# 20th ANNIVERSARY ISSUE

INSPIRE
INTERACTIVE NASA SPACE PHYSICS IONOSPHERE RADIO EXPERIMENTS

# The INSPIRE Journal

THE INSPIRE PROJECT, INC | VOL. XIX | DECEMBER 2009

# Contents



## INSPIRE'S LEGACY

**Dr. William (Bill) W. L. Taylor** was a leader in the field of space science education and public outreach. He co-founded and was president of INSPIRE, one of the pioneering successes in NASA Sun Earth Connection Education. NASA Goddard Space Flight Center honored the late William W. L. Taylor with an *Excellence in Outreach in Science* Award for his accomplishments.


**The INSPIRE Journal** is a publication of The INSPIRE Project, Inc., a 501(c)(3) nonprofit educational scientific corporation. The INSPIRE Project, Inc. has both federal and tax exempt status (FEIN 95-4418628).

Letters to The INSPIRE Journal should be submitted to Kathleen Franzen, The INSPIRE Project, Inc., 518 Sixth Street SE, Washington, DC 20003 or emailed to: President@TheINSPIREProject.org



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## MISSION

The INSPIRE Project, Inc. is a non-profit scientific, educational corporation whose objective is to bring the excitement of observing natural and manmade radio waves in the audio region to high school 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 that might be used in a basic research project.

~ *William W. L. Taylor and William E. Pine, Founders of The INSPIRE Project, Inc.*

In 2006, The INSPIRE Project Inc. mission was expanded to develop new partnerships with multiple science projects. Links to magnetospheric physics, astronomy, meteorology, and other physical sciences are continually being explored.

# To Our INSPIRE Journal Readers

*Kathleen Franzen*
*President & Managing Editor*

This letter for INSPIRE's 20th Anniversary Journal has been a difficult letter for me to write. It is both bitter sweet yet it holds a much deserved celebratory voice. My view of the last 20 years of INSPIRE is very personal. When William and I began our life together, education and public outreach was a constant conversation. We knew the importance of a solid education in the sciences, reading and an adept command of the English language.


As William started talking about what would become INSPIRE I was acutely reminded that I did not come from the world of science. However, through some serendipitous alchemy I have worked with and socialized with scientists all of my adult life. This became very helpful when I started asking questions about the concept of INSPIRE. Listening to William it was clear that he felt the need for students to see the magic of physics and discover those lyrical VLF sounds. William was shaping a way to learn about physics with a "hands on" approach that hopefully would assist those reluctant students who felt intimidated in their science classes.

INSPIRE was born in Redondo Beach, California by two guys with beards. Many weekend days found William and Bill Pine around our dinning room strewn with wires, diodes, capacitors and everyone's favorite, soldering irons. Knowing me I probably held my breath when those soldering guns were fired thinking only of the furniture and not serious research and development. Each time they worked on the dinning room table, quasi-lab, they always had a visit by our Norwegian Forest kitty, Smudge. Of course she spread out in the middle of the table flicking various parts and switching components off the table with her tail. The beginning INSPIRE Project was serious science but the unexpected was that it would become an amusing play and lauds to all the actors!

*Bill Pine and Smudge in Redondo Beach*

During the next sixteen years I was a willing gopher and schlepper of all things. William's protector in P.J.'s when he made those very early morning observation runs to Hains Point. That location provided a very quiet listening place and is where the Potomac and Anacostia rivers blend. Delighted to welcome the ever growing INSPIRE team into our home as the project evolved and ideas were exchanged. A guidance counselor when fatigue was present and the last trek up the hill to work with a prototype receiver antenna – didn't go well. The straight man when the Palos Verdes police called me to verify what William was really doing late evening with a PVC antenna the size of a appliance box and the lights from his 1971 red Cadillac convertible, "Big Red", lighting the observation site.

So that's what our very well respected scientific educational non-profit experienced in the very early years. It was a privilege then to be in the audience and it continues for me each and every day. And what a class in science and whimsy I received from great teachers. Dr. Gail Godwin, an American Novelist, writer and Guggenheim fellow, observed that, "Good teaching is one-fourth preparation and three-fourths theatre." I applaud her observation.

Now what have we being doing? First of all we have exercised incredible perseverance while navigating major changes. I cannot stress this enough. And my thanks to the many of you who used your talents and energy to enable INSPIRE to keep moving ahead with the work of our Mission.

Let me present the continuing journey of INSPIRE...

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## 2005
I respectfully accepted the role of President and never looked back.

## 2006
The Board and Advisory Team approved the rebranding of INSPIRE and enlarged Mission. We got it done.

## 2007 & 2008
We presented the rebranded INSPIRE with poster papers at the fall American Geological Union meeting in San Francisco.

INSPIRE launched its new website via the new URL, TheINSPIREProject.org, to attract, recruit and maintain a larger student and workforce ready population. To add educator and science value, the INSPIRE website is now posting related scientific papers. Many of these papers are contributions from our new partners in various science disciplines.

INSPIRE redesigned and expanded the scientific content of the bi-annual publication, *The INSPIRE Journal*. The new *INSPIRE Journal* features programs information, scientific submissions, VLF observations and research. The content of the Journal was broadened to include additional STEM articles that have links to INSPIRE. In addition, *The INSPIRE Journal* now contains articles related to expanded usages of VLF-receiver data from contributors from around the world. *The INSPIRE Journal* is currently emailed to over 300 recipients and posted on the website. All previous INSPIRE Journals have been located, successfully archived, and are available on the website.

Dr. Jim Green, Director of Planetary Sciences Division, NASA Headquarters and INSPIRE board member, taught an INSPIRE lab-based workshop at the International Space University in Barcelona, Spain.

The first INSPIRE based university-level course was taught at University of Maryland Baltimore County (UMBC) as a result of winning the NASA New Investigator Award (NIP) submitted by Dr. Phillip Webb of Goddard Space Flight Center and UMBC. The course entitled “Chasing Lightning: Sferics, Tweeks and Whistlers” was a 1st year course as part of UMBC First Year Seminar (FYS) series.

Dr. Phillip Webb, Dr. Leonard Garcia from Goddard Space Flight Center and I were interviewed by National Public Radio in Baltimore about VLF and how INSPIRE was created. The complete interview is available on the website (*News section*).

We moved to increase award and education programs. This continues to lead us into larger and more diverse audiences.

## 2009
INSPIRE was invited to George Mason University to make a presentation on the INSPRE course. Phillip Webb’s and my presentation was well received; and the course is pre-scheduled be offered at George Mason in spring 2010.

INSPIRE secured a new VFL-3 receiver kit fulfillment house. As you may imagine this was not an easy task but it was timely. Not only to maintain continuing excellence in INSPIRE’s customer service history but in meeting the new demand in VLF-3 receiver kit requests.

Dr. Paul Kintner from Cornell University and I made an INSPIRE presentation at the National Science Foundation. The purpose of the meeting was two-fold – 1) To find mentors at NSF for INSPIRE; 2) to discuss possible NSF partnership opportunities. A result of this presentation was that INSPIRE was introduced to a possible project/partnership the SuperDARN project. This project is run out of Virginia Teach in Blacksburg, VA. For more information about SuperDARN please go the their website.

Jim Green arranged for an INSPIRE course to also be taught at this year’s International Space University at Ames Research Center in Sunnyvale, CA. INSPIRE has participated in twelve of the twenty-two International Space Universities.

