Mei-Yun Lin

Research Interests

It is estimated that trillions of dollars, on the order of the gross domestic product of a large country, will be lost immediately after an extreme space weather event impacts the Earth. Space weather events involves drastic re-configurations of all current systems in the near-Earth space, with deleterious effects on engineering infrastructure, power grids, satellites, navigation systems, telecommunications, and more.

I study the dynamics of plasmas and electromagnetic fields in the Terrestrial environment, and in particular, the ionic component of our atmosphere, known as the ionosphere, as it responds to the energy input from the Sun. My research addresses the need to understand the physical mechanisms responsible for its acceleration from a subsonic to supersonic flow, and the altitude dependent transport, as this plasma experiences several physical regimes. For this, I am developing high-performance first-principles physics models capable to predict and describe the conditions in near Earth space.

In addition, these models are used to address open questions in Earth and Planetary science, and pave the path to new exploration endeavors. For instance, understating the loss and evolution of our atmosphere over geological times can place bounds and determine if, and under what conditions, Earth-like conditions for habitability can exist.

Education

2019 - Present **University of Illinois at Urbana-Champaign**, *Urbana, IL*.
Ph.D. Candidate, Electrical and Computer Engineering
Advisor: Raluca Ilie

2017 - 2019 **University of Illinois at Urbana-Champaign**, *Urbana, IL*.
Master of Science, Electrical and Computer Engineering
Thesis: *Determine the Role of Neglected Heavy Ions N^+ in the Earth's Inner Magnetosphere*
Advisor: Raluca Ilie

2013 - 2017 **National Taiwan University**, *Taipei, Taiwan*.
B.S., Electrical Engineering

Research Experience

Aug. 2017 - Present **Graduate Research Assistant**, *University of Illinois at Urbana-Champaign*, Urbana, IL.
Advisor: Raluca Ilie

- Developed **Seven Ion Polar Wind Outflow Model (7iPWOM)**, the first polar wind model to describe the outflow of nitrogen and molecular ions along the magnetic field lines in the polar cap area. This effort not only improved our modeling efforts and showed significant improvement as compared with observations, but demonstrated the key role nitrogen ions play in the overall ionospheric outflow.
- Further developed the **Hot Electron Ion Drift Integrator Model (HEIDI)**, to include an additional ions species, which makes HEIDI the first and only ring current model to track the evolution and dynamics of all relevant ring current ions species.
- Devised and developed the **Energetic Neutral Atom (ENA) visualization model** to generate TWINS-like ENA images from the simulation data.
- Led a proposal that **granted computer allocation on the XSEDE Bridge Supercomputer**, which provides the computing resources to several other group members.

Sept. 2016 - Jun. 2017 **Undergraduate Research Assistant**, *HPC Lab*, National Taiwan University.
Advisor: Wang Shengde
- Developed the software interface on Google Cloud Computing for the computational model and communication system, which created an algorithm for fast data transfer between the server and multiple sensors.

Sept. 2015 - Dec. 2016 **Undergraduate Research Assistant**, *RFIC lab*, National Taiwan University.
Advisor: Huang Tianwei
- Developed multi-project chip (MPC) held by National Chip Implementation Center, which were integrated as elements in the research of high frequency communication system. The two projects are "A One-Stage 24GHz Compact Fully-Integrated Transformer CMOS Power Amplifier" and "3D 60GHz Power Amplifier with TSMC 65nm".

Awards

Dec. 2020 **Outstanding Student Presentation Award (OSPA)**, *2020 American Geophysical Union (AGU)*, Virtual.
- Title of presentation: Revealing the role of "hidden heavy ions" component in the terrestrial polar wind outflow
- This award recognizes top 2-5% students at a meeting attended by more than 25,000 researchers from more than 100 countries.

Dec. 2019 **Outstanding Student Presentation Award (OSPA)**, *2019 American Geophysical Union (AGU)*, San Francisco, California.
- Title of presentation: How are the N+ ions affecting the transport and acceleration of ionospheric outflowing ions?
- This award recognizes top 2-5% students at a meeting attended by more than 25,000 researchers from more than 100 countries.

