The Cedar Post

May 1995 No. 25

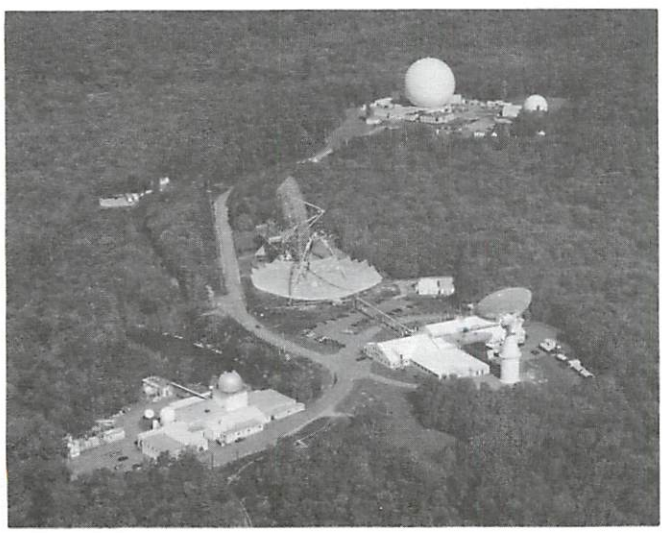
The Millstone Hill Observatory

Introduction

The Massachusetts Institute of Technology maintains an extensive upper atmosphere research facility at Millstone Hill as a part of its interdisciplinary Haystack Observatory located in Westford, MA, 35 miles northwest of Boston. Investigations of the mid- and high-latitude ionosphere and thermosphere are carried out in support of the international World Day and CEDAR programs using the Millstone Hill UHF incoherent scatter radars (ISR) and the instrumentation clustered around them. Research capabilities at the Observatory have been enhanced through new CEDAR instrumentation sited near the ISR in order to capitalize on the enhanced scientific output and economy of operation associated with clustered instruments. Optical research facilities including a Fabry-Perot interferometer, all-sky digital imaging system, and photometers, as well as other upper atmospheric research systems including a digital ionosonde are maintained at the Millstone Hill site by MIT and other area institutions. The location of Millstone Hill in the heart of the New England academic community enhances its capability as a center for collaborative and student research.

Extensive information, schedules, and access to data are available over the WWW for Millstone Hill (http://hyperion.haystack.edu/homepage.html) and for the Haystack Observatory (http://hyperion.haystack.edu/haystack/haystack.html). Table 1 provides a listing of the research equipment currently available at the Millstone Hill Observatory.

In This Issue:



Millstone Hill as a CEDAR Class-I Facility

Millstone Hill has evolved over the past two decades as a broad-based observatory capable of addressing a wide range of atmospheric science investigations. The incoherent scatter radar facility has been supported by the National Science Foundation since 1974 for studies of the earth's upper atmosphere and ionosphere, and the scientific capability of the facility was greatly expanded in 1978 with the installation of a fully-steerable 46-meter antenna to complement the 68-meter fixed zenith pointing dish. The favorable location of Millstone Hill at sub-auroral latitudes combined with the great operational range afforded by the steerable antenna permit observations over a latitude span encompassing the region between the polar cap and the near-equatorial ionosphere.

Since 1982, Millstone Hill has been a part of the incoherent scatter meridional radar chain which extends from Sondre Stromfjord, Greenland through Millstone

Hill at mid-latitudes, beyond Arecibo at low latitudes, to the Jicamarca facility at the magnetic equator in Peru. The radar chain forms an integral part of the CEDAR observing network, and Millstone Hill Observatory observations and analysis have contributed extensively to the successes of the CEDAR initiatives. An extensive analysis capability has evolved in parallel to the hardware improvement so that the acquired data can be quickly and efficiently processed, distributed, and analyzed. A common data format is being developed which will enable the monitoring and remote control over the internet of the full array of instrumentation at Millstone Hill.

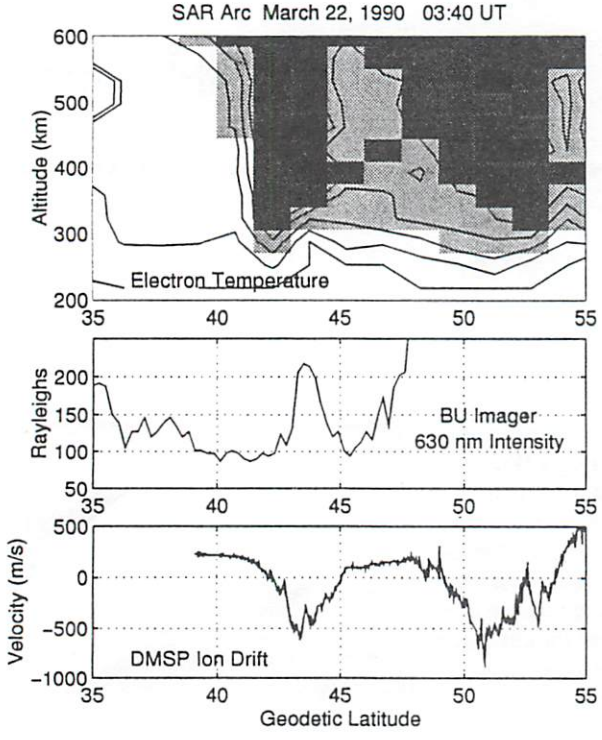


Figure 1. Electron temperature (ISR), red-line intensity (imager), and horizontal drift speed (DMSP) observed in the vicinity of an SAR arc from Foster et al. *[J. Geophys. Res., 99, 11429, 1994]*

