

whether auroral brightenings and fading form a continuous spectrum, or even whether large decreases in auroral power likewise occur over a short time scale (which could be considered a negative, or inverse substorm). We used Polar UVI images of global auroral power to investigate these and related questions. Specifically we considered the distribution of dP/dt and $(dP/dt)/P$, that is, the distribution of absolute and relative changes in auroral power. At small values of $-dP/dt$, negative changes are much more frequent than positive changes. In fact, a small negative change in auroral power is by far the most common type of change. Hence the typical behavior of the aurora is a slow decline in power from one image to the next. Large magnitude changes are rare, but turn out to be almost exclusively positive (i.e., inverse substorms do not exist). Beyond about 0.2%/s relative change in auroral power (amount to a 20% change over 100 s), only positive events occur, within the measurable noise levels. However no clear boundary exists which divides substorms from other types of auroral boundaries: the spectrum of large positive changes in auroral power is continuous, without any apparent inflection point.

SM72D-02 1545h

Multipoint Magnetic and Electric Field Measurements in the Auroral Ionosphere

Eric M Klatt¹ (1-607-255-4641; ek59@cornell.edu)

Paul M Kintner¹ (1-607-255-5304; paul@ee.cornell.edu)

Elizabeth A MacDonald²

Kristina A Lynch³

¹Cornell University, Department of Electrical and Computer Engineering, Ithaca, NY 14853, United States

²University of New Hampshire, Institute for the Study of Earth Oceans and Space, Durham, NH 03824, United States

³Dartmouth College, Dept. of Physics and Astronomy, Wilder Hall, Hanover, NH 03755, United States

In this study, we examine magnetic and electric field data taken from the NASA SIERRA multiple-payload rocket mission, which flew into a 100 nT auroral substorm at altitudes up to 735 km over the Poker Flat Research Range in Alaska on January 14, 2002. The SIERRA experiment was composed of three payloads synchronized with GPS and employing a new COWBOYS (Cornell Wire Boom Yo-yo System) electric field boom configuration. First we give an overview of the deployment, rough attitude, and geometry of our three-spacecraft system. We then show that the magnetic variations found on all three spacecraft magnetometers is consistent and that a field-aligned current interpretation of the magnetic variations is believable. The measured magnetic field gradients are shown to be correlated with precipitating electrons in typical inverted-V structures. Using accurate GPS positioning and timing and the magnetometer data from these multipoint observations, we infer current densities, assuming a static interpretation. We also examine the magnetic field variations for the presence of Alfvénic activity. Future work will be enabled once a full attitude solution is obtained for all three payloads, permitting the calculation of $\nabla \times B$ and the DC-electric fields.

URL: <http://sierra.ece.cornell.edu/>

SM72D-03 1600h

Auroral Precipitation and Quasi-Trapped electrons

Daniel W Swift¹ (907-474-7507; swift@gi.alaska.edu)

Mei-Ching Fok² (301-286-1083; mei-ching.fok@gsfc.nasa.gov)

George Khazanov³ (george.khazanov@msfc.nasa.gov)

Dirk Lummerzheim¹ (907-474-7564; lumm@gi.alaska.edu)

Yihua Zheng² (yzheng@lpvax.gsfc.nasa.gov)

¹Geophysical Institute, University of Alaska, Fairbanks, AK 99775-7320

²Goddard Space flight Center, Goddard Space Flight Center, Greenbelt, MD 20771

³Marshall Space Flight Center, Marshall Space Flight Center, Huntsville, AL 35812

The visual auroral takes on a bewildering variety of forms ranging from the discrete, highly structured to the diffuse glow. There is a similarly large variety of electron distribution functions associated with aurora

precipitation ranging from the field-aligned monoenergetic to the broad spectrum, nearly isotropic. An enormous conceptual simplification can be obtained by assuming that auroral electrons are accelerated as spatially narrow, field-aligned beams, which are immediately scattered. The scattering leaves the bulk of electrons in quasi-trapped orbits. The trapped electrons are subject to a rapid pitch-angle scattering process that maintains pitch-angle isotropy and continued auroral luminosity after the acceleration event has passed. Gradient and curvature drift of electrons acts to spatially diffuse the forms.

A radiation transport code is used to test this hypothesis. Auroral imagery from the Polar Satellite is used to define an initial radiation distribution, assuming pitch angle isotropy. The radiation transport code, is used to compute subsequent precipitation patterns, due to rapid pitch angle diffusion between a prescribed set of altitudes. These precipitation patterns can be compared with subsequent Polar images. It is found for a particular isolated substorm event that the luminosity decay time of about a half hour can be accounted for with the radiation transport code, assuming rapid pitch angle scattering occurs between the altitudes of 6,000 and 30,000 km. Eventually, the trapped electron population will fall to the point that it will no longer sustain the instability responsible for rapid pitch-angle diffusion. This will leave a residual population more permanently trapped. The role of the aurora in replenishing the radiation belts will be discussed.

