The INSPIRE Journal

Volume 9 Number 2

April 2001

The End of MIR Means the End of INTMINS But Not the End of INSPIRE!

When the MIR Space Station was deorbited, the instruments used for the INTMINS observations, Istochnik and Ariel, came with it. That event marked a definitive end to the 5-year INTMINS Program. While this marks the end of an important and historic phase in the life of INSPIRE, it does not mark the end of INSPIRE.

In this issue of *The INSPIRE Journal*, we give a retrospective view of the INTMINS Project. INTMINS was historic because it represented perhaps the first formal agreement between IKI, the Russian Space Agency, and a private, nonprofit educational/scientific organization, INSPIRE. On Page 11 the original agreement is reprinted. A final roster of all who contributed data to INTMINS is found on Page 16. Finally, on Page 18, is a reprint of the article "Looking Back on INTMINS...".

The Coordinated Observation schedule for April/2001 has been expanded to two weekends – the last two weekends of April. The schedule is found on Page 5.

To further support the Coordinated Observation program, new log forms have been devised. The forms are introduced in an article that appears on Page 22.

The third in a series of articles by Mark Spencer on using a graphing calculator to analyze whistler data can be found on Page 6. On Page 20, Phil Hartzell of Aurora, Nebraska tells us about his brother-in-law, "The First Astronaut from Nebraska".

Table of Contents

The INSPIRE Journal
Volume 9 Number 2
April 2001

The INSPIRE Journal is a publication of The INSPIRE Project, Inc., a nonprofit educational/scientific corporation of the State of California. The purpose of the INSPIRE Project, Inc., is to promote and support the involvement of students in space science research. All officers and directors of the corporation serve as volunteers with no financial compensation. The INSPIRE Project, Inc., has received both federal and state tax-exempt status (FEIN 95-4418628). The *Journal* is published two times per year: November 1 and April 1. Submission deadlines: October 1 and March 1

Contributions to the *Journal* may be sent to:

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Chaffey High School
1245 N. Euclid Avenue
Ontario, CA 91762

email: pine@mail630.gsfc.nasa.gov
billpine@earthlink.net
Fax: 909 931 0392

INSPIRE Workshop Held in San Antonio, TX

On Monday, February 12, 2001, an INSPIRE workshop was held at O'Connor High School in Helotes, TX, near San Antonio. Teachers from the Northside Independent School District gathered to learn about natural radio and the VLF2 receiver. A second session was held on March 2 when students joined their teachers to learn about The INSPIRE Project and complete assembly of their receivers. Dr. Jill Marshall of Utah State University and Marilyn Koch from Marshall High School organized the workshop. Presenting at the workshop were Bill Pine from Chaffey High School in Ontario, CA, and Bill Lewis from Southwest Research Institute in San Antonio.

Teachers attending included:

Robert Luna	Health Careers High School
Tony Pearson	Holmes High School
Elizabeth Quick	Marshall High School
Kathryn Robinson	O'Connor High School
Cip Munoz	Taft High School
Ray Gonzales	Clark High School

Also attending from the local area were Jim Crawford, Ralph Hill and Jim Hoback.

email List of INSPIRE Participants Being Collected

If you would like to receive notification of the any observing opportunities when they become available, send a message to:

pine@mail630.gsfc.nasa.gov

Write for *The INSPIRE Journal*

The procedure for contributing articles for *The INSPIRE Journal* could not be simpler! Just send it in! Any format is acceptable. Electronic format is easier to work with. A Word file on disk for either the PC or Mac platform is preferred. An email message will work, too. If that does not work for you, a paper copy will do. Any diagrams or figures can be scanned in.

What about topics? Anything that interests you will probably interest most INSPIRE participants. As long as the topic is related to natural radio or the equipment used, it will get printed. The deadlines for submissions are March 1 for the spring edition and October 1 for the fall edition. Don't worry about the deadlines, though. If you miss a deadline, you will just be very early for the next edition!

We at INSPIRE are looking forward to hearing from you.

Subscription Information Included on the Address Label

You can determine the status of your subscription to *The INSPIRE Journal* by looking at the address label. In the upper right corner of the label is a 2-digit number that indicates the year your subscription will expire. All subscriptions expire with the November issue. If your label shows "01", then the November issue will be the last under this subscription. If your label shows "02", then your subscription is good through the November 2002 issue. If you have any questions or if you feel that the information shown is incorrect, please contact the editor.

