Meeting notes for Friday

Science topics

Survey form before end of May

Tomorrow meeting

Bob Robinson:
Main message is that there are funding opportunities with different price tags.

- PI driven 100K
  - Optics for AMISR there will be AMISR optical workshop Nov 2004 (Poke Flat and Resolute)
  - May 2005 CEDAR will cover that.

- New instrument 100ks
- AMISR will be covered by NSF geoscience 14 Million/year fund and 10 million /year for some years and after that Few million dollars
- NSF major research equipment fund 80 million, there is a long waiting list.
- John Foster Distributed Array of Small Instruments (DASI) idea. Global coverage network (200 millions)

**Bionde**
All FPI at Millstone hill
15 minute 10 minutes integration time
120 locales to cover many range.
Wind fields and temperature fields
E-F coupling effect
5577 2 minute exposure
6300 10 minute exposure
ring shifted
find center use laser fringes
lens defects make the rings not round. 100m/s Andor camera will reduce the physical shift.
Background subtraction problem twilight condition particularly
Moon
Physical stability
After filling LN2 center position shift

**Mierkiewicz**

Wisconsin FPI
Balmer alpha
Balmer beta
Lyman beta

H profile
ISM emission

ISR site optics possible improvements

**Nossal Susan**
Aeronomy
Thermospheric and exospheric H alpha column emission intensities.

Solar maximum difference 90 and 2000.
Preliminary results
Pine Bluff WI observatory
Comparison with TIMEGCM

Lyman line
WhalphaM

Halpha

**Mike Taylor**
Calibration source issue needs to addressed.

**John Meriwether**
Arequipa FPI
Andor camera

North at magnetic equator
South –20 degree
BC scint. Drift obs.
Carmen Altos.

Neutral and ion decoupling
Long term temperature trend
Solar cycle variation
MTM effect thermal
Two FPI common volume measurements
Gravity wave activity
SOFDI upstate New York
El Lenoncito Argentina
Arecibo.
MiniME  F region wind mainly.
**Rick Niciejewski**

Michigan Aeronomy  
Sonde  
Plane detector  
7320

**Mark Conde**  
All sky FPI  
Small structure  
Three imaging FPI to reduce uncertainties in wind determination  
Millstone Hill needs support core aeronomy program NSF to fund this.  
Post Doc. Short term. Maintained optics at ISR sites.  
Phasing out optics at Millstone, aging equipment at Millstone.  
Arecibo

**Rick Doe**  
High latitude Dayside observation  
HIRISE instrument 6300 A dayglow  
One January  
TE signature  
Ne signature  
HIRISE total 6300 emission  
Auroral primaries  
ISR hot thermal  
Photoelectrons  
O2+ dissociation and recombination  
GLOW O2 photo dissociation  
HIRISE and HITIE

**Tom Slanger**

Geocorona 100% radiative recombination  
Unique instrument  
Simultaneous measurements

**Jim Hecht**

Polar spectrograph network study composition change  
30K.  
signal with different intensity (order magnitude different).  

H  
6560  
H  
4860  
ratio to energy (factor 10 geocorona, ISM 5)
shift to energy
proton auroral emission

Science topics
Auroral spectroscopy
Energy transfer radiative transfer,
Dayglow
Locate the spectrometer in the polar region
Lunar light absorption

Nielsen
Imaging
Alaska high image

Meteor bow shock
1g 1cm expected but inconsistent with air force model of the size from bow shock.

Plasma processes
Photoionization effect
xLens flares
xCloud scattering
xClassical fluid shock
100ms to move the imager towards meteor to capture the thing

sprite

Jim Hecht
Aerospace camera
MMAO
80 degree FOV
1.55-1.75 OH
1-2 s integration time 3 s frame rate
automatic dusk to dawn

Fast AGW 150 m/s 3 min period JGR

Evolution of KH Billow JGR in review
Acoustic Evanescent wave
1 second integration time

have not seen the wave.
Ripple pattern wavelength going with wind fast wave apparent no truly fast wave.