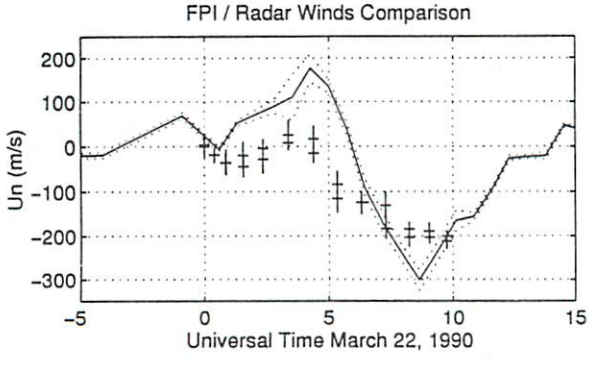


Figure 2. Meriodional neutral wind speed measured by the Millstone Hill radar (solid line) and FPI (points) from Buonsanto et al. *[J. Geophys. Res., 97, 1225, 1992].* Differences in the winds observed by the two techniques were addressed by Buonsanto et al. *[J. Geophys. Res., 97, 8673, 1992]*

The enhancements and diversification of the research capabilities at Millstone Hill have contributed to the site's status as a Class-I CEDAR research facility. Atmospheric optical observing facilities were added to the radar program in 1988 through CEDAR support. The Millstone Hill Observatory Experimenters Working Group coordinates the instrumentation programs at the site in order to promote and facilitate multi-instrument experiments. Examples of the collaborative work being pursued are provided in Figures 1 and 2 which present ground and satellite-based observations of a Stable Red Auroral arc, and a comparison of the meridional neutral winds observed from Millstone Hill on the same night by radar and optical techniques.

Most recently, a transportable version of the Millstone Hill MIDAS radar controller/signal processor has been produced, under support of the Canadian Centers of Excellence, for use as a bistatic receiver in conjunction with the Millstone Hill UHF radar. Synchronization to the radar timing is accomplished by using GPS receiver/clocks. Use has been made of the 46-meter Algonquin Observatory antenna as the remote receiving antenna. Using this major enhancement of the Millstone Hill radar capabilities, we expect that simultaneous coherent and incoherent scatter probing of the E region will be possible as will bi-static mid-latitude convection observations.

Education and Infrastructure Support

Graduate and undergraduate participation in the Atmospheric Sciences research program at Millstone Hill has always been emphasized. Several recent MIT doctoral students have pursued research at Millstone Hill under the direction of the Haystack staff and graduate students from other institutions, particularly Boston University and U. Mass./Lowell, make regular use of the Observatory facilities in their research. Each summer, the Atmospheric Sciences group hosts and directs four or five summer undergraduate students as a part of the NSF Research Experiences for Undergraduates program. In addition, the Haystack Observatory has launched several educational initiatives at the pre-college level to augment its graduate and undergraduate level programs. Each summer the Observatory runs a NSF Young Scholars Program for middle school students aimed at exciting them with hands-on research projects in atmospheric science and other disciplines.

International Programs

A CEDAR program was initiated in 1993 to support visits from the former Soviet Union to the Millstone Hill Observatory for work with MIT staff or other CEDAR researchers on the development of collaborative programs in keeping with the goals of the CEDAR program. A total of nine visitors are being supported over a three-year period. Visitors have been sited at U Massachusetts Lowell, Cornell, and U Maryland, as well as at MIT, and topics addressed have included HF propagation techniques, high-altitude incoherent scatter observations, and temperature enhancements associated with plasma effects.

The Russian-American Tomography Experiment involved a collaboration between researchers at Murmansk and Moscow with MIT which resulted in the establishment of a temporary, four-site ionospheric radiotomography chain co-located with the Millstone Hill ISR field of view and the successful experimental campaign of late 1993. The excellent storm-time data obtained with both Russian and US tomography receivers and the Millstone Hill ISR are being used to advance the tomographic technique as well as to probe the geophysics of the storm onset.

A program of collaboration with the Ukrainian incoherent scatter radar facility located near Kharkov has been initiated and will result in growing research involvement with the CEDAR community during the next several years. The facility consists of a 100-meter fixed, zenith-directed, parabolic antenna, a 25-meter steerable antenna, a separate 2-MW 150 MHz transmitter for each antenna, and a computer center for radar control and data analysis. Coordinated experiments between the Millstone Hill and Kharkov radars have been carried out in 1993 and 1994, and such experiments are currently directed towards studies of light-ion composition.

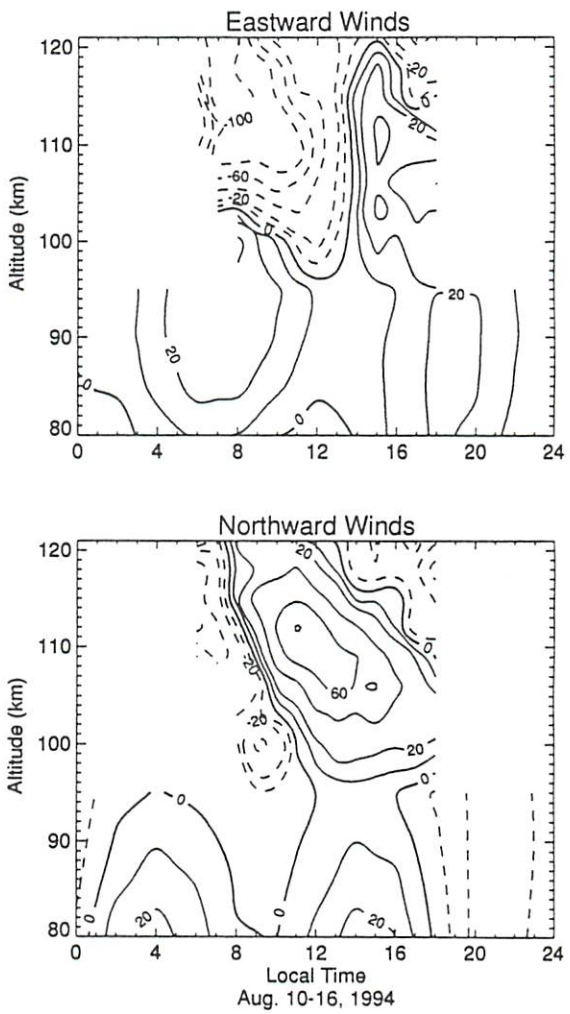
Research Facilities - Millstone Hill Observatory