The INSPIRE Project Inc. teamed up with the NASA Marshall Space Flight Center and the U.S. Space & Rocket Center in Huntsville, AL to offer scholarships to Space Academy for Educators and Robotics Camp. Space Academy for Educators is a 5-day program offered every summer for teachers from around the world to come and participate in 45 hours of intensive classroom, laboratory and training time, focusing on space science and space exploration. INSPIRE awarded its first scholarship that summer to a DC area female high school physics teacher.

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A new model INSPIRE workshop was held in early October 2009 and was graciously hosted by Gallaudet University. The workshop was developed at the request of the DC Office of the State Superintendent of Education-State Office of Career and Technical Education. The title of this workshop was: *Teaching Science with an Enthusiastic Attitude*. This workshop was well received. Each participating school will receive a complimentary INSPIRE receiver to assemble. A follow-up to this workshop will take place in late winter with workshop attendees.

Through INSPIRE team members we are now campaigning to have an INSPIRE Ambassador at every appropriate high school, college and university in the greater metropolitan Washington area to get the INSPIRE message out on a one-to-one basis. In addition, INSPIRE has international ambassadors in Greece, Italy and Switzerland.

We have accomplished a great deal in four years and still have a very long list of projects remaining. But since we keep adding programs and projects we become that self-fulfilling prophecy of never really getting to the end. But good for us! I look forward to our successes and to the work and challenges ahead.

I wish you and yours peaceful holidays and a patient 2010.

## The INSPIRE Project Welcomes Payload Specialist to Board

*The INSPIRE Project is please to announce that **Dr. Rick Chappell** has joined INSPIRE's Board of Directors.*

At Vanderbilt University, Dr. Rick Chappell is a Research Professor of Physics and a Consulting Space Scientist in Public Affairs involved in teaching, research, and science communication. He was the Executive Director of the Vanderbilt Dyer Observatory from 2002-2009. Chappell graduated magna cum laude in physics from Vanderbilt and received a Ph.D. degree in space science from Rice University. He has authored more than 150 published scientific articles and has testified before Congress on the importance of communicating science to the public. Before returning to Vanderbilt in 1996, he served as the Chief Scientist at NASA's Marshall Space Flight Center in Huntsville, Alabama. From 1976 to 1985, Chappell was the mission scientist for Spacelab 1, a joint European/American shuttle mission. In December 1985, he was selected to train as an alternate payload specialist for the space shuttle mission STS-45, which was carried out in March 1992. As a scientist and spokesman for the space program, Chappell has been interviewed on NBC's Today Show, ABC's Nightline and the BBC and has provided color commentary on CNN for space shuttle missions. Chappell is a member of Phi Beta Kappa and has twice received the NASA Medal for Exceptional Scientific Achievement. At his retirement from NASA In 1997 he was presented the NASA Medal for Exceptional Service.

*A special thanks to Paul Schou for the INSPIRE receiver map; Dennis Gallagher for technical editing; Jay Friedlander for cover images; Antonia Gambacorta for translations; Michael Mideke for INSPIRE receiver history in the very early years; and to all who contributed to the 20th Anniversary issue of The INSPIRE Journal.*

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# Jack Reed in Memoriam

**To: Jack Reed**
**From: Kathleen Franzen**
**Re: In Remembrance from INSPIRE 1993-2009**

Hi Jack,

This is not your normal format for a remembrance but I feel as if you would appreciate it and that it would reflect your worldview of life.

I first met you in Rosslyn, VA late spring of 1993. William asked me to come and join him to meet some of his colleagues at Nichols Research. I was a little dubious when we walked into a little "hole-in-the-wall Mexican restaurant which you all loved. I worked hard on being nice because I don't "do" these kinds of restaurants. You had a great handshake and mischief in your blue eyes. I found out quite quickly that those eyes were accompanied by an extremely dry sense of humor. Yes, the food was very authentic and good. It was the beginning of a fine friendship.

Shortly after, you and Barbara got together with the two of us and we delightfully clicked. That's what getting together a few cynics will do!

You began to include INSPIRE's receiver along with Radio Jove instruction when you did your volunteer years at the Smithsonian's Natural History museum. I remember you at INSPIRE workshops. You did not have to take the time to present but you graciously did. William was thankful and so was I. The last time we did a workshop together was at the Cosmos Club in 2007. Having you present there was a calming influence for me. It was the first time I ever was the responsible point person at an INSPIRE workshop.

You were a pragmatic and wry Board member. When I sent budgets out I knew that I would be getting an email from you soon with questions and observations. The good news was that you agreed with me. You just wanted to make sure I was thinking clearly and that I would have the right answers for other Board members and the Advisory team. You were also of what I call "my go-to guys." If I sent you an inquiry technical email you simply followed-up for me. I was very appreciative and I knew the question would be answered as correctly as possible.

There was always a humbleness in you of which I now know was that quiet side of you. You never really talked about yourself. What a generous and brave human being you have been. When I went to your Mass of Christian Burial at St. Agnes's Church on 11 November, Father Carroll let us know many parts of your life. You spent much time in the Army in many places. Did I know that you were a lieutenant colonel? No, I did not. Did I know about your work with the Red Cross or that you were a member of Community Emergency Response Team? No I did not. What I do know is what a kind, fabulous human being you have always been. Yours and Barbara's friendship for so many years have been filled with appreciation, coherent discussion, laughter and of course a good French Beaujolais.

Thank you Jack for not only being part of our lives but that of INSPIRE.

Just us,
*Kathleen and William*

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# Remembering Jim Ericson

## *The First Vice President of INSPIRE*

*Michael Mideke*

*Jim Ericson in his element.*

Hey Jim,

West out of Springtime on USFS Trail 43, I'm writing you a letter. Starting on this trail that goes from a place called Springtime to the top of San Mateo Peak, where I plan to spend the night. I'm making notes on sweaty file cards from my shirt pocket when I stop either to catch my breath or because a memory has struck…a lot of memories.

Remember the first time we met? It was on the radio, June 27, 1984. At 10 PM, with 1995 kHz on top of the 160 Meter Band. Art Child, W6TYP was there along with W6LNG. We talked about longwave low power transmission experiments. I only remember these details because I recorded the contact in my radio logbook. According to the log we did not speak again until Sept. 16. I believe your longwave EK signal was up and running and I was hearing it by then.

Switchbacks in the sun. It is a hot trail this morning. Forty-eight pounds on my back, thinking of times we shared.

Our visits were many but the radio contacts number in the hundreds. Do you remember our first face-to-face meeting? It must have happened sometime in 1985. I cannot remember if it was at the ranch where I lived at the end of that hairy jeep road, or your house in Sunnyvale? Or maybe it was at the Los Altos Hills swap meet? Back then I lived down in the Coast Range, miles from a telephone or paved roads and you would get home from work, turn on your ham radio and check into the Western Public Service net. I'd meet you there and you would become my family's telephone operator, relaying messages, patching our voices into the system, maintaining our broad network of friends and experimenters.

A couple miles down the trail I'm in the deep woods at San Mateo Spring. I see a rotted out log cabin, stone fireplace intact. The spring is dusty dry. Good thing I'm packing water up this mountain.

Do you remember Project Active/Activny? American students, teachers, hams invited to join in a Soviet space physics experiment. I don't know how it happened but somehow you and I were at Stanford, then the Loma Prieta earthquake hit, and we were meeting Dr. Helliwell at STAR Lab, and Dr. Inan, Ev Paschal and Bill Trabucco of the Antarctic VLF transmission experiments. Then there were the Soviet space physics guys who had stopped over in Cuba to pick up ground station recordings from an orbital VLF receiver.

