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Title:	Suggested Projects, Mentors and Mentor General Interest Areas for 2023 Los Alamos Space Weather Summer School - PART 2
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Intended for:	List of additional suggested student projects for 2023 LANL Space Weather Summer School
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Los Alamos NATIONAL LABORATORY

Suggested Projects, Mentors and Mentor General Interest Areas for 2023 Los Alamos Space Weather Summer School – PART 2

Please contact mentors to discuss either the projects listed or suggest your own (mentor's general interests are listed to aid in choosing a mentor for your suggested projects.)

Additional projects may be added, so check back before finalizing applications.

Suggested Project: Coronal-hole-origin solar wind
Mentor: Joe Borovsky (jborovsky@SpaceScience.org)
At 1 AU we have a collection of "flattop" intervals of coronal-hole solar wind. It is a straightforward task to perform some simple statistics on this collection, such as the wind speed versus the size (temporal duration) of the coronal hole, the wind speed versus the magnetic-field strength, etc. These statistics can be compared with expectations for solar-wind models such as the flux-tube-expansion-factor model.
There is a special issue of JSWSC on "Solar Sources of Space Weather" with a submission deadline of September 30. https://www.swsc-journal.org/topical-issues-open-for-submission

Suggested Project: Plasmasphere early-time Coulomb-scattering calculations
Mentor: Joe Borovsky (jborovsky@SpaceScience.org)
Assessing the amount of angular scattering that low-energy beam protons receive owing to (1) cold protons from the geocorona, (2) warm oxygen and protons of the plasma cloak, and (3) the counterstreaming proton beam from the opposite ionosphere.

Suggested Project: Statistical comparison between current sheets and velocity shears in the solar wind
Mentor: Joe Borovsky (jborovsky@SpaceScience.org)
Making statistical comparisons for Alfvenic and non-Alfvenic solar wind. What is the nature of the velocity shears in the non-Alfvenic wind. The current sheets control the Fourier magnetic power spectral density of the solar wind: do the velocity shears control the Fourier velocity power spectral density? Are the differences between the magnetic and velocity Fourier spectra owed to differences between current sheets and velocity shears?

Project: High-Resolution Ionospheric modeling of Ionosphere Heating by HAARP
Mentor: Chris Jeffery (ISR-2) (cjeffery@lanl.gov)
General interests: Ionospheric modeling, geomagnetic storms, solar flares
Suggested Project: We would like to investigate the sensitivity and resolution of the SAMI3 global ionospheric model with a regional embedded grid. Can the embedded grid allow the model to more accurately capture the small-scale features of HAARP ionospheric heating? This project will involve designing and implementing ionospheric model runs with a new LANL model, GeoRad, that is based on SAMI3 and includes a nested grid, as well as analysis and visualization of the results.

Project: Ionospheric irregularities
Mentor: Erin Lay (ISR-2) (elay@lanl.gov); Chris Jeffery (ISR-2) (cjeffery@lanl.gov)
General interests: Ionospheric/magnetospheric coupling, ionospheric conductivity in auroral regions, ionospheric irregularity scale sizes
Suggested Project: Ionospheric electron density and conductivity in the auroral regions. This project will involve collection and analysis of ionospheric data, specifically SuperDARN measurements in the auroral region. The project would involve learning how to use the DavitPy SuperDARN data analysis toolkit to plot ionospheric parameters. Additional co-located data sources are also of interest, such as GPS TEC, Fabry-Perot Interferometery, and the ISR radar measurements.

Project: Understanding and Simulating Observed Solar Energetic Protons
Mentor: Yue Chen
General Interests: Data analysis and modeling solar proton fluxes
Suggested Project: Solar eruptions, such as flares and coronal mass ejections (CMEs), frequently generate particles accelerated to extremely high speeds. Among them, solar energetic protons (SEPs), with energies ranging from ~10s MeV up to GeV, sweep across the heliosphere with some of them hitting the Earth. SEP events with high intensities and long durations pose a severe space radiation hazard associated with both dose (ionizing and non-ionizing) and single event effects, particularly on spacecraft with high-altitude orbits in near-Earth space or even inside the cis-lunar space, where protection from the strong geomagnetic field is limited. Therefore, understanding and simulating incoming energetic solar protons has been significant and critical for space sectors. This project aims to use the temporal history of related preceding X-ray event as inputs to reproduce the temporal flux profiles of 10s to >100 MeV solar protons, including their peak intensities and decay rates, in well-connected SEP events. This study includes examining proton fluxes observed by GOES and GPS satellites in a list of selected SEP event as well as developing a simple model to reproduce observed proton fluxes as a function of time with the consideration of initial anisotropic pitch-angle distributions and other factors. Results from this study will prove the feasibility of one simple way of predicting the maximum intensities and durations of Earth-bound solar energetic protons in well-connected events.

Project: On the Wave-Wave Correlation inside the Outer Radiation Belt Region
Mentor: Yue Chen
General Interests: Data analysis of Van Allen Probes wave observations
Suggested Project: Theoretic studies have suggested that electromagnetic ion cyclotron (EMIC) waves can cause significant precipitation of ~MeV electrons, supposedly accounting for the fast dropouts of outer-belt electrons during storm main phases. Several previous observational studies have found supportive evidence for the above picture; however, the presence of EMIC waves is often observed not to be related to MeV electron losses. Among others, the quick dissipation of EMIC waves through wave-wave interactions—with the cold plasma as a mediator—is one possible explanation. Here, using wave magnetic and electric field (i.e., EMFISIS, WFR and EFW) data from Van Allen Probes mission, this project will statistically examine the correlation between EMIC and lower-hybrid (LH) waves observed inside the outer radiation belt region. This study includes first constructing two independent event lists for intensified EMIC waves and elevated LH waves, respectively. Then the two lists will be cross checked to identify if any significant occurrence correlation exists between them, and further to characterize the

correlations in terms of wave power for different L-shells, magnetic local time zones, as well as the background plasma conditions. Results from this study will advance our knowledge of the wave-wave interactions inside the inner magnetosphere, which can be critical for building high-fidelity physics-based models of the radiation belts.

Mentor: Robert Haaser (ISR-2) (rhaaser@lanl.gov).
General interests: Ionospheric/magnetospheric coupling, ionospheric conductivity in auroral regions, ionospheric irregularity scale sizes, mechanisms for TID at high and low latitudes.
Suggested Project: Exploring observations/mechanisms for changes in Traveling Ionospheric disturbances (TIDs) between Quiescent and Storm-time with ground-based GNSS stations in the Northern and southern hemisphere. Project would improve understanding of magnetosphere-ionosphere physical coupling mechanisms at high/low latitudes via study properties of traveling ionospheric disturbances using remote/ground-based GNSS TEC data comparing northern-southern hemispheres, and connect space weather model inputs/solar storm strength parameters with ionospheric properties by (any/all of these) scale, propagation speed, location and seasonal variation.

Mentors: Erin Lay (elay@lanl.gov), Amitabh Nag
Title: D-region ionosphere remote sensing
Project Description: Use a newly developed D-region remote sensing technique that uses lightning signals as probing waveforms to correlate D-region perturbations globally with space weather disturbances. The D-region technique has been developed at LANL, so the student would run the code to study D-region variations globally, and then bring in additional space weather information to understand solar/geomagnetic conditions. This student would need to be a U.S. citizen due to the nature of the D-region code.