The GEMstone

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Notes from NSF Program Director

Kile Baker

You may have noticed that things in the government are kind of confused right now. If you haven't noticed this, you need to get out of the lab more often. We are now in the first few months of fiscal year 2011 but let me back up a bit and take a look at FY2009 and FY2010.

FY2009 was the miracle year. NSF received approximately 40% more money in that year than in FY2008 because of the American Recovery and Reinvestment Act (ARRA). My base budget for FY09 was $7.9M but I was able to use an additional $6M in ARRA funds and other special project funds. While NSF as a whole received a 40% increase the Magnetospheric Physics program was lucky enough to receive almost 75% more funds. This allowed me to fund a number of proposals that I otherwise would not have been able to fund and it also allowed me to reduce my out-year commitments. By reducing the commitments for FY10 I was able to effectively extend the ARRA benefit into that fiscal year and even into this new fiscal year. As a result, the funds I have available for GEM as

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Editor: Peter Chi

well as my core program for FY11 are somewhat greater than might otherwise have been expected.

So how did all this ARRA stimulus money end up affecting GEM funding? In FY09 I was able to fund 14 of the 26 GEM proposals for that year – an astoundingly good success rate. In FY10 I was able to fund 9 of 35 proposals. Obviously a much reduced success rate, but nevertheless an increase in the actual number of GEM awards compared to pre-ARRA years. The GEM proposals for FY2011 have only recently been submitted and so, of course, I don't know how many will be funded, but my guess is that I will be able to fund 7 or 8 proposals. The bad news is that the total number of proposals submitted continues to grow and this year I received 39 GEM proposals.

This fiscal year is going to be the last one in which there will be any improvement because of the 2009 ARRA stimulus funding and the outlook for future years is looking pretty bleak right now. As always, anything I can say about future funding is very speculative. As I write this we are still operating under a Continuing Resolution and the funding situation for FY11 is still very uncertain. It is pretty much guaranteed that the currently sitting congress will not pass appropriations bills before the current congress is dissolved.

The most likely scenario is that the current congress will pass a CR that will continue the operation of the government until the new congress takes over. Several members of the new congress have expressed a wish to return federal budgets to FY2008 levels. If those cuts are taken across the board then the Magnetospheric Physics budget would go back to $7.8M, a drop of approximately 10% (ignoring the ARRA stimulus bump). But the situation could be even worse. The overall drop in the NSF budget would be close to 20% and in order to save some of NSF's newer initiatives the core programs may have to be cut back even further. So stayed tuned to find out just how bad the news actually will be.

Although the funding situation for the future is looking pretty bad, I know that the GEM program will continue and the GEM community will remain at the forefront of magnetospheric physics research. As you know, the summer workshop for this coming year will be held jointly with the CEDAR workshop in Santa Fe. The planning for the joint workshop is already in motion and I think we will see a very scientifically stimulating meeting this coming June. I look forward to seeing you all there.

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2010 GEM Mini-workshop
December 12, 2010
Westin San Francisco Market Street
50 Third Street
San Francisco, CA

Notes from GEM Chair

Mike Liemohn

It's been a great year for GEM. You might not have noticed, but this year posed a big test for the GEM community. How so? We have witnessed the successful transition of existing Focus Groups (FGs) into completion and the smooth launch of new FGs to take their place in the line-up. I think that this is a significant moment in GEM history and one worth noting and remembering.

Ever since its inception, inertia has been against the GEM community when it comes to wrapping things up. In the past organizational structure, the Campaigns seemed to go on and on. There were, of course, reasons for the continuations and extensions being granted: leadership of the campaign or working group would change; new Working Groups were sometimes formed; new data or techniques would become available; new research thrusts would emerge; or new "challenges" would be extended. Furthermore, with the all-or-nothing scenario of a campaign, the researchers within that topic knew that they would not have a reason to come to the GEM Workshop if "their" campaign was allowed to end. Consciously or not, I was whole-heartedly guilty of this when I was chair of a near-termination campaign. The lingering on of existing campaigns, however, meant that new campaigns with different emphases could not be started.

When we switched the format of the GEM program from the Campaign/Working Group structure to the Research Area/Focus Group structure, this problem was supposed to go away. The Research Areas are permanent organizational entities within GEM, representing the main topics of geospace science. People from across the magnetospheric disciplines are welcome to attend GEM every year, and they will always find a discussion somewhere at the GEM Workshop within their field. However, the specific activities within these broad scientific categories are expected to regularly change, with the Focus Groups having a set lifetime of 5 years with no exceptions. While no specific number is set for the limit of active FGs, it has hovered around 12, meaning that the 5 Research Areas should hopefully have 2 or 3 active FGs at any one time. GEM instituted a competitive proposal and selection process for determining new FGs and this seems to be working fairly well (with my regrets to those that have proposed new FGs and not been selected).

Last summer (June 2009), we had 2 FGs reach the end of their 5-year lifetime. And they did it; they wrapped it up, ended their discussions and activities, and the FG leaders wrote a final report on what was accomplished. This summer (June 2010), we had 3 more active FGs reach the end of their timeline and again they concluded their activities and wrapped it up. This, I think, is truly amazing, especially given the history of GEM. The FG concept is working; we are staying on track with the systematic and timely creation and termination of FGs. Discussion topics are ending and GEM is moving on, yet GEM is not dying. Far from it. We are initiating new FGs through the proposal process to take their place in the summer workshop schedule and successfully transitioning the discussion and activities of GEM to these new topics. All 5 Research Areas are active and all within the geospace research community are welcome to attend the GEM Workshop. I love it!

None of this would happen without the active participation of <u>you</u>, the GEM research com-

munity. The activities of GEM are not dictated by the NSF program manager but rather are purely grassroots efforts born from the creative minds of geospace researchers. We need people to step up and be willing to lead a conversation on an unresolved question and to guide the community in activities (e.g., challenges) to help us move towards an answer. The 5-year lifetime of a FG allows the community to dwell on an issue for several years, allowing us to organizing ourselves, formulate and implement ways to address the issue, debate the data and model results (and perhaps reach consensus), and advance our understanding. Then, after 5 years, you are done as a FG leader and can move on to other roles. I greatly appreciate the service of the many GEM community members who make GEM what it is. GEM is *the place* for magnetospheric modelers to get together and talk shop, *the place* for GGCM development discussions and consensus, and *the place* for building community consensus on difficult issues of geospace science. This wouldn't happen without your active involvement in the organization and management of the program.

So, on this note: I would like to encourage the GEM community to be thinking about the next great idea for FGs. The call for new FG proposals will be issued very soon, with a deadline just before the GEM Mini-Workshop (which is on the Sunday before the Fall AGU Meeting, December 12 this year). Please be starting to think about this over the coming weeks and, if you have any questions, then please feel free to contact the appropriate Research Area Coordinator (RAC) or me.

There is one special request for FG leadership this year. One of the FGs that just ended is the Metrics and Validation FG within the GGCM Research Area, and this is something that the Steering Committee feels should not go away. However, being a FG, we are officially ending the existing Metrics and Validation FG and reforming a new one, perhaps with new leadership but definitely with a new 5-year plan. We would love to receive one or more FG proposals for this kind of activity. If you are interested in leading this effort, then please contact the GGCM RACs (Stan Sazykin and Slava Merkin).

Also, the next summer workshop is a joint GEM-CEDAR Workshop, to be held in Santa Fe, NM, June 26 - July 1. A joint task force has been created to truly integrate the programs and activities of these two groups and make it a genuinely joint meeting. Our theme for the joint workshop is "Connections in Geospace" and we hope that the two communities take the opportunity to get to know one another. Regarding this, there will be a special call for joint session proposals. This call will also be issued in a few weeks, with a deadline sometime after the Fall AGU meeting. These will essentially be one-year-only Focus Groups on topics of mutual interest with leadership from both the GEM and CEDAR communities. Please be thinking about the possibilities and look for the call when it appears in your email inbox.

I look forward to seeing you all at the GEM Mini-Workshop in San Francisco.

Cheers,
Mike Liemohn

2011 GEM/CEDAR
Joint Summer Workshop
June 26—July 1, 2011
Santa Fe, New Mexico

GGCM Research Area Report

Coordinators: Stan Sazykin and Slava Merkin

GGCM Metrics and Validation Focus Group

Co-chairs: Masha Kuznetsova and Aaron Ridley

The group met for 1.5 hours on Tuesday at 1:30 pm to discuss the status of the GEM Modeling Challenge. The goal of the Challenge is to help to evaluate the current state of GGCM models, to track model improvements over time, to demonstrate effects of model coupling and grid resolution and to facilitate interaction between research and operation communities in developing metrics for space weather model evaluations.
Events and physical parameters for the Modeling Challenge were selected at the GEM 2008 Workshop.

- Event 1: Oct 29, 2003 06:00 UT - Oct 30, 06:00 UT
- Event 2: Dec 14, 2006 12:00 UT - Dec 16, 00:00 UT
- Event 3: Aug 31, 2001 00:00 UT - Sep 01, 00:00 UT
- Event 4: Aug 31, 2005 10:00 UT - Sep 01, 12:00 UT

Status of on-going Metrics Studies (MSs).
MS 4: Ground magnetic perturbations. First report is submitted to Space Weather J. (Pulkkinen et al, 2010). Howard Singer made a presentation on NOAA SWPC metrics and validation needs. The MS on ground magnetic perturbations is of primary interest and will be used by NOAA SWPC as a base for validation of geospace prediction models to determine which model or models should begin transition to operations in 2012. Suggestions on further refinement of ground magnetic perturbation MS: focus on regional dB/dt and Kp (noon, dusk, midnight, dawn, high-latitude, low-latitude, …).

MS 1: Magnetic field at geosynchronous orbit. First report is submitted to Space Weather J. (Rastaetter et al, 2010). MS 1 and 4 will be repeated next year with updated models to show progress over time.

MS 3. Plasma parameters at geosynchronous orbit – on hold. SOPA ion corrections for MPA are needed for pressure comparison. J. Borovsky and R. Friedel are working on removal of electron contamination from the low-energy ion channels of SOPA.

MS 2: Magnetopause crossings by geosynchronous satellites. Comparison with LANL magnetopause in/out time series demonstrated wide variety of model results. In-depth comparative study of magnetopause positions was addressed at the "Baseline model comparison" session (Tuesday 3:30).

MS 5: Dst index study (added at GEM 2009 Summer Workshop) in collaboration with Inner Magnetosphere FG. CCMC staff demonstrated updated Metrics Tool Suite that now include Dst Index study. Dan Welling showed the results of early RAM_SCB validation. Lutz Rastaetter presented report on first round of DST submissions (two events only). The results are quite different for weak and strong storms. We agreed to add more events and more empirical models. Metrics to be used: RMS prediction efficiency and Maximum ratio. Different methods for Dst calculations will be analyzed. A draft report will be discussed at GEM mini-workshop in December. The Deadline for timeline submission for all models/events: October 15, 2010.

Ideas for new Events and Metrics Studies.
NOAA SWPC recommendations (Howard Singer):

- First priority: Regional dB/dt, Kp.

– Second priority: Auroral boundary position. This study is also a priority for AFWA.

Plans: Analyze ground magnetic perturbation dependence on local time using the same events and model outputs (short-term). Analyze latitude dependence (long-term). Continue discussion on settings for auroral boundary position study at GEM mini-workshop.

Dayside FAC and Energy Deposition FC recommendations (Delores Knipp)
– Ionosphere Joule heating. Delores will provide DMSP Poynting flux timelines.
– CCMC will add Joule heating to on-line plotting tool, provide information on model output format for model output submissions.
– Additional events recommended for ionosphere Joule heating metrics study (MS 6):

Event 5: May 15, 2005 00:00 – May 16, 2005 00:00.
Event 6: July 9, 2005 00:00 – July 12, 2005 00:00.

Continue discussion on settings for Ionosphere Joule heating study at GEM mini-workshop.

Ideas for Joint GEM-CEDAR project:
– Ionosphere Joule heating + hemisphere power.
– Coupled magnetosphere/ionosphere runs. Compare with stand-alone models.