Fall 2019, Spring 2020 **Listed as *Teachers Ranked as Excellent***, *University of Illinois at Urbana-Champaign*, Urbana, IL.
- Course: ECE 329 Fields and Waves I.
- This award is given to top 30% faculty and teaching assistants across the entire UIUC campus each semester, based on students' feedback.

Jun. 2018 **Best Student Presentation Award**, *2018 Geospace Environment Modeling (GEM) Workshop*, Santa Fe, New Mexico.
- This award is given to top 5% students among 100 student attendees each year.

Jul. 2018 **Heliophysics Summer School Scholarship**, *University Corporation for Atmospheric Research (UCAR)*, Boulder, CO.
- Selected, and awarded Travel Grant to attend the summer school.

Jul. 2018 **Space Weather Summer School Scholarship**, *High Altitude Observatory (HAO)*, Boulder, CO.
- Selected, and awarded Travel Grant to attend the summer school.

Jan. 2014 **Presidential Award**, *National Taiwan University*, Taipei, Taiwan.
This award recognizes top 5% of the class.

Leadership

Jul. 2019 - Present **Student Representative**, *NSF Geospace Environment Modeling (GEM) Program*.
- Elected as the student representative, whose responsibilities include: organizing the "student day" (1 day student led workshop within the main GEM workshop) lectures and tutorials, selection of student tutorial speakers, and presentation competitions during the GEM workshop. In addition, the GEM Student Representative is granted a seat and voting privileges in the GEM Steering Committee.

Sept. 2019 - Present **Software Development Manager**, *Electromagnetics (EM) VR Lab of University of Illinois at Urbana-Champaign*, Urbana, IL.
- Led the software archiving efforts, and worked with $\sim$ 20 software developers for the Virtual Reality project to establish best practices for software development.

Teaching/Mentor Experience

May 2020 - Nov. 2020 **Mentor**, *ECE undergraduate students*.
Mentored Student and Project:
- Mentored the senior student, Isha Garg on the prject of "Visualizing the TWINS Energetic Neutral Atom figure", which improved the ENA visualization model with an user-friendly interface and was presented in the conference talk.

Jan. 2021 - Present **Mentor**, *ECE undergraduate students*.
Mentored Student and Project:
- Mentored the senior student, Shiru Shong on the prject of "Does the magnetic field help maintain the habitable atmosphere?", which investigation the polar wind solution in various electrodynamic condition and plan to present in Undergraduate Research Symposium in April 2021, University of Illinois at Urbana-Champaign.

Fall 2019, Spring 2020 **Teaching Assistant**, *University of Illinois at Urbana-Champaign*, Urbana, IL.
- Course: ECE 329 Fields and Waves I.
- Became the first teaching assistant to teach Mathematica/Virtual Reality (VR) Lab, which is the first lab developed at the Electrical and Computer Engineering Department to help the education of the electromagnetism through VR technology.
- Guided approximately 70 students in the Mathematica/Virtual Reality (VR) Lab each semester.
- Hold a review session for 180 students of ECE 329 and graded the exams.

Professional Service

Jul. 2020 **Co-Convener**, *2020 VGEM Workshop*.
- Guided and led MPS1 Poster session on July 21, 2020.

Jul. 2020 **Moderator**, *2020 VGEM Workshop*, Focus Group Session.
- Assisted the session held by the Focus Group, "The Impact of the Cold Plasma in the Magnetospheric Physics" (CP), on July 24, 2020.

Work Experience

Jul. 2016 - Jul. 2017 **Software Intern**, *WASAI Technology*, Taipei, Taiwan.
- Became Software developer at WASAI, a company that won the Cloud Computing Start-up Award.
- Developed driver code to connect the FPGA and user interface to accelerate the algorithms of Map-Reduce and BZip2 under Hadoop data system, which became the first, and critical elements of the FPGA acceleration projects in WASAI.

Publications

- *Peer-Reviewed:*
  - **M-Y. Lin**, R. Ilie, A. Glocer, (2020). "The contribution of N^+ ions to Earth's polar wind", Geophysical Research Letters, 47, e2020GL089321, https://doi.org/10.1029/2020GL089321.
  - R. Ilie, **M-Y. Lin**, M. F. Bashir, A. Glocer, (2020). "The neglected component of the ionic composition in the MIT system", Heliophysics 2050 Workshop.
  - R. Ilie, M. F. Bashir, **M-Y. Lin**, (2020). "A brief review of nitrogen ion observations in the ionosphere-magnetosphere system", under review in Journal of Atmospheric and Solar-Terrestrial Physics, Paper ID JASTP-D-20-00291.
  - **M-Y. Lin**, R. Ilie, (2021). "Observation of molecular ions in the Earth's magnetosphere-ionosphere system ",*invited review paper*, to be submitted in Frontiers in Astronomy and Space

Physics (May, 2021).