There we were; crammed into a dark little room listening to the distorted VLF sounds while real-time spectrum displays blossomed on the big screen. It was the first time the Soviets shared this kind of data with their western counterparts. This was no formal occasion, just a gathering of enthusiasts and us; two ham operators feeling completely welcome. As someone pointed out, our interest and knowledge was quite unusual in a field that concerned only a couple hundred people worldwide. How things have changed! How the people in that room along with countless others have changed things!

Early evening now, after some rain and lightning, I'm making a meal. I'm comfortably installed in an abandoned but sound (and well grounded) 1930s vintage fire lookout cabin, 10,000 square feet, witnessing a glorious sunset.

Project Active failed as a science experiment because of mechanical problems in space but it succeeded as an educational concept which led to Project INSPIRE. Soon after Project INSPIRE was born came the Bills - Taylor and Pine. There were NASA conference calls at ungodly hours of the morning and receiver designs and prototypes and schemes to hijack WWV transmissions. Boards of Directors were formed and endless communications relayed to and from the Ranch. You pretty much took on a second full time job.

After many frenzied months it all came together with the Shuttle Atlantis, STS 45, Atlas 1 mission. Hundreds of ground stations equipped with our kit design and a US Coast Guard time slot on WWV loaned to us for coordination. You and Mark Mallory flew (and at least once drove) in and out of Saline Valley to meet the schedules.

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Saline Valley, just west of Death Valley and many miles from AC power lines, is one place where you and I never met. I didn't get there until this spring.

My friend and I arrived at the hot springs after fifty miles of trucking over severe washboard when we finally saw the little desert airstrip. My first thoughts were of you and Mark and the numerous radio conversations we had those mornings after the VLF monitoring was done. We compared notes on the whistlers heard, particularly huge sferics or late-lingering tweeks.

That evening, up to our necks in hot water, my friend and I along with several strangers were treated to the vision of ISS arcing brilliantly across the sky, followed on a different trajectory a few minutes later by the Shuttle. For my companions it was an interesting event. I had a feeling they took it for granted, while I was moved to tears. I remembered Bill Taylor sitting at our kitchen table at the Ranch (he was Chief Scientist of ISS back then) explaining gravity, of ISS and the importance of the Russians to my sons. I remembered, years later, going to shoot video at the Very Large Array on the morning when Challenger came over our heads in pieces.

There, in Saline, watching the shuttle slowly crossing the sky, I was awed once again by the fragility and the courage of it, knowing that people like you and me were up there doing those jobs, enjoying that view, taking risks; performing a magnificent human feat. It was such a joy to see the Station in place with people coming and going, and such a prayer for their well-being and the well-being of us all on this wondrous little world.

My head is abuzz with the past. Now that darkness has come on the mountaintop there's a chill in the air. Scatters of stars glimmer through dispersing clouds and I'm remembering our last conversation, not long before I went to Saline Valley. We spoke about INSPIRE and a new generation receiver, of Bill Taylor and ISS and what a good idea it would be to do the experiment again. This time from ISS, we're at it, how about another go at Active? How about getting some students up there? That's what it's for, our little house in the sky.

Thank you, Jim, for sharing the journey.
*Mike*

# All Science Teachers Should Go to Space Camp

## *INSPIRE Scholarship Recipient Shares Her Experience*

***Ellen McLean***

*Last January while I was working with our strategic consultant, Eva Kloostra, putting together the 2009-2010 programs schedule, she told me she was going to the next Space Shuttle launch and was beyond excited. That reminded me of all the time I spent in Huntsville, AL accompanying William when he went to work on projects with his colleagues at Marshall Space Flight Center. I remembered visiting the Space and Rocket Center and reading about the various Space Camp programs offered. And of course I remembered my first and only Shuttle launch from Kennedy Space Flight Center many years ago. Eva's enthusiasm combined with my memories turned my thoughts to wouldn't something like Space Camp for Educators be a natural program for INSPIRE to award. I felt that it would be a motivating tool for teachers. They could take their hands-on space experience back to their classrooms hopefully assisting them with getting their students additionally enthused about science. So I decided that INSPIRE would add Space Camp for Educators to our programs. I'm delighted to say that we had a great success in the guise of Ellen McLean. Ellen embraced her experience and brought her Space Camp for Educators story to our Workshop at Gallaudet last October with gusto! So now it is a privilege to present to you Ellen's article. ~ Kathleen Franzen*

"This summer I went to space camp". Can you imagine the reaction of students when you greet them at the door wearing a NASA flight suit and have videos of toys in space playing when they sit down? What better way to grab their attention! As it turns out, it is also a great way to keep their attention. Being sent to Space Camp for Educators by The INSPIRE Project has given me valuable experiences and materials I use daily, a new energy in my lessons, and a fun factor in my classroom that goes through the roof nearly every day. I truly believe that every science teacher should go to Space Camp for Educators.

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Last March one of the usual “opportunities for professional development” emails came to me. I opened it, planning to close it quickly, but something stopped me. Maybe it was the name, The INSPIRE Project, because I was surely in need of some inspiration. I had been trying to think of some new way to start the next year with a bang; to grab them the minute they came into the classroom. When I clicked the link and read about what you get to do at space camp, I started smiling immediately. “I have to do this!” I thought to myself. Well, one essay, two recommendations, and four months later, I was on a plane for Huntsville Alabama and SPACE CAMP!

I felt like a kid the whole time I was there. Not only did I get to dress up in (and keep) real NASA flight suits, but I met astronauts and test pilots, was given mountains of free stuff, built and fired rockets, constructed and flew balloons, made and burned up heat shields, trained for and completed two simulated shuttle missions (awesome!), was spun around along all axes, propelled backwards from great heights down a zip line and into the water. Did I mention being spun around along all axes, free stuff, and meeting astronauts? And please don’t think that it is in any way like going to an amusement park. The whole time you are at space camp, you know it is the real thing. You can feel the living history all around you. There are rockets everywhere you turn: big ones, small ones, old ones, new ones, rockets that have been into space, and even the dreams of rockets yet to come. For it is in imagining that the true lesson of space flight can be found. How can we get there? What will we find? How will it change us? I brought all of this back to school with me in September and it has made all the difference.


For a teacher, one of the best things is being given lessons, activities, and materials for free! At Space Camp we attended two or three workshops a day learning about ways to cultivate in our students the different skill sets used by NASA. We didn’t have to take notes; all the activities were included in a CD set given to us upon graduation at the end of the week. Fully differentiated, multimedia, and 100% hands-on, the activities given to us are a highly qualified teachers dream! My group was contained of elementary, middle school, and high school science teachers, right through AP Physics, and we were all delighted with the lessons and materials and were eager to bring it all back to the classroom and really start to have fun.

Many of the activities I brought back I use daily for team building and to increase students mental math skills (you know, math without a calculator!). Other activities I am incorporating into the lessons as I go. Using NASA videos to introduce a topic on acceleration, inertia, or momentum is a great way to both demonstrate large concepts, and to give real life applications to the work we do in class. I also apply the differentiated nature of the space program in my classroom. There are so many ways to be involved in the space program, and anyone can be a part of it, engineer or not.