Millstone Hill Incoherent Scatter Radars

The Millstone Hill UHF radar (J. Foster), operated by the MIT Haystack Observatory Atmospheric Sciences group, consists of two 2.5 MW 440-MHz transmitters, a fully steerable 46-meter antenna, a zenith-directed 68-meter fixed antenna, and dedicated computer and database facilities. Principal operational support derives from the National Science Foundation Upper Atmosphere Facilities Program for incoherent scatter investigations of large-scale processes in the thermosphere, ionosphere, and magnetosphere. The facility is situated at 550 L such that its extensive field-of-view encompasses mid-latitude, sub-auroral, and auroral features and processes.

The Millstone Hill Radar uses Thomson backscatter from the ionospheric electrons to deduce height- and time-resolved plasma drift velocities, electron and ion temperatures, electron densities, ion composition, and ion-neutral collision frequencies. These parameters provide further information about the neutral gas, neutral temperatures and winds, and electric fields present in the medium. The incoherent scatter technique provides observations of many of these parameters over an altitude range extending from less than 100 km to 1000 km or more. Modern techniques allow a resolution of hundreds of meters at altitudes below the F peak, and the complete steerability of the radar allows horizontal gradients and structure to be examined along with vertical variations. Extensive data base and real-time support capabilities have been developed to support the atmospheric sciences program at Millstone Hill. Ease of access to the data from remote sites and an interactive experimental capability have been emphasized in order to fully support cooperative and multi-instrument ionospheric experiments.The MIDAS data acquisition system was designed to be monitored and controlled remotely, making a telescience capability a basic feature of the system. Using a standard data structure which incorporates experiment description and status information, a distributed data acquisition system can be implemented which permits the radar or other data to be interpreted and processed by any computer.

Figure 3. Averaged winds observed by the Millstone Hill ISR (above 95 km) and by the Durham meteor radar (80 km - 100 km) during the August 1994 CEDAR MLTCS campaign. [From the ongoing CEDAR Postdoctoral research of Wei Deng at Millstone Hill.]



MIT Fabry-Perot Interferometer

A Fabry-Perot interferometer (D. Sipler, MIT) is operated every night on a patrol basis at Millstone Hill Observatory, observing 630 nm emissions from the F region. A tilting-filter photometer is boresighted with the interferometer, making it possible to identify periods of cloud contamination in the data. The data are analyzed for winds and temperatures and are sent regularly to the CEDAR data base. Data from the patrol operations are available for the period May 1989 to the present. Most of the data are taken in a 5-point observing sequence in which the instrument looks at 300 elevation to the NW, SW, SE, NE and Zenith. This mode of operation results in two orthogonal observations at the same latitude to the north of Millstone Hill Observatory and two to the south, separated in longitude, which we assume is equivalent to a local time variation. These observations reveal gradients in both meridional and zonal winds which occur frequently at Millstone Hill. Bistatic measurements with the University of Pittsburgh (F. Biondi) have allowed us to derive vertical atmospheric motions, which appear to be small when averaged over long periods. However, large vertical motions have been observed, particularly during active conditions. The interferometer is currently operational and we will be operating it at least through solar minimum in the patrol mode.

Table 1

Research Instrumentation at Millstone Hill Observatory

UHF Radars	Massachusetts Institute of Technology [1965-present] 440 MHz, 2-5 MW, dual-transmitter incoherent scatter radars 68-m zenith and 46-m steerable parabolic antennas *E* and *F* region ionospheric studies; lower and upper thermosphere operates 1000+ hours/year; supports World Day and CEDAR campaigns Contact: J. M. Holt (jmh@hyperion.haystack.edu)
Digisonde	U. Massachusetts/Lowell [1987-present]; Digisonde 256 0.5-30 MHz digital ionospheric sounder 60-m rhombic transmit antenna; directional receiving array operates continuously with 15-min resolution Contact: B. Reinisch (reinisch@caedc0.uml.edu)
Meteor Wind Radar	U. New Hampshire 30 KW, 36.8 MHZ; dual receiving arrays regular, automatic operation for lower thermospheric winds Contact: R. Clark (rrc@hopper.unh.edu)
FPI	MIT/U. Pittsburgh [1989 - present]; 100 mm field-widened Fabry-Perot interferometer automated continuous observations of atomic oxygen 630 nm nightglow Contact: D. P. Sipler (dps@hyperion.haystack.edu)
FPI	Boston University/CEDAR [1990-present]; 150 mm Fabry-Perot interferometer single/dual etalon; atomic oxygen 630 nm, 845 nm nightglow; helium 1.08 micron Contact: R. Kerr (kerr@moe.bu.edu)
FPI	U. Wisconsin [1995]; 150 mm Fabry-Perot/CCD annular-summing spectrometer triple-etalon; oxygen 630 nm dayglow for thermospheric winds and temperature Contact: M. Coakley (mmc@hyperion.haystack.edu)
All-Sky Imager	Boston University/CEDAR [pre-1988 - present] image intensified TV camera observes atomic oxygen lines (630 nm, 558 nm) nightglow and SAR arc studies Contact: M. Mendillo (mendillo@buasta.bu.edu)
Imaging Spectrometer	Boston University [1992-present] meridian slit dispersed by grating onto image intensified TV camera Contact: M. Mendillo (mendillo@buasta.bu.edu)
IR group	Utah State University [1991-present] (1 - 1.7 micron) scanning infrared radiometer; two Fourier transform spectrometers primarily OH observations Contact: R. Huppi (617)-275-8273