Presentation

Oral Presentation

Dec. 2020 **M-Y. Lin**, R. Ilie, A. Glocer, Do "hidden heavy ions" play an important role in the polar wind study, *invited*, Department of Space Science and Engineering, National Central University, Taoyuan, Taiwan

Dec. 2020 **M-Y. Lin**, R. Ilie, A. Glocer, Revealing the role of "hidden heavy ions" component in the terrestrial polar wind outflow, Virtual American Geophysical Union

Dec. 2020 R. Ilie, **M-Y. Lin**, C. S. Borlina, R. Oran, C. I. O. Nichols , A. Glocer, What Makes the Earth Lose Weight? , Virtual American Geophysical Union

Dec. 2020 **M-Y. Lin**, R. Ilie, A. Glocer, How do the Nitrogen Ions Escape the Earth's Atmosphere?, *invited*, Virtual American Geophysical Union

Oct. 2020 **M-Y. Lin**, R. Ilie, A. Glocer, The Role of Molecular Ions in the Overall Ionic Composition of Polar Wind Outflow, Virtual Cold Plasma Workshop

Jul. 2020 **M-Y. Lin**, R. Ilie, A. Glocer, How does the Polar Wind Solution Change in Response to the Presence of N^+ Ions? , Virtual GEM Workshop

Jul. 2020 **M-Y. Lin**, VGEM Student Tutorial: Magnetosphere-Ionosphere-Thermosphere Coupling, Virtual GEM Workshop

Aug. 2019 R. Ilie, **M.Y. Lin**, A. Glocer, On the role of ionospheric heavy ions in the dynamics of the near-Earth environment, Ion Composition in the Sun-Earth System, Durango, CO

Jun. 2019 **M-Y. Lin**, R. Ilie, A. Glocer, Tracking the Differential Behavior of N^+ and O^+ Ions from the Outflowing Ionosphere to the Inner Magnetosphere, GEM Workshop, Santa Fe, NM

Jul. 2018 R. Ilie, **M-Y. Lin**, Y. Huang, Assessing the role of outflowing ionospheric heavy ions in the dynamics of the near-Earth environment, C1.3-0002-18, COSPAR, Pasadena, California

May. 2018 R. Ilie, **M-Y. Lin**, M. F. Bashir, Y. Huang, The Role of Heavy Ions in the Loss of Near Earth Plasma, The Triennial Earth-Sun Summit (TESS), Leesburg, VA

Poster Presentation

Dec. 2020 R. Ilie, C. D'Angelo, E. Shaffer, E. Kudeki, D. Cermak, **M-Y. Lin**, O. Coiado, L. K. Wagner, Using Immersive Technologies to Teach Advanced STEM Concepts in Engineering Education, Virtual American Geophysical Union

Dec. 2019 **M-Y. Lin**, R. Ilie, A. Glocer, How are the N^+ ions affecting the transport and acceleration of ionospheric outflowing ions?, American Geophysical Union, San Francisco, CA

Jun. 2019 **M-Y. Lin**, R. Ilie, A. Glocer, Determine the Role Of Outflowing N^+ Ions In the Inner Magnetosphere Dynamics By Tracking the Different Behavior of N^+ and O^+, GEM Workshop, Santa Fe, NM

Jun. 2019 **M-Y. Lin**, R. Ilie, A. Glocer, Determine the Role of Nitrogen Ions In the Ionospheric Outflow: Tracking the Differential Behavior of N^+ and O^+ Ions from the Outflowing Ionosphere to the Inner Magnetosphere, CEDAR Workshop, Santa Fe, NM

Jun. 2018 **M-Y. Lin**, Y. Huang, R. Ilie, Determining the role of nitrogen ions in the evolution of the ring current, GEM Workshop, Santa Fe, NM