Imager with lidar observation
Ripple
Climatology
Dynamical and convective instability
Richardson number
Fast waves
AGW with periods below BV period
Near BV period
Alice Spring observations
5 filter
2 OH, 2 O2A, Background
airglow intensity and temp

Steve Smith
Boston University Imaging Science
Four Millstone Hill ,McDoungld, Arecibo O, El Leoncito Argentina .
524x524
no gravity wave near auroral zone
Bore event in Texas

Josh Semeter
Tomography science
Aurora
Gravity wave
Low latitude plasma instability
Diffuse aurora with coTIF
Stable auroral arcs
Physics bases inversion

Biff William
Imager and Lidar
Gravity wave OH imager
Yucca Ridge Japanese imager

Jon Makela
Low and mid-latitude ionospheric studies
  • High September to April American and African maybe
  • High may to September rest of the world

Mamoru Ishii
Tohoku University
Takahashi’s work

What approach
Coordinated project
DASI chain
Energy transfer from below and above into the polar region
Eric Donovan
NORSTAR Science
Canadian Chain

Mark Conde

On NSF report
List of publications and graduate students
Questions:
  • How far we want to go back? (Lidar report 85)

John Meriwether:
Blue Sky will be enhanced if a strong report can be produced.
We are coupled with other communities how to report the coupling with other community

J. Hecht:
We have done great stuff
Science objectives should not be just for passive optics
Laboratorial studies may also should be included.

  • Figures with Captions from everyone.
  • Inventory of instrument
  • List of graduate students
  • REU student under students involved for their eduation single number
  • Separate under student student went to CEDAR may be counted
  • Special section of JGR need large number if small don’t worry about it

Structure of the document

Tim Killeen ’s comment (I will try to get something from Tim, Qwu)
Write report important to NSF funding mature over time coupling new capability

Point of departure
Large project from other science with model large network
Need a compelling case
California congressional delegate help
Showing graduate student probably will not do that much

Eric ‘s work impressive
Sun to earth model has been development how to couple that with our array
Large array of capability
Recent IT work allows virtual observatory (there are several already)
SPARC went through many cycles not use the common standard CEDAR has a common standard more probably are needed.

Building on experience
Add Value, obvious, easy to use
Other fields have done similar things
  - Biomedical research
  - ESDSC
  - Geophysics
  - Solid earth

Issues
Data set availability
TIMED CEDAR database is an attempt for common standard
Context should include changes the field in the past
  - Provide mass array data for mathematical model
  - Energy flux and momentum flux
  - Model with limited predictability
  - Auroral activity prediction
  - How to you know have succeeded

How to drive our instrument development

Executive summary
How much scope for international involvement?
AMISR Canada Europe and other country

Metadata standard independent of other nation
NSF is looking for recommendations to fund this effort
It certainly would like to have other country involved.

NIH data universal translator to translate to uniform standard should be looked at.

30 million dollar project from NSF to study uniform standard.

Translator IDL program may needed for the future.

Scope and vision
With recommandation for future directions
Menu form
Short term and long term goals

Other issues

1. Network of instrument
2. Campaign is still needed with network?
3. NSF opportunity may need us to organize together
   You can still do campaign with network or existing instrument
Blue sky is a long term project and needs recommendation from us to NSF
NSF would like to hear new Bluesky idea

Blue sky with 10 million, we can do about it?

Super chains from pole to pole to address energy flux
US effort needs to involve with other counties

Energy flux
- High latitude to low latitude
- Stratosphere to mesosphere
- From magnetosphere to upper atmosphere

One Blue sky idea
CCD zero read noise 100% what can be done

Funding element for instrument development
Radio science topic, how can tidal forcing be determined with cheaper means

We need a living (life?) document for CEDAR
This report should be a living document

NSF to accept community input every two years
You can revise priorities in the report

AMISR major topic for NSF. (repeating Bob Kerr’s comments)

Canadian has built half the chain
Campaign before the radar deployment

AMISR has no major optical component yet.
AMISR arrays schedule
  • One in Alaska 2005
  • Three in Resolute 2006

Will the two planned for Resolute look up or the third one is to do that?
We can use the two arrays to look up. Rick Doe
Submissions should address:

- References to publications.
- Campaigns.
- International programs.
- List of names, degree, graduation date for graduate students.
- Postdocs.
- REU students.
- Science highlights including figures and captions – assuming half page of space.
- Your science goals.
- Instrumentation goals.
- Educational outreach activities.