Space Camp gave me much more than just a week away from home, and I am grateful to The INSPIRE Project for sending me. I have gained a renewed spirit of adventure, love for the space program, hope for the future, and new ideas and materials for the classroom. Being able to share with students the intrinsically positive point of view associated with space exploration is an excellent way to blend science, math, and engineering with citizenship, leadership, creativity, and the purely human ability to dream. Even high school juniors and seniors get a bit dreamy eyed when you design a lunar settlement and tell them they are just the right age and could well be on such a mission, if they so choose. Sharing my experiences at space camp with my students began creating the bond I have with each of them. They know that teacher is fun-loving, adventurous, and does really cool things during class. What student can resist that combination? None, as far as I can tell. And that is why all teachers should go to space camp. Just go to The INSPIRE Project website and apply!

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# A Long Day Full of Whistlers

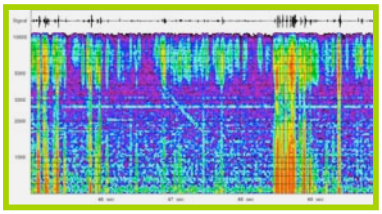
*Joachim Köppen*

### From France

When I am at my home in Kiel, on the coast of the Baltic Sea, I go as often as possible for long walks along the beach. With me, I carry my back pack which holds lunch, a book, and my VLF receiver. Of course, there also is a tape recorder and spare batteries! Although I've done that walk many times, I haven't got tired of it. Each day is different; the colours, the sky, the clouds, the sea and what I can hear on VLF. This summer, August 18th proved to be a long one…

### My equipment: VLF receiver, whip antenna, earphones, cassette tape recorder, audio cable

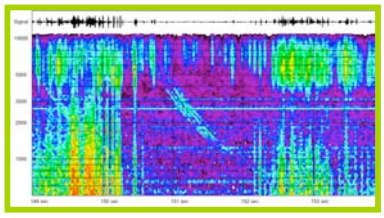
On my path along the coastline, I have found a couple of stations where the hum from the main power, from houses and street lamps, is very low or absent. Leaving the bus that brought me to a seaside village, I went straight to my first station, a sandy peninsula far from the houses. Once there, I took out the receiver and started to listen for about a minute. As I heard almost immediately a swishing sound among the medium strong spherics, I got out the tape recorder and started it. A typical whistler is shown in the following spectrogram



*Spectrogram of a whistler at about 47 sec after 12:42 CEST, done with Gram 16.0. The two red horizontal lines mark frequencies of 1700 and 3400 Hz.*

I chose the frequency axis to be logarithmic, because whistlers would show up as nearly straight lines, whose slope can be more easily measured. This one starts at 6000 Hz and sweeps down to about 1600 Hz.; it takes 0.4 seconds to drop from 4000 to 2000 Hz. Based on previous experience, this tells me that the whistler is a one-hop variety, coming from south Africa. There also is another, much shorter whistler, showing up only near 3000 Hz. Since I do not carry with me any equipment to put accurate time ticks on the recorder, the times I give here are the seconds after the start of the recording, whose time I simply noted from my wrist watch, by the nearest full minute.

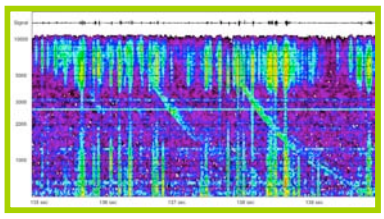
At this time and place, I observed about 6 whistlers per minute. This number was obtained later, by listing to the audio file and simply counting all whistling sounds. The whistler shown above was nearly pure-tone, but I also heard several more hissy ones, which are composed of several whistlers spaced very closely in time, between 0.1 to 0.4 sec. In my count, I do not (yet) distinguish between faint and strong ones, or pure-tone and multiple whistlers. Let us first get a rough idea, and let us see how the whistler frequency evolves during this day!



*A multiple-component whistler at 151 sec after 13:35 CEST.*

Often I noticed that I hear whistlers every half an hour. So on this day I kept listening and recording, about every half hour – the background hum permitting. All recordings were done with the same receiver, the tape recordings converted into audio files using the same play back volume, and I shall show the results using the same time span and the same parameter settings of the Gram software.

My next station unfortunately is within sight of an overland power line, thus the hum background is stronger which prevents me from hearing the fainter whistlers. However, I was gratified by numerous whistlers which also appeared to be louder. One example of a multiple one is shown to the right:



*A long-drawn whistler at 138 sec after 13:35 CEST reaching down to 1000 Hz.*

One may distinguish 5 or 6 components, separated by as little as 0.05 sec; they start at about 6000 Hz and reach frequencies as low as 1200 Hz. This is already quite noticeable during the direct listening, by the lower frequency and also by the longer duration of the entire feature.

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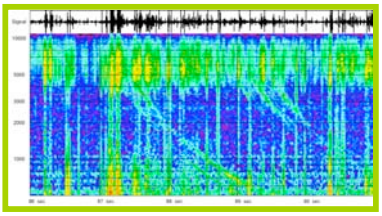
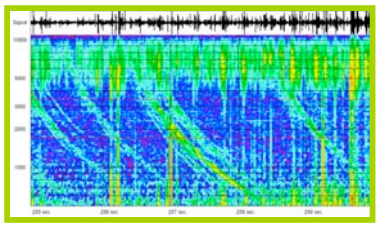
Shortly before this example, there came an almost pure-tone; one reaching down to 1000 Hz: One notes that it seems to split up at its low frequency tail into three components. Such a specimen is quite prominent when directly heard.

As an observer one has to resist the temptation to display and discuss in detail every single whistler that was recorded, so let us be reasonable and get on. For the next three hours, I could hear a rich mixture of whistlers, faint and loud, single or multiple, short as a mere hint or long reaching low tones. At 16:14, on a quiet part of the beach itself, I picked up two other nice specimens; both composed of several signals. The first one starts at 4000 Hz and reached down to 1000 Hz, but with a gap near 2000 Hz. The second group starts in the same way, but after the gap at 2000 Hz it does not come back with a low-frequency tail. This may tell us that the duct for the whistler was subject to rapid changes.



*A long multiple-component whistler at 88 sec after 16:14 CEST reaching down to 1000 Hz, followed by a shorter one.*

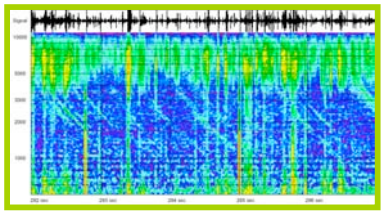
There is also an interesting optical illusion: It might appear that the second group decreases more rapidly in frequency, but if one compares the slopes of the features at the same frequency, they turn out to be identical.



*A whole fleet of long whistlers at 250 sec after 18:25 CEST, all reaching down to 1000 Hz: one whistler group per second!*

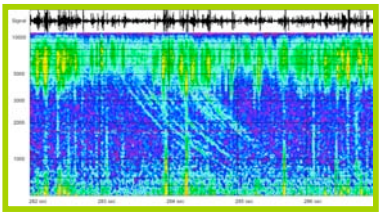
At this time, there were numerous faint and quite loud whistlers, but most of them were audible only above 2000 Hz, and only rarely one would sweep down to 1000 Hz. This carried on for another hour, but at 18:25 the situation had changed:

Nearly every whistler could be heard between 5000 and 1000 Hz! Also, they were rather strong, coming about every second. Moreover, despite some hum background – fortunately limited to below 500 Hz – I could hear many faint whistlers piling on top of each other. An example of a swarm of faint whistlers is shown (left).