Experiments With the IMAGE Satellite on Hold

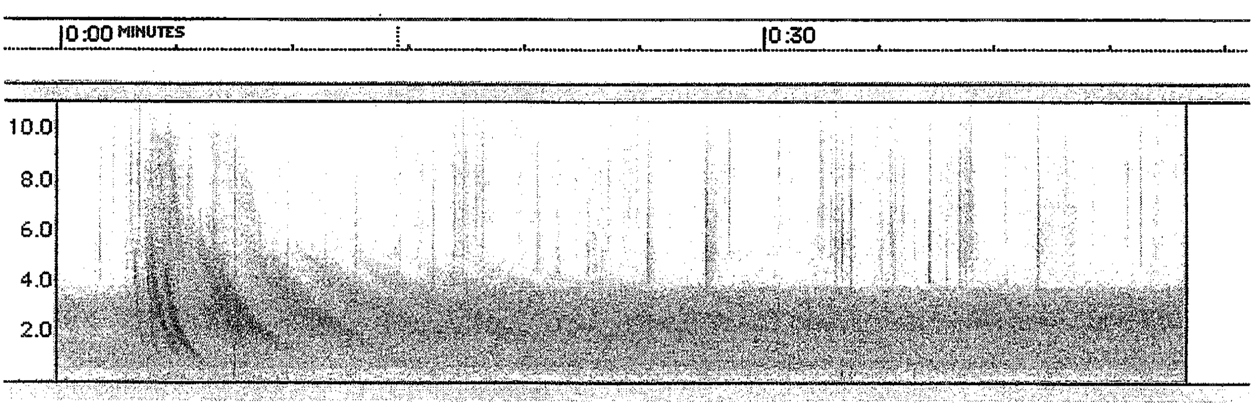
Due to a problem with the transmitting antenna on the IMAGE satellite, proposed attempts to detect the radio signal on Earth during perigee passes have been delayed indefinitely. If you would like to be informed of any observing opportunities, please send your email address to:

pine@mail630.gsfc.nasa.gov

The Latest from Shawn Korgan

Just a brief email. I was out Monday night (March 19) and heard some TERRIFIC sounds as I watched the aurora all night into early morning. I figured I would head out again Tuesday night and boy am I glad that I did! Here is just one of the MANY LOUD whistlers I recorded. These whistlers were occurring for at least six hours and were still going strong when I left at 9:30 am this morning. You will be glad you spent the time downloading this whistler! Trust me!

Shawn Korgan
INSPIRE Team 32



This file starts out with a triple whistler (three whistlers almost on top of one another) followed by multiple overlapping echoes. Notice the cutoff frequency is well below 2 kHz meaning Shawn must have been at ground zero for the entry of the whistlers.

Coordinated Observation Schedule
April 2001

By Bill Pine Ontario, CA

Since INTMINS operations are at an end, Coordinated Observations are now INSPIRE's primary observations. The Coordinated Observation schedule will be expanded to include four dates – the last two weekends of April. All data is welcome and should be submitted even if the conditions are quiet. It is not required that you observe on all four days. Any data you can contribute is valuable. The procedure to use for Coordinated Observations will remain unchanged and will be as follows:

1. Use the Data Cover Sheet and Data Log or data forms of your own design.
2. Record for 12 minutes at the start of each hour that you can monitor on the specified days. Keep a detailed log of all signals that you hear and indicate any items of interest. When you submit your tapes, spectrograms will be made of any parts of the tape that you indicate.
3. Place a time mark on the tape on the hour and each two minutes for the next 12 minutes. Use Coordinated Universal Time (UTC) for all time marks.
4. Record at 8 AM and 9 AM **LOCAL** time.
5. In addition, record on other hours to compare results with those in neighboring time zones. For example, an observer in the Central Time Zone might record at 7 AM (8 AM EDT), at 8 and 9 AM CDT and at 10 AM (9 AM MDT).
6. Use 60 minute tapes (30 minutes per side) with two sessions per side. It is preferred that you record on one side of the audio tape only.
7. Label all tapes and logs to indicate the sessions monitored and send to:

   Bill Pine
   Chaffey High School
   1245 N. Euclid Avenue
   Ontario, CA 91762

8. Your tapes will be returned with spectrograms of your data. An article reporting on the results will appear in the next *Journal.* .
9. SPECIAL NOTE: If you are hearing whistlers, replace the data tape after 12 minutes with a "Whistler" tape and continue recording with time marks every two minutes. If we get whistlers, this would be a good opportunity to try to determine the "footprint" of a whistler (the "footprint" is the geographical area where a whistler can be detected).

Specified Coordinated Observation Dates for April/2001:

Saturday, April 21, Sunday, April 22

Saturday, April 28 and Sunday, April 29

What Does Dispersion Tell Us?

By: Mark Spencer
774 Eastside Rd.
Coleville, CA 96107
e-mail: wa8sme@gbis.com

ABSTRACT

"Okaaay;……So What!?" That is a tough question to answer, particularly when it comes from a student. This article is the next installment in my quest to answer that question. In the first installment in the April 2000 INSPIRE Journal, I presented a technique that used a graphing calculator to analyze whistlers. My purpose was to provide a tool that students can use to translate the signal received in the field and displayed on the computer screen in the classroom into a mathematical model that can be studied and analyzed. The second installment in the November 2000 Journal used the graphing calculator analysis tool to test and verify low-frequency and high-density models of whistlers with actual collected data.