For the **GEM Baseline Model Comparison session**, there were four presentations that compared the location of the magnetopause at different IMF strengths. CCMC, GUMICS, BATSRUS and LFM all participated in the comparison. It was determined that the OpenGGCM and LFM typically had magnetopauses that were 1-2 Re inside of BATSRUS and GUMICS. The modelers were unsure as to why this may occur. The group also discussed the strength and morphology of magnetospheric currents, particularly the magnetopause and bow shock currents, during weak, moderate and strong solar wind driving, and significant differences between the different models were found. The modelers are going to work to try to ensure that the models' boundary conditions and other parameters are as close as possible in further comparisons. It was also suggested that the leaders of the working group collect data files from each of the modeling group, so the exact locations and current structures could be directly compared, instead of just images.

GGCM Methods and Modules Focus Group

Co-chairs: Brian Sullivan and Michael Shay

The overarching goal of this focus group is to understand the physics of collisionless magnetic reconnection on magnetospheric length scales (100-1000 ion inertial lengths). This was the final year for this focus group. The two sessions included 9 speakers this year:

Ray Fermo, Dmitri Uzdensky, Joachim Birn, Kittipat Malakit, John Meyer, Michael Shay, John Lyon, Brian Sullivan, Kai Germaschewski

Primary areas of focus this year included:

- Asymmetric reconnection: corrections and additions to Cassak-Shay formula & asymmetric reconnection in turbulence, and
- The role of plasmoids in magnetic reconnection

Asymmetric Reconnection

Reconnection is generally asymmetric in nature, and asymmetric reconnection has been a major focus over the lifetime of this focus group. Joachim Birn presented corrections to the Cassak-Shay formula for asymmetric reconnection. These corrections include compressibility effects, and proper treatment of Poynting flux and enthalpy flux through the reconnection region. New effects include a plasma-b dependence for the reconnection rate, and an even split of the Poynting flux

between enthalpy flux and bulk kinetic energy flux. This even split occurs independent of b, and independent of the ratio of upstream densities and field strengths on the two sides of the reconnection layer.

One context in which asymmetric reconnection occurs is in the reconnection of plasmoids in turbulent plasma. Intermittent turbulence with reconnection has been observed just downstream of the bowshock, within the magnetosheath (Retino et al. Nature Physics 3, 235 - 238 2007). Michael Shay presented simulations of reconnection in turbulence. The results indicated that understanding current sheet formation and reconnection in turbulent regions is likely key to understanding the dissipative physics in MHD turbulence.

Role of Plasmoids in Reconnection

Reconnection research currently finds itself in a paradigm shift due to the realization that in large systems such as the magnetosphere, Sweet-Parker current sheets at high Lundquist number are unstable to a super-Alfvénic, secondary tearing, or "plasmoid" instability. This instability has been seen in resistive MHD, Hall MHD, and PIC simulations. In two-dimensional simulations of reconnection, this leads to reconnection regions containing many x-points separated by plasmoids. Flux-ropes are the three-dimensional analog of these plasmoids.

This plasmoid instability leads to reconnection rates much higher than those predicted by Sweet-Parker theory, although not as high as the rates previously reported in Hall MHD, for example, in the GEM reconnection challenge papers, which focused on a relatively small system. Plasmoids speed up the reconnection process within resistive MHD, but they also rapidly generate kinetic scale current sheets, which may make Hall physics important at lower Lundquist numbers than previously thought.

Plasmoid dominated reconnection is inherently dynamic, and potentially bursty. Consequently Sweet-Parker theory, which assumed quasi-steady behavior does not apply well in this regime. Understanding such inherently dynamic reconnection requires a statistical treatment. Dmitri Uzdensky *et al.* and Raymond Fermo *et al.* have presented statistical models of plasmoid distrubution (size, lifetime, etc.) Fermo's model has been found to compare favorably with data from ~1000 Cluster crossings of FTEs at the dayside magnetopause.

Understanding plasmoid-dominated reconnection in large-scale systems will likely be a major part of global scale reconnection research for the next several years. Outstanding questions include:

How do plasmoids impact the onset of fast reconnection in collisionless systems? Are they merely a transient phase, or do they play a key role in generating sub-d_i scale current sheets?

Can global models achieve realistic reconnection rates and current sheet geometries with plasmoids simply by simulating high Lundquist number resistive MHD reconnection, or is the Hall term vital to fast reconnection even in a plasmoid-dominated regime?

What might be the role of plasmoids in generating enhanced localized resistivity around the many x-lines that separate plasmoid.

Dayside Research Area Report

Coordinators: Jean Berchem and Karlheinz Trattner

The following report summarizes the dayside science discussions held during the 2010 GEM meeting in Snowmass, Colorado. This meeting marked the beginning of two new focus groups: the Magnetosheath and Dayside Field-Aligned Currents and Energy Deposition (also part of the Magnetosphere-Ionosphere Coupling research area) and the conclusion of the Cusp Physics focus group. The final report of the Cusp Physics will appear in another GEMstone issue.

Cusp Physics Focus Group

Co-Chairs: Karlheinz Trattner, Nick Omidi, and David Sibeck

The GEM Focus Group on "The Cusp" has come to an end this year. With 12 confirmed speakers distributed over two sessions this Focus Group showed a continued strong interest throughout the community with many interesting topics. It was the ultimate goal of the workshop to enhance our understanding of the cusp physics, its coupling to other parts of the system such as the bow shock, magnetopause and the ionosphere and the important role it plays in dayside particle transport and energization. The Cusp session covered the following subjects:

Interactions of FTE's with the cusp

David Sibeck reported on an ongoing project about FTE motion towards the cusp. Hybrid simulations are used to determine if events generate density variations in front of an FTE and subsequently cause fast or slow shocks as discussed by Sonnerup. Only fast moving events exhibit wakes (slow mode density enhancement), which should be visible on Cluster in front of fast moving FTE's as the satellites cross the magnetopause. Early in life an FTE starts out below Mach 1. It subsequently speeds up to a sonic Mach number of ~4. However, the FTE never gets into the fast (or slow) shock regime, by staying below Alfven Mach number 1.

Nick Omidi presented 3D hybrid simulations of FTE interaction with the cusp and showed that as in the 2.5-D simulations, when an FTE enters the cusp, a secondary magnetic reconnection takes place. The resulting reconnection jets inject plasma into the magnetosheath and the cusp with the latter leading to density enhancements in the cusp.

Plasma transport into the cusp

Pat Newell reported on DMSP merging cusp bursts, and showed auroral observations from the Polar UVI instrument including data from two DMSP satellite crossings at local noon during that event. The event is driven by southward IMF conditions. The DMSP satellites detected two large Alfvenic electron bursts, one located at the poleward edge of the old cusp location and one at the equatorward edge of the new cusp location. Associated flow bursts contributed a significant fraction of the typical cross polar potential. Ion observations which showed low energy cutoffs revealed details of the timing sequence.

Steve Petrinec presented a study addressing energetic particle transport into the cusp in energetic ions near the magnetopause reconnection site. Steve started his presentation with observations from the IBEX satellite. The IBEX satellite was launched to image the edge of our solar system, the termination shock, in neutral atoms. However, IBEX can also be used to image charge exchange with the geocorona in the cusps and at the subsolar point where the strongest fluxes of neutrals have been observed. To investigate energetic ion transport into the cusp, Steve used THEMIS observations near the reconnection site at the magnetopause and discussed an event to determine if shock accelerated energetic ions can make it into the magnetosphere, and subsequently into the cusp. The quasi-parallel bow

shock during this event was located in the northern hemisphere and THEMIS showed energetic ions streaming in from the bow shock when the satellite was located north of the reconnection site. No energetic ions are detected at THEMIS when the satellite is located south of the reconnection site since the reconnection site cuts off the access to the northern hemisphere quasi-parallel bow shock region.

Hyun Conner used MHD codes to reconstruct cusp ion structures observed by satellites and presented simulations results on cusp structure during southward and northward IMF. She found that the observed model MHD cusp structures depend strongly on the chosen virtual satellite orbit.

Tom Guild presented high-altitude ion dispersion signatures observed with TWINS. The plasma instruments onboard the TWINS satellites in a highly elliptical orbit show isolated ion energy dispersions in the high altitude cusp on lobe field lines. Tom wants to determine if flank processes can account for the observations (e.g., Kelvin-Helmholtz) and if the dispersions are consistent with cusp injections.

Energization of ions in diamagnetic cavities

Katariina Nykyri's presentation on cusp diamagnetic cavity (CDC) structure fluctuations and origin of high-energy particles covered several research topics within the Cusp Focus Group, also addressing the origin of waves observed in the cusp and the source region of cusp energetic particles". Katariina investigated a Cluster cusp crossing which showed an extended CDC and energetic ions and electrons by using Cluster data and MHD simulations. The Cluster data are used to place the satellite within the MHD simulation frame. Katariina found that electrons in the CDC are trapped within the CDC which favors local acceleration. Most of the wave power is at low frequencies. However, most of the waves observed in the CDC are encounters with the boundary of the cavity. Katariina suggested a couple of observational features to be answered in future studies by various groups interpreting energetic particle data in the cusp. These questions include (a) Ion flux drops off as a function from distance to the cavity boundary, (b) High energy ions with ~180 degree pitch angle on magnetosheath field lines (c) Observed pitch angles for energetic electrons and (d) High energy particle fluxes drop sharply at the magnetosphere boundary.

Brian Walsh investigated Cluster data for his study on energetic pitch angle distributions in the exterior cusp. Pitch angles of energetic electrons observed by Cluster in the cusp peak at 90 degrees. These observations are used to model pitch angle scattering in the cusp by assuming random polarization, random direction of propagation, a set spectral length and a set correlation length. His model also shows that the energetic electrons in the cusp behaved adiabatically and peak at 90 degrees. Future studies will expand this model to use ions.

Ted Fritz presented the work of an extensive statistical study by John Niehof on CDC and CEP correlation study. The study is based on Polar data in the cusp. Out of 2117 satellite passes, 1192 cusp crossings were observed. In this cusp survey 734 CDC and 970 CEP events were recorded. Of those 681 cusp crossings showed CDC and CEP events. John concluded that CDC and CEP are directly related. Other source regions for CEP ions discussed in the literature are the quasi-parallel bow shock and magnetosphere which were also discussed in the survey but showed no significant correlation.

Julia Pilchowski reported on particle acceleration in CDC for southward IMF. Julie uses test particles in an MHD simulation to model CDC and their characteristics. The simulation model was set for southward IMF and uses electric and magnetic fields from local cusp simulations. Test particles are launched within the cavity and remain trapped for 50 minutes. The maximum energy gain reached by the ions is 70 keV while the maximum energy gain reached by electrons is 40 keV. The particle movement within the CDC is an oscillation between the boundaries (gyration and drift).

The Magnetosheath Focus Group

Co-Chairs: Katariina Nykyri and Steve Petrinec

The Magnetosheath FG had its first session at the GEM meeting on 23rd of June 2010. The session held five oral presentations, a planning session and one poster presentation on Thursday 24th. The organizers had asked the participants to focus their presentations around three main categories: 1) Large Scale Structure of the Magnetosheath, 2) In-situ Magnetosheath Physics and 3) Magnetosheath Impact on the Magnetosphere.

Large-scale structure of the magnetosheath and surrounding regions

Merka et al. used a 'machine learning technique' (SVRM) to model the outer boundary of the magnetosheath. Model inputs include solar wind parameters and dipole tilt angle of the magnetosphere. Model is trained on a large subset of observations, and tested against a separate subset of observations. This method is to be used to aid in the empirical understanding of the large-scale configuration of the outer magnetosheath boundary.

Yongli Wang used the same 'machine learning technique' described in the previous presentation to model the magnetosheath. Similar model inputs as for the bow shock. This method is to be used to empirically model of the large-scale configuration of the magnetosheath region.

Michael Schulz developed an orthogonal coordinate system for the magnetosheath. The motivation for developing this coordinate system is to create analytic streamline models for a general class of magnetopause shapes. This is to aid in the analytic understanding of the large-scale configuration of the magnetosheath.

Magnetosheath processes and impact on the magnetosphere

Nick Omidi presented some observations in the magnetosheath that show there are regions of depressed magnetic field associated with increased fluxes of energetic particles. Nick's 2D global hybrid simulations were able to capture these phenomena. Observations and simulations indicate that these regions are more likely during small IMF cone angles, when the Q-|| region of the bow shock is close to the subsolar location. These regions could alter the plasma entry into the magnetosphere.