Boston University/CEDAR Fabry-Perot Spectrometer

The Boston University/CEDAR Fabry-Perot spectrometer (R. Kerr) is capable of measuring a wide variety of visible and near infrared airglow emissions over a wavelength range of 5500 A - 11000 A. State-of-the-art detector technologies are used, including a red-sensitive GaAs photomultiplier tube (PMT), an EEG/Judson Germanium-Nitride integrating detector, and a new CID system. This unique combination of detectors, in tandem with image-quality, broadband, optical coatings, provides additional red-sensitivity needed for near-infrared operation. In addition to being operated as a single-etalon, pressure-tuned interferometer, it features twin-etalon configuration which provides increased wavelength resolution, spectral range, and background rejection. Possible applications include high resolution studies of multiplet emissions and applications where nearby contaminant lines generally preclude single-etalon investigations. The double-etalon configuration improves Rayleigh scattered background rejection, permitting measurements in the bright twilight. The instrument includes a six-element filter wheel permitting multiple emission measurements in a single evening. A dual axis mirror system provides directional tracking.

Triple-Etalon Fabry-Perot Spectrometer

The Wisconsin triple-etalon Fabry-Perot/CCD annular summing spectrometer (M. Coakley, MIT) has been located at Millstone Hill Observatory since early 1995. Its large throughput and ring-imaging capability allow both daysky and nightsky observations to be taken without instrumental reconfiguration. Automation of the system is anticipated during the next two years. Operating at a resolving power of about 300,000, the spectrometer will be used primarily to observe OI 6300 A to determine daysky winds and temperatures in the thermosphere using short (4 minute) integration times to facilitate comparisons with radar data.

All-Sky Doppler Interferometer (ASDI)

An imaging Fabry-Perot interferometer, built by the University of Pittsburgh, is undergoing testing and development at Millstone Hill (M. Biondi, U. Pittsburgh; D. Sipler, MIT). This instrument, the All-Sky Doppler Interferometer (ASDI), combines an interferometer and an all-sky camera. The ring interference pattern of the FPI is superimposed on the all-sky image, giving a series of measurements at constant elevations determined by the position of the rings. The ring/sky pattern is imaged onto a CCD detector which is sensitive out to about 900 nm, making it useful for near IR emissions. The plates have fairly narrow band coatings with two peaks, one of which was originally designed for infrared work, with a secondary peak near 633 nm for laser alignment. This makes them ideal for 630 nm observations or near IR OH observations, but the plate reflectivities are too low for operation at 558 nm (E-region oxygen green line). Since the ASDI obtains measurements from all parts of the sky simultaneously, it will enhance the time resolution of the measurements. An improved (broadband) version of this instrument is being built at the University of Pittsburgh, which will make possible simultaneous bistatic measurements and normal sky-mapping observations.

Boston University Imaging System

The Boston University imaging system (M. Mendillo) was first operated at Millstone Hill in November 1987. Since that time, it has been upgraded to the CEDAR Imaging Facility and housed in a specialized 8x20 foot building adjacent to the Millstone Hill optical facility. The core instrument is the CEDAR Class-I Imager, an image-intensified CCD system optimized for low light levels (f/1) using all-sky optics. A filter wheel makes available 6300 A, 5577 A, and 7774 A observations on a routine basis, with appropriate off-band (background) images, and a capability for additional wavelengths upon request. An imaging spectrograph, using a 1800 meridional slit, also operates on a campaign mode basis at the site. Routine operations involve a 14-day period each month centered on the day of new Moon. In this mode, over 900 nights of observations have been made with visible structures (diffuse aurora, stable auroral red (SAR) arcs), in addition to background airglow, on approximately one third of the nights. Imager operations can be viewed in real time using standard video telephone systems; data are reduced each month and are deposited in the CEDAR database at NCAR.

Requests for specialized reduction of images is handled by Boston University/Center for Space Physics' Imaging Science Laboratory.

Imaging science at Millstone Hill will be significantly improved in 1995 as Boston University's new CEDAR Optical Tomography Imaging Facility (COTIF) becomes operational. The facility will involve adding imaging spectrographs at sites to the north (Presque Isle, Maine) and south (Block Island) of Millstone in order to attempt tomographic-like reconstruction of volume emission height profiles of features captured in the all-sky imager at Millstone.

Digisonde 256

Since 1987, the U. of Mass./Lowell has operated a Digisonde 256 (B. Reinisch) at Millstone Hill using a 60-m vertical rhombus antenna for transmission and four spaced, crossed-loop antennas for reception. Routine ionogram soundings are made every 15 min, normally followed by 5 min F region drift observations. All data are stored on cartridge tape for further analysis. Remote access to the ionogram data via dial up telephone lines is available. In the ionogram mode, the Digisonde measures echo amplitude, ordinary/extraordinary polarization, a coarse resolution Doppler spectrum and angle of arrival. The ionograms are scaled automatically and the electron density profiles calculated in real time. A modem connection feeds these data to the Incoherent Scatter Radar computer which uses the scaled foF2 values to calibrate the ISR electron density profiles. In the drift mode the Digisonde determines the locations of all F region reflection points within a 300 zenith angle (skymaps). From the line-of-site velocities of these reflection points, the three-dimensional plasma bulk velocity is calculated.

GPS TEC Observations

A real-time synoptic ionospheric monitoring system is operated by MIT Lincoln Laboratory (A. Coster) in association with the Millstone Hill satellite-tracking radar whose operations support the U. S. Air Force. This system has been operational since 1991 and predicts the total electron content (TEC) in any direction around the radar site using data acquired from an Allen Osborne Turbo Rogue GPS receiver which can track up to 8 different GPS satellites at one time. Each GPS satellite transmits at two different L-band frequencies and the TEC along the path to each satellite can be determined by combining the pseudorange and integrated phase data at both frequencies. These TEC measurements extend out to the altitudes of the GPS satellites, approximately 20,000 km.