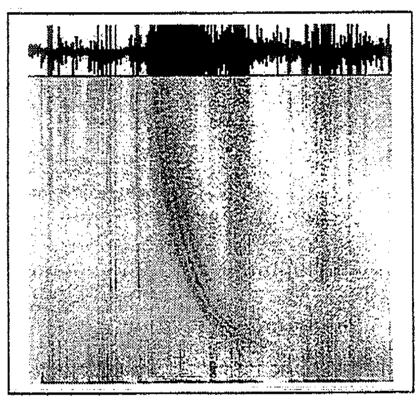
In this installment I will first present a shorthand way of determining the dispersion of a whistler using a graphing calculator. Then I will illustrate how a collection of dispersion data can be used to explore and speculate what is happening out there beyond the ionosphere. Read on and let the quest continue.

DISPERSION

The concept that different frequencies of a wave travel at different velocities is defined as the dispersion of the wave. Mathematically, dispersion is defined by:

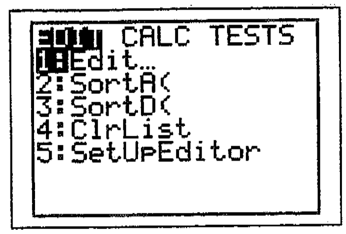
$$D \approx \frac{t}{\sqrt{f}}$$

You can use the following technique on the TI-83Plus graphing calculator to calculate the dispersion of a whistler.

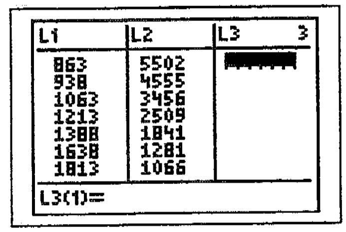


For this illustration I will use the whistler displayed here. From the display program, carefully place the mouse cursor at various locations along the length of the whistler and record the time and the frequency of the cursor location. You should record as many different points as you can but as a minimum, you will need three; I prefer five. Once you have the time and frequency data points, enter them into the graphing calculator **LISTS 1** and **2**.

Press [STAT] to enter the list editor. Select [1] and enter the time data in **L1** and frequency data in **L2**. The time data should be normalized to begin around one second so enter the lowest 3 or 4 digits of the time data (i.e. 17345 absolute time would be entered as either 345 (milliseconds) or 1345 (1.345 seconds) normalized time). Normalizing the time will keep the calculations within the limitations of the calculator and also keep the calculated dispersion consistent between whistlers for future comparison.

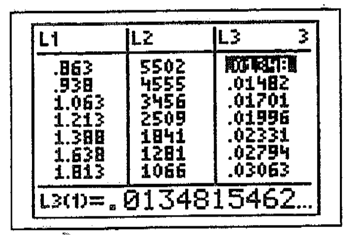


You now need to prepare the data for the curve fitting operations. First, convert the milliseconds in **L1** into seconds by dividing the list by 1000. Use the following keystrokes:



[2nd][1][÷][1][0][0][0][STO▸][2nd][1][ENTER]

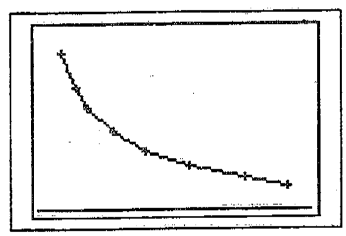
Next, take the reciprocal square root of the frequency in **L2** and store the result in **L3**. Use the following keystrokes:



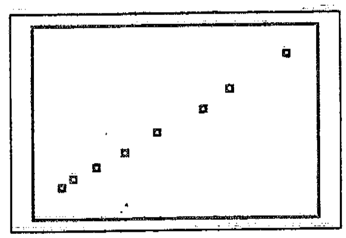
[1][÷][2nd][x^2][2nd][2][STO▸][2nd][3][ENTER]

The resulting table listing should look like this.

You can confirm that your extracted data is close to reality by displaying a plot of frequency (**L2**) on the Y-axis and time (**L1**) on the X-axis. This plot should be similar to the display of the actual whistler. Using the data from the example whistler you will see this display.



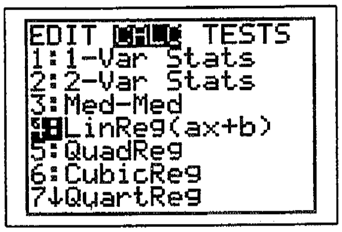
Next, confirm that the data follows the mathematical model for dispersion by displaying a plot of the square root of the frequency (**L3**) on the X-axis and time (**L1**) on the Y-axis. The resulting plot should be linear; the slope is the dispersion. Using the data from the example whistler you will see this display.

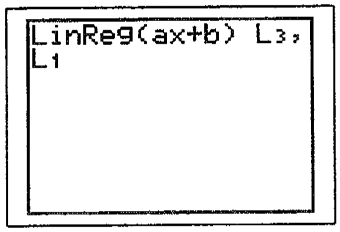


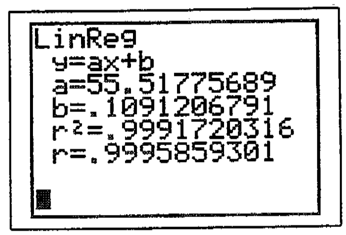
DISPERSION CALCULATION

You can use the curve fitting capabilities of the graphing calculator to determine the slope of the data. Use the following keystrokes to find the function that fits the data of **L3** and **L1**.

