room 1528	13:30-15:00	7-Dusty Plasmas	Ed Thomas Auburn University
	15:00-15:30	*Break*	
	15:30-17:00	8-Low Pressure Plasma Surface Interactions	Gottlieb Oehrlein University of Maryland
	17:30-19:30	*Free night*	a) Nichols Arboretum b) Ann Arbor Comedy Showcase c) Recreation Sports Facility
Wednesday 28 June			
North University Building, Room 1528	08:15-9:45	9-Plasma Sources and Power System Design	Steve Shannon North Carolina State University
	9:45-10:15	*Break*	
	10:15-11:45	10-Modeling	Mark Kushner University of Michigan
	11:45-12:00	Group Photograph	
	12:00 - 13:30	*Lunch*	
North University Building, Room 1528	13:30-15:00	11-Diagnostics	Peter Bruggeman University of Minnesota

UM North Campus	15:30-18:00	*Lab Tours/Hands On Experiences*	See schedule below.
Thursday 29 June			
North University Building, Room 1528	08:30-09:45	12-High Pressure Plasma Surface Interactions	Katharina Stapelmann North Carolina State University
	09:45-10:00	*Break*	
	10:00-11:15	13-Electric Propulsion	Mitchell Walker Georgia Institute of Technology
	11:15-12:30	14-Health Applications	David Graves Princeton University
	12:30-14:00	*Lunch*	
North University Building, Room 1528	14:00-15:15	15-Environmental and Agricultural Applications	Selma Mededovic Thagard Clarkson University
	15:15-17:00	16-Materials Processing and Functionalization	Daphne Pappas PlasmaTreat, Inc.
Michigan Union, Anderson Room	18:00-20:00	*Banquet and Career Panel Discussion*	Slava Lukin, National Science Foundation Daphne Pappas, PlasmaTreat, Inc. Elijah Thimsen, Washington U.-St. Louis
Friday 30 June			
North University Building, Room 1528	08:30-09:45	17-Combustion and Flow Control	Igor Adamovich Ohio State University
	09:45-10:00	*Break*	
	10:00-11:15	18-Energy Applications	Elijah Thimsen Washington University-St. Louis
	11:15-11:45	*Wrap-Up*	
		End of Summer School	
	11:45-12:45	Lunch (optional)	
North University Building, room 1528	12:45 - 15:00	Special Session (optional): "Entrepreneurship in Low Temperature Plasmas"	
		S1-High-Energy Company: Starting and Running an LTP-Powered Business	Gregory Fridman AA Plasma LLC
		S2-Revolutionizing Water Treatment: Navigating the Challenges and Opportunities in Bringing Plasma-based Systems from the Lab to the Market	Selma Mededovic Thagard Clarkson University/DMAX Plasma Inc.
		S3-Bringing Plasma-Produced Materials to the Market: An Ongoing Learning Process	Lorenzo Mangolini University of California – Riverside/ SiLi-ion Inc.
		S4-Funding Academic Entrepreneurship	Mitchell Walker Georgia Institute of Technology

Tours, Demos and Moose-Zapdos Training (Wednesday Afternoon)

Low Temperature Plasma Measurements – Langmuir Probe

One of the most widely used diagnostics in the field of low temperature plasma (LTP) physics is the Langmuir probe, first introduced by Irving Langmuir, the founder of modern plasma physics. The Langmuir probe is used throughout plasma science as a means to obtain basic plasma data such as electron density, ion density, the floating potential, electron temperature and electron energy distribution. The probe itself is an electrically biased wire immersed in a plasma and collected current (I) is measured as a function of applied voltage (V). This I-V characteristic curve can then to related to the plasma properties. In this hands-on demonstration laboratory, you will generate a neon DC glow discharge plasma on which you will use a Langmuir probe to obtain an I-V characteristic curve and analyze it to get plasma properties. You will also have the opportunity to estimate the ionization potential of neon.

- Location: Cooley Laboratory, room 1958, 2355 Bonisteel Blvd, Ann Arbor, MI 48109 (UM North Campus)
- Session length: 45 minutes
- 5 Students/session
  Session 1: 3:30 pm - 4:15 pm
  Session 2: 4:30 pm - 5:15 pm
  Session 3: 5:30 pm – 6:15 pm
- Point of Contact: Roxanne Walker (rzpinsky@umich.edu)

Tour and Demonstrations of the *Plasmadynamics and Electric Propulsion laboratory*

Participants will receive a tour of the *Plasmadynamics and Electric Propulsion Laboratory,* one of the leading academic centers in the world for researching advanced forms of in-space propulsion (https://pepl.engin.umich.edu). The tour will highlight on-going work related to Hall thrusters, magnetic nozzles, and pulsed plasma thrusters. There also will be a demonstration of a table top Hall thruster in operation.