Jan Soucek reported that Soucek et al. (2008) have found that the mirror mode instability changes character (or, evolves) with distance from the bow shock. Near the bow shock, there are many instances of quasi-sinusoidal compressional magnetic waves. Further from the bow shock, there are more 'peaks' (i.e., occasional large compressions superposed on a background level). Closest to the magnetopause, there are almost no quasi-sinusoidal compressional magnetic waves; only 'peaks' and 'dips'. The results of this study have important implications for the heating and anisotropy of the magnetosheath plasma; and how the mirror mode instability can potentially affect plasma entry into the magnetosphere e.g. change reconnection rate at the magnetopause.

Alexander Sjogren presented initial results of the statistical study of magnetosheath temperatures (measured by THEMIS spacecraft) vs. solar wind conditions. The goal is to study whether the dawn-side magnetosheath is statistically hotter than the dusk-side flank for the Parker-Spiral IMF and vice versa because the location of the quasi-parallel bow shock changes. These initial results did not show any clear trend. The work is continuing on this in order to address if the plasma sheet temperature asymmetry could partly be generated by initial asymmetry present already in the magnetosheath.

Future activities

Planning was undertaken for next year's joint meeting with CEDAR, and for the future efforts of this focus group. In particular it was discussed how it would be beneficial for the magnetospheric physics and CEDAR community if the magnetosheath focus group activities would results in a statistical spatial map of magnetosheath properties for different IMF and solar wind conditions such as turbulent

properties of the magnetosheath. Seed turbulence in the magnetosheath has impact on transport across the magnetopause by affecting growth rates of various instabilities such as Kelvin-Helmholtz and tearing-mode. Correlation studies between different geomagnetic indices and spatial distribution of magnetosheath properties would be useful in this effort. The focus group plans to utilize the NASA web-meeting interface offered by David Sibeck to coordinate activities for next summer's joint GEM-CEDAR workshop.

Dayside Field-aligned Currents and Energy Deposition Focus Group

Co-Chairs: Delores Knipp, Geoff Crowley, Stefan Eriksson, and Ramon Lopez

The goals of the Dayside Field-aligned currents and Energy Deposition (FED) Focus Group goals are: Discover/Explain the relation between enhanced dayside field-aligned currents, their sources in the solar wind and the impacts in the ionosphere-thermosphere system.

FED activity status

As of the summer 2010 GEM meeting, the FED Focus Group had been functioning for 6 months. The FG was established to address the occurrence of anomalous thermospheric density signatures that seem to be associated with interplanetary shocks and large in-the-ecliptic interplanetary magnetic field (IMF) values. These often, but not exclusively, occur while the IMF BZ is positive. New Poynting flux data from the DMSP F-15 satellite suggest extreme localized field aligned currents are playing a role in the intense energy input. Figure 1 shows an example of extreme Poynting flux calculated from the DMSP F-15 spacecraft during an interval of northward IMF.

During the remaining 2.5 years of the Focus

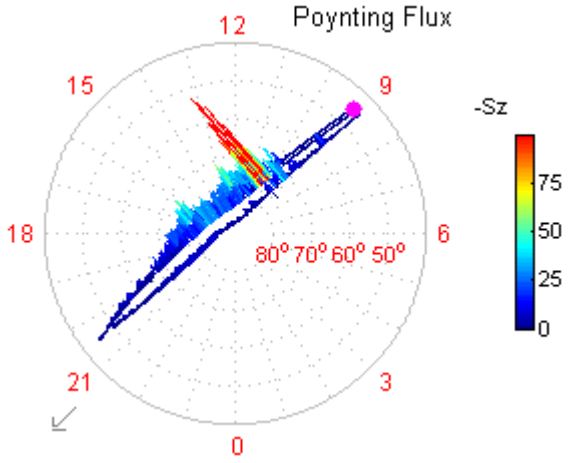


Figure 1. Poynting flux calculated from DMSP electric and magnetic field measurements. The data show an order-of-magnitude localized Poynting flux enhancement during intervals of strong B_Y and northward IMF on 21 Jan 2005

Group there will be a sustained effort to incorporate AMPERE data into the mix of observations and include available data from polar cap observatories. Two of the storm events (15 May 2005 and 9-11 July 2005) have been adopted by the Metrics Study Focus Group in order to bring a multiple model perspective to the events. The FED FG will likely be the subject of a joint session at the 2011 combined GEM-CEDAR meeting.

FED session highlights

Delores Knipp presented an overview of the FED effort and showed DMSP Poynting flux from select events. The data reveal localized Poynting flux enhancement during intervals of strong BY (DMSP) and neutral/northward IMF (see Figure 1).

Stefan Eriksson reviewed Poynting flux observations for the 15 May 2005 storm: He showed the relation between high-latitude reconnection driven convection and NBZ currents. His presentation illustrated FACs adjacent to well-defined flow channels.

Geoff Crowley presented an overview of thermospheric response from select events. He presented conclusive evidence of large thermospheric density effects associated with localized Poynting flux deposition based on CHAMP satellite data and TIMEGCM simulations.

Bob Strangeway related cusp-region FACs, IMF By control and ion outflows. His report fo-

cused on FAST data.

Mike Wiltberger showed preliminary results from the Major Storm of August 24, 2005. He will be doing further analysis of the LFM Run.

Dan Weimer reviewed measurements and predictions of thermospheric temperature changes based on work he has done with drag data provided by US Space Command. He reported good global agreement from the empirical model.

Simon Wing discussed source regions of dayside field-aligned currents based on statistical analysis of many years of DMSP data.

Wenhui Li showed results from an OPEN GGCM study of dayside energy deposition during northward IMF during the January 21, 2005 storm event. He has been able to trace the field lines from the flank merging region to the location of strong Poynting flux deposition shown by Delores Knipp.

Bob Strangeway led an additional discussion on determining the open-closed field line boundary from low altitude spacecraft.

Betsy Mitchell showed evidence from her PhD. dissertation work that IMF By decouples energy input into the ionosphere from energy input into the inner magnetosphere.

Gang Lu showed ionospheric convection, field-aligned current, and Poynting flux under strongly northward IMF conditions during the November 08, 2004 storm onset. She showed evidence of reverse convection in both hemispheres.

Ramon Lopez suggested that some of the field aligned current associated with the large dayside energy deposition events originate at the bow shock.

There was additional discussion of the relation between ion upwelling and ion outflows and possible association of these with polar cap scintillation.

Paul Song offered additional perspective and discussion about the magnetic field configuration during northward IMF.

Dayside Research Area Planning

Co-Chairs: Jean Berchem and Karlheinz Trattner

Because the activity of the Cusp Focus Group was coming to an end a Dayside Research Area planning session was convened. The goal of that session was to identify areas of interest and foster collaborations that will lead to proposals of new dayside focus groups at the GEM meeting during Fall AGU. About 25 people met and discussed the status of our comprehension of physical processes occurring in the dayside magnetosphere. The consensus was that one of the main issues is the lack of quantitative models that predict where, and the form that energy, momentum, and mass enter the magnetosphere. In particular, the group identified areas that could be of interest for future dayside focus groups:

- *Connecting cusp and auroral structures:* e.g. use dayside wave phenomena and energetic particles entering/leaving the cusp (Cluster, DMSP, ground-based observatories)
- *Dynamic processes at the magnetopause:* e.g., effects of FTEs, dayside transients, pressure pulses, KH waves (THEMIS, Cluster)
- *Interhemispheric coupling:* e.g., summer/winter hemispheres and North/South high latitudes; effects on polar cap potential saturation; results could be used to modify global models (DMSP, ground-based observatories, IRIDIUM, SWARM, CHAMP)
- *Mapping magnetopause structure to the ionosphere and vice versa:* e.g., open/closed field line delineation; polar cap morphology (THEMIS, ground-based observatories, IRIDIUM, SWARM, CHAMP)
- *External causes of internal waves in the outer magnetosphere* (THEMIS, Cluster, ground-based observatories, satellite imaging)
- *Interaction of dense cold plasma plumes with the magnetopause* (THEMIS, IMAGE, ground-based observatories)

Tail Research Area Report

Larry Kepko and Mike Henderson

The following report summarizes the discussions held by the Tail Research Area Focus Groups at the most recent GEM Workshop in Snowmass, Colorado.

Plasma Entry and Transport Focus Group

Co-Chairs: *Antonius Otto, Jay Johnson, and Simon Wing*

PET had three breakout sessions on Monday Jun 21, 2010. Overall, the sessions were well attended and two of the breakout sessions were oversubscribed. There was a good balance of observational and theoretical/modeling presentations.

Session 1: Ion outflow effects in the plasma sheet

Three Cluster O+ studies were presented. Observations of O+ outflow during storm and substorm in the magnetotail suggest that cusp was the source and that the southern hemisphere has higher frequency of O+ outflow, although the reason is not clear (Lynn Kistler). Evidence of O+ heating was presented and attributed to pressure (Jichun Zhang). The solar EUV radiation conrols H+ and O+ densities and consequently their density ratio (Chris Mouikis). Three Multi-fluid LFM (MFLFM) O+ outflow studies were presented. MLFLM with three combinations of Strangeway et al. [2005] and [2009] relationships show that O+ outflow moves tail X-line, which is attributed to increased pressure due to O+ (Oliver Brambles). In MFLFM, higher O+ decreases polar cap potential, increases tail Vx, and higher tail width (Katherine Garcia). Moreover, O+ outflow leads to more unstable KH on the flanks and reduces the magnetic activity (Slava Merkin). KH simulations in Saturn's magnetosphere suggest that mass increase leads to lower growth rate (Peter Delamere). Reconnection due to heavy ions may lead to dawn-dusk asymmetry as observed in Wing et al. result (Jay Johnson). Due to the oversubscription of the session, Simon Wing's presentation on field-aligned current was voluntarily withdrawn.

Session 2: Constraints on the plasma sheet entry and transport

An MHD simulation on bubble transport in the magnetotail was presented and how the transport is affected by the shape and size of the bubble. (Joachim Birn). Apparently Te/Ti ratio is conserved during magnetosheath entry into the plasma sheet, despite the fact that the entropy is not conserved (non adiabatic process) (Joe Borovsky). LASK simulation examined the storm time the H+ density, H+ energy density, O+ density, and O+ energy density (Vahe Peroomian). The same simulation shows that IMF field line can get intertwined with closed field line in the magnetotail. LFM simulations show flows channels in the magnetotail, which are manifested as BBFs during southward IMF and "fingers" during northward IMF (John Lyon). The same study shows that an entropy profile that is similar to the empirical profile (Joe Borovsky) after southward IMF turning. An event of bubble propagation in the magnetotail and its signatures in the ionosphere were observed. Cooling of the ion hot component and dawn-dusk temperature asymmetry were modeled and compared with Wing et al. observations (Colby Lemon). PBI's flow in the polar cap and Harang reversal are linked to the plasma sheet plasma bubbles (Larry Lyons). Perpendicular flow fluctuations are observed to be

larger than the average values; the tail transport is determined to be competition between convection and diffusion (Chih-Ping Wang). Large entropy increases associated with slow shocks were examined with energy conserving MHD simulations (Antonius Otto).

Session 3: GEM challenge

John Lyon presented successes and difficulties with RCM – MHD coupling. For example, coupling MHD with RCM can provide R2 current, but the convection pattern is unusual. MHD-RCM field aligned currents show small pearl structures. One of the difficulties is that slow flow is violated at the MHD – RCM boundary. Challenges were introduced – (1) How much entropy can increase in reconnection and the role of slow shocks; (2) Why the Ti/Te ratio seems to be conserved; and (3) Entropy changes associated with the collective behavior of bursty bulk flows.

Near-Earth Magnetosphere: Plasma, Fields and Coupling Focus Group

Co-Chairs: *Sorin Zaharia, Stan Sazykin, and Benoit Lavraud*

The Near-Earth Magnetosphere focus group held 3 breakout sessions at the 2010 GEM Summer Workshop in Snowmass, CO. The main goal of the focus group is to improve our physical knowledge and modeling of the near-Earth magnetosphere and its coupling with the outer magnetosphere. The focus group is coordinated by Sorin Zaharia, Stan Sazykin and Benoit Lavraud.