[STAT] [▶] [4] [2nd] [3] [,] [2nd] [1] [ENTER]

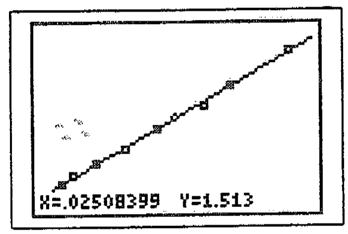






The resulting equation that fits the data is displayed. In this case, the dispersion (slope) is **a** = 55.5.

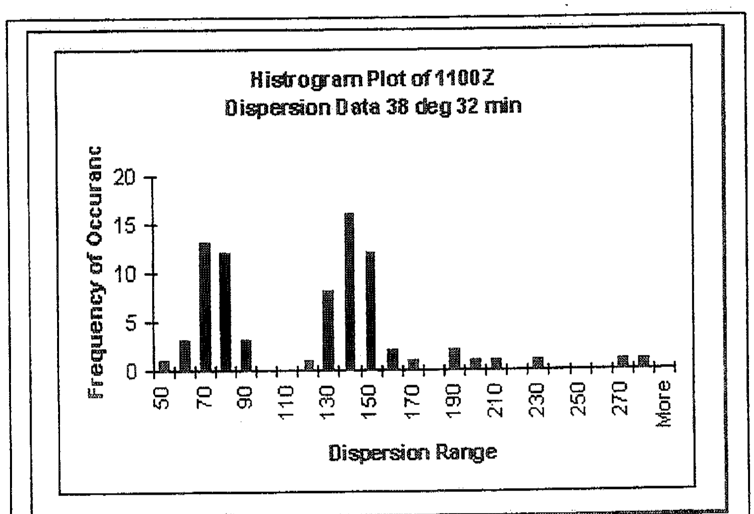
You can confirm the validity of the fitted curve by displaying the curve on the plotted data. Use the following keystrokes:



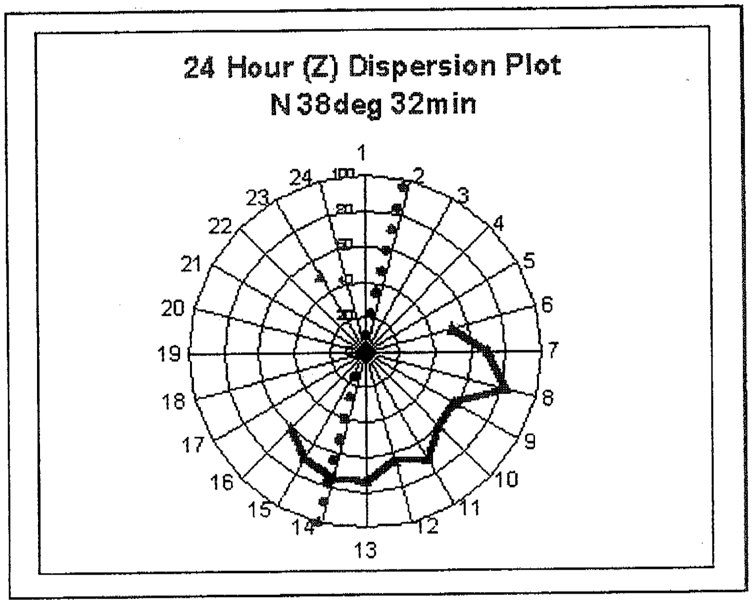
[Y=] [CLEAR] [VARS] [5] [▶] [▶] [ENTER] [ZOOM] [9]

The resulting display will look like this.

EXPLORING WHISTLERS BY OBSERVING THEIR DISPERSIONS



Over time I have collected a few hundred whistlers and calculated their dispersions. I keep a log of the data in an Excel Spread Sheet so that I can manipulate the data. In one analysis I look at the distribution of dispersion magnitudes within one Zulu hour time blocks. This is a histogram of the 1100z time block. You will note there are distinct clusters of whistler dispersions that indicate one, two, etc. hop whistlers. You can validate that these clusters represent multiple hop whistlers because the dispersion values (proportional to the distances traveled by the signals) are harmonic. The first cluster centers on 70, the second cluster (harmonic) centers on 140, the third cluster centers on 210, the fourth cluster centers on 280 (all multiples of 70). It stands to reason that one and two hop whistlers would be the strongest signals received, and therefore more prevalent, due to the shorter distances traveled (and less signal loss).



Another interesting way of looking at the accumulated data is to compare average dispersions within Zulu hour time periods over the 24 hour day. In this polar graph, the average one-hop whistler dispersion is plotted radially around a 24-hour period. The dotted, heavy line from 2 Zulu to 14 Zulu indicates the day/night terminator line at this longitude. There is a noticeable lack of whistler data when the ionosphere is energized (a few hours after sunrise until well after sunset). This is due to the absorption/reflection of potential whistler generating signals. There appears to be an hourly variation in dispersion. I tentatively speculate that the variation in dispersion is due in part to solar wind distortion of the earth's magnetosphere. Logically this distortion would elongate the areas of the magnetosphere that are tangential to the solar wind vector and down-wind at higher latitudes, compress the areas of the magnetosphere that are up-wind and frontal to the solar wind vector, and have lessened effect on areas of the magnetosphere that are down-wind and shielded from the solar wind by the earth's disk (at my low latitude). My speculation is very tenuous because there are many uncontrolled variables that contribute to variation in the dispersion that have not been accounted for by this elementary analysis.

