

US Low Temperature Plasma Summer School (v19)
University of Michigan
24-28 June 2024

Monday	24 June		
<i>Modern Languages Building, Auditorium 3</i>	07:45-08:20	<i>Registration and Breakfast</i>	
	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	<i>Break</i>	
	10:30-12:00	2-Low Pressure Plasmas	Uwe Czarnetzki Ruhr University
	12:00-13:30	<i>Lunch</i>	
<i>Modern Languages Building, Auditorium 3</i>	13:30-15:00	3-High Pressure Plasmas	Katharina Stapelmann North Carolina State University
	15:00-15:30	<i>Break</i>	
	15:30-17:00	4-Magnetized Collisional Plasmas and Plasma Wave Interactions	Larry Overzet University of Texas at Dallas
<i>Michigan League, Hussey Room</i>	17:30-19:30	<i>Poster Session and light dinner/refreshments</i> (See poster list below.)	
Tuesday	25 June		
<i>Modern Languages Building, Auditorium 3</i>	08:00-08:30	<i>Breakfast</i>	
	08:30-10:00	5-Plasma Kinetics and Reactions	Uwe Kortshagen University of Minnesota
	10:00-10:30	<i>Break</i>	
	10:30-12:00	6-Thermal Plasmas	Javad Mostaghimi University of Toronto
	12:00-13:30	<i>Lunch</i>	
<i>Modern Languages Building, Auditorium 3</i>	13:30-15:00	7-Dusty Plasmas	Ed Thomas Auburn University
	15:00-15:30	<i>Break</i>	
	15:30-17:00	8- Plasma Sources and Power System Design	Steve Shannon North Carolina State University
		<i>Free night</i>	
Wednesday	26 June		
<i>Modern Languages Building, Auditorium 3</i>	08:00-08:30	<i>Breakfast</i>	
	08:30-10:00	9-Plasma Chemistry	Mark Kushner University of Michigan
	10:00-10:30	<i>Break</i>	
	10:30-12:00	10-Fluid Modeling of LTPs	Juan Trelles Univ. of Massachusetts-Lowell
	12:00-12:15	Group Photograph	
	12:15-13:30	<i>Lunch</i>	
<i>Modern Languages Building, Auditorium 3</i>	13:30-15:00	11-Diagnostics	Peter Bruggeman University of Minnesota

UM North Campus		15:30-18:00	Lab Tours/Hands-On Experiences (See descriptions below) • Low Temperature Plasma Measurements • Tour and Demonstrations of the Plasmadynamics and Electric Propulsion Laboratory • Demonstration and Training on the MOOSE/Zapdos MultiPhysics Plasma Modeling Software • Tour of NSF ZEUS Laser Facility	
Thursday	27 June			
Modern Languages Building, Auditorium 3		08:00-08:30	Breakfast	
		08:30-09:45	12-Materials Processing and Functionalization	Daphne Pappas PlasmaTreat, Inc.
		09:45-10:00	Break	
		10:00-11:15	13-Plasma Biotechnology	Stephan Reuter Polytechnique Montreal
		11:15-12:30	14-Combustion and Flow Control	Igor Adamovich Ohio State University
		12:30-14:00	Lunch	
Modern Languages Building, Auditorium 3		14:00-15:15	15-Environmental and Agricultural Applications	Selma Mededovic Thagard Clarkson University
		15:15-15:30	Break	
		15:30-16:45	16-Energy Applications	Elijah Thimsen Washington University-St. Louis
		16:45-17:00	17-Overview of Plasma/ LTP Programs at the National Science Foundation	Jeremiah Williams, National Science Foundation and Wittenberg College
Rackham Assembly Hall		18:00-20:00	Banquet and Career Panel Discussion Career Panelists: • Prof. Jeremiah Williams, National Science Foundation and Wittenberg College • Prof. Selma Mededovic Thagard, Clarkson University • Dr. Daphne Pappas, PlasmaTreat, Inc. • Prof. Satoshi Hamaguchi, Osaka University	
Friday	28 June			
Modern Languages Building, Auditorium 3 Plasma Materials Processing (PMP) for Microelectronics Fabrication		08:00-08:30	Breakfast	
		08:30-9:45	PMP1-Plasma Etching	Vincent Donnelly University of Houston
		9:45-10:00	Break	
		10:00-11:15	PMP2-Plasma Deposition	Erwin Kessels Eindhoven University of Technology
		11:15-12:00	Early Lunch	
		12:00-13:15	PMP3-Feature Level Processes	Satoshi Hamaguchi Osaka University
		13:15-14:30	PMP4-Machine Learning in Plasma Processing	Peter Ventzek Tokyo Electron America

Tours, Demos and Moose-Zapdos Training

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 electrical 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 be 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, UM North Campus
- Session length: 45 minutes, 6 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: Chelsea Tischler (chemay@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, UM North Campus
- Session length: 45 minutes, 20 Students/session
Session 1: 4:00 pm - 4:45 pm Session 2: 5:00 pm - 5:45 pm
- Point of contact: Eric Vigas (eviges@umich.edu)

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

This workshop will be a hands on demonstration of the 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, UM North Campus
- Session length: 3 hours, 3:30 pm – 6:30 pm
- 47 available seats
- Point of contact: Prof. Steven Shannon (scshanno@ncsu.edu)