Meteor Wind Radar

The University of New Hampshire meteor wind radar (R. Clark), located at (430N, 710W) is a 30 KW HF coherent pulsed radar system operating at 36.8 MHz. Two transmitting and receiving antenna arrays at 450 elevation and looking NE (450 azimuth) and NW (3150 azimuth) are used to obtain northward and eastward components of the neutral wind. Each receiving system utilizes two orthogonal phase-sequenced interferometers to measure the direction cosines of the meteor trail reflection point. A doppler system with an offset local oscillator is used to measure the slant range velocities. The radar is computer controlled for unattended operation and operates routinely with the Millstone IS radar and as part of the mesosphere lower-thermosphere CEDAR initiatives. Figure 3 presents combined meteor-radar and ISR mean winds observed during a recent MLTCS campaign.

The Millstone Hill Observatory
Experimenters Working Group

1995 Annual CEDAR Meeting Agenda
Sponsored by NSF, HAO/NCAR, University of CO, NIST

1995 CEDAR Workshop Agenda
NIST and NCAR Mesa Lab
June 25-30, 1995

1995 CEDAR Workshop Plans

The 1995 CEDAR Workshop will be held in Boulder, Colorado between Sunday June 25 and Friday June 30. The plenary sessions will be held at the National Institute for Standards and Technology (NIST), while the poster sessions will be held at the Mesa Laboratory of the National Center for Atmospheric Research. The workshops will be held at both locations simultaneously, except for Sunday afternoon, when the registration and workshops will be held at NIST. There will be a bus between various locations as indicated in the agenda. The reception and the buffet will be held at the Mesa Lab on Sunday and Wednesday evenings, respectively. All alcohol will be bought with voluntary contributions. The extracurricular activity for those interested is the Shakespeare Festival play *Hamlet* on **Tuesday evening, 8:30,** in the outdoor Mary Rippon Theatre on campus. (Rain is not usually a problem.) We have reserved **70 tickets at $18/ticket**. For tickets and more information, please contact Barbara Emery (emery@ucar.edu).

Sunday, June 25

1:00 Registration begins at NIST

1:30 - 5:30 Workshops at NIST only
1) *January 1993 10-Day Campaign* - Fesen
2) *CADRE* - Fritts
3) *Student Workshop* - Sahr/Miller

5:30 **Bus** from NIST to Mesa for Reception
5:30 - 7:00 Reception at Mesa
7:00 **Bus** from Mesa to Williams Village

Monday, June 26

8:30 - 9:00 Welcome/Introductions at NIST
U of CO, Jeff Forbes
HAO director, Michael Knoelker
NSF Welcome/Comments
Sunanda Basu and Bob Robinson

9:00 - 9:30 CSC Comments, Introductions of Post-docs, students by Forbes

9:30 - 10:00 CEDAR Prize Lecture

10:00 - 10:30 Break

10:30 - 11:30 Tutorial #1
Global Change in the MLT Region: Has It Already Arrived? by Gary E. Thomas, U of CO

11:30 - 11:45 CEDAR Data Base Update by Barbara Emery, HAO/NCAR

11:45 - 12:00 Further Data Base Updates by John Holt, Millstone Hill

12:00 **Bus** from NIST to Mesa
12:00 - 1:30 Lunch

1:30 - 4:00 Workshops at NIST and Mesa
Mesa 1) *Gravity Wave Spectra and Dynamical Forcing* - Killeen
2) *Accessing the CEDAR Data Base,* sign-up sheet

NIST 3) *HLPS/(STEP-GAPS)* - Sojka/Weber
4) *Millstone Hill* - Foster

4:00 **Bus** from NIST to Mesa
4:00 - 6:00 Poster Session A at the Mesa Lab
(up for viewing Mon AM to Tues PM)
6:00 **Bus** from Mesa to Williams Village

Tuesday, June 27

8:30 - 9:30 Tutorial #2 at NIST
a) *Testing Theories of Gravity Wave Saturation and Dissipation in the Middle Atmosphere* by Chet Gardner, U of IL

b) *Testing Theories of Gravity Wave Transports and Their Effects on Wind, Temperature and Composition in the Middle Atmosphere* by Richard Walterscheid, Aerospace Corporation

9:30 - 10:10 Post-Doc Reports

9:30 - 9:50 Rick Doe, second year, SRI Internat'l, *Ground-Based Signatures of the Polar Cap Boundary*

9:50 - 10:00 Wei Deng, first year, Millstone Hill, *Millstone Hill Radar Observations of the Lower Thermosphere Winds during Recent Long Period CEDAR Campaigns*

10:00 - 10:10 Susan Nossal, first year, Arecibo Observatory, *Optical Observations of Methane/Hydrogen*

10:10 - 10:30 Break

10:30 - 10:50 The National Space Weather Program by Rich Behnke, NSF (TBD)

10:50 - 11:50 Tutorial #3
Solar Wind/Magnetosphere Drivers for Space Weather by Dan Baker, U of CO

11:50 - 12:00 PCO update by Rich Behnke, NSF (TBD)

12:00 - 12:10 EISCAT/Svalbard Radar update by EISCAT representative

12:10 **Bus** from NIST to Mesa

1:30 - 5:30 Workshops at NIST and Mesa
Mesa 1) *LTCS* - Johnson/Fesen
2) *Accessing the CEDAR Data Base,* sign-up sheet

NIST 3) *CEDAR/GLO Airglow Obs on Feb 1995* - Broadfoot
4) *Jicamarca* - Farley

5:30 **Bus** from Mesa to Williams Village

Wednesday, June 2

8:15 **Bus** from Williams Village to Mesa

8:30 - 12:00 Workshops at NIST and Mesa
Mesa 1) *Lidar Science and Technology* - Thayer/Meriwether
8:30-11:00 2a) *Sondrestrom Users* - Kelly
11:00-12:00 2b) *IS World Day Scheduling* - Holt