WHAT'S IN THE NEXT INSTALLMENT?

I plan to collect data over a number of 24-hour periods when the opportunity arises. This collection strategy should minimize the effects on dispersion by changes in electron density and variations in solar wind velocity, leaving only the effect of solar wind and the earth's orientation to the solar wind vector. A similar polar display of dispersion variation as done above should prove interesting.

Happy Listening.

INTMINS is Over: Looking Back

By Bill Pine
Ontario, CA

When Mir was launched, the planned life span of the space station was five years. Fifteen years later, Mir has reached the end of its mission. During this time, tremendous strides were made in space research. One area, of course, is the effect on humans of extended exposure to weightlessness. Another important area is space physics research.

Instruments on Mir were used to investigate the behavior of electromagnetic waves in the space plasma near Earth. A pulsed electron gun, Istochnik, was operated on Mir and the resulting electromagnetic waves were detected and analyzed by another satellite called Interball located at the opposite end of the magnetic field line passing through Mir. Another instrument, a plasma generator called Ariel, was also used in similar experiments. The lead scientist of this effort is Stanislas (Stas) Klimov, Head of the Laboratory for Electromagnetic Emissions Investigation of IKI (Russian Space Research Institute).

William (Bill) Taylor, co-founder of The INSPIRE Project, Inc., is a long time friend and colleague of Stas. About 6 years ago the two of them began discussing the possibility of conducting space to ground experiments in addition to and in conjunction with the experiments of Interball. The end result of these discussions is the program known as INTMINS (Interball-Mir-Inspire).

A formal agreement was drawn up and signed in 1995. A signatory on this agreement was Academician Albert A. Galeev, the Director of IKI. Other members of the Russian space science community have also been instrumental in the success of INTMINS. Yuri Lissakov, a senior researcher at IKI, coordinated the parts of the INTMINS program. Victoria Prokhorenko, a senior scientist at IKI, assisted in the planning and the communication of the schedule with Mir. She was especially helpful on those occasions when the schedule had to be modified on short notice to bring the ground track into agreement with the plan. Oleg Prokhotelov of the United Institute of Physics of the Earth was also helpful.

INSPIRE owes a debt of gratitude to all of our Russian colleagues who were so helpful. We look forward to continuing our association with them and all space scientists everywhere.

On the following pages you will find:

INTERBALL-MIR-INSPIRE AGREEMENT

OBJECTIVES OF PROJECT

INTERBALL is a Russian space physics program to investigate the physics of magnetosphere processes. It has two satellites, Tail Probe and Auroral Probe. Each probe has a subsatellite. MIR is the Russian space station, currently in orbit. INSPIRE is a project to interest students in science and technology by making it possible for them to observe very low frequency (VLF, 3 to 30 kHz) radio waves. INTERBALL-MIR-INSPIRE (INTERMI) is a planned joint IKI/INSPIRE space physics research project, based on the Mir-INTERBALL program which is planned to start after the Tail Probe launch in June 1995. INTERMI will perform coordinated activities of MIR, INTERBALL, and INSPIRE.

The scientific objectives of MIR-INTERBALL are to:

- Study the interactions between the ionospheric plasma and the injected plasma and electrons.

- Understand the dynamics of the injected, artificial plasma in the ionosphere

- Investigate the initial phase of plasma instabilities, the resulting electromagnetic emissions and their propagation in the ionosphere, magnetosphere, and atmosphere

- Investigate effects of wave particle interactions

INSPIRE is a scientific/educational project to bring the excitement of observing natural and manmade VLF radio waves to students. Underlying this objective is the conviction that science and technology are the underpinnings of our modern society and that only with an understanding of science and technology can people make correct decisions in their lives, public, professional, and private. Stimulating students to learn and understand science and technology is key to them fulfilling their potential in the best interests of our society. INSPIRE also is an innovative, unique opportunity for students to actively gather data for basic research projects, such as INTERMI.

DESCRIPTION OF INTERMI EXPERIMENTS

Ariel and Istochnik instrumentation on the MIR station will inject plasma clouds and beams of electrons into the ionospheric plasma. Experiments will be performed to determine the effects of the injection angle with respect to the earth's magnetic field lines. Using plasma and wave instruments of the INTERBALL project and the observations of the VLF radio waves on the ground from the INSPIRE project, the scientific objectives listed above will be met.

INSTRUMENTATION DESCRIPTION

An electron gun (Istochnik) and plasma pulse generators (Ariel) have been installed on the KVANT module of MIR. Istochnik and Ariel are now being used in conjunction with the Freja satellite. In mid-June the Space Shuttle is to dock with MIR, and it is proposed that Istochnik and Ariel be operated after the docking. The INTERMI project will plan injector operations in June over the US, so that INSPIRE participants can attempt to receive the VLF waves that may propagate to the ground.