The three focus group sessions, held on Wednesday and Thursday (06/23-24) featured short presentations and discussions related to the following scientific research topics:

Session 1: Inner-outer magnetosphere coupling:

Effect of depleted entropy bubbles on the inner magnetosphere as obtained from a 3D MHD simulation (J. Birn)

- Coupling of Rice Convection Model (RCM) with a global MHD code: interchange-related dynamic flows and oscillations; plans to modify RCM to include inertial terms (F. Toffoletto)
- Effect of ion outflow on ring current (through plasma sheet density/temperature, cross polar cap potential drop and ion composition) (D. Welling) 1-way coupling of the BATS-R-US global MHD code with the Comprehensive Ring Current Model (CRCM) and Radiation Belt Environment (RBE) codes; importance of electric field self-consistency (Q. Zheng)
- Specification and effect of plasma properties at geosynchronous orbit in RCM; ring current dependence on ionospheric conductivity (M. Gkioulidou)

Session 2: Observational studies and empirical models:

- Empirical magnetic field modeling – modification of the T96 model by adding a substorm current wedge; importance of magnetic field model for M-I coupling (G. Lu)
- Results from the TWINS mission; stereoscopic ion inversion providing pitch angle information; validation vs. THEMIS data; presentation of available TWINS data products (J. Goldstein)
- Exploring plasmaspheric subcorotation through radar observations (Blackstone – mid-latitude) of westward flows on field lines mapping into the plasmasphere (L. Claussen)

Session 3: Interaction between plasma and fields in the near-Earth magnetosphere - coupling between different elements in numerical models (plasma, electric and magnetic fields):

- Two presentations accompanied by spirited discussions on comparisons of different formalisms for studying plasmas: MHD, guiding center and Vlasov theory (R. Strangeway); differences between single-fluid MHD and kinetic formalisms, and what one needs to add to MHD in order to reproduce inner magnetosphere physics (S. Zaharia)
- Effect of self-consistency/stretched magnetic fields on ring current morphology and dynamics (V. Jordanova; R. Ilie) Importance of self-consistent treatment of particles and fields in the storm-time inner magnetosphere, explored through comparison of simulated and observed magnetic intensities and ion plasma parameters from GOES, Polar, LANL (M. Chen)
- Simulation of Steady Magnetospheric Con vection (SMC) event with RCM-E needs to be driven with depleted flux tubes in order to reproduce THEMIS observations (F. Tof foletto)

The second half of the 3rd breakout session was devoted to a community discussion on future plans for Focus Group activities. A list of tentative topics emerged regarding breakout sessions at the 2011 GEM Summer Workshop:
1). Simulate events in the GGCM Modeling Challenge/calculate observable metrics;
2). Obtain fields/plasma conditions with applications to radiation belts/inner magnetosphere waves;
3). Obtain electric field maps with applications to plasmasphere physics; and 4). Conclude Phase 1 of the Near-Earth Magnetosphere Challenge, involving the simulation of an idealized geomagnetic storm.

The above topics will be further refined at a Mini-workshop session that the focus group intends to organize before the 2010 AGU Fall Meeting in San Francisco. Some of the sessions above could be organized as joint sessions with other relevant focus groups.

Finally, the discussion steered toward ideas for wrapping up the focus group activities in 2012. Starting from the focus group proposal approved by the GEM Steering Committee, several possible deliverables as the outcome of the focus group were discussed, to be conveyed through various media: a final report or a review paper (with individual papers attached), as well as publication on the Web; these deliverables would include:

- A description of progress in inner magneto sphere physics undergone under the focus Group
- A list of inner magnetosphere models, im proved physics features and couplings developed
- Physics results from the Near-Earth Mag netosphere Challenge; a comparison of diff erent models and a discussion of the effects of different physics features through simu lating both an idealized (Phase 1) and real (Phase 2) geomagnetic storm.

Modes of Magnetospheric Response Focus Group

Co-chairs: Robert McPherron and Larry Kepko

The goal of the Modes of Magnetospheric Response Focus Group is the improvement of knowledge of the physical mechanisms that provide different dynamical modes of response of the magnetosphere to the solar wind. These include substorms, steady magnetospheric convection, sawtooth injection events, pseudo breakups, and poleward boundary intensifications. The Modes of Magnetospheric Response held three breakout sessions this past meeting, loosely organized around themes of non-linear coupling, sawtooth events, and the magnetospheric mode response to the extreme solar minimum.

In the first breakout, non-linear coupling, we were interesting in exploring how aspects of non-linear coupling affected or determined the response mode. Speakers and topics included: Bob Weigel,

who expressed the idea that a quantitative understanding of solar wind coupling should begin with linear prediction to obtain a basic understanding of how much can be explained without more complex models; Delores Knipp showed unexpectedly large increases in ionospheric mass density that have been found in the declining phase of cycle 23; Jennifer Kissinger presented an overview of SMC; Larry Lyons presented evidence that IMF fluctuations during high-speed streams appear to be an independent driver of convection as measured by radars; Jennifer Kissinger suggested that SMC and stream I/F are highly correlated in the declining phase with SMC occurring after the stream interface; Bob McPherron estimated the viscous interaction impulse response function and showed that it explains about 5% of AL variance.

The second breakout sought primarily to establish the observational features of sawtooth events. Mike Henderson presented an overview of sawtooth injection events developing the thesis that they are simply very large substorms during steady strong driving, and do not represent a fundamentally different mode of magnetospheric response. One of the defining characteristics of sawtooth events are injection signatures that appear sunward of the terminator. During the spirited discussion, it was suggested that rather than representing a fundamentally different mode of reconfiguration, the sawtooth injection region was a 'standard' injection that was rotated towards the dusk terminator. Joe Borovsky took the counter position and argued that these are a distinctively different state of the magnetosphere. He suggests that there is a problem in the definition and selection of events.

The final breakout session encouraged presentations covering the magnetospheric response, state of the magnetosphere, and solar wind energy transfer during the extreme solar minimum. Dan Baker showed SAMPEX data indicating that relativistic electrons vanished from the magnetosphere during the end of this last solar cycle. He tied this to the solar wind velocity dropping below 500 km/s for an extended interval. Howard Singer summarized the Galaxy 15 failure that occurred during an extremely large substorm produced by a weak CME and magnetic storm. Suzie Imber determined the probability of earthward and tailward TCR motion from Themis data as a function of distance down the tail, and concluded that these are equal at 30 Re much further than previous estimates of the location of X-line. Tung-Shin Hsu (presented by Bob McPherron) showed that the recurrence rates and intensity of substorms in rising and declining phase of solar cycle differ substantially.

Substorm Expansion Onset: The First 10 Minutes Focus Group

Co-chairs: Vassilis Angelopoulos, Kazuo Shiokawa, Andrei Runov, and Shin Ohtani

The group had four separate sessions to discuss the following topics:

Topic 1: Onset timing: observations/theory/simulations
Topic 2: How do midtail onset signatures propagate to near Earth and to the ground?
Topic 3: Ground-Space Mapping of Physical Processes
Topic 4: Substorm processes near transition between stretched and dipole field lines

All presentations in this focus group were summarized into a matrix showing correspondence of each observation/model result to various substorm-onset physical models whether it gives positive or negative supports of the models. The matrix is available at the GEM Wiki page (http://www-ssc.igpp.ucla.edu/gemwiki/index.php/FG12._Substorm_Expansion_Onset:_The_First_10_Minutes).

1. Onset timing: observations / theory / simulations

This session addressed the following problems:

1. The substorm onset timing as determined from multiple satellites,
2. Determination of the location of the first energization in the magnetotail,
3. Determination of the propagation time delays of the signal from the tail to the ground.

Pre-onset and onset auroral forms, visible in THEMIS all-sky images, obtained during a set of isolated substorms were discussed. The sequence, including pre-onset polar boundary intensification (PBI) was reported for a large number of isolated substorms (Y. Nishimura). The time delay between the PBIs and substorm onset was reported to be up to 5 - 10 minutes. It was noted, that PBIs are not necessarily associated with the near-Earth reconnection, but may be caused by distant tail reconnection.

New analysis of THEMIS observations during Jan 29, 2008 and Feb 2, 2008 substorms, reported earlier by A.T.Y. Lui and S.B. Mende, respectively, showed that in the coordinate system, rotated with respect to Y GSM in order to account the solar wind Vz, variations in magnetic field and plasma velocity, contrary to previous conclusions, indicate signatures of reconnection prior to auroral onset (V. Angelopoulos for J. Lui). The timing was found to be consistent with fast magnetosonic wave propagation time. Results of statistical timing analysis of cumulative magnetic flux transfer in the plasma sheet with respect to auroral and Pi2 onsets were reported (V. Angelopoulos for J. Lui). The results show an increase of flux transport in the tail ~1 min prior to the Pi2 onset.

Onset signatures on MF radio waves coming from poleward arc were reported (J. LaBelle). These signatures can be an indicator of PBI. Their spectra show patchy structure and group delay with a time scale of 0.1s, giving F-region density profile. SuperDARN (7s resolution) show Pi2 oscillation (4.5-6mHz, amplitude=~50m/s) at subauroral latitudes (J. Baker).

Recent progress and problems in construction of substorm timing database were reported (C. Gabrielse). Error bars for Pi2, AE, Bz, Vx, flux, and Ey are now added. Data need to be binned with respect to MLT distance from the substorm meridian.

Theoretical considerations of momentum transfer via Alfvenic interaction from magnetopause into the magnetosphere were discussed (Y. Song). It was suggested that during the growth phase the tailward force in the plasma sheet balances with earthward JxB force. Sudden change of solar wind condition may terminate the tailward force and then the earthward force excess initiates substorm. Multiple onset corresponds to multiple localized Alfveninc interaction at the plasma sheet and breakdown of the frozen-in condition.

2. How do midtail onset signatures propagate to near Earth and to the ground?

The session discussed

1. Physical mechanisms of energy release in mid-tail and near-Earth plasma sheet and their possible relationships;
2. The role of magnetotail transients (BBFs, dipolarization fronts, flux ropes, PV$_Y$-depleted tubes, transient FACs, etc…) in energy and mass transport during substorms;
3. Mechanisms of particles energization and injection;
4. Physical constrains for the plasma sheet-ionosphere communication.

THEMIS observations during the March 1, 0155 UT substorm suggested that mid-tail reconnection triggered an instability in the near-Earth plasma sheet (A. Runov). The time delay between the very first signatures of reconnection and first signatures of the near-Earth plasma sheet instability was reported to be 5 min.

The multi-point observations of dipolarization fronts showed that they are thin boundaries separating ambient plasma sheet and energetic plasma, intruded into the near-Earth plasma sheet (A. Runov). Formation and earthward propagation of dipolarization fronts in the course of a substorm was shown in the event-oriented global MHD simulations (Y. Ge). This indicates that although the thickness and structure of the fronts are dictated by kinetic processes, their origin may be described using the MHD-approach. THEMIS observations demonstrate an increase in 30 – 500 keV particle fluxes (both ion and electron) at the fronts. Thus, the dipolarization fronts are important agents in context of energy transport and particle energization during substorms.

Role of PBIs as precursors for substorms was discussed based on THEMIS ASI observations (S. Mende) and MHD simulations (P. Zhu). The THEMIS ASI observations suggest that PBIs are indeed often observed ahead of auroral substorm onset, however, they are not necessary for substorm development. The event-oriented MHD modeling reproduced PBIs and their equatorward motion. The model PBI, however, was located equatorward of open-closed field lines boundary. An origin of the PBI in the plasma sheet is to be established.

The particle-in-cell simulations of reconnection showed generation of kinetic Alfven waves (KAWs) which may carry 0.001- 0.09 erg/sm^2/s energy at a distance of 20 RE downtail (M. Shay). In the ionosphere, it corresponds to 1-10 erg/cm2/s, which is sufficient to create visible aurora. A scale of this structure, mapped onto the ionosphere, is of a few hundreds up to a thousand kilometers. Propagating at a velocity of 1000 km/s or more, the KAWs may establish a connection between plasma sheet and ionosphere in time scale of a few tens of seconds. This may explain the 70 – 90 s-time lag between reconnection signatures in space and aurora, reported recently (e.g., Angelopoulos et al., 2008, Gabrielse et al., 2009).