*A swarm of faint whistlers at 290 sec after 18:25 CEST.*

Later, the counting would reveal 25 whistlers per minute. This was the peak of the day's activity! Since the present station was not free of hum, I hasted to carry on through the next settlement and reach my favourite low-noise site at the end of the dyke at 19:28. The situation had changed a little, as the strong and long whistlers had become less frequent, there were quite a few with almost pure-tone, and I captured many with fine structure such as the multiple one below:



*Whistler with multiple components at 280 sec after 19:28 CEST.*

By now, most whistlers were audible in the frequency range from 4000 to 1500 Hz. One and a half hours later, shortly after sunset, whistlers had become much rarer, and the fainter ones had to compete with the tweeks which became louder.

One of the few whistlers I could hear was a rather hissy one, composed of perhaps ten components, which also appear to have different slopes. Just before it there is a strong tweek whose frequency tails off somewhat below 1700 Hz – which would imply a height of the ionosphere of slightly below 300000 km/s / 2*1700 Hz = 88 km.

This was my last station on the beach. I took the bus home, but being too curious I went out after midnight to the meadow in a nearby park for another look (and a fresh tape cassette). The whistler activity was still continuing at a lower intensity, no low frequency tails were heard.

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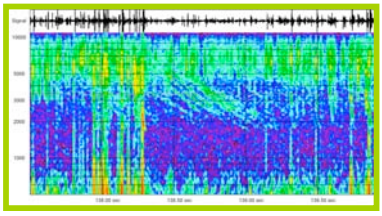
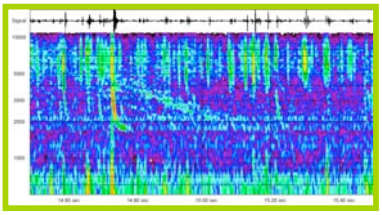
Tweeks had become prominent, in the example above, a strong tweek occurs just at the start of a faint whistler. It also shows a trail at 3400 Hz, i.e. twice the cut-off frequency.

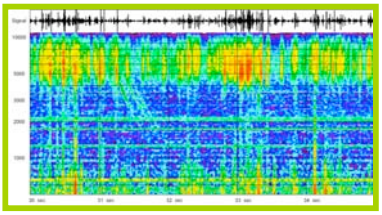


*Strong tweek and faint multiple component whistler at 138 sec after 21:01 CEST. *Note that the time axis is expanded to show the tweek.*



*A strong tweek and faint whistler shortly after 01:10 CEST. The time axis is expanded and the signal level was changed to bring out the features.*

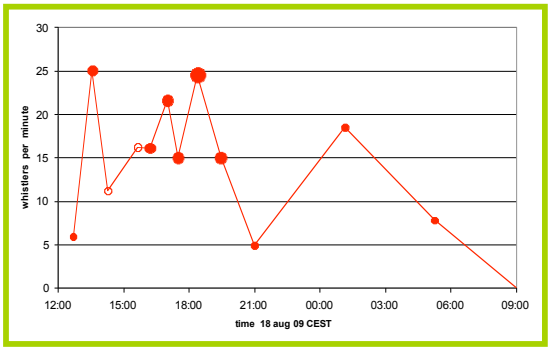
Early next morning, I went to the park again, only to find that the whistlers were still coming. The strongest one is shown here:



*The strongest whistler shortly after 05:16 CEST.*

It was similar in loudness and frequency range as the whistlers heard at the start of this long day of VLF listening! I went back home and into bed again. At 09:00, after I woke up and had breakfast, no whistler could be heard any more! Also, with the rising sun, the tweeks had gone. After an eventful time, we had gone back to normal!

Later, by listening to the audio files, I counted all the whistlers and computed their number frequency of them. However, for a first look I neither distinguish multiple whistlers nor the ones which reach low frequency. The result is shown below:




*The evolution in time of the whistler number frequency. The size of the data dots indicates the fraction of whistlers tailing into low frequencies. Open circles mean a location with appreciable hum background.*

The data for 14:18 and 15:40 – marked by open circles – was taken with appreciable hum background, which would make it difficult to hear any faint whistlers. The curve traces only one aspect of the whistler activity. A couple of strange effects can be observed: the high number at 13:35 was obtained at a site with appreciable hum, at which one should expect to miss some whistlers. On the contrary, the low count rate at 21:00 was done at a low-noise location! This indicates that the count rate shows the lightning activity at the source, but not really when the conditions are favourable for the radio impulse to travel to the other hemisphere as a whistler. Thus, the higher rate at 01:00 might simply mean that the thunderstorms in southern Africa had regained in strength since 21:00.

Nonetheless, it is interesting to compute the total number of whistlers I could have heard if I had kept listening. Let us assume an average rate of 10 whistlers per minute. Over a total time of – let's say – 17 hours, we get about 10,000 whistlers!

The high point of this activity certainly was at 18:25, with a high count rate, but also with almost all whistlers consisting of long and complete sweeps in frequency, down to 1000 Hz. That day I could observe that whistlers first appear audible near 3000 Hz and are first limited to a short sweep, such as between 4000 and 2000 Hz. Then, the lower limit frequency seemed to have gone down, and whistlers became not only more numerous, but also more spectacular and louder. Eventually the phenomenon slowly disappeared, their sweep range again became more restricted, their numbers and loudness came down, and eventually whistlers were gone. Perhaps it is the lower limit of the frequency sweep, or the range of the swept frequency, or the loudness which tells something about when conditions are right for lightning to produce whistlers. In the above plot, the size of the data dots gives a rough impression of how frequent the long-sweep whistlers were. This is not quantitative, but definitely something to be looked up in the next round!

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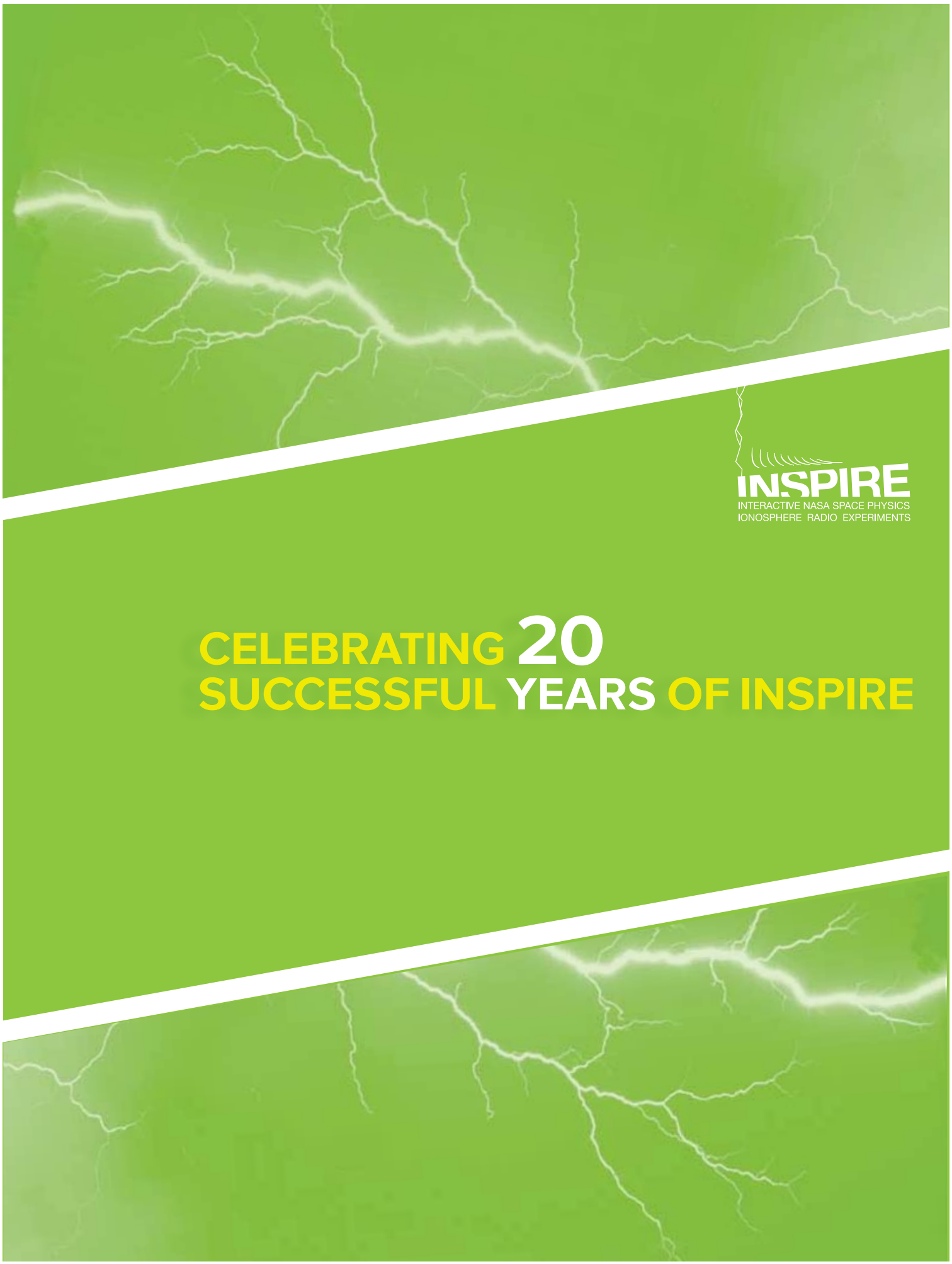
INSPIRE
INTERACTIVE NASA SPACE PHYSICS
IONOSPHERE RADIO EXPERIMENTS
CELEBRATING 20
SUCCESSFUL YEARS OF INSPIRE