Details of the MIR instrumentation are given in Annex 1, INTERBALL instrumentation in Annex 2, and INSPIRE instrumentation in Annex 3.

SCHEDULE

Item	Planned Date
Launch of STS-71	May 24, 1995
Shuttle docking with MIR	Late May, 1995
Launch of the Tail Probe and its subsatellite	June 8, 1995
First period of MIR-INSPIRE operations	June 15-30, 1995
Possible meeting to discuss MIR-INSPIRE results	August/September 1995
Second period of MIR-INSPIRE operations	October 1995
Third period of MIR- INSPIRE operations	To be determined
Launch of the Auroral Probe and its subsatellite	March/April 1996

AGREEMENT

IKI and INSPIRE will make their best efforts to fulfill their obligations under this agreement, recognizing that resources to meet them may not be available.

The following factors will be taken into account for selecting time periods of the experiment operations:

- The MIR station must be above the US or on a magnetic field line in the southern hemisphere that passes through the US.

- Experiments will be preferably performed during the day.

- Experiments should be performed during undisturbed conditions in the ionosphere.

- The time schedule of the other global geophysical projects, e.g. the International Geophysical Calendar's Regular World Day (RWD), Regular Geophysical Day (RGD) and Incoherent Scatter Coordinated Observation Day, will be considered.

IKI will:

- Schedule experiment operations as early as possible.

- Inform INSPIRE of the experiment operations, as soon as they are scheduled, by electronic mail, including the Universal Time, geographic latitude, and geographic longitude of the start and stop times. If possible, plots of the orbit during operations will be sent by facsimile.

- Report the start and stop times of actual experiment operations to INSPIRE.

INSPIRE will:

- Publicize INTERMI in the INSPIRE Journal and elsewhere, and recruit INSPIRE observers.

- Notify INSPIRE observers of upcoming experiment operations.

- Provide selected recordings of INSPIRE observations during experiment operations to IKI.

A. A. Galeev
Director, IKI

W. W. L. Taylor
President, INSPIRE

S. I. Klimov
Project Scientist

W. E. Pine
Secretary/Treasurer, INSPIRE

Annex 1. MIR Instrumentation

The main technical parameters of Ariel and Istochnik are given below.

Ariel (Plasma pulse generator)	
Power consumption	130 watts
Maximum current	10 amperes
Pulse duration	10 E-4 seconds
Pulse repetition frequency	10 seconds
Source material	BaCl
Discharge channels:	
Electromagnetic channel (-Y axis)	
Ejection velocity	15 kilometers per second
Number of Ba ions in pulse	10 E 18
Total number of Ba ions	>10 E 19
Electron temperature	2-3 eV
Specific ionization	10%
Plasma density in jet	10 E 18 per cubic cm
Jet divergence	30 degrees
Thermal channel (+Z axis)	
Ejection velocity	3 kilometers per second
Number of Ba ions in pulse	5 x 10 E 18
Electron temperature	1-2 eV
Specific ionization	10%
Plasma density in jet	5 x 10 E 18 per cubic cm
Jet divergence	70 degrees
Istochnik (Electron gun)	
Electron energy	10 keV
Pulse duration	4 microseconds
Pulse current	0.7 amperes
Pulse frequency	10,140 and 1000 Hz

The experiment will be performed when the electron beam plasma blobs can be injected approximately along or perpendicular to the earth's magnetic field. There are three modes of operation of the instruments. The first two have different sequences of alternating plasma injections between the electromagnetic channel (-Y axis, approximately perpendicular to the magnetic field) and the thermal channel (+Z axis, approximately parallel to the magnetic field. The third mode, using the electron gun, will probably be the most likely to be observed on the ground. The pulsing frequency of 1000 Hz will generate plasma waves at 1000 Hz and its harmonics (2000 Hz, 3000 Hz, etc. . .). The harmonics are in the pass band of the INSPIRE VLF receiver.

Annex 2. INTERBALL Instrumentation

TAIL PROBE AND SUBSATELLITE SPACE PHYSICS INSTRUMENTS	
Electromagnetic fields and waves	0 to 1.5 MHz
Particles	
Electrons	.01 to 400 keV
Protons	0 to 1000 keV
Ions	0 to 100 keV/Q
Xrays	2 to 200 keV
AURORAL PROBE AND SUBSATELLITE SPACE PHYSICS INSTRUMENTS	
Electromagnetic fields and waves	0 to 240 kHz
Ion beam source	1 to 10 microamperes
Particles	
Electrons	0 to 400 keV
Protons	0 to 350 MeV
Ions	0 to 500 keV/Q
Optical	
Auroral emissions	130 to 160 nm
Xrays	2 to 200 KeV