3D MHD model of substorm suggests the combination of fast reconnection and ballooning instability in the course of substorm development (J. Birn). The simulation shows that the ballooning instability may increase a speed of reconnection outflow and plays an important role in penetration of reconnected flux tubes into the near-Earth plasma sheet.

Results of MHD comprehensive MHD modeling also suggest that equatorward-moving aurora may be caused not only by earthward fast flow, but also by Alfven wave propagation and total pressure fluctuations (B. Lysak). Analysis of simultaneous measurements of the waves in PiB range on gound and in space indicates a clear relation between them: PiB observed on the ground, GOES, and THEMIS corresponds well (M. Lessard). Time delay from THC, THD, THE, GOES12, and South Pole is within 2 minutes, from THC first to South Pole last. Earthward fast flow caused compressionl PiB that is transferred field-aligned Alfven waves to cause Alfvenic aurora at the onset. (both reconnection and near-eath instability can make Alfven waves).

3. Ground-Space Mapping of Physical Processes

In this session we discussed the mapping of substorm-related ionospheric signatures/structures to the night-side equatorial plane.

It was reiterated that the field-line mapping requires extreme caution. The improvement of the adaptive time-dependent field-line model was reported, which shows, for an example event, that the auroral onset can be mapped to 22-26 R_E down the tail instead of 15 R_E (Kubyshkina/Angelopoulos). It was also discussed that because of the stretched configuration of tail magnetic field, large-scale FAC sheets on the night side can be mapped to completely different parts of the magnetotail. Whereas the R1 current is mapped to the flanks, R2 is mapped to the midnight sector of the near-Earth plasma sheet, and accordingly, the Harang discontinuity mapped to the equa-

tor extends in the radial, rather than the azimuthal, direction (Lu).

A few different approaches were reported, which addressed mapping by comparing ionospheric signatures with in situ measurements in the plasma sheet. One approach is to map the front of the auroral streamer to the satellite location when the satellite observed a fast plasma flow in the plasma sheet (Nishimura & Xing). In one example event one THEMIS probe observed a fast flow at x = -11 R_E when an auroral streamer was heading to the Harang discontinuity, which was followed by a breakup (Nishimura). The result suggests that the onset location as well as the Harang discontinuity was inside the field line on which the satellite was located. However, caution needs to be exercised in discussing the radial distance since the satellite is often located off the equator. A similar approach was also reported for particle precipitation. The precipitation energy spectrum measured by DMSP and the energy spectrum of the plasma-sheet plasma measured by THEMIS agree best for electrons when the equatorial footpoint of DMSP is close to the THEMIS probe location in MLT, but such a tendency was not clear for ions (Gabrielse). Another approach was to use the (empirical) relationship between proton aurora intensity and proton precipitation for locating the satellite footpoint in the 2D proton aurora image based on the satellite observation of proton flux in the loss cone in the plasma sheet (Spanswick).

The general morphological mapping of onset arc was also discussed. The onset arc tends to be located at the poleward edge of the proton aurora (Donovan). This is consistent with the fact that the precipitating proton flux in the downward R2 current is smaller than that in the upward R1 current by almost an order of magnitude (the b2i boundary can be found in the middle of R2 currents) and that the most equatorward auroral acceleration very often takes place at the equatorward edge of the upward R1 current (Ohtani).

4. Substorm processes near transition between stretched and dipole field lines

This session is focused on the temporal and spatial transition from stretched to dipole field lines at substorm onset. THEMIS P3/P4/P5 (apogee of 10-12 Re) have surveyed this region since 2007 and will make more focused multi-satellite measurements with separations of 100-3000 km in 2010-2012 together with the conjugate ionospheric measurements by optical instruments, SuperDARN radars, magnetometers, and riometers.

During this session, Xiaoyan Xing showed that the azimuthal pressure gradient at the substorm growth phase estimated by two THEMIS satellites shows development of sharp gradient a few min before onset corresponding to upward field-aligned current. Ping Zhu showed using the Open CCGM model for a spatially-periodic black auroral event on February 22, 2009, that the plasma sheet become (interchange) unstable at highly-stretched transition region at pre-onset phase. Vadim Utritsky (presented by Eric Donovan) showed that east-west wave-like structure on the multiple onset arc show different propagation at three neighboring arcs, suggesting distant reconnection (poleward arc) initiate ballooning instability (wave structure in the equatorward arc) in the inner magnetosphere.

Inner Magnetosphere – Storms Research Area Report

Coordinators: Reiner Friedel, Anthony Chan

This year's GEM workshop was an active one for the Inner-Magnetosphere Storms Research Area. In particular with the new of the new Radiation Belts and Wave Modeling Focus Group. This is a highly topical FG in light of the upcoming RBSP Mission, which hosted specific sessions on modeling in support of the RBSP science objective. At times close to half of all GEM attendees crowded into the Sessions of this Focus Group, and larger rooms needed to be sought!

RBSP related themes were prevalent in most of the focus groups, with several joint session highlighting the required linking up of traditionally separate research regimes if progress is to be made. The Space Radiation Climatology FG entered it's final year and plans were laid for its wrap up at this GEM.

What follows here are the individual Reports on the GEM SUMMER activities of the IMS and joint Focus Groups.

Plasmasphere-Magnetosphere Interactions (PMI) Focus Group

Co-Chairs: J. Goldstein, M. Spasojevic, J. Borovsky

This is a report of activities of the Plasmasphere-Magnetosphere Interactions (PMI) Focus Group (FG) at the 2010 Geospace Environment Modeling (GEM) Workshop in Snowmass, Colorado. This document presents a broad overview of the physical ideas discussed rather than a detailed summary of each and every presentation.

Documents posted on the PMI Wiki Page
http://tinyurl.com/pmiFGwiki

This report and detailed information about the presentations is available on the PMI Wiki Page, as follows.

PMI10_Session_Notes.doc Detailed notes from the various PMI sessions.

GEM_PMI10_v4.pdf The schedule of presentations for all PMI sessions.

Format of the 2010 GEM PMI Sessions

Presenters were encouraged (both in advance and at the sessions) to keep their presentations brief and informal, leaving time for questions and discussions, fostering an atmosphere of active exchange of ideas among speaker and audience.

PMI Breakout Sessions

To address the PMI FG's central question, "*How Are Magnetospheric Processes Regulated By Plasmaspheric Dynamics (and Vice Versa)?*" we hosted five (5) Breakout sessions at the 2010 GEM Summer Workshop. PMI Breakout 5 was convened jointly with the Radiation Belts & Wave Modeling (RBWM) focus group. The detailed schedule (GEM_PMI10_v4.pdf) is posted on the PMI Wiki. These PMI Breakout sessions were very well-attended, and there was generally a great deal of animated discussion. It was resolved that at GEM 2011 to more actively discourage any formal presentations.

In this next section of the PMI Focus Group Report, each PMI Breakout Session is listed with its Topic, and Purpose, followed by a

brief summary of what was discussed and accomplished at the session.

This report is a *top-level report*. If you are looking for detailed notes on individual PMI talks, please see PMI10_Session_Notes.doc, posted on the PMI Wiki page.

Monday, 21 June 2010

PMI Breakout 1: 10:30am - 12:15pm.
Topic: "EMIC Waves".

This session featured four (4) presentations by Denton, Posch, MacDonald, and Fraser. EMIC linear wave growth proxies are in agreement with actual EMIC wave observations, and can be useful where actual wave measurements are not available. Simulations indicate that knowledge of cold plasma composition is crucial to properly constrain and understand EMIC wave propagation and growth. While cold plasma properties make a big difference in simulations of EMIC wave growth and propagation, statistical analysis of ground-based Pc1 observations from AGO stations reveals at best a weak correlation with the simultaneous occurrence at geostationary orbit of plasmaspheric plumes. On the other hand, EMIC wave occurrence does correlate well with solar wind pressure pulses. It has been noted before that EMIC waves can be produced by magnetospheric compression or temperature anisotropy in a ring-current/plume overlap region. In CRRES observations, EMIC waves are much more likely to occur during main phase, and found to occur in the plasmaspheric "drainage corridor", i.e., the noon-to-dusk MLT sector, at L-values nominally occupied by the ring current. Taken together, these observations might indicate the need to separate out EMIC wave events into those triggered by pressure pulses and those possibly growing in the plume.

PMI Breakout 2: 1:30 - 3:00pm.
Topic: "Wave-Particle Interactions".

Five (5) presentations were given in this session, by Streltsov, Chen, Jordanova, Clausen, and Albert. Simulations were prominent in this session, providing some key results. Ducting of whistlers is most effective for density irregularities satisfying particular relationships to the wave properties. Modeling of mgnetosonic wave growth in the nonlinear approximation reveals that the unstable frequency band is modulated by the non-Maxwellian ("ring") velocity of the hot ions normalized to the bulk Alfven speed. Non-linear (or quasi-linear) theory may very well be required, in fact, given some very large wave amplitudes (e.g., 2-100 mV/m chorus) found in recent observations. Ring current ion pitch-angle anisotropy has a peak near dusk when self-consistent magnetic fields are included, and there is also a peak in EMIC wave growth in this local time sector, consistent with CRRES statistical studies of Breakout 1 (see above). Penetration electric fields have a strong influence on the lower-energy range of the ring current, and these fields are observed in SuperDARN radar to closely correlate with the IMF north-south conponent, with a 15-20 minute delay—consistent with recent IMAGE-EUV-based estimates for the "penetration delay time" for the inner magnetospheric E-field.

PMI Breakout 3: 3:30 - 5:00pm.
Topic: "Plasmaspheric Dynamics and Plume Recirculation".

This session hosted six (6) presentations, by Chappell, Liemohn, Gallagher, Schulz, Ozhogin, and Tu. The concept of a "plasmaspheric drainage corridor" was introduced. This is a region where plumes are most likely to be found (based on global convection characteristics found from a simple superposition of cross-tail and corotational E-fields); the plasmaspheric drainage corridor is the global pathway for cold plasma to make its way to the dayside reconnection site. From simulation results, it may be that plumes affect the dayside reconnection rate most strongly for the strongest storms, which feature severe magnetopause contractions. Plasmaspheric models do a good job of predicting where and when plumes will occur, and what density they will have, but

the structure inside plumes is not yet so well captured. The high degree of plasmaspheric and plume density structure (and sub-structure) was discussed in detail, and can arise from either rapid temporal variation of the solar-wind-driven E-field, or local inhomogeneity of the convection field; it is the latter effect in particular that is not yet well characterized enough for models to reproduce interior density structure. Interhemispheric asymmetries (linked to north-south asymmetry in the field-aligned flows), composition of the ionosphere, and kinetic processes add yet more complication to the density structure of the plasmasphere.

Tuesday, 22 June 2010

PMI Breakout 4: 10:30am - 12:15pm.
Topic: "Closing the Loop on PMI".

After two spillover talks by Li and Dodger, the rest of this session was devoted to a detailed, in-depth discussion of the important topics and priorities of the Plasmasphere-Magnetosphere Interactions focus group, and how to address them in the remaining years of this effort. Talking points included:

- The relationship of plumes to the global (and sub-global) features of convection that produce a corridor where dayside drainage plumes are likely to be found.
- Comparisons between observations and our existing dynamic plume models, which do capture where and when plumes occur (in a global sense) but do not capture the structure inside of plumes, and also do not yet capture the dynamic, spatially-dependent refilling process accurately.
- The integration of plume models into larger global circulation models.

Several top PMI priorities were established for the next year of this focus group:
(1) Plasmasphere/Plume internal structure should be a strong focus of attention.
(2) We must get global MHD simulations to capture plasmaspheric dynamics.
(3) The modeling of filling flux tubes needs to be improved significantly, and integrated into the overall modeling infrastructure.
(4) The EMIC Wave Challenge. Led by Brian Fraser and Richard Denton, this will be a GEM-style challenge: to reproduce the spatial distribution, temporal dependence, and wave amplitude of EMIC waves. This will undoubtedly involve proper treatment of plasma composition, density, and Alfven waves.
(5) GEM 2011 PMI Session on Ground Based Observations. At next year's GEM, PMI will host a special breakout session on ground-based observations of plasmaspheric densities. A handful of selected speakers will be invited.

PMI Breakout 5: 1:30am – 3:00pm.
JOINT SESSION with "Radiation Belts & Wave Modeling" (RBWM) focus group.