NIST 3) *GEM/ATLAS-1/SUNDIAL* - Szuczewicz

12:00 **Bus** from NIST to Mesa
(those going from Mesa to NIST take the NCAR shuttle)

12:00 - 1:30 Lunch

1:30 - 4:00 Workshops at NIST and Mesa
Mesa 1) *PRIMO* - Sojka/Anderson/Fuller-Rowell

NIST 2) *TERRIERS - A STEDI Mission* - Cotton/Mendillo
3) *Arecibo* - Tepley

4:00 **Bus** from NIST to Mesa

4:00 - 6:00 Poster Session B at the Mesa Lab
(up for viewing Wed AM to Thur PM)

6:00 - 8:00 Buffet on Mesa Lab Tree Plaza

8:00 **Bus** from Mesa to Williams Village

Thursday, June 29

8:30 - 8:40 Announce student poster prize winners at NIST

8:40 - 9:00 SuperDARN initiative by Mike Ruohoniemi/Bill Bristow, APL

9:00 - 10:00 Tutorial #4
Review of Comprehensive Meteorological Modelling of the Middle and Upper Atmosphere by Kevin Hamilton, Geophysical Fluid Dynamics Lab/NOAA, Princeton U

10:00 - 10:30 Break

10:30 - 11:00 *The Re-scoped TIMED Mission* by Jeng-Hwa Yee, APL (TBD)

11:00 - 12:00 Tutorial #5
Ionospheric/Thermospheric Space Weather Issues
a) "Product Specifications" by Jan Sojka, Utah State U
b) "Scientific Issues" by Bob Schunk, Utah State U

12:00 **Bus** from NIST to Mesa

(continued on page 9)

NATIONAL MST RADAR FACILITY (NMRF*)

The National MST Radar Facility is established at Gadanki (13°N, 79°E) near Tirupati under a multi-agency funded project. Its primary objective is to study the dynamics and related phenomena in the troposhere, middle atmosphere and the ionosphere. The facility is available for scientific utilization by interested groups/ individual scientists from national laboratories/institutions and universities.

Request for proposals
Proposals for scientific utilization of MST radar are solicited from scientists pursuing research in lower, middle and upper atmospheric phenomena and related topics as per the proposal preparation format (see below). Priority is assigned to proposals containing new ideas of research not yet conducted elsewhere.

Observation period
The experiments will be scheduled in two time slots every year viz. Oct.-March and April-September.

Last date of proposal submission
For the October-March observation period the proposals are to be submitted no later than June 30, and for the April-September period the deadline is December 31 of the previous year. In addition, proposals may be submitted against special announcements made from time to time covering periods of specific coordinated observations, special intervals, etc.

Proposal submission requirement
Four copies of the proposal should be addressed to the Director, National MST Radar Facility (NMRF), P.B. No. 123, Tirupati - 517502, and one copy for information to Space Science Office, ISRO HQ, Antariksh Bhavan, New BEL Road, Bangalore - 560094. The Format for Proposals is given below. For further information including specifications of the Indian MST Radar, contact the Director.

Acceptance of proposals
The Principal Investigators will be intimated about the acceptance or otherwise of their proposals within three months of receipt, indicating the schedules of the experiment, if selected.

Request for financial support
Investigators with university affiliation can get limited travel support for conducting the experiments. Please write to the Convenor, UGC-SV University Centre for MST Radar Application, Physics Department, Sri Venkateswara University, Tirupati - 517502. The application for travel support should reach the Convenor at least one month in advance with a copy to Director, NMRF.

Availability of accommodation
NMRF at Gadanki and SV University Centre at Tirupati have limited Guest House facilities to meet the requirements of the experimenters on payment basis. Request for accommodation and logistic support can be sent to Director, NMRF/ Convenor, UGC-SV University Centre for MST radar application.

Proposal Preparation Format
1. Title of the Proposal
2. Name of the Principal Investigator (PI) and Co-investigator (CI)
3. Full postal address of PI and CI
4. Telephone, Telex and Fax Nos.
5. Introduction (Brief background of proposed study, including investigations carried out elsewhere, if any)
6. Scientific objectives of the proposed investigation
7. Details of the planned experiment
8. Details of time requirement on the radar for conducting the experiment
9. Requirement on data product (arrangements will be made to provide data in the form of Doppler power spectra)
10. Data utilization plan
11. Data analysis plan and expected results
12. Requirements of travel assistance, if any (only limited funds are available for supporting TA/ DA of university participants through UGC-SV University Centre for MST radar applications)
13. Total duration of proposed study including analysis of data and publication of results (for every accepted experiment, a report should be submitted after 6 months)
14. Signature of PI with date
15. Bio-data and list of publications (in refereed journals only) of PI and CI (attach as appendices)
16. Certificate from the Head of the Institution on availability of institutional support for the experiment should accompany the application in the following proforma.

CERTIFICATE
Certified that in the event of acceptance of the proposal entitled "_____" by "_____", necessary institutional support will be provided to the Principal and Co-investigators for carrying out the experiment at NMRF, data analysis and publication of results.
Date:
Signature of the Head
of the Dept./Institution Seal:

*NMRF is an autonomous scientific institution under the Department of Space

CEDAR Summer Meeting Agenda/ Workshops Cont...