Annex 3. INSPIRE Instrumentation

The VLF or INSPIRE receivers are high input impedance, band limited audio amplifiers with electric field (whip or long wire) antennas. They are sensitive to frequencies from about 3 kHz to 15 kHz. The lower frequency cutoff is to reduce the effects of noise from power lines, both the fundamental frequency (60 Hz in the US) and its harmonics (120 Hz, 180 Hz, . . .). The upper frequency cutoff is to reduce noise from man made radio transmitters. Other receiver/antenna combinations are also in use, such as the magnetic field antenna/receiver designed for the ACTIVE project. Data from the VLF receivers is recorded with a portable tape recorder. Time announcements or recordings of WWV (the US time standard short-wave radio station) provide coarse (within a few seconds) timing. More accurate timing can be achieved using the signals of the OMEGA (the 10 to 15 kHz radionavigation beacons which are recorded with the data on the tape) stations. Some information can be achieved by listening to the tape, but the best way to analyze the data is by making spectrograms from the data. Spectrograms are frequency time plots of the data, with intensities, at a frequency and time coded as colors in the z axis of the plot.

INTMINS OBSERVERS

Final Roster – April/2001

This is the final roster including all who have contributed INTMINS observations during the five and one half year lifetime of INTMINS. New team numbers will be established starting with the April/2001 Coordinated Observations.

(Unless noted otherwise, all longitudes are West and latitudes are North.)

Team #	Observer	Location	Longitude/Latitude
1	John Lamb, Jr.	Belton, TX	97° 27’ 50” / 31° 7’ 45”
	University of Mary Hardin-Baylor		
2	Stephen G. Davis	Fort Edwards, NY	73° 29’ 30” / 43° 18’ 00”
3	Don Shockey	Oklahoma City, OK	97° 40’ 5” / 35° 43’ 30”
4	Mike Aiello	Croton, NY	73° 46’ 45” / 40°
5	Jean-Claude Touzin	St. Vital, Quebec	79° 10’ / 48° 55’
6	Bill Pine	Ontario, CA	117° 41’ / 34° 14’
	Chaffey High School		
7	Dean Knight	Sonoma, CA	122° 33’ / 38° 21’
	Sonoma Valley High School		
8	Mike Dormann	Seattle, WA	123.4° / 47.2°
9	Robert Moloch	Greentown, IN	85° 58’ / 40° 28’
	Eastern Elementary School		
10	Bill Taylor	Washington, DC	77° 2’ / 38° 54’
	INSPIRE		
11	Mark Mueller	Brown Deer, WI	87° 56’ / 43° 10’
	Brown Deer High School		
12	Jon Wallace	Litchfield, CT	73° 15’ / 41° 45’
13	Bill Combs	Crawfordsville, IN	86° 59’ / 40° 4’
14	John Barry	West Lebanon, IN	87° 22’ / 40° 18’
	Seeger High School		
15	Robert Bennett	Las Cruces, NM	106° 44’ / 32° 36’
16	Leonard Marraccini	Finleyville, PA	80° 00’ / 40° 16’
17	Kent Gardner	Fullerton, CA	117° 48’ 30” / 34° 12’ 13”
18	David Jones	Columbus, GA	77° 07’ / 35° 00’
19	Larry Kramer / Clifton Lasky	Fresno, CA	119° 49’ / 37° 01’
20	Barry S. Riehle	Cincinnati, OH	84° 15’ / 39° 7’
	Turpin High School		

21	Phil Hartzell	Aurora, NE	98° 0' / 41° 0'
22	Rick Campbell	Brighton, MI	83°50'2.7" / 42°16'43.7"
23	Jim Ericson	Glacier, WA	121° 57.91' / 48° 53.57'
24	Paul DeVoe	Redlands, CA	116° 52' / 34° 10'
	Redlands High School		
25	Norm Anderson	Cedar Falls, IA	92° 15' / 42° 20'
26	Brian Page	Lawrenceville, GA	83° 45' / 34° 45'
27	Ron Janetzke	San Antonio, TX	98° 47' / 29° 35'
28	Thomas Earnest	San Angelo, TX	100° 25' / 31° 16'
29	Janet Lowry	Houston, TX	95° / 29°
30	Linden Lundback	Watrous, Sask,	105° 22' / 51° 41'
31	Lee Benson	Indianapolis, IN	86° 3' / 39° 23'
32	Shawn Korgan	Gilcrest, CO	104° 67' / 40° 22'

European observers:

Team #	Observer	Location	Longitude/Latitude
E1	Flavio Gori	Florence, IT	11° 50' 18" E/ 43° 50' 18" N
E2	Silvio Bernocco	Torino, IT	7° 12' E / 44° 54' N
E3	Fabio Courmoz	Aosta, IT	7.7° E / 45.7° N
E4	Joe Banks	London, UK	0° / 50° 52' N
E5	Renato Romero	Cumiana, IT	7° 24' E / 49° 57' N
E6	Marco Ibridi	Finale E., IT	11° 17' E / 44° 50' N
E7	Alessandro Arrighi	Firenze, IT	10° 57' 50" E / 43° 43' 21" N
E8	Zeljko Andreic	Zagreb, Croatia	
	Rudjer Boskovic Institute		
E9	Dr. Valery Korepanov	Lviv, UKRAINE	24° E / 50° N
	Lviv Center of Institute of Space Research of NASU		
E10	Sarah Dunkin	London, England	0° 02' E / 51° 40' N
	University College London		

Looking Back on INTMINS ...

by: Dean Knight, Sonoma, CA
Jack Lamb, Belton, TX
Bill Pine, Ontario, CA

With the approach of the end of the MIR Space Station, we also approach the end of the INTMINS operations. Several participants have contributed thoughts on the value of the INTMINS operations and the future of this type of scientific investigation. Similar contributions are solicited from any other INSPIRE participants. Another article "Looking Back on INTMINS..." will be published in the nest *INSPIRE Journal*.

