2016 Workshop: suprathermal particles

Long title
Origin and effects of suprathermal particles in the MI system
CEDAR-GEM
Conveners
Evgeny Mishin
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Description

Suprathermal particles in the energy range of a few eV to several hundred eV are ubiquitous in the MI system particularly during active periods. The objective of this workshop is to make an assessment of a wide range of processes that control the generation of suprathermal electrons and ions in the ionosphere and magnetosphere and their effects at subauroral and auroral latitudes. Possible topics of discussion will include (but not limited to): What is the role of suprathermal electrons in the energy/momentum transfer between the hemispheres in the quiet time and magnetosphere-ionosphere in the disturbed time? How significant are suprathermal electrons in ion outflow events and heating of ionosphere plasma? What are key generation mechanisms of suprathermal particles in the magnetosphere and ionosphere? Invited/solicited speakers will summarize recent progress in satellite and radar observations and theory/modeling and discuss future directions of research to advance better understanding of the role of suprathermal particles in the MI system.

Justification

In the auroral ionosphere, suprathermal electrons, the major cause of greatly enhanced incoherent backscatter plasma lines, appear during keV-range electron precipitations. Suprathermal ions, the seed particles for auroral ion conics, are related to intense small-scale auroral arcs. CRRES, Cluster, Polar, and DMSP observations link the enhancement of the suprathermal population in the plasmasphere to substorm ring current injections. Ion outflows in the region of subauroral polarization streams (SAPS) accompany strongly elevated electron temperatures apparently caused by suprathermal electron fluxes from the conjugate plasmasphere. By the same token, strong electron heating and acceleration of

suprathermal electrons in HF modification experiments result in fast ion outflows in the topside ionosphere detected by the DMSP and Demeter satellites. These and related observations raise a number of questions about the mechanisms of generation of suprathermal particles and of the energy/momentum transfer in the perturbed geospace. These questions remain of great interest for the CEDAR and GEM communities. This workshop will bring to bear satellite and radar observers and geospace plasma modelers to address these problems.

Summary

A two-hour joint CEDAR-GEM session on suprathermal particles was held at the 2016 CEDAR-GEM workshop in Santa Fe. Half dozen solicited speakers discussed a wide range of processes relevant to the generation of suprathermal particles and their effects in the ionosphere and magnetosphere. The session covered theoretical and modeling aspects as well as discussions on recent advances in incoherent scatter radar (ISR) measurements of plasma waves enhanced by suprathermal electrons via wave-particle interactions. In addition to the speakers, the session was attended by about 15 spectators. Below is the list of the six speakers along with the title/short summary of their talk.

George Khazanov (NASA/GFSC) summarized modeling results on the role of photoelectrons and secondary electrons in the M-I coupling. A self-consistent first-principle kinetic model takes into account trapping and bouncing of suprathermal electrons between the conjugate ionospheres that have significant effects upon the ionospheric electron temperature and density, as well as airglow.

Frank Djuth (Geospace Research Inc. + Herb Carlson) presented results from the Arecibo ISR plasma lines where night time plasma line enhancements of about 2.5 times above the thermal level were measured and concluded as a signature of very soft (~10 eV) electron precipitation of unknown origin. Several possibilities for the origin of the predicted precipitating flux were discussed.

Meers Oppenheim (Boston University + Yakov Dimant) presented particle-in-cell simulations of plasma turbulence induced by suprathermal photoelectrons as the cause of the "mysterious" 150-km radar echoes commonly detected at low latitudes, especially by the Jicamarca radar.

Asti Bhatt (SRI International) presented recent Sondrestrom measurements of broadband plasma lines enhanced by the secondary electrons during periods of

electron precipitation.

Hassan Akbari (Boston University) presented recent Poker Flat ISR measurements thought to indicate the natural generation of Langmuir turbulence at high latitudes and presented simulation results on the effect of suprathermal electrons on the dynamics of Langmuir turbulence.

Evgeny Mishin (AFRL) discussed the effect of heater-accelerated suprathermal electrons on ion outflows and the generation of artificial ducts during ionospheric heating experiments by HAARP.

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