Tour of NSF ZEUS Laser Facility

ZEUS (<https://zeus.engin.umich.edu>) is a recently opened laser facility designed to investigate interactions of high power lasers with plasmas. The name ZEUS (Zettawatt-Equivalent Ultrashort pulse laser System) refers to the interaction of a PetaWatt laser pulse colliding with a GeV energy electron beam. This geometry provides the equivalent of a “Zettawatt” power laser interaction (10^{21} Watts) in the rest frame of the electron beam. It will consequently allow exploration of fundamental yet unanswered questions regarding non-linear quantum electrodynamics in relativistic plasmas, including non-perturbative quantum radiation reaction and electron-positron pair production mechanisms. . The tours will start with short videos about the facility (history, flythrough) followed by a tour of the facility (target areas and our experimental control room).

- Location: Carl A. Gerstacker Building, 2200 Bonisteel Blvd., UM North Campus
- Session length: 30 minutes, 8 Students/session
Session 1: 3:30 pm - 4:00 pm Session 3: 5:00 pm – 5:30 pm
Session 2: 4:15 pm - 4:45 pm Session 4: 5:45 pm – 6:15 pm
- Point of contact: Elizabeth Oxford (oxforda@umich.edu)

Poster Session Presentations

Michigan League, Hussey Room, Monday, June 24, 17:30-19:30

Session 1: 17:30 - 18:15

Session 2: 18:15 - 19:00

Session Poster		Presenter	Institution	Title
1	1	Michael Stokes	University of Alabama	Numerical Modeling of Non-equilibrium Laser-Induced Plasma Plumes in Materials Processing Applications
1	2	Ho Jun Kang	Osaka University	The Influence of W-based Materials in High Aspect Ratio Etching
1	3	Masayuki Karato	Osaka University	Effect of Hydrogen on Tungsten Surface Crack Initiation under Pulsed Thermal Loading
1	4	Md Arifuzzaman Faisal	Michigan State University	Parametric Analysis on Enhancement of THz Smith-Purcell Radiation by Two Layer-Grating Structure
1	5	Haneul Lee	Seoul National University	Investigation of Agglomeration Effect on Tin-doped Indium Oxide (ITO) Etching Using H ₂ -Ar Two-step Plasma Processes
1	6	Nusrat Karim	North Carolina State Univ.	Impact of Ambient Gas Pressure on Self-reversal of Li I in Laser Produced Plasmas Relevant to Isotopic Analysis
1	7	Airah Osonio	Nagoya University	Plasma-assisted Atomic Layer Etching of Silicon Dioxide via Surface Fluorination and Argon Bombardment
1	8	Blake Koford	Auburn University	Effect of Dust Clouds on Electrostatic Perturbation Transmission Across Unmagnetized and Weakly Magnetized Plasmas
1	9	Julia Simon	Yale University	Electrochemical Plasma-Activated CO ₂ Reduction at a Plasma-Water Interface
1	10	Md Wahidur Rahman	Michigan State University	The Effect of Space Charge on the Performance of Linear Beam Devices
1	11	Junki Morozumi	Kyoto University	In-situ Measurement Techniques for Plasma and Solid Materials Based on Electric Circuit Model
1	12	Takahiro Goya	Kyoto University	Effects of Plasma-induced Damage on the Mechanical Property
1	13	Yuya Asamoto	Kyoto University	Boron Nitride Film Deposition by a Reactive Plasma Assisted Coating System
2	14	Xuefei Zhang	University of North Dakota	Realizing Beneficial Use of Produced Water by Plasma Desalination
2	15	Cole Stewart	Michigan State University	The Effect of Super-particle Weight Factor on Particle-in-Cell Simulations in Low-pressure Capacitively-coupled Plasmas
2	16	Tiago Cunha Dias	University of Michigan	Are Local-Field and Local-Energy Approximations Appropriate for Nanosecond Discharges?
2	17	Swathy Jayaprasad	Nagoya University	Radical Enhanced Growth of GaN on Si with a Buffer Growth of GaN at a Low Temperature of 600 °C
2	18	Colin Wadsworth	University of Minnesota	Surface E-FISH Measurements on Plasma Interactions with Surfaces
2	19	Sk Azmaeen Bin Amir	North Carolina State Univ.	Impact of Electronegativity on Argon/Oxygen Capacitively Coupled Plasmas with Tailored Voltage Waveforms

2	20	Ardita Kurtishaj Hamzaj	Jozef Stefan Institute	Plasma-Assisted Reduction of Graphene Oxide for Room Temperature Gas-Sensing Applications
2	21	Juš Polanšek	Jozef Stefan Institute	Trust Force Generated by Surface Dielectric Barrier Discharge
2	22	Bingqing Wang	Michigan State University	Effects of a Series Resistor on Quantum Tunneling Current in Dissimilar Metal-Insulator-Metal Nanogap
2	23	Jelena Strbac	Jozef Stefan Institute	Preparation of Plasmonic Sensors for Detection of Biomolecules
2	24	Takamasa Okumura	Kyushu University	Effects of Carbon Nanoparticle Interposed between Hydrogenated Amorphous Carbon Films on Surface Morphology of a-C:H Film
2	25	Sam Austin	Mass. Institute of Technology	Finite Element Discharge Framework for Low Temperature Plasmas