- Location: 1919 Green Rd, Ann Arbor, MI 48105 (UM North Campus)
- Session length: 45 minutes
- 20 Students/session
  Session 1: 3:45 pm - 4:30 pm
  Session 2: 4:45 pm - 5:30 pm
- Points of Contact: Parker Roberts (pjrob@umich.edu), Will Hurley (wjhurley@umich.edu)

Demonstration and Training on the MOOSE/Zapdos MultiPhysics Plasma Modeling Software

This workshop will be a hands on demonstration of plasma simulation software Zapdos developed in the MOOSE framework (https://shannon-lab.github.io/zapdos/). Software will be preinstalled and tested on lab computers at the University Michigan and students will reproduce a series of 0D and 1D simulations of low temperature plasmas to learn how to do plasma simulation in the MOOSE multi physics framework. A two-fluid (electron and ion) drift diffusion model will be used to study low temperature plasma simulation including plasma formation, steady state operating conditions, and chemistry tracking.

- Location: GG Brown Laboratory (GGBL), room 2517, 2350 Hayward St, Ann Arbor, MI 48109 (UM North Campus)
- Session Length: 3 hours
- Session time: 3:30 pm – 6:30 pm
- 47 available seats
- Point of Contact: Prof. Steven Shannon (scshanno@ncsu.edu

Poster Presentations

	Presenter	Institution	Title
1	Omar Alsaeed	North Carolina State University	Plasma Stability Models for Radiofrequency Discharges
2	Aishwarya Belamkar	University of California,-Riverside	Synthesis of Carbon Black from Methane Using a Non-Thermal Plasma
3	Shubham Dongarwar	University of Minnesota	Laser Induced Fluorescence (LIF) on RF Plasma Jet
4	Ulisses Alberto Heredia Rivera	Purdue University	Cold Atmospheric Plasma Assisted Direct Deposition of Polypyrrole-Ag Nanocomposites for Flexible Electronics
5	Yves Heri	Michigan State University	Space Charge Effects on the Short Pulse Beam Profile
6	Mohammad Sazzad Hossain	North Carolina State University	Computational Modeling of an Atmospheric Pressure Plasma Containing CF_4
7	Maryam Khaji	University of Illinois at Urbana-Champaign	Plasma-assisted CO_2 Dissociation in Supersonic Nozzles
8	Nicholas Murphy	Center for Astrophysics | Harvard & Smithsonian	A Low Temperature Plasma Working Group for PlasmaPy?
9	Ripudaman Singh Nirwan	West Virginia University	Detecting Energetic Electrons in Magnetic Reconnection in the PHAse Space MApping (PHASMA) Experiment
10	Mohammed Sahal	Arizona State University	Improved Solid Electrolyte-Electrode Interface with Open-Air Plasma Treatment
11	Ephraim Simasiku	University of Massachusetts Lowell	Three-dimensional Modelling of an Atmospheric Pressure Glow Discharge with a Liquid Anode
12	John Stiller	Thermo Fisher Scientific	Plasma Focused Ion Beam Source on Dual Beam Microscopes
13	ChienHsiu Ho	Pennsylvania State University	Development of Hybrid Plasma Simulation of Plasma-Enhanced Catalytic Conversion of Renewable Natural Gas to Value-Added Petrochemicals
14	Lee Strobel	Massachusetts Institute of Technology	Electric Field Measurements of DC-driven Streamer Coronas Using the E-FISH Method
15	Joseph Theis	University of Colorado	Current-voltage Scaling of Direct-Current Magnetron Sputtering via Particle-in-Cell Simulation
16	James Trettin	Princeton University	Mechanistic Insights via Operando Spectroscopy of Plasma-Assisted Methane Reforming on Metal-Organic Framework Composite Catalysts
17	MacKenzie Warrens	Rice University	Shockwaves in Ultracold Neutral Plasmas
18	Hongtao Zhong	Stanford University	High Pressure CO_2 Dissociation with Nanosecond Pulsed Discharge
19	Lanie McKinney	Massachusetts Institute of Technology	Modeling Nonthermal CO_2 Plasmas for Reactor Design with Applications to Mars In-Situ Resource Utilization
20	Jarett LeVan	University of Michigan	Strong Correlation Effects in Molecular Atmospheric Pressure Plasma
21	Berkay Ekinci	Pennsylvania State University	Plasma-Assisted Catalytic Hydrogenation of Carbon Dioxide into Higher Hydrocarbons: Synergy of Plasma, Catalyst, and Support Combination
22	Stanislav Musikhin	Princeton Plasma Physics Lab	Synthesis and characterization of ultra-fine nanoparticles using metal arc discharge