2019 Workshop: ACTIVE EXPERIMENTS WORKSHOP

Long title
New Techniques for Active Experiments Workshop
Conveners
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Description

The study of plasma interactions is a key to understanding the dynamics of Earth's atmospheric regions, and the ionosphere is a particularly challenging region to study. In recent years, plasma experiments have emerged from the laboratory, where it is difficult to replicate ionospheric conditions, into the ionosphere through various active experiments. Ionospheric modification experiments using high-power HF radio waves, chemical releases from sounding rockets, or particle beams emitted from satellites can induce upper atmosphere phenomena that are observed only sporadically in the natural undisturbed ionosphere, if at all. High-power HF radio waves incident on the ionosphere can generate artificial aurora or airglow, HF-enhanced plasma and ion lines observed with radar, induce scintillations or otherwise affect radio propagation by creating plasma density irregularities due to complex interactions between the powerful HF transmissions. There are currently two HF facilities operating in US territory, the high-latitude HAARP facility in Alaska and the Arecibo Observatory in Puerto Rico at mid-latitude. HAARP is the most powerful and flexible ionospheric heater, with sweeping frequencies and multi-beam modes. Arecibo has the largest gain, up to 26 dB, and has the additional advantage of being collocated with the Arecibo ISR. Both facilities provide diagnostic optical and radio instrumentation for detecting ionospheric modification effects. Chemical releases from rockets into the natural ionosphere can also induce scintillation and even airglow, in addition to other unique effects. Recent experiments have demonstrated that artificial ionospheric layers can be created through chemical releases. For example, the Charged Aerosol Release Experiment (CARE) is designed

to study artificial charged particulate (or dusty plasma) layers in the upper atmosphere and their effects on ULF, S-band, and L-band radars. This workshop will convene experimentalists to present some of their recent results and explore the potential of developing new techniques for future experiments.

Agenda

This workshop will convene experimentalists to present some of their recent results and explore the potential of developing new techniques for future experiments.

10:00-10:10 Kylee Branning, UAF: Examining Upper E-Region Winds Using Heater Induced Airglow

10:10-10:20 Augustine Yellu, Cornell: Pioneering New Ionospheric Diagnostic Capabilities using Stimulated Radiation at HAARP

10:20-10:28 Matt Blandin, UAF: Kinetic-scale energy and momentum transport experiment (KiNET-X) two barium injections with in-situ plasma instrumentation

10:28-10:38 Natasha Jackson-Booth, QinetiQ: Modelling Plasma Cloud Evolution using HF data

10:38-10:48 Nick Shuman, AFRL: Laboratory Studies of Plasma Cloud Chemistry

10:48-10:56 Paul Bernhardt, NRL: Arecibo HF Experiments

10:56-11:04 Ethan Miller: Partially-Cooperative Observations of Arecibo HF Heating Campaigns 2015-2017

11:04-11:12 Eliana Nossa, NRL: Spectral Plasma Line Analysis of HF Experiments at Arecibo

10:12-10:20 Alexander Fletcher, NRL: The SMART (Space Measurement of A Rocket-released Turbulence) experiment

10:20-10: 28 Carl Siefring, NRL: Overview of the DARPA Sponsored CENTRS rocket campaign

Justification

Justification: The 2012 Decadal Survey for Solar and Space Physics prioritized the Ionospheric Modification facilities as a way to use the ionosphere as a "laboratory

without walls" to explore complex plasma interactions that could not be studied in a confined lab and that regulate most of the natural ionospheric phenomena. Two facilities are now operating in US territory: HAARP at high-latitude and Arecibo at mid-latitude. Several HF campaigns and other ionospheric modification experiments have been conducted in the past few years. This workshop will report on recent work as well as discuss ways to expand and promote this new area of knowledge in future experiments.

Question to be addressed: Characterizing plasma structures and irregularities in the ionosphere and the interaction of HF radio waves and chemical agents with the ionosphere plasma.

How the associated questions will be addressed: Several experiments that artificially modify the ionosphere have been conducted in recent years, and for some analysis continues in an effort to understand the formation and evolution of plasma irregularities. At the workshop, the facilities will present updates on their current operations; users will present experimental results as well as discuss suggestions for future experiments and campaigns to advance the state of the art.

How progress should be measured: By the numbers of new experiments, projects, campaigns proposed in the following year.

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