Need a statement of where we were pre CEDAR, where we are now, where we are going

**Phenomenology**

Small-scale instabilities
Solar cycle comparisons
Equatorial and mesospheric long term temperature trends
Midnight temperature maximum
Thermospheric dynamics and composition climatology
Wave climatology
Wave ducting, transport. Bores.
Medium scale traveling ionospheric disturbances
Equatorial plasma bubbles
Low latitude variation of zonal winds and plasma drifts
Small-scale auroral forms dynamics
Small scale thermospheric neutral dynamics
Auroral morphology over extended ranges of local times
Global distribution of tidal waves
Proton precipitation
Gravity wave sources
Morphology of convective at high latitudes
Conjugate phenomena
Regional reconnection electric fields
Mesospheric and thermospheric, and exospheric emissions
Midlatitude auroral SAR arcs
Joule heating at high latitudes
Wave dissipation and breaking
Spring and transition phenomena in the mesosphere
Sudden stratospheric warming events – coupling between altitudes
Planetary waves
Sprites
Daytime optical emissions, wind fields, temperatures
Storm events
Storm induced composition studies
Polar cap arc and patch morphology
Active ionospheric heating – optical diagnostics
Sporadic mesospheric metal layers (collaboration with lidar & radar)
Semi annual oscillation
Quasi-biennial oscillations
Ter-diurnal oscillations
Noctilucent clouds, polarization, particle sizes, low-latitude detection.
Airglow enhancement by conjugate photoelectrons
MLT wind shears?

**Figures and Topics**

Wave climatology
Instability processes
Mesospheric bores
Plasma bubbles – Hawaii
Thermospheric wind fields near the aurora
Storm induced composition changes
TIMED comparisons – TIDI winds
Daytime auroral spectra
Ionospheric oxygen spectra
Old versus new spectra – comparison
Composite MTM data
Topside hot oxygen(?)
Hydrogen densities
Mesospheric wave field
Tomographic auroral reconstruction
Profile height analysis from all-sky images
Sprites
Sodium line ratio
High latitude tidal waves
Maps of instrument locations
Lunar sodium tail
Comparison of facilities then and now
Image satellite, ASI, SMI, cross comparison
Rocky mountain chain image

**Movies, perhaps**

Plasma bubbles
Auroral boundary movie
Sentman gravity wave/sprite movie
Peach mountain gravity waves and winds
Lightning triggered plasma bubbles
Upward propagating jet
Leonid meteor?
Instability movie

**Campaigns**
ALOHA 90, 93, ANLC
AIDA 89
MISETA
CORN
CHARM
HLPS
LTCS
COQUI-DOS
CIC
MAUI-MALT
CEDAR-TIMED

**Satellite Collaborations**
TIMED
ROCSAT
UARS
DMSP
IMAGE
POLAR
FAST
GPS
FREJA
CRESS
OERSTAD
CRISTA
CHAMP
CLUSTER

**Homework**
Detector advances – Jeff Baumgardner
CEDAR database, potential for data distribution – Peter Fox
Data portal – Peter Fox
Remote control of instruments/telescience – Jim Hecht
Data formats and translators – Jonathan Makela
AMISR and passive optics – Rick Doe to threaten Jeff Thayer
Calibration – Susan Nossal, John Noto, Mike Taylor
International Collaborators – Eric Donovan, Mamoru Ishii
Existing facilities at ISR sites – John Noto
Model collaboration – Stan Solomon

**Pole-to-pole chain along the Americas**
(Augments Japan/Australian chain, and other programs – eg BAS)
Global measurements of tides
Storm events
Coupling between scales
Small scale gravity wave meridional energy transport
Large-scale F-region phenomena – TIDs, [O]/[N2] depletions
Electro buoyancy waves
Input to GAIM and other data assimilation models

→ Seems likely at meridional chain must run along US east coast.
Connects to South Pole and international polar year