Thursday, June 29 (continued)

12:00 - 1:30 Lunch

1:30 - 5:30 Workshops at NIST and Mesa

Mesa
1) *Space Weather/Experiment* - Killeen
2) *Space Weather/Theory* - Sojka/ Schunk
3) *Accessing the CEDAR Data Base,* sign-up sheet

NIST
4) *MISETA* - Meriwether

5:30 **Bus** from Mesa to Williams Village

Friday, June 30

8:15 **Bus** from Williams Village to Mesa

8:30 - 12:30 Workshops at NIST and Mesa

Mesa
1) *CEDAR Storm Study* - Buonsanto

NIST
2) *MISETA/PRIMO* - Meriwether, Sojka, Anderson, Fuller-Rowell
3) *Shuttle GLO Experiment* - Taylor

12:30 Adjourn 1995 CEDAR Workshop

12:30 **Bus** from Mesa to Williams Village?

INTERPLANETARY ASPECTS OF SPACE WEATHER Workshop Announcement

On Sunday, July 2, 1995, the day before the IUGG meeting in Boulder begins, there will be an informal one-day workshop on the "Interplanetary Aspects of Space Weather". This date was chosen to take advantage of the many potential participants from the space-weather community in transit between the Solar Wind Conference, GEM and CEDAR meetings, and the IUGG meeting. The location will be the NOAA Space Environment Laboratory in Boulder.

This workshop (sponsored by NSF with endorsement by NASA) will be held in a discussion group format. Allowance for the presentation of small numbers of visuals by all participants will be provided. Discussion leaders will coordinate the inputs and focus the debates.

Primary topics to be covered include: **solar particle, photon and plasma influences on space weather, their relative importance, their solar causes, and their potential predictability through use of observations and physical models.** The workshop organizers will generate a written summary for distribution to the sponsoring agency and the larger community.

Please communicate your interest in attending this workshop to Janet Luhmann by e-mail. (jgluhman@sunspot.ssl.berkeley.edu)

Organizers:
Janet Luhmann, UC Berkeley
Vic Pizzo, San Juan Capistrano Inst./SEL
Pat Bornmann, NOAA/SEL
Sara Martin, Helio Research

NOCTILUCENT CLOUDS Workshop Announcement

Sponsored by The Working Group on Noctilucent Clouds (of the International Commission on Middle Atmosphere Science), this workshop will consist of invited presentations, contributed papers and a panel discussion. It will be held on June 29, 30 and July 1, 1995 at the Laboratory for Atmospheric and Space Physics of the University of Colorado in Boulder as part of the CEDAR annual meeting. It will precede the General Assembly of the IUGG which will be held in Boulder on July 3-14, 1995. **Please note that this NLC Workshop is separate from the CEDAR Workshop. There are no additional fees for the NLC Workshop; it is not necessary to register for the CEDAR meeting to attend.**

For more information, contact:
Gary E. Thomas
Laboratory for Atmospheric and Space Physics
University of Colorado, Campus Box 392
Boulder, Colorado 80309-0392 USA
Currently on sabbatical at:
gthomas@physics.adelaide.edu.au

Boulder Lodging and Local Transportation Information

1995 Tenth Summer CEDAR Workshop
June 25-30, 1995

The facilities listed below have blocked rooms for workshop participants between the nights of June 24-June 30, 1995. Reservations must be accompanied by a credit card charge number or a deposit for the first night's lodging; Visa, MasterCard, American Express, and Discover credit cards are accepted at most of the hotels. Cancellations must be made before 4:00 PM on the arrival day to avoid being charged for the first night's lodging. The blocks of rooms at special workshop rates are only being held until the dates indicated below and they may fill up early. **MAKE ALL RESERVATIONS AS SOON AS POSSIBLE AND SPECIFICALLY MENTION THE CEDAR WORKSHOP HOSTED BY NCAR.** (If using a travel agent, have them identify you in the same manner.) Participating hotels and rates for June 24-June 30, 1995 are:

Hotel	Single*	Double*	Deadline	No. of Rooms
Days Inn 5397 S. Boulder Road Boulder, CO 80303 (303) 499-4422; Fax: (303) 494-0269	$74	$79 (Up to 4 People)	May 24	65
Holiday Inn of Boulder 800 - 28th Street Boulder, CO 80303 (303) 443-3322	$73	$73	May 24	35
Courtyard by Marriott 4710 Pearl East Circle Boulder, CO 80301 (303) 440-4700 or 1-800-321-2211; Fax: (303) 440-8975	$94	$104	May 26	40
Homewood Suites 4950 Baseline Road Boulder, CO 80303 (303) 499-9922 or 1-800-225-5466; Fax: (303) 499-6702	$119 for a Suite w/Kitchen (will accommodate 3-4 people)		May 24	10

RESERVE ROOMS BEFORE DEADLINES TO ASSURE LOWER RATES

All hotels have comfortable accommodations and all of them, except the Courtyard, can provide shuttle service to local meetings if requested by individuals *in advance* (based on availability). The Days Inn and Homewood Suites provide free continental breakfasts with lodging. Homewood Suites also has a free social hour Monday through Thursday. Checkout times are 12:00 noon. All hotels have swimming pools. We were unable to book blocks of rooms at the Broker Inn or the Clarion again this year, but some individual rooms may be available.

*Hotel rates do not include 9.65% sales tax.

UNIVERSITY OF COLORADO DORMITORY ROOMS AND MEALS

	Single	Double	No. of Rooms
Main Campus Conference Housing Area 142 Cheyenne-Arapaho Hall Boulder, CO 80310 Fax: (303) 492-4646	~$150	~$120 (per person) [NOTE: FOR EMERGENCIES ONLY: (303) 492-6885 (Suzy Campbell or her secretary)] e-mail: campbell%eagle@vaxf.colorado.edu	70(S), 65(D)

NO PHONE-IN RESERVATIONS ACCEPTED. PLEASE SEND THE REGISTRATION FORM PROVIDED HEREIN TO THE MAIN CAMPUS CONFERENCE HOUSING AREA. Rates for the campus package include a dormitory room from 6/25 to 6/29 and breakfast every day from 6/26 to 6/30. The exact rates are not available yet. Early arrivals (6/24) will pay an extra ~$25/night (single) or ~$20/night (double, per person). NO LATE DEPARTURES ARE POSSIBLE due to the 5000 people expected for the IUGG/IAGA meeting that starts the following week. If you plan to stay for IUGG/IAGA, make sure you ask for a dormitory room for that period separately through the IUGG registration procedure. You will have to move your dorm room on Friday, June 30. Have only ONE individual in charge of each group from each university. CU accepts VISA and MasterCard. Please check in at Hallett Hall. Parking permits for a week can be obtained from campus police. Students receiving travel funds will not have to pay for their dorms upon arrival, but NCAR will pay this bill in lieu of per diem.