For notes on this Joint Breakout, see report from the RBWM FG.

Planned Activities: 2010 – 2011.
There are numerous ongoing studies by researchers participating in the PMI FG. Coordination of these various studies will be via the PMI Wiki page (http:// tinyurl.com/ pmiFGwiki) and via the PMI Mailer List, which includes 71 people as of the writing of this report (with several joining after this year's workshop).

The goal is to promote synthesis of the various studies into a system-level conceptual framework; PMI is by its very nature a system-level FG. We also plan to continue to recruit participation (in the form of crossover talks) in PMI from other focus groups whose topics overlap ours. We also will continue to solicit and encourage participation from other non-GEM disciplines such as CEDAR, thus promoting the system-level view of the geospace environment.

As a result of the Group Discussion that took place at PMI Breakout 4 ("Closing the Loop on PMI"), the PMI focus group has established several priorities for the coming year, which are listed in the notes for Breakout 4 above. These priorities include several key physics topics, as well as the formulation of an EMIC Wave Challenge, and the resolution to hold a special Ground-Based Observations breakout session at GEM 2011.

Radiation Belts and Wave Modeling (RBWM) Focus Group

Co-Chairs: Yuri Shprits, Scot Elkington, Jacob Bortnik, and Craig Kletzing

Session I Model development and validation.

During the first session we discussed various acceleration mechanisms. We agreed, that we need to move from simply identifying potential candidates to quantifying different acceleration and loss mechanisms. We all agreed to make a list of mechanisms accounted for by different models and also a list of what different modeling groups are planning to include into their codes in the future. We decided to identify important mechanisms by performing a set of test simulates for a number of storms and also perform long term simulations of ~100 days when it's numerically possible. We decided to set up specific metrics that will be used for these GEM challenges.

Session II Preparing Radiation Belt Models for RBSP Data.

We discussed comparing models with observations and preparing models for observations. Virtual RBSP data for preparing models for RBSP data will be available soon. We had presentations from ECT; EMFASIS; RPS teams; We discussed what we can learn from models in preparation for RBSP.

Session III Wave-particle interactions.

We discussed observations and theoretical estimates of losses to the atmosphere. LASP group is working on measuring losses to the atmosphere and comparing them to theoretical quasi-linear lifetimes. We discussed non-linear effects and how they can be included into a global code and compared with observations.

Session IV ULF.

Discussions have been devoted to Shabanski orbits and their effect on the particle dynamics,theoretical study of waves produced by the variable solar wind dynamics pressure and observations of KH instability.

Session V ULF/ VLF session.

We discussed radial diffusion simulations, pic simulations of magnetosonic waves, self-consistent hybrid simulations of the excitation of EMIC waves. We also discussed how whistler mode waves may remediate the radiation belt hazard .

Session VI

We continued discussing VLF waves and looked at the statistical distribution of waves from different satellites that can be used for understanding of waves and statistical properties of waves. We discussed the DSX mission and it's scientific objectives.

Planning:

We formulated 2 GEM challenges.
We chose data, time periods.

Data and model results will be posted on the VIRBO web site.

Space Radiation Climatology (SRC) Focus Group

Co-Chairs: Paul O'Brien and Geoff Reeves

The GEM Space Radiation Climatology Focus Group held three sessions, one joint with Radiation Belt/Waves. We heard project updates from LANL, UCLA, ONERA, and AE9/AP9. Of particular note is the recent beta release of AE9/AP9 to US Government and Contractors. We heard scientific talks on multiple topics, highlights follow:

Proton belt dynamics exhibit systematic climatological features that cannot be explained easily (see Selesnick et al., JGR, 2010)

Richard Denton has developed a full solar cycle of mass density at GEO.

ViRBO is growing, and is prepared to help transfer our non-NASA data sets or derived data sets to NASA deep archives (e.g., NSSDC).

LANL has developed new climatology models of GPS protons and LEO electrons.

Themis SST data is usable for inner magnetosphere work, and a preliminary calibration has been done at UCLA (with caveats, of course)

There are systematic spectral shapes in the outer zone electrons, and their occurrence frequency appears to be modulated by the plasmapause location.

We are planning to collect and release ~6 month reanalysis data sets at Fall AGU. These data sets can be analyzied and results presented at the GEM Summer workshop.

For more information, including selected presentation charts, visit
http://virbo.org/GEM_FG9_2010

Diffuse Auroral Precipitation (DAP) Focus Group

Co-Chairs: Richard Thorne and Joe Borovski

The Diffuse Aurora Focus Group held 4 breakout sessions at the 2010 GEM meeting in Snowmass. The session topics and session chairs are listed below together with a brief summary of the topics discussed.

1.Relationship between auroral phenomenology and scattering mechanisms
Monday June 21: 10:30-12:15: Co-chairs, Binbin Ni (bbni@atmos.ucla.edu) and Robert Michell (rmichell@swri.edu)

Topics:

- Relative role of ECH and chorus scattering at different locations and activity levels
- Formation of observed electron pancake distributions due to chorus scattering
- Temporal variability of DA up to 10 Hz: related to chorus elements?

2. Modulation of DA brightness by large-scale magnetospheric processes.
Monday June 21: 1:30-3:00: Co-chairs, Marilia Samara (marilia.samara@swri.org) and Jacob Bortnik (jbortnik@gmail.com)

Topics:

- Modulation of chorus emissions by large-scale magnetospheric density and magnetic field structures: possible relationship to DA spatial features.

3. Spatial and temporal extent and spatio-temporal occurrence of DA/scattering mechanisms.

Monday June 21: 3:30-5:00: Co-chairs, Toshi Nishimura (toshi@atmos.ucla.edu) and Richard Thorne (rmt@atmos.ucla.edu)

Topics:

- Statistical survey of DA variability from ground based auroral images. Pulsating aurora dominant over equatorial edge of DA zone at periods between 5-10 s.
- Strong correlation between DA pulsations seen by the THEMIS ASI images and chorus modulation observed directly on THEMIS spacecraft.

4. Importance of DA for Geospace at the system level.
Tuesday June 22: 10:30-12:15: Chair, Richard Thorne (rmt@atmos.ucla.edu)

Topics:

- Formulation of a campaign to identify global DA periodicity and compare with THEMIS wave observations.

Near Earth Magnetosphere: Plasma, Fields, and Coupling Focus Group

Co-Chairs: Sorin Zaharia, Stan Sazykin and Benoit Lavraud

The Near-Earth Magnetosphere focus group held 3 breakout sessions at the 2010 GEM Summer Workshop in Snowmass, CO. The main goal of the focus group is to improve our physical knowledge and modeling of the near-Earth magnetosphere and its coupling with the outer magnetosphere. The focus group is coordinated by Sorin Zaharia, Stan Sazykin and Benoit Lavraud.

The three focus group sessions, held on Wednesday and Thursday (06/23-24) featured short presentations and discussions related to the following scientific research topics:

1. **Inner-outer magnetosphere coupling**:
   - ·Effect of depleted entropy bubbles on the inner magnetosphere as obtained from a 3D MHD simulation (J. Birn)
   - ·Coupling of Rice Convection Model (RCM) with a global MHD code: interchange-related dynamic flows and oscillations; plans to modify RCM to include inertial terms (F. Toffoletto)
   - Effect of ion outflow on ring current (through plasma sheet density/temperature, cross polar cap potential drop and ion composition) (D. Welling)
   - 1-way coupling of the BATS-R-US global MHD code with the Comprehensive Ring Current Model (CRCM) and Radiation Belt Environment (RBE) codes; importance of electric field self-consistency (Q. Zheng)
   - Specification and effect of plasma properties at geosynchronous orbit in RCM; ring current dependence on ionospheric conductivity (M. Gkioulidou)

2. **Observational studies and empirical models**:
   - Empirical magnetic field modeling – modification of the T96 model by adding a substorm current wedge; importance of magnetic field model for M-I coupling (G. Lu)
   - Results from the TWINS mission; stereoscopic ion inversion providing pitch angle information; validation vs. THEMIS data; presentation of available TWINS data products (J. Goldstein)
   - Exploring plasmaspheric subcorotation through radar observations (Blackstone – mid-latitude) of westward flows on field lines mapping into the plasmasphere (L. Claussen)

3. **Interaction between plasma and fields** in the near-Earth magnetosphere - coupling between different elements in numerical models (plasma, electric and magnetic fields):

- Two presentations accompanied by spirited discussions on comparisons of different formalisms for studying plasmas: MHD, guiding center and Vlasov theory (R. Strangeway); differences between single-fluid MHD and kinetic formalisms, and what one needs to add to MHD in order to reproduce inner magnetosphere physics (S. Zaharia)
- ·Effect of self-consistency/stretched magnetic fields on ring current morphology and dynamics (V. Jordanova; R. Ilie)
- ·Importance of self-consistent treatment of particles and fields in the storm-time inner magnetosphere, explored through comparison of simulated and observed magnetic intensities and ion plasma parameters from GOES, Polar, LANL (M. Chen)
- ·Simulation of Steady Magnetospheric Convection (SMC) event with RCM-E needs to be driven with depleted flux tubes in order to reproduce THEMIS observations (F. Toffoletto)

The second half of the 3rd breakout session was devoted to a community discussion on future plans for Focus Group activities. A list of tentative topics emerged regarding breakout sessions at the 2011 GEM Summer Workshop: 1). Simulate events in the GGCM Modeling Challenge/calculate observable metrics; 2). Obtain fields/plasma conditions with applications to radiation belts/inner magnetosphere waves; 3). Obtain electric field maps with applications to plasmasphere physics; and 4). Conclude Phase 1 of the Near-Earth Magnetosphere Challenge, involving the simulation of an idealized geomagnetic storm.

The above topics will be further refined at a Miniworkshop session that the focus group intends to organize before the 2010 AGU Fall Meeting in San Francisco. Some of the sessions above could be organized as joint sessions with other relevant focus groups.

Finally, the discussion steered toward ideas for wrapping up the focus group activities in 2012. Starting from the focus group proposal approved by the GEM Steering Committee, several possible deliverables as the outcome of the focus group were discussed, to be conveyed through various media: a final report or a review paper (with individual papers attached), as well as publication on the Web; these deliverables would include:

- ·A description of progress in inner magnetosphere physics undergone under the focus group
- ·A list of inner magnetosphere models, improved physics features and couplings developed
- ·Physics results from the Near-Earth Magnetosphere Challenge; a comparison of different models and a discussion of the effects of different physics features through simulating both an idealized (Phase 1) and real (Phase 2) geomagnetic storm.

GEM Student Report

Representative: Brian Walsh

The student experience at GEM this year was a successful one. 53 students with a wide range in experience and background attended our student taught tutorials. The tutorials were held on the Sunday before the meeting and covered a variety of magnetospheric topics, reviewing old theory and discussing new areas of research in the field. The feedback forms indicated people found the tutorials "Using the CCMC" and "Upcoming spacecraft missions" the most useful. All the tutorials have been posted online for people to view and learn from (http://aten.igpp.ucla.edu/gemwiki/index.php/GEM_Student_Forum).

Student participants reviewed the tutorials on several criteria to determine a "Best Student Tutorial Award." This year's recipient was Dave Berrios from NASA Goddard who gave a tutorial on using the CCMC. He was acknowledged at the banquet for his service. Lastly, we are excited to have Jennifer Kissinger from UCLA as the new student representative for 2011.

GEM Steering Committee Report

SC Meeting at June 2010 Workshop, Snowmass, CO

Meeting Organizer: Robert Clauer

The June 2010 GEM workshop was attended by 59 students supported by the workshop using NSF funding, and 159 scientists for a total attendance of 218.

Discussions focused on the upcoming GEM/CEDAR combined workshop to be held in Santa Fe during June 2011. A joint taskforce will be formed to coordinate sessions for the combined meeting. The taskforce will solicit sessions that will be of interest to both CEDAR and GEM scientists and report the proposed sessions to the GEM Steering committee at the GEM miniworkshop in December. Mike Ruohoniemi was voted to be chair of the joint taskforce. Mike will work with John Foster (the current CEDAR science steering committee chair) to select membership. The meeting should have joint plenary tutorial talks during some of the days. GEM and CEDAR students should coordinate activities (Jenny Kissinger-UCLA is the new GEM Student representative). Some students should join the taskforce.