**Zonal chain**
At low latitudes, useful for seeding of plasma instabilities – ESF
Non-migrating tides, GSWM
Source variability of gravity waves
Ion neutral coupling at high latitudes
Azimuthal extent of auroral forms
Zonal momentum flux
Planetary waves

**Pearls in the chain**
“Pearl” = “Passive environmental atmospheric research location”
Poker
Best seeing site in US Northwest
Mexico (Baja), @ same latitude as Hawaii, Arecibo
Site in South America – Cerro Tololo
Blue Sky Science
• Chains of imagers mimicking sun-sync satellites.
• Can we propose a generic facility? Would include imagers, an FPS, lidar, etc.
• We do not want an omnibus proposal; we really need individual PI proposals.
• Virtual observatory mimics a single instrument, with each instrument maintained by individual groups.
• Can we motivate NSF to announce a special competition?
• Risk is fragmentation. Do we want top-down or bottom up driver for the next initiatives?
• We should try to coordinate.
• DASI is something we must focus on. Schunk gave good focus for how we might participate.
• Perhaps a meridional chain would be appropriate for DASI, but we may be able to fund this much directly from NSF, without requiring DASI.
• A common theme of our work is energy transfer both from below and from the magnetosphere. But do we need to distinguish this from CEDAR?
• We can itemize the list of instruments we’d like – chains, imagers, FPS, spectrometers etc. We can cost this. Then we can propose elements of this set, with priorities driven by campaigns.
• Many CEDAR campaigns were held in the early 90’s; they worked well and provide a good model.
• Instruments need a plan for deployment and operation.

• An NSF opportunity would drive proposals and campaigns – but only for a few years. We need an ongoing process.

• Can we organize ourselves so we can purchase parts to leverage economies of scale. Can we ever coordinate purchases? This is particularly true for filters.

• Perhaps a central facility could provide an equipment library.
• Can a large purchase (~100 cameras) be used to motivate suppliers to offer good prices in return for publicity?
• But, we’ll all have our own individual needs.
• Cameras are perhaps not good candidates for bulk purchases – but filters are, at least in small apertures.
• How do we manage any new facilities that we might create. PIs are usually not available for caretaking.
• Maintaining facilities is not trivial. Should we setup our new instruments as a facility class operation?

• Can we propose initiatives like a science and technology center effort?

• We should focus on getting low, mid, and high latitude cluster sites. Perhaps include southern hemisphere?

• Can we create mosaic optics to get large collecting area?

• The initiative should include the new high-sensitivity spectrograph.
• Spectrograph request should include all three latitude bands. Simultaneous measurements are of more value than isolated single measurements.
• These devices can access weak lines, or be used to provide high time resolution.
• Is there any reason to target auroral features at the theoretical limit of possible scale sizes (perhaps 10-meter scale size). Auroral experts say yes, subject to nesting inside a larger FOV for context.
• Comparative aeronomy – comparison with other planets. Mars lander spectrometer? Perhaps this is NASA’s field.

• Can we develop remotely deployable autonomous instruments like AGOs. This would involve interesting technology, at least.

• Existing cameras are pretty good. Perhaps the way forward is to deploy multiple cameras observing simultaneously to improve time resolution.
• THEMIS imagers may be a good model for multiple camera arrays.

• Perhaps we should form a team to propose 20 identical instruments (say imagers) under a single PI. This might be more fundable than 20 single proposals? This would give critical mass to a common format.

• But…not all science requirements can be met by a single camera. If we have a problem with some aspect of the instrument, we get 20 bad ones.
• 20 identical units offer no diversity.
• If we can cover 80% of the needs with a common system, that is worthwhile – but should not be the sole option.
• Experience has been that we have not traditionally been able to agree on a single system.
• SuperDARN is a good model. A modular approach could allow some commonality.
• Innovation versus standardization has been faced by others. The appropriate strategy depends on uniformity of purpose.
Imaging Science
• Auroral Science: meridian imaging spectra in conjunction with an imager – to resolve ambiguities in meridian spectrometer observations. South pole a possible site. THEMIS is coming on line – dense array of white light imagers. Imager is cheap, spectrometer is costly.