# 20 Years of INSPIRE
# Looking Back

*Bill Pine*
*INSPIRE Co-Founder*

As I look back over the last 20 years, I have many happy memories of INSPIRE. These memories include memorable people that I met and worked with and historic events that I witnessed. I would like to briefly recount some of these things.

## PEOPLE

I had the chance to meet and work with many fine people over the years. To attempt to list them all would negate my attempt to make this brief. I will describe a few of these people. Of course, my friend of more than 40 years, Bill Taylor, is first on this list.

The first activity of what would soon become INSPIRE occurred in 1989. Bill Taylor, the founder of INSPIRE, had been involved since graduate school in the sixties in research involving space plasmas. At that time the Soviet Union had a satellite in orbit called ACTIVE. The primary mission of ACTIVE was to investigate the propagation of radio signals from ACTIVE to other satellites in orbit to try to define and explain the interactions of the radio signals with space plasma structures.

Bill had been working with scientists in the Soviet Space Agency (IKI). It was a revelation to me that there was cooperation of any kind between us and our Cold War foes, but cooperation in science was common. This is how I came to know Stas Klimov, a space scientist with IKI. Bill's idea was to try to detect on earth the radio signals that ACTIVE was sending out. This involved planning operations of the ACTIVE transmitter in coordination with when and where we would have ground observers here in the US. Stas was our contact in IKI and he was vital to the success of the operation. Now, "success" is defined as being successful in getting students interested and involved in the observations. The radio signals from ACTIVE were calculated to be just above natural background radio levels at earth's surface. The signals were not detected on earth, but this did not affect the level of success!

*(Above) 1989 ACTIVE team members.*
*(Below) USSR scientists for ACTIVE enjoy a drive in Bill Taylor's "Big Red".*

In 1992, I had the opportunity to work with the SEPAC (Space Experiments with Particle Accelerators) team during the flight of the Space Shuttle Atlantis, STS-45. For the launch, Bill Taylor and I met in Orlando and traveled to Kennedy Space Center for the launch. The day before the launch we were in the Ron Jon Surf Shop in Cocoa Beach. While there, we ran into an old friend of Bill's, Owen Garriott. Now, Owen Garriott was an astronaut on Skylab and that mission was part of the Earth Science curriculum I developed and taught at Chaffey High School in Ontario, California. I was more than a little star-struck and I was proud that I had resisted the urge to ask for an autograph!

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During the mission I was at the Payload Operations Control Center (POCC) at Marshall Space Flight Center in Huntsville, Alabama. I had a console in the SEPAC area that allowed me to listen in on any of the various communication channels ("comm loops") and to watch the big map display of the mission. I was very impressed, but not surprised, by the extremely high level of expertise that is common at all levels of NASA.

It was for this mission that we had kits produced that we sold to teachers and radio amateurs to form a large-scale ground observation team. In order to sell these kits we incorporated and that is when the INSPIRE (Interactive NASASpace Physics Ionosphere Radio Experiments) corporation was formed. Bill Taylor coined the name INSPIRE. Since this represented a continuation of activities that started in 1989, we consider 1989 to be the birth date of INSPIRE.

In 1995, INSPIRE was once again working with IKI, now the Russian Space Agency. The fall of the Soviet Union had no impact on the cooperation between Russian and American space scientists. The MIR Space Station had a couple of instruments that could generate radio signals by emitting beams of charged particles. We decided to use our existing array of volunteer observers to attempt to detect these radio signals on earth. In Russia, Stas Klimov made arrangements for an agreement between IKI and INSPIRE to describe operations of the MIR instruments while MIR was over the US. This agreement was signed by Bill Taylor, President of INSPIRE, Bill Pine, Secretary-Treasurer of INSPIRE, Stas Klimov, Project Scientist, and Albert Galeev, Director of IKI. I think this is the first (and possibly the only) example of an agreement between IKI and any American non-government entity. I never met Dr. Galeev in person, but I was honored to work with him.

Later in the 1990s I met Dr. Owen Storey. In the mid-1950s Owen provided the explanation for the formation of whistlers. He said that radio waves that head away from earth can, under the right conditions, follow magnetic field lines out and return to earth as dispersed signals – whistlers. Bill and I had lunch with Owen and I attended a talk he gave. I even understood some of it! For a whistler hunter, this was a dream come true.

## EVENTS

The first event, I suppose, is the fall of the Soviet Union in 1991. From our perspective of having cooperated with Soviet scientists, the significance of this event is that the event had no impact on the cooperation. I see this as strong evidence that science is independent of politics and that is a good thing.

In 1992, an interesting event occurred during the tour of the launch pad area prior to the launch of Atlantis STS-45. When the bus took us by launch Pad 39A we saw Atlantis. In nearby Pad 39B we could see the Shuttle Endeavour being readied for STS-49, its first mission less than two months later. This was the first time that two shuttles had been on the launch pads at the same time.

While observing natural radio signals over the years, constant companions were the transmitters of the OMEGA navigation system. These radio signals were a pattern of tones between frequencies between about 10 and 15 kilohertz. The signals provided a constant indicator that the natural radio receiver was working and, later, during analysis of the data (which was one of my responsibilities) OMEGA served as excellent time and frequency calibrations on the spectrograms. As GPS navigation became more common, the value of OMEGA declined. It was decided by the US government to shut down OMEGA in 1997. On September 30, 1997, several of my students went with me into the mountains to our observation site. As the scheduled shutdown time approached we recorded the natural radio signals along with OMEGA. At the appointed time, the OMEGA signals ceased never to be heard again. Actually, since my high frequency hearing had degraded, I never heard OMEGA in the field (a circumstance that my students found endlessly amusing). I did miss the presence of the horizontal dashes in the spectrograms!