Dean Knight, Sonoma Valley High School, Sonoma, CA

If I were to list the primary contributions of INTMINS, it would be a statement that included two parts: one for my students and one for international cooperation.

First and foremost is that for my students. The chance for the students to do real science in a relaxed, fun, exciting situation that involves a bit of hiking (both daytime and night), a bit of involvement with technical apparatus (other than a TV or computer), a bit of camaraderie (quite a bit), a bit of careful observation, a bit of new ideas (both up on the mountain-our radio site- and back in the classroom), a bit of continuity (we have been involved with this for a while, and this year we had a group of senior students who had been involved as freshmen as well as present freshmen students who had participated with their older brothers or sisters several years back), and a bit of a chance for students to claim on resumes that they have been involved in an international physics study. (There have also been a few perks for the school to be involved in such a project--actually at this point it may surprise some that this is our last year with the project as it is now configured--hard to believe!) Needless to say, I hope that every effort will be taken to continue the study in a meaningful international way.

The second part (the international cooperation one) has advantages that speak for itself. YES, I think an experiment like INTMINS should be included in the International Space Station, but I hope we don't wait until the Station is available- we need to occupy the intervening years with another project. Coordinated observations are, of course, a possibility, but I personally would like to see a project that would continue to more directly involve the Russians. I really think this is important. Maybe there is something significant that can be done. Thanks for keeping the project going.

Jack Lamb, Belton, TX

So far, I think INTMINS' contribution to science has been minimal since I am not aware of any discoveries that resulted from our work. The fact that we have worked with MIR in this study is a fine example of international cooperation in science. Perhaps it will lead to more such cooperation in the future.

My wife and I have enjoyed getting out to our quiet site to record the various operations. We wish we knew more about what we were doing, but we are happy to know we are contributing something to a project that we feel is very worthwhile. My grandson is not as excited about standing around listening to static. A few minutes is enough for him. He always brings a book to read while I stand around and listen to static. It is nice to have him there anyway in case something goes wrong.

The value of INTMINS is not entirely clear to me. It has certainly been a valuable experience for me and, hopefully, for all other participants to be part of a team that spans the globe. It is interesting to see the graphs of our data we send in. I am beginning to understand what the dark marks mean. I hope we discover something dramatic (maybe even useful) before MIR burns up in the atmosphere next year. INTMINS should certainly be included in the International Space Station so we can continue our research. Hopefully, the novelty of the new space station will attract more members for our team.

I mentioned a global team above, but have noticed, in particular, that there are no Russian observers as far as I know. I hope that will change soon. I wonder if we would benefit from observers in the southern hemisphere? Now that we are on line, perhaps we can make ourselves known to more people in the world so that they can consider joining us.

I hope there reflections on the past and wishes for the future are helpful for your retrospective article in the April, 1999 issue of *The INSPIRE Journal*.. I am looking forward to reading it.

Bill Pine, Chaffey High School, Ontario, CA

I have been involved with natural VLF radio observations for the past 10 years. I have taught physics for the past 25 years, so I am in a position to compare the physics curriculum with and without VLF radio observations. Even though the radio observations occur outside the normal school day and outside the formal physics curriculum, participation in INSPIRE activities has had a positive impact on both my students and me. INTMINS, as the latest example of INSPIRE activities, is a prime example of that positive influence. There are many good things about being involved in something like INTMINS:

1. Spending time off campus with students allows everyone to get better acquainted - both with the teacher and with each other. Lasting friendships have been forged between students who might not otherwise have even met. The times riding up the mountain and back down are very pleasant and the feeling of accomplishment after successfully meeting an operation schedule is something to be proud of.

2. Meeting a schedule like that of INTMINS is an important activity for students (and teacher). In the school system, the emphasis seems to be less on encouraging students to be responsible and more on constantly giving them second chances. With INTMINS, if the team is late, MIR does not wait! Your "second chance" may not come for another six months. Students do a pretty good job of meeting their time obligations, but when they do not, they find that the "bus" has left and they miss out. This is a good experience for them especially since the only consequence is that they miss out.

3. Finally, INTMINS has a positive impact on physics enrollment and attitude. Each year several students who might not have taken physics otherwise enroll in physics. The enthusiasm and positive attitude of the students involved in INSPIRE is a good example for other students to follow - and some of them do!

I don't know what the physics program at Chaffey High would be like without INSPIRE and INTMINS, but I strongly believe that it would not be as good.