• Small-scale structure and instabilities. Occurrence frequencies, propagation, tomographic resolution, vertical extent, etc. Can do at multi wavelength.
• Need cluster instrument support.
• Narrow-field imagers at high time resolution for separating temporal/spatial effects. Millisecond sampling with 12-bit dynamic range – this will require “burst mode” recording. This will be campaign only.
• Cluster meteor radar, imager, lidar to characterize ducted gravity waves.
• South westward waves need bistatic FPI in conjunction with imagers over a wide geographic area (grid) to cover propagation.

• Common volume imagers (perhaps under DASI).

• Also we need a mobile facility that can be deployed for campaigns. A mobile wind/temp lidar is proposed that could be deployed along with the mobile imagers.

• Perhaps chain is a permanent setup, grid for campaigns?
• Push for latitudinal chain? Japan & Australia already provide the start of a chain. US could deploy another chain through N&S America.

• Question: What does an elongated chain add? Would a latitudinally extended chain capture tidal effects better? Gravity waves mainly move north-south and would be well covered with a longitudinal chain.

• East-west chain including FPS would be good for non-migrating tides.
• Perhaps Rocky mountain chain provides a good starting point for a US chain.
• A Rayleigh Doppler lidar in addition to the chain could help characterize wind filtering.
• Momentum flux, flux divergence never been examined at 5577A. Multi wavelength data would help sort out wave breaking and momentum deposition. Multiple imagers with simultaneous obs needed for high-frequency waves.
• Wave breaking in the mesosphere as a source for thermospheric waves.
• Central management of network will require a pool of common codes for data processing.
• Solar & geomagnetic activity effects can be tracked globally via an array of imagers. A chain around the equator or midlatitudes would help characterize tides.
• High latitude convection pattern – to augment superDARN.
• Zonal chain of 20 degrees extent under Appleton anomaly needed to characterize onset of equatorial spread F.

• Perhaps we need to add ionosonde (digisonde) support?

• Connecting auroral zone to mid & low latitudes. Are we really seeing waves propagating from auroral zone? What/where are the sources.

• What are the best places to go to study thunderstorm-generated waves? Need models to answer this.
• Mesoscale complexes.
• Source geometries – linear wave fronts imply either distance sources, or line sources) – can we resolve?
• Aircraft-borne imagers? (lidars, FPS, etc?)
• NCAR has a new aircraft. Would like a temperature capability on the plane. Good for convection campaigns – storms are often accompanied by clouds…
FPI Science
Science Questions

• Auroral Science – small scale structuring to study coupling
  – Wind imaging on small-scale around aurora (regional length scales)

• Studying ion-neutral momentum coupling
  – In conjunction with AMISR

• Winds needed for Joule heating calculations

• Use FPI in conjunction with other instruments to get height information
Science questions

- Tidal wave and planetary wave (global scale) in lower thermosphere (MLT)
- Electric fields on auroral boundaries using monostatic measurements (E-region)
  - Wind profile would be ideal, but any information useful
- Wind mapping at all latitudes
- Global wind fields for characterizing transport in models
  - E region and F region and mesosphere
Science Questions

• Extending spatial wind mapping to mesopause
  – Breaking waves

• Gravity waves in the F region
  – What are the origins?
  – Common volume
    • Horizontal gradient and temperatures (clustering)

• Gravity waves in mesosphere
  – Combination of ASI and FPI (clustering)
Science Questions

- Vertical motions (F region)
  - As error bars decrease these can be pursued
- Looking for patterns of natural variability
  - Solar cycle length trends
- Composition of the upper atmosphere (transport?)
  - How they vary in response to storms
  - Space weather
  - Global change
Science Questions

• The hot O question
  – O+ outflow in the cusp
• Composition changes
• Hemispherical differences between seasons
  – Need for daytime observations
  – Conjugacy
• Neutral winds in plasma instabilities
  – Midlatidue mesoscale TIDs
Science Questions

• ESF seeding by gravity waves (day-to-day variability)
  – Collaborate with C/NOFS etc
  – Tidal structure
  – Vertical winds, horizontal gradients, temperature

• Neutral drivers of ion dynamics

• Mesopause temperatures (OH)