Goal: joint sessions should be defined by September or October, The taskforce should announce deadlines for proposals in August or September. By December the title, chairs, and session description should be presented to the GEM steering committee at the December miniworkshop.

The GEM and CEDAR workshops typically do meals, breaks and posters differently so some compromises will be required. While there are a number of topics of common interest there are others that probably have interest in only one or the other community. The workshops sessions for these topics should also be supported and not neglected in favor of the joint sessions. We will probably try to have common sessions and plenary sessions on some of the early days of the workshop.

The Village of Snowmass and Silvertree Properties is campaigning hard to have GEM return to Snowmass in 2012 and beyond. We note that 2012 is the 20th anniversary of GEM. The award to Virginia Tech expires with the

2011 workshop, but we will explore continuation of our support for the workshops for another 2 years or so.

Steering committee: Terry Onsager and Maria Spasojevic terms are ending. Nominations and a vote followed and Elizabeth MacDonald (LANL) and Emma Spanswick (U. of Calgary) were elected to the steering committee.

Discussion of the GGCM focus groups – Methods and Modules is ending this year. Need proposals at December workshop from the GGCM area coordinators. There is a need to improve communication between focus group leaders and the Metrics and Validation group. Should there be more joint sessions between Metrics & Validation and other focus groups. Perhaps there should be a Plenary report given at the summer workshop giving GEM Challenge results.

We should encourage Lotko and Siscoe to repropose the system level science focus group with a more focused goal and methodology.

Mike Henderson, Jean Berchem, and Bob Lysak were tasked to develop guidelines for running focus group sessions so that the workshop nature of the GEM meeting stays intact and does not migrate to an AGU style series of presentation with little discussion.

Delores Knipp asked for an extension from 3-years to 5-years for her group scheduled to end in 2014. We should provide a decision at the December workshop steering committee meeting.

GEM Web site: focus group conclusions should be posted in a final report location.

Student report: Of the 59 students, about half were 1st year. They liked the organization this year. The Condos were closer to the conference center. Some problems existed, however, because in the 2-bedroom condos, some rooms do not have 2 beds (we assign 4 student per condo). Also, it is recommended that the organizer create a student support timeline to submit to the steering committee to set policy for student support.

In other business, the suggestion was made that Instrument tutorials would be good and that we should consider technical breakout sessions devoted to new developments in instruments.

The meeting adjourned.

GEM Workshop Website

http://www.cpe.vt.edu/gem/

SHINE Liaison Report

Christopher T. Russell

The 2010 SHINE meeting took place in Santa Fe, New Mexico, July 26-30. Topics of interest included CME modeling; energetic neutral atoms, pickup ions and anomalous cosmic rays; the connections between the chromospheres and the heliosphere, imbalanced solar wind turbulence; forecasting; solar flares; solar energetic particles; reconnection; the acceleration of the solar wind; the solar minimum; and solar cycle predictions. The next meeting is planned for July 11-15, 2011, in Snowmass, Colorado, at the Silvertree Hotel. Current SHINE chair Christina Cohen is at the end of her term and the new chair is David Alexander.

CEDAR Liaison Report

Michael Ruohoniemi and Barbara Emery

Like GEM, CEDAR (Coupling, Energetics, and Dynamics of Atmospheric Regions) is a research program sponsored by NSF that brings together researchers and students to address common interests and societal needs. CEDAR includes coupling of the upper atmosphere to the ionosphere and magnetosphere and the connections to the solar wind, and so there are important overlaps with GEM objectives. Both programs feature annual week-long workshops.

The CEDAR workshop this year was held in Boulder, Co the week June 20 – June 25, i.e., the same week as the GEM workshop in Snowmass. A number of GEM and CEDAR participants made return drives between the two sites. A major topic of discussion was planning for the joint workshop in Santa Fe in 2011. The dates for the workshop are 26 June – July 1 and the venue is the new Santa Fe convention center, which is not more than a 5 min walk from the Eldorado hotel, and is within 10 minutes of the other hotels. A joint CEDAR-GEM taskforce has been organized with the idea of integrating the scientific and social programs of the two workshops. This represents a significant departure from previous joint meetings, which may have been collocated but were conducted independently. The concept was discussed in a GEM workshop on planning for the joint meeting and to the two steering committees and won broad endorsement. Many details remain to be worked out but the general idea is that, to the extent possible, sessions will be organized jointly with conveners from both the CEDAR and GEM sides. An announcement of the Joint Meeting is under preparation. A plan of the joint meeting will be worked out between the taskforce and steering committees for presentation at Fall AGU venues.

The membership of the joint taskforce on the CEDAR side includes John Foster, Barbara Emery, and Tim Fuller-Rowell. On the GEM side the membership includes Mike Liehmohn, Bob Clauer, Bill Lotko, David Murr, and Bob Strangeway. I am serving as the Chair of the taskforce.

In 2005 when CEDAR and GEM met together in Santa Fe, CEDAR was at the Eldorado Hotel and GEM was at the La Fonda hotel, with CEDAR students at Fort Marcy Suites. For 2011, all the students will be in 3 hotels along with non-students, and the rooms are shared proportionately between CEDAR and GEM at the Eldorado, La Fonda, and the Hilton, which is located across the street from the Eldorado Hotel.

The meeting rooms are at the Santa Fe Convention Center, and the Eldorado Hotel, again shared between CEDAR and GEM or used jointly. Our goal is to combine 50% of the individual GEM and CEDAR workshops together. We plan a joint poster session in the Santa Fe Convention Center and 2 separate poster sessions on Tuesday and Thursday. We will have a joint 'Icebreaker/Banquet' with music from the HooDoos on Monday night, June 27, while the students will have a joint dinner after the annual (CEDAR) soccer games held after their joint student workshop on Sunday June 26. We will be more physically integrated in 2011 than we were in 2005, and we hope this will lead to stronger interactions and networking between GEM and CEDAR people.

Personnel turnover at CEDAR this year included the transfer of the chairmanship from Jeff Thayer to John Foster. The GEM community should also be aware that the CEDAR Science Steering Committee is preparing to release a new strategic plan.

NASA Liaison Report

Mona Kessel

NASA's Solar Dynamics Observatory Delivers Stunning First Images of the Sun

NASA's recently launched Solar Dynamics Observatory, or SDO, is returning early images that confirm an unprecedented new capability for scientists to better understand our sun's dynamic processes. These solar activities affect everything on Earth. Some of the images from the spacecraft show never-before-seen detail of material streaming outward and away from sunspots. Others show extreme close-ups of activity on the sun's surface. The spacecraft also has made the first high-resolution measurements of solar flares in a broad range of extreme ultraviolet wavelengths.

A Heliophysics Division Transition highlighted that Mona Kessel is the new Geospace Discipline Scientist with a team that includes Guan Le (GSFC), Dave Rusch (LASP), and Mary Mellott (HQ). The LWS TR&T program lead remains Lika Guhathakurta, but she now has two IPAs: Chuck Goodrich (BU) and Bob Leamon (Montana). Other announcements included the release of the LWS TR&T Steering Committee report (and more recently, the ROSES10 announcement); the release of the Senior Review for Missions; and the announcement of no GI competition in 2010.

The NASA SMD budget took a major hit in 2010, but after that increases annually at a low rate. The FY2011 Budget request include sufficient funds to

- Enable a robust schedule of small, medium and flagship mission launches,

funded to a 70% confidence level, to achieve the vision for heliophysics set forth in the 2003 NRC Decadal Survey.

- Develop and launch SDO and RBSP, the first 2 missions in the LWS Program, with the goal of creating a predictive capability for space weather.
- Continue formulation and development of MMS, the number 1 priority moderate class mission and Solar Probe Plus, the number 1 priority large class mission in the decadal survey.
- Preserve the availability of Explorer Program missions to provide frequent, low cost flight opportunities that target focused science topics and fill important science gaps in Heliophysics and Astrophysics.
- Based on the FY2010 Senior Review, continue to fund existing mission operations to achieve maximum science return.
- Maintain robust Research Program (including competitively selected science investigations, suborbital program, supporting research and technology and science data archiving and computing) and E/PO Program.

The 2009 Heliophysics Roadmap was completed and is available online http://sec.gsfc.nasa.gov/sec_roadmap.htm. More recently the SMD Science Plan was released http://science.nasa.gov/about-us/science-strategy/. The decadal survey is now underway.

The Radiation Belt Storm Probes Mission passed CDR December 2009 and is currently in phase C with a launch date of 2012. The objective of the mission is to provide understanding, ***ideally to the point of predictability,*** of how populations of relativistic electrons and penetrating ions in space form or change in response to variable inputs of energy from the Sun. The Magnetospheric Multiscale (MMS) mission recently passed CDR and has a launch date in 2014. Solar Probe instrument selections were announced recently.

There was a Community Announcement for an Explorers (EX) Announcement of Opportunity on December 10, 2009. The current state of planning calls for NASA SMD to release an AO in the early fall of 2010 that will solicit proposals for what will be called EX missions. NASA also plans to release simultaneously a solicitation for Explorer Missions of Opportunity (MO) through the Stand Alone Missions of Opportunity Notice (SALMON). Additional information can be found at http://explorers.larc.nasa.gov/EX.

ESA Liaison Report

Benoit Lavraud

This report concerns news regarding space plasma missions at ESA level in 2010.

1- Current missions

ESA very recently decided to extend the four-spacecraft Cluster mission, which was launched in 2000, up to 2014 (subject to mid-term review in 2012). A large number of the instruments are still working at nominal level and return high-quality science data. In recent years, the orbits have been changed (line of apsides) to allow the sampling of new regions – as compared to the original Cluster orbit – such as the low-latitude dayside magnetopause or near-Earth tail regions. In additions, the inter-spacecraft separations have been changed to allow multi-scale studies, i.e., two closely separated spacecraft (<100 km) with the two others at larger scales (several thousand km). Note also that the CHAMP (Germany) and Oersted (Danmark) low orbiting spacecraft (for ionospheric studies) are still running.

2- Upcoming mission

The ESA SWARM mission is planned for launch in 2011. It consists of a constellation of three satellites in three different polar orbits between 400 and 550 km altitude. In addition to its geophysics- and weather-oriented science objectives, SWARM will allow magnetosphere-ionosphere coupling studies with unprecedented capabilities. The TARANIS mission (France) was very recently approved for conception phases. In addition to the atmospheric-sprite phenomena targets, it will allow interesting magnetosphere-ionosphere coupling studies.

3- Medium-size call M2 selection

The medium-size multi-spacecraft Cross-Scale mission proposal, which consisted of 5-7 spacecraft planned either alone or in conjunction with JAXA/CSA's SCOPE mission, was unfortunately not selected for ESA's Cosmic Vision competitive definition phase early this year. The primary issue was the cost estimate being above the M-class limit. The Solar Orbiter mission was selected in this round and has now moved into the definition phase.