SM72D-04 1615h

Electron distributions produced by kinetic Alfvén waves on auroral field lines

Robert L Lysak¹ (612-625-1323; bob@aurora.space.umn.edu)

Yan Song¹ (612-624-4053; yan@aurora.space.umn.edu)

¹University of Minnesota, Tate Lab of Physics 116 Church Street SE, Minneapolis, MN 55455, United States

A non-local kinetic theory has been developed to describe the interaction between electrons and Alfvén waves on auroral field lines, including the mirroring of electrons by the dipole magnetic field. Calculations of the relative wave power converted to particle acceleration have been performed. For the model density profile considered, the peak power dissipated occurs for a plasma sheet temperature of 1 keV, a frequency of 0.2 Hz, and a perpendicular wavelength of about 10 km. At frequencies above 0.1 Hz, the power dissipated has a sensitive dependence on the frequency due to the effect of the ionospheric Alfvén resonator. At lower frequencies, the wave reflects from the region of large parallel electric field, and so the ionospheric conductivity does not affect the results. The variations in the electron distributions will be considered, with emphasis on the energy flux of electrons precipitating into the ionosphere. The effective current-voltage relation as a function of the frequency of the Alfvén waves will be determined.

SM72D-05 1630h

Cluster Observations of Banded fine Structure in AKR Burst Emission

Robert L Mutel¹ (319-335-1950; robert-mutel@uiowa.edu)

Doug Menietti¹ (319-335-1919; john-menietti@uiowa.edu)

Ivar Christopher¹ (319-335-1953; ivar-christopher@uiowa.edu)

¹University of Iowa, Dept. Physics and Astronomy, Iowa City, IA 52242, United States

We have detected banded fine structure in dynamic spectra of auroral kilometric radiation (AKR) from the WBD instrument on multiple Cluster spacecraft. The banded structure consists of periodic amplitude modulation of AKR burst emission with a frequency separation close to the local proton cyclotron frequency. We have analyzed ten examples of this fine structure in the 250-262 KHz and 500-512 KHz frequency bands. The modulated AKR bursts were received on multiple Cluster spacecraft during six epochs from 20 June to 27 July 2002. The banded structure is similar to that reported by Grabbe (1982) from ISEE-1 observations, but detailed measurements of the frequency spacing show that it is systematically lower than the local proton cyclotron frequency by 5-20% at 250 KHz and 20-40% at 500 KHz. This systematic difference appears to rule out the three-wave model proposed by Grabbe. We discuss an possible alternative mechanism in which the banded structure is caused by a diffracting screen located above the AKR region.

URL: <http://phobos.physics.uiowa.edu/rlm/research/>

SM72D-06 1645h

Enhanced Auroral Proton and Electron Precipitation Immediately Following Rapid Magnetopause Compressions

Eric Donovan¹ (eric@phys.ucalgary.ca); David Knudsen¹; John Wygant²; Michael Henderson³; Robert Ergun⁴; Leroy Cogger¹; Robert Pfaff⁵; Fokke Creutzberg⁶

¹University of Calgary, 2500 University Drive, Calgary, AB T2N 1N4, Canada

²University of Minnesota, Tate Lab Physics 116 Church St SE, Minneapolis, MN 55455, United States

³Los Alamos Natl Lab, MS D436, Los Alamos, NM 87545, United States

⁴University of Colorado, LASP 1234 Innovation Dr Campus Box 530, Boulder, CO 80303, United States

⁵NASA Goddard SFC, MC696, Greenbelt, MD 20771-100, United States

⁶Keometrics, 5 Massey Lane, Ottawa, ON K1J 6C7, Canada

Sudden increases in the solar wind dynamic pressure compress the magnetopause, leading to significantly enhanced Chapman-Ferraro currents, and a corresponding increase in the magnetic field strength throughout most of the magnetosphere. This is the dominant magnetic effect during the initial phase of storms, particularly so when the IMF is northward at the time of the solar wind dynamic pressure increase. At least four times during the past decade, a sudden, significant step in solar wind pressure occurred when the viewing conditions at Gillam (Canada) were good enough to allow for observations of the proton aurora, and the CANOPUS Gillam Meridian Scanning Photometer was operating. In each case, a virtually instantaneous increase in the proton auroral brightness occurred simultaneously with the ground magnetic signature of the dynamic pressure increase. Here, we focus on one of these three events, for which there is excellent supporting in situ and ground-based observations. Based on FAST satellite transits of the auroral oval before and after the pressure step, it is clear that the enhanced proton auroral intensity results from adiabatic energization, and not an increased effectiveness of the pitch angle scattering process that causes the precipitation. The sudden step in dynamic pressure leads to a sudden change in the magnetospheric topology. This change is communicated to the ionosphere by a transient Alfvén wave, the passage of which is clearly detected by the magnetic and electric field instruments on Polar. This Alfvén wave causes a brief burst of electron precipitation that results in a transient (3 min.) enhancement of the electron aurora. This "shock aurora" was recorded by the CANOPUS All-Sky Imager and MSP at Gillam. Events such as this provide us with an excellent opportunity to quantify one way that the solar wind provides energy to the magnetosphere, and to elucidate some important aspects of auroral electron acceleration, and auroral proton pitch angle scattering.

SM11A MCC: 134 Monday 0830h

Nicolet Lecture (joint with SA, SH)

Presiding: D N Baker, University of Colorado, Boulder

SM11A-01 0830h INVITED

Aeronomy: From Exploration to Data Assimilation

Robert W Schunk (schunk@cc.usu.edu)

Utah State University, Center for Atmospheric and Space Sciences 4405 Old Main Hill, Logan, UT 84322-4405, United States

Please see paper number SA11A-01 for abstract.