• Composition of the upper atmosphere (topside)
  – Needed to understand TEC
Science Questions

• Exobase winds
Instrumentation needs

- Multiple instruments to work together
  - Regional and global
  - Move existing instruments?
- Upgrade facility instruments (for long term)
- Portable instruments for campaigns
  - What type? (wind mappers, narrowfield)
- Campaign capability using high-quality instruments
Instrument Needs

• Location of instruments for a large chain
• Zero velocity calibration sources
• Improved calibration facilities (all passive optics)
• Extended coverage to obtain measurements over the AMISR FOV
  – FPIs fill gap between Poker and Resolute
• Science that supports AMISR is high priority
• Keep flexibility (where else might AMISR go?)
  – Move optical instruments or stay put for long-term synoptic measurements?
• Large-scale (global) mapping long-term
• F-region dynamics (waves, ESF)
• Equatorial aeronomy
  – C/NOFS flies in Nov 2004
• Cannot lose sight of other ISRs
  – Millstone Hill
• Human resources
Spectrograph Science
Science Questions

• General auroral spectroscopy
• Neutral/mesospheric, radiative, dissociative recombination
  – Energy transfer/radiate transfer
• Dayglow photo-excitation
  – Evening and morning high-altitude observations
  – Polar summer observations where “twighlight” is long
  – Lunar absorption spectroscopy
Science Questions

• Auroral meridian spectroscopy
  – Energy flux, composition
  – Angstrom resolution on proton aurora
    • Needed for determination of proton energy
    • Better model input

• Thermospheric temperatures \((O_2)\)

• Energy flows and budgets
  – Better understanding of chemistry
Science Questions

• Solar max/min differences
  – Effects at different sites
• Ability to use “forecasting” to study proton events after solar events
• Simultaneous observations to look at different species (or different lines from the same species)
• Need for high-speed spectra (1 ms)
  – Temporal development of filamentary aurora
Science Questions

• Combining spectra with imaging
  – Determine what emissions are within filter passband
Summary Science
- Data formats.
- Perhaps central database contains keogram summaries, thumbnails, or movies, plus links to original data at source institutions.
- Storage is now cheap. Can we ask CEDAR database to archive all images? Might only need export routine to CEDAR DB format.
- Peter Fox is interested in helping add data to CEDAR DB. We can give them raw data plus reader programs.
• Issues of interpretation of raw data.
• Irradiance calibration. We need to identify facilities.
• Many factors influence whether the data are contaminated – even after calibration. Data quality determination will require additional instrumentation – spectrometer – alongside the imager to identify contamination.
• Must agree on a reference source/sources. Also need a transfer detector (portable photometer) for cross calibration.
• Astronomers have IRAF as a standard for data reduction.
• CEDAR workshop could include a half-day calibration session.
• Do we want a central calibration facility. We do need a traceable standard which may reside at a central facility. Model is Japanese facility at NIPR.
• Calibration is very difficult. How dependable are portable sources, how uniform are they. Difficult at 6300; a nightmare at 4278.
• Transfer sources needed, as main sources have been damaged by shipping.
• Common analysis package may provide star calibration routines.
• C14 source was very convenient for mobile calibration – but radiation safety officers make this no longer a convenient option.
• Can we use current limited LEDs as a replacement for C14? An array of such diodes may be even more stable.
• Can we have a source that is constantly traveling to labs.
• Detectors are more stable than light sources. Is it better to transport a detector instead.

• What precision do we want. Can be done to 20%, but 1-2% is not.

• Other issues – persistence, linearity.

• Should we setup a calibration working group?

• Do not underestimate the difficulty of field deployment. This requires costly engineering. It means a long-term investment.
• Do we need new spectrometers at ISR sites? This requires human resources as well as hardware.

• A station has been identified near Jicamarca (Pura) near the coast, with good seeing, to augment the radar which is at a lousy optical site. SOFDI will be at Huancayo.

• A meridional chain through the Rockies will be subject to orographic effects. Do we need a chain in a quieter longitude?
• A goal should be to identify mountain forcing.
• New Japanese radar in Indonesia (EAR).