Eric Donovan Midway Utah – June 21, 2007

- 1. Introduction
- 2. Where do the particles come from?
- 3. How do they become diffuse aurora
- 4. Remote sensing the magnetosphere
- 5. Unstructured quiet time H+ aurora
- 6. Structure in the diffuse aurora
- 7. Opportunities for future studies
- 8. Final thoughts

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Where we started

Plasma Physics What causes the precipitation??

ECH Chorus

EMIC Turbulence Potential Difference FL Curvature MASER Geospace Remote Sensing What can we infer about geospace from the diffuse aurora?

OC Boundary E- CPS inner edge H+ CPS inner edge Stretched-dipolar trans Stretching H+ pressure Presence of MHD waves Presence of waves Role in Dynamics Is the diffuse aurora "important"?

Loss of low E e-Loss of high E e-Loss of low E H+ Low of high E H+ Direct role in currents Conductivity effects Role in wave generation

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not so much



Images from rom http://spaceweb.oulu.fi/~jussila/aurora/



Where we started







Where we started



Where we started









- High Points

Where we started

Discovery & Early Exploration of the Diffuse Aurora

Rees, M., A. Belon, and G. Romick, *The systematic behvior of H emission in the aurora, PSS, 5, 87-91, 1961.*Petschek., H., and C. Kennel, *Tail flow, auroral precipitation, and ring currents., Trans. Am. Geophys. Union, Volume 47, 137-138, 1966.*

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Eather, R., and S. Mende

Airborne Observations of Auroral Precipitation Patterns, JGR, Volume 76, 1746-1755, 1971.

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Dynamic relationship between proton and electron auroral substorms, JGR, Volume 80, 553-574, 1975.

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Monochromatic all-sky observations and auroral precipitation patterns, JGR, Volume 81., 3771-138, 1966.

High Points

Properties of the major relevant plasma populations (mostly the CPS)

Frank, L., Relationship of the plasma sheet, ring current, trapping boundary, and plasmapause near the magnetic equator and local midnight, JGR, 76(2265-2275), 1971.

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Diffusion mechanisms

- Kennel, C., and H. Petchek, *Limit on stably trapped particle fluxes*, *JGR*, 71(1-28), 1966.
- Sergeev, V., E. Sazhina, N. Tsyganenko, J. Lundblad, and F. Søraas, *Pitch-angle* scattering of energetic protons in the magnetotail current sheet as the dominant source of their isotropic precipitation into the nightside ionosphere, PSS, 31(1147-1155), 1983.

High Points

Where we started

Inferring things from diffuse auroral boundaries

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- W. Imhof, Fine resolution measurements of the L-ependent energy threshold for isotropy at the trapping boundary, JGR, 93(9743-), 1988.
- V. Sergeev and B. Gvozdevsky, *MT-index: a new index to characterize the configuration of the magnetotail, Ann. Geophys., 13(1093-1103), 1993.*
- G. Blanchard, L. Lyons, J. Samson, and F. Rich, *Locating the polar cap boundary from observations of 6300 Å auroral emission, JGR, 100(7855-7862), 1995.*
- E. Donovan, B. Jackel, I. Voronkov, T. Sorirelis, F. Creutzberg, and N. Nicholson, Ground-based optical determination of the b2i boundary: A basis for an optical MT-index, JGR, 108(doi:10.1029/2001JA009198), 2003.
- Rae, Kabin, Rankin, Fenrich, Liu, Wanliss, Ridley, Gombosi, and De Zeeuw Comparison of photometer anf glbal MHD determination of the open-closed field line boundary, JGR, 109(doi:10.1029/2003JA009968), 2004.

- High Points

Where we started

Papers from which I learned the most

M. Ashour-Abdalla, and C. Kennel, Diffuse auroral precipitation, in Auroral Processes, C. Russell Ed., 1977.

V. Sergeev, E. Sazhina, N. Tsyganenko, J. Lundblad, and F. Søraas, *Pitch-angle scattering of energetic protons in the magnetotail current sheet as the dominant source of their isotropic precipitation into the nightime ionosphere, PSS, 31(1147-1155), 1983.*

D. Fontaine and M. Blanc

A theoretical approach to the morphology and dynamics of diffuse auroral zones, JGR, 88(7171-7184), 1983.

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The inner edge of the PS and the diffuse aurora, JGR, 89(841-854), 1984.

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Diffuse Aurora - some thoughts on where we are now -

Eric Donovan – Santa Fe NM – June 30, 2011

Regions of specific auroral type: Where, when, and how big? How do they start? How do they stop?





Figure 7. (a) NORSTAR GILL MSP green-line (557.7 nm) auroral observations for an hour period from 07:50 UT to 08:50 UT on February 5, 2009. The superimposed rectangle denotes the footprint of THD for the time interval of interest, 08:38:43 – 08:38:51 UT. (b) The latitudinal variation of MSP green-line auroral intensity for the time stamp centered at 08:38:45 UT. The gray band shows the THD footprint in magnetic latitude, plus/minus 0.3°. The horizontal line in red represents the modeled gree-line auroral intensity based upon the estimate of ionospheric electron precipitation flux caused by the ECH wave scattering. (c) Electron energy flux near the equatorial loss cone obtained from the THD ESA differential flux measurements with pitch angle information.

Where do specific auroral forms come from in the magnetosphere?











Eric Donovan

June 2007/June 2011



(1 min) correlation between GOES 13 ~50 keV e- fluxes and THEMIS white light ASI pulsations

Blue: 0.5-0.6 Green: 0.6-0.7 Red: 0.7+ Max correlation = 0.74

1105-1106 UT

Telescope 6



Diffuse Aurora - some thoughts on where we are going -

Eric Donovan – Santa Fe NM – June 30, 2011



20051228_131342

Eric Donovan





Diffuse Aurora - some thoughts on where we are going -

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Magnetic Mapping FG - flows naturally from the -









June 2007/June 2011





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