4- Medium-size call M3 proposals

ESA has issued a new M-class call this year. It gives the possibility to propose full M-class missions, as well as missions-of-opportunity (if mission cost is targeted to only part of the 470 MEuros pot available in the context of this call). The selected mission(s), whether full M-class or mission-of-opportunity, would be planned for launch in 2022 or earlier, dependent upon potential slippage of other programs (e.g., L-class missions such as Jupiter's EJSM). Primary mission proposals relevant to GEM activities include (note that astrophysics missions are also proposed in such calls):

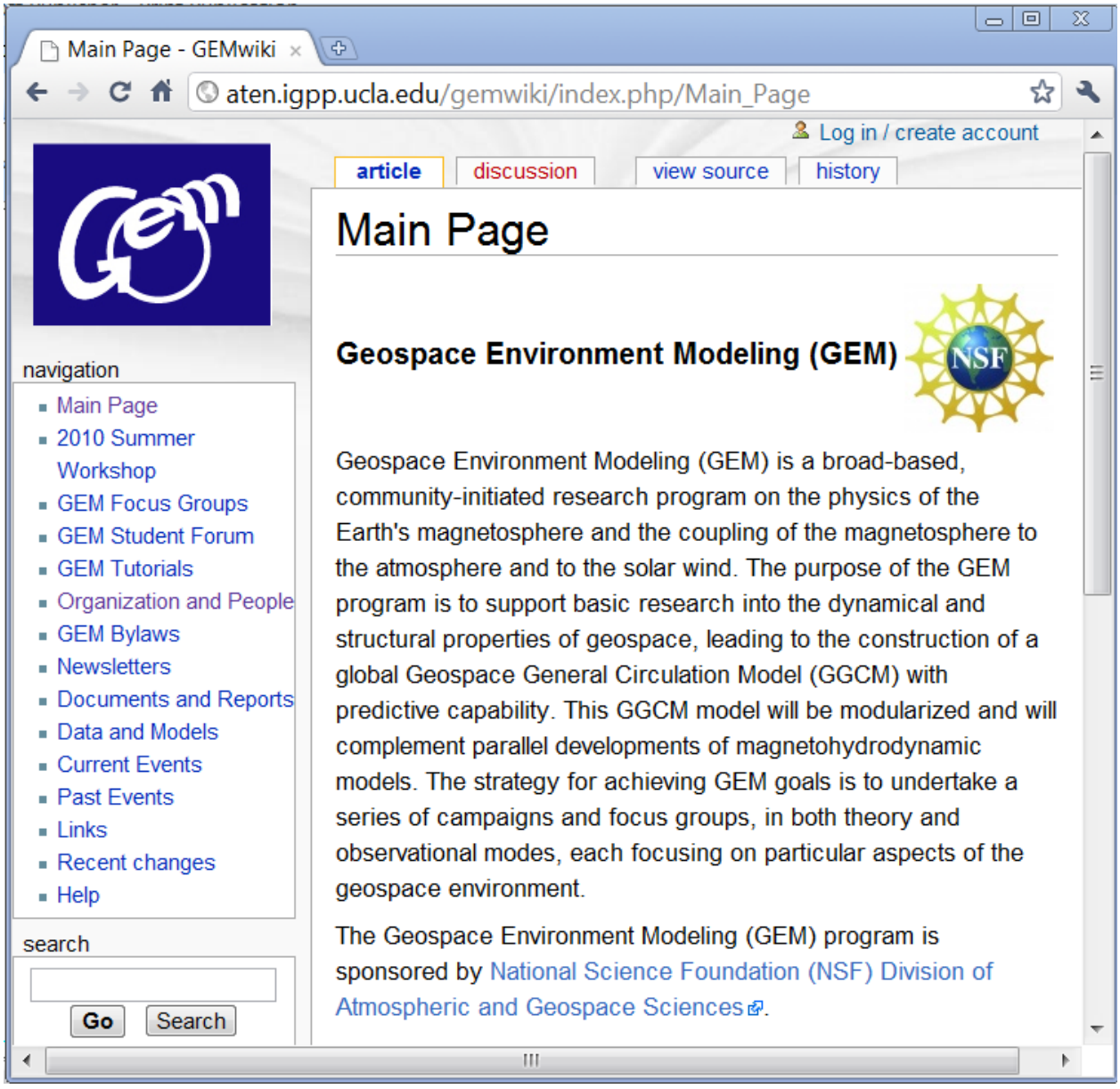
- EIDOSCOPE: A single-spacecraft, highly-instrumented contribution to the JAXA/CSA SCOPE mission, to allow for multi-scale plasma studies of acceleration processes at major magnetospheric boundaries.
- Alfvén/MICE: A two-spacecraft (optional 3), highly instrumented mission targeting the detailed study of auroral phenomenon and magneto-

sphere-ionosphere coupling from a multi-point perspective.

- IMPALAS: A three-spacecraft mission targeting studies of the dayside magnetopause. The circular, near-equatorial (yet with different inclinations) orbits would allow studies of magnetopause processes with respect to latitude.
- RAVENS: This mission is a continuation of the ESA-China-CSA Kuafu mission project effort, consisting of two spacecraft with polar orbits in Earth's magnetosphere and an L1 solar wind monitor. It targets space plasmas and space weather studies.
- 1-2 others might exist, but which I am not aware of yet.

GemWiki

http://aten.igpp.ucla.edu/gemwiki/



JAXA Liaison Report

Hideaki Kawano, Masaki Fujimoto, Iku Shinohara

(1) GEM 2010 Summer Workshop, GEM Steering Committee meeting, International Liaison Report ISAS/JAXA, Japan Hedi Kawano, Currently-running space-physics satellites of ISAS are Akebono, GEOTAIL, and REIMEI.

(2) Akebono is a monitor of the inner magnetosphere. It is for sure that ISAS will keep running Akebono till the end of 2011.

Requests of Akebono data are to be sent to Dr. Matsuoka (Project Manager): matsuoka [at] stp.isas.jaxa.jp

(3) It is for sure that ISAS will keep running GEOTAIL till the end of 2012.
It has been approved that, until the same time, NASA will keep tracking GEOTAIL by the DSN (Deep Space Network), and keep processing the level-1 data of GEOTAIL.

Until now the US-side PIs of GEOTAIL have been supported in the "Mission and Operation" framework in NASA, but NASA is currently considering using the "Guest Observer" program from 2011 for the US-side instruments on board GEOTAIL: The "Guest Observer" program offers openings for proposals to use the US-side instruments, selects a few proposals at a time, and funds them.

(4) THEMIS-GEOTAIL conjunctions are a reason why NASA keeps supporting GEOTAIL; thus, when you analyze THEMIS data, please also use simultaneous GEOTAIL data.
To help it, ISAS has promised to NASA that they will make efforts to further facilitate access to GEOTAIL data, such as making it possible that the THEMIS TDAS software will directly read GEOTAIL data.

(5) At the same time, you can easily browse data plots of both GEOTAIL and THEMIS at a website called CEF (Conjunction Event Finder): http://darts.isas.jaxa.jp/stp/cef/cef.cgi

At CEF, GEOTAIL data can be browsed about two weeks after the acquisition of the data. (To be more specific, magnetic field data, electric field data, and low-energy plasma data, can be browsed.)

(6) GEOTAIL digital data are open to public at a website called DARTS at http://darts.isas.jaxa.jp/stp/index.html.en

When you have used the GEOTAIL data in your paper, please tell that to ISAS, for the record. The DARTS website shows where to contact.

Requests of GEOTAIL digital data that are not found at DARTS are to be sent to both Prof. Fujimoto (Project Scientist): fujimoto@ stp.isas.jaxa.jp and Dr. Shinohara (Project Manager): iku@stp.isas.jaxa.jp.

(7) REIMEI is at 600km height and provides high-resolution data on auroral dynamics. High cadence electron and imagery data are available till 2007. Only imagery data are available after 2008. Since the REIMEI camera zooms-in to a 100km x 100km region possibly embedded in the THEMIS GBO field of view, there is a chance of performing cross-scale coupling science in the

context of auroral physics.

The Point of Contact for REIMEI is Dr. Asamura at ISAS, JAXA: asamura [at] stp.isas.jaxa.jp

(8) SCOPE is a mission for simultaneous multi-scale observations of space plasma. It consists of multi satellites, and international collaborations are in its vision.

The mission proposal of SCOPE was submitted to ISAS in September 2008, and it has passed the mission definition review (MDR). Collaborative study with Canadian CSA is in progress to pass the joint system requirement review (SRR) expected in fall-winter of 2011.

The planned launch year of SCOPE is 2019.

While the original plan of collaborating with European Cross-Scale was terminated, there still is a strong interest from both sides in collaborating via one shape or another.

Strong interest from the US community is acknowledged, and even stronger interest would be appreciated.

(9) ERG is a satellite to explore the inner magnetosphere. It is in the waiting status to become the second mission in the line of "small scientific satellite program" at ISAS.

The planned launch year of ERG is 2014.

Collaborations with RBSP and RESONANCE are in its vision.

(10) ISAS has the vision to perform the above-stated Earth-orbiting missions, its Mercury mission (MMO [Mercury Magnetospheric Orbiter] for BepiColombo, Launch in 2014) and its Jupiter mission (JMO [Jovian Magnetospheric Orbiter] for EJSM [Europa Jupiter System Mission]) in a unified framework: This everything-linked-together style is the strength of the Japanese community. Indeed, recent exciting plasma measurement results from the lunar orbiter Kaguya are elevating the mood of the MMO team.

GEM Messenger

The Electronic Newsletter for GEM

- To subscribe GEM Messenger, send an e-mail to majordomo@igpp.ucla.edu with “subscribe gem” (without quote) in the body of your message.
- To remove yourself from the mailing list, use “unsubscribe gem” (without quote) in the body of your message.
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  - http://heliophysics.blogspot.com/
  - http://www.facebook.com/heliophysics/
- Back issues of GEM Messenger are available at ftp://igpp.ucla.edu/scratch/gem/

Current GEM Structure

Steering Committee

NSF Program Manager
- K. Baker

Steering Committee Regular Members (Voting Members)
- M. Liemohn (Chair, 2009 - 2011)
- D. Sibeck (Chair-elect, 2011 - 2013)
- T. Onsager (2007 - 2010)
- M. Spasojevic (2007 - 2010)
- N. Omidi (2008 - 2011)
- M. Wiltberger (2009 - 2012)
- E. MacDonald (2011 - 2013)
- E. Spanswick (2011 - 2013)
- Research Area Coordinators (see below)
- Meeting Organizer (see below)

Steering Committee Liaison Members
- K. Baker (Liaison to NSF)
- X. Blanco-Cano (Liaison to Mexico)
- E. Donovan (Liaison to Canada)
- B. Fraser (Liaison to Australia)
- M. Hesse (Liaison to CCMC)
- H. Kawano (Liaison to Japan)
- R. Kessel (Liaison to NASA)
- B. Lavraud (Liaison to Europe)
- M. Moldwin (Liaison to DASI)
- T. Moretto (Liaison to NSF)
- C. Russell (Liaison to SHINE)
- M. Ruohoniemi (Liaison to CEDAR)
- H. Singer (Liaison to NOAA)

Meeting Organizer
- B. Clauer (2007 - 2010)

Communications Coordinator
- P. Chi (2009 - 2014)

Student Represenatives
- B. Walsh (2010)
- J. Kissinger (2011)

Research Areas

Research Area Coordinators
- Dayside, including boundary layers and plasma/energy entry. (Dayside)
  - J. Berchem (2009 - 2012)
  - K-H. Trattner (2009 - 2015)
- Inner magnetosphere and storms. (IMS)
  - R. Friedel (2006 - 2012)
  - A. Chan (2009 - 2015)
- Tail, including plasma sheet and sub-storms. (Tail)
  - M. Henderson (2006 - 2012)
  - L. Kepko (2009 - 2015)
- Magnetosphere - ionosphere coupling, aurora. (MIC)
  - D. Murr (2006 - 2012)
  - B. Lysak (2009 - 2015)
- GGCM
  - S. Sazykin (2006 - 2012)
  - S. Merkin (2009 - 2015)

List of Active Focus Groups

Focus Group	Duration	Co-Chairs	Association with Research Areas				
			Day-side	IMS	Tail	MIC	GGCM
Cusp Physics	2006-2010	K-H Trattner N. Omidi	•				
Dayside FACs and Energy Deposition	2010-2012	D. Knipp G. Crowley S. Erikson R. Lopez	•			•	
The Magnetosheath	2010-2014	S. Petrinec K. Nykyri	•				
Near Earth Magnetosphere	2007-2012	S. Zaharia S. Sazykin B. Levraud		•	•		
Space Radiation Climatology	2006-2011	P. O"Brien G. Reeves		•			
Diffuse Auroral Precipitation	2006-2011	R. Thorne J. Borovsky		•		•	
Plasmasphere-magnetosphere Interactions	2008-2013	J. Goldstein J. Borovsky		•			
Radiation Belts and Wave Modeling	2010-2014	Y. Shprits S. Elkington J. Bortnik C. Kletzing		•			
Plasma Entry and Transport into and within the Magneto-tail	2006-2011	S.Wing J. Johnson A. Otto			•		
Substorm Expansion Onset	2008-2013	V. Angelopoulos S. Ohtani K. Shiokawa			•		
Modes of Magnetospheric Response	2008-2013	R. McPherron L. Kepko			•		
GGCM Metrics and Validation	2005-2010	M. Kusnetzova A. Ridley					•
GGCM Modules Modules and Methods	2005-2010	J. Dorelli M. Shay B. Sullivan					•

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