*2000 IMAGE Satellite pre-launch.*

In March of 2000, the IMAGE satellite was launched. I had been working at Goddard Space Flight Center as part of the IMAGE Team during the summers since 1995 writing educational materials for high school students. IMAGE is an historic satellite for its creative ways of observing space plasmas in the space surrounding earth. To witness the launch was a thrill. I worked for IMAGE for 12 summers and enjoyed every minute of it.

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The end of another era occurred in 2001 when MIR was deorbited. For six years we had been making observations of natural radio during MIR passes while MIR operated its instruments. When the scheduled observations were just before dawn or just after sunset, we commonly saw MIR as it passed over. It was kind of neat to think that we were watching MIR while its instruments were operating for our benefit. After MIR fell from orbit, a group of students wanted to make one final "MIR Run". Using orbit prediction software, I was able to run the orbit ahead to a time after the deorbit and predict when MIR would have been visible. A large group of us went up to the mountains one evening and, at the appointed time and looking in the appropriate direction, we were able to see quite clearly that MIR was NOT there! Like losing an old friend, it was a sad moment for us all.

*Life-long friends Bill Taylor, John Herrelll and Bill Pine at Zaka Lake for IMAGE launch in 2000.*

In March of 2004, Bill Taylor and I were joined by Shawn Korgan, a longtime INSPIRE observer, for a trip to Alaska. The occasion was participating in a BBC Radio documentary about the aurora. We spent 5 days in Chatanika, Alaska, north of Fairbanks. During the day we saw sun dogs and halos and during the night we saw aurora every night. It was spectacular! We met with the BBC crew who went with us observing the aurora. INSPIRE was later mentioned in their story, "Songs of the Sky". We stayed at the Chatanika Lodge and spent a fair amount of time talking to the locals. If you picture a kind of "Northern Exposure" meets "Cheers", that was it. At the time, there was no way to know that 16 months later Bill Taylor would die from a sudden heart attack. It is nice to have memories of Alaska to add to the many memories I have of Bill.

*Bill and Bill with BBC "Songs of the Sky" radio producers K. Bissell and A. Fowler in Chatanika, Alaska.*

## NOW

My wife, Beth, and I retired in June of 2005. For me it was the end of a 35-year teaching career; for Beth it was the end of more than 20 years as a hospital nurse and school nurse. In the summer of 2006 I retired from active involvement with INSPIRE. That fall we bought a lakeside cottage in Central New York on the shore of Cayuga Lake, one of the Finger Lakes. For the past 3 years we have spent from May through October at the lake and from November to April at our home in Southern California. We drive back and forth across country. We have three daughters and five grandchildren (and counting!). Life is good. I have nothing but fond memories of INSPIRE and I treasure the time I spent on this wonderful enterprise.

INSPIRE is in good hands. Its mission continues. Bill Taylor's legacy lives.

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# Twenty Years Later
## (Reflections on Project INSPIRE)

*Michael Mideke*

In the very beginning there was a lot of STUFF moving mighty fast, making lots of noise.
So much noise that when Humans came along they called it the Big Bang.

It took a while (several billion years) for the Humans to show up but when they finally arrived they were quick to invent radios and start making their own noise. They also tuned in the noise that was already here; listened to it, thought about it.

Electro-magnetic noise. Charge in motion. Fields in motion. Currents, waves. Particles. Particles from sub-atomic to planetary to galactic. All spinning, orbiting. All making noise at particular frequencies from milli-micro-nano-pico seconds to millions of years. Web of interlaced tones, imperfectly intercepted, gradually interpreted to reveal increasingly detailed map of Universe.

Twenty years ago we who gathered into INSPIRE were very lucky to play with the noise of our local electromagnetic environment. Whistlers, tweeks, chorus. Lucky to attempt a new path of investigation. Very lucky indeed to have available the electromagnetic spaces of radio, telephone, the computer, the Web where we were able to meet and work. Spaces without which the project would have been impossible. Real spaces that we have created and climbed into in one short century. Living spaces that are changing us in ways we can only begin to imagine. Evolution in the fast lane.

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# Bill Roberts Recounts the Early Years

In the mid-60's, Bill Roberts, a Space Lab Scientist and Program Developer at Marshall Space Center in Huntsville, AL, and INSPIRE's founder William Taylor met for the first time at the University of Iowa. The two scientists collaborated on space environment criteria for the James Van Allen's Radiation Belts.

In the early 70's at the start of the Shuttle program, the two scientists were reconnected through a new concept – plasma physics through environmental perturbations. Prior space research had been conducted through observations of cause and effect. Bill Roberts, Bill Taylor and Bob Fredricks, both of TRW at the time, had a different concept – create manmade disturbances of environmental plasma and record the effects based on the desired manmade cause. They presented the concept to the Associate Director of Space Science at NASA Headquarters who authorized them to explore the interest in this concept among space scientists. They mailed 1,000 letters out and received 400 responses – the project was a go. NASA Headquarters put out an announcement of opportunity to define the program and a Task Team at Marshall Space Flight Center was formed to do an engineering study for a payload concept. NASA then hired a new Administrator that did not 'fully understand the concept' and felt Goddard should run it due to their involvement in space science for NASA.


In 1976, NASA issued an RFP for the first Space Lab Mission. A group from the Institute of Space & Astronomical Science in Tokyo, Japan teamed with a group of US scientist to respond to the RFP. As a result, SEPAC, was selected to build a plasma pertibation and plasma diagnostic package. Marshall was to provide monitoring and interactive communication control function. In 1981, the night before the shuttle launch, the SEPAC payload was loaded and a bolt was loose on the electron accelerator causing it to malfunction. A decade later, they got to re-fly it!

The second flight of SEPAC was on the Space Shuttle Atlantis, STS-45 and was successful generating artificial auroras. Bill Taylor developed an experiment to monitor VLF waves – this was the official beginning of INSPIRE. Observers on the ground set the channels on the VLF kits and on the shuttle's re-entry, Bill maxed out the payload on the modulating accelerator and burned it out. It was exciting!

A few years later, NASA was searching for a Space Station Chief Scientist, Bill Roberts recommended Bill Taylor for the position. Bill Taylor was awarded the position and moved back to DC.

*ATLAS-1 Team, NASA Marshall Space Flight Center*

*INSPIRE consultant, Eva Kloostra, interviewed Bill Roberts in Huntsville, AL in August 2009. Bill is enjoying his retirement after working for NASA Marshall Space Flight Center for 33 years.*

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# Growing up on Nature's Radio

*Dennis Gallagher*
*NASA Marshall Space Flight Center*

I did my graduate work in space plasma physics at the University of Iowa under Professor Donald Gurnett. During graduate school I learned about very low frequency plasma waves of all kinds and the oddity that you could convert natural radio noise to audible sound. Bill Taylor had also graduated from the U. of Iowa some time earlier and through that association I learned about his efforts with Bill Pine to start the INSPIRE Project and to take on various field experiments. Almost ten years ago it came up in our conversations that it would be great to stream VLF that could be received on the ground out onto the Internet so everyone could listen even if they didn't have a receiver themselves. As a result of that conversation we installed an INSPIRE receiver in Huntsville, Alabama and began streaming audio from it for all to hear. That lead to at least two 10-foot weather balloon flights with VLF receivers into Leonid meteor showers, a teacher workshop to build INSPIRE receivers, and ultimately to flight on a huge two-ton gondola in New Mexico with an INSPIRE receiver as part of the Deep Space Test Bed Project.