GROUND TRANSPORTATION (Airport). The Rocky Mt. Supercoach (303/499-1951, ~$15.00) and the Boulder Airporter (303/321-3222, ~$13.00) will take reservations for direct transportation between Denver International Airport, the hotels, and the University. Their schedules are staggered so you may find one more convenient for your arrival/departure.

DAY CARE. For child care while you attend the Workshop, Children's World at 5377 Manhattan Cir. in Boulder will accept children on a drop-in basis (based on space availability). They also offer summer field-trip programs. If you're interested, please call Children's World at (303) 494-3694. Many other daycare facilities are listed in the Boulder telephone directory under "Child Care."

Registration Form
1995 Tenth Summer NSF CEDAR Workshop
June 25–30, 1995

National Institute of Standards and Technology – NIST
National Center for Atmospheric Research – NCAR

1. **PLEASE PRINT**

   Name: _____

   Institution: _____

   Address: _____

   _____

   Telephone: (_____)_____ Fax: (_____)_____

   E-mail: _____ Citizenship: _____

   Are you a: Student ( ) Tutorial Speaker ( ) Neither ( )

   NOTE: Students registering after **May 31** will be charged a $5.00 late fee. Students wanting travel funds should register **before April15.**

2. I plan to present a poster at the meeting _____. **NOTE:** Students will be given preference if there are space limitations. Send title and author list to Dr. Jeffrey Thayer (jeff_thayer@qm.sri.com) by **May 31** to be considered. Please be sure to indicate whether or not the first author is a student.

3. I plan to attend the reception at NCAR (Mesa) on Sunday, June 25 (additional $10, free for students and tutorial speakers) _____.

4. I plan to attend the buffet at NCAR on Wednesday, June 28 (additional $15, free for students and tutorial speakers) _____.

5. **FEES:** The regular total fee for the CEDAR Workshop is $85. It could be more or less depending on attendance at the reception and buffet. **ALL FEES ARE WAIVED FOR STUDENTS AND TUTORIAL SPEAKERS. Fees for guests are not waived, nor are late assessments.** [Any alcohol at the reception and buffet will be funded strictly out of voluntary contributions (g) below. Any extra amount will be gratefully accepted.] **Foreign registrants are not assessed the late fee of $15, provided they register by May 31; they may wait to pay their fees at the meeting.**

   (a) Regular registration $60.00 (register by **May 31**) _____

   (b) Registration for Retirees $20.00 (register by **May 31**) _____

   (c) Reception $10.00 _____

   (d) Guests for reception $10.00/ea or $5.00/child _____

   (e) NCAR buffet $15.00 _____

   (f) Guests for NCAR buffet $15.00/ea or $7.50/child _____

   (g) Voluntary contribution for alcohol at reception/buffet _____

   (h) Late fee if registering after May 31 $15.00 _____

   (i) Late fee FOR STUDENTS registering after May 31 $5.00 _____

   TOTAL FEES _____

NOTE: If registration payment is not enclosed with this form, please be certain that checks sent separately identify you and the workshop. Checks for the workshop should be made payable to NCAR. NCAR does not accept VISA or MasterCharge. Foreign registrants may pay on arrival provided they mail their registration forms in early. Please send correspondence to: Barbara Emery, HAO/NCAR, P.O. Box 3000, Boulder, CO 80307-3000; Phone: (303) 497-1596; Fax: (303) 497-1589; Internet: emery@ncar.ucar.edu; SPAN: 9580::"emery@ncar.ucar.edu".

*** Refer to the February '95 CEDAR Post for CU-Housing and/or Financial Aid application forms. ***

The Cedar Post

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Prof. Jeffrey M. Forbes
Aerospace Engineering Sciences
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University of Colorado
Boulder, CO 80309-0429

Address correction requested.

Barbara Emery
NCAR
High Altitude Observatory
P.O. Box 3000
Boulder, CO 80307-3000

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J. M. Forbes, Editor.
P. Gassaway, Production Manager.

Listing of 1995 CEDAR Workshop Tutorials

Tutorial #1: Monday 10:30-11:30
Global Change in the MLT Region: Has It Already Arrived? by Gary E. Thomas, U of CO

Tutorial #2: Tuesday 8:30-9:30
a) *Testing Theories of Gravity Wave Saturation and Dissipation in the Middle Atmosphere* by Chet Gardner, U of IL
b) *Testing Theories of Gravity Wave Transports and Their Effects on Wind, Temperature and Composition in the Middle Atmosphere* by Richard Walterscheid, Aerospace Corp.

Tutorial #3: Tuesday 10:50-11:50
Solar Wind/Magnetospheric Drivers for Space Weather by Dan Baker, U of CO

Tutorial #4: Thursday 9:00-10:00
Review of Comprehensive Meteorological Modelling of the Middle and Upper Atmosphere by Kevin Hamilton, Geophysical Fluid Dynamics Lab/NOAA, Princeton U

Tutorial #5: Thursday 11:00-12:00
Ionospheric/Thermospheric Space Weather Issues
a) "Product Specifications" by Jan Sojka, Utah State U.
b) "Scientific Issues" by Bob Schunk, Utah State U.