The INSPIRE Project has been easy for me to identify with and spend time supporting. I have had a hobby in electronics since Junior High School and an interest in the natural processes taking place all around us. Being able to introduce students and adults to the otherwise hidden VLF radio noise is especially fulfilling. The rich history of discovery and personal challenge for the original pioneers is a compelling story that can help all those interested in science to better understand what it means to do the work of seeking new knowledge. Today the INSPIRE Project is looking outward to apply its hands-on approach to new areas of science in our natural universe. I think it is safe to say that the Project will continue to inspire me and many others well into the future.

# Remembering INSPIRE from an Italian Perspective

*Flavio Gori*

In the very beginning of the '90s I was very interested to know more about Very Long Radio Waves. In Italy most people were not used to working with those frequencies, so I had to look in the USA, where I did found a good amateur magazine called *The Lowdown*. I ordered a copy, but I sent too much money, so they sent me two copies. This proved to be important because only the second magazine showed something about the INSPIRE Project. The magazine showed Inspire Project notes about the SEPAC emission on the Space Shuttle STS 25 that would be done in the spring 1992. The Inspire Project asked for collaboration in the world wide amateur radio community, so I decided to join the crew! I think I was the very first Italian guy to be part of the team. My objective was to inform all the amateur Italian radio users and listeners about that project.

I kept in touch with Inspire Project's American members and founders such as: Bill Taylor, the President, Bill Pine, Jim Ericson and Mike Mideke (at that time living in San Simeon, California in a very remote area). Mike sent me some audiocassettes that he produced so that I could hear what Natural Radio Sound really sounded like. That cassette was one of the coolest things I have ever heard in my life. I still have it as a memory.

My American friends sent me a lot of information about Natural Radio and the SEPAC experiment. With that information I was able to translate it and publish it on some Italian radio stations, daily newspapers and related magazines such as the Geodesy Bulletin, which is published by the Italian Geographical Institute by the Italian Army. These articles took back many Italian amateurs that had never heard a lot about Very Long Frequency Waves.

The SEPAC experiment did not work for all the scheduled experiments but enough to realize that people worldwide were excited to be part of a scientific experiment, even if they had to go out in the field at night hours during the cold

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winter months. So, the INSPIRE Project got a joint experiment with the Russian Space Agency (IKI). Stas Klimov was the most important member involved with the experiment. I had the honor of hosting Stas, as well as Bill Pine and his wife, Beth, at my home in the late '90s as a way to underline the good relationship between us all. What a time!

Thanks to the Bill Taylor (the INSPIRE Project and NASA) and Stas Klimov (IKI) agreement, INSPIRE members were able to work out a very nice project working with the MIR spaceship. Twice a year it transmitted energy impulses from its orbit directly over the geographical coordinate where INSPIRE members recorded the impulses from their VLF receivers to their cassette. All the audiocassettes were then sent to Bill Pine in California, so Bill could analyze the tapes to figure out when a MIR signal might arise from the noise.

At the same time all this was happening a lot of projects were performed in the natural emission realm such as; the eclipse or the Shoemaker-Levy comets crashing in the Jovian atmosphere. But even some manmade activity was under investigation, such as the so-called *Tethered Satellite* Space Shuttle events, performed by Italian astronauts Franco Malerba and Umberto Guidoni. The European and particularly the Italian teams were at work looking for VLF signals coming from the wire running in space.

In 1999 the INSPIRE Project sent a VLF radio receiver to the Marshall Space Flight center in Huntsville, Alabama, to work a suggestion of mine. I suggested that we fly the VLF receiver by a balloon to the area where the Leonids hit the terrestrial atmosphere, as a means to understanding if a meteorite can release an electromagnetic emission in the VLF. NASA and the INSPIRE Project were kind enough to name the receiver with my daughter's name: *Marina*.

In the same year we started a Norwegian project, which was to help the EMBLA Italian and Norwegian team of researchers to investigate the so-called *Hessdalen Phenomena*. Hessdalen is a small and remote Norwegian valley where inhabitants reported strange lights around the valley, probably since the late 1700s.

EMBLA researchers were there since 1984 establishing an automatic research station to record video and photographs when light may arise. My proposal was to investigate, even in the VLF frequency, what happened in low radio waves when light phenomena occurred. Unfortunately the phenomena were really difficult to work. Bill Taylor and Dennis Gallagher from the Marshall Center encouraged me and helped me analyze my .wav file.

These are just some of my wonderful memories with the INSPIRE Project. I have served as European Coordinator since 1993 and am very happy to say that I have had an amazing time with all of you. I have worked for INSPIRE in Italy and Norway and kept in contact with most of our European members. I am very glad to work with Kathleen Franzen, our President, and have had the pleasure to work on the field, understanding the overall environment where the VLF waves do appear. I really thank all of you. I will never forget the INSPIRE group and I am extremely proud to be part of the group.


# My way in INSPIRE, as I now understand, began long ago.

***Dr. Stas Klimov***
***Space Research Institute (IKI) of the Russian Academy of Sciences***

*Dr. Klimov has worked at the Space Research Institute (IKI) of the Russian Academy of Sciences since 1967.*

## Preliminary Stage (1967 - 1995)

From the very beginning of working at the IKI, I have become to prepare experiment on research of electrical fields in space plasma (in ionosphere). In 1972 there was such experiment was carried out on the Soviet satellite "Kosmos-484". It was practically the first experiment in the world on the measurement in ionosphere DC electric field vector (3 orthogonal components). In 1974 the "Interkosmos-10" (with participation of the scientists from USSR, Czehoslovak, DDR) was started which the experiment for measurement of ULF electric field vectors (ULF receiver) was carried out.

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In 1985 the high elliptical orbit "Prognoz-8" was started, on which for the first time ULF electromagnetic emissions at the front of Earth's bowshock were investigated. These researches highly appreciated Fred Scarf. I met Fred Scarf – patriarch of electromagnetic radiations investigation with the help of space vehicles – personally for the first time at a conference on " Collisionless Shocks", which was held in 1987 in Balatonfured (Hungary). Fred was accompanied by his wife Mimi. In Balatofured, a discussion of a Soviet- American experiment on "multidot" measurements in a magnetosphere of the Earth was carried out also. This experiment was discussed over the next few years. In these discussions Bill Taylor took part.

Unfortunately, the international space community in 1985 incurred a heavy loss. During start in the Soviet Union of the International Space Project Venera-Halley (VEGA), Fred was in IKI. At once after crossing by a space vehicle VEGA-1 of Earth bowshock (this crossing was magnificent detected by the device APV-N, Soviet-Polish ULF-receiver, in which I was PI from the Soviet party), Fred felt poorly. He immediately was delivered in one of the best governmental clinics in Moscow. The next day, unfortunately, Fred died. I was in mourning and escorted Fred in his last flight from the Sheremetevo (Moscow) airport.

In USSR we believed, that Fred's successor, will be Bill Taylor. I think, that the death Fred caused the project was not to be realized.

May 6-14, 1990 in Washington the Soviet-American working group on solar-terrestrial physics met. Here I again met with Bill Taylor. He had just moved (on smart collection and very large red Cadillac) from California to Washington, DC and to work at NASA. On May 9 (in the Soviet Union and now in Russia a Holiday of a Victory) in the Officers Club at Fort Bellvoir (about hour of driving from Washington) there was a friendly supper, at which Bill was with the wife Kathleen.

*Bill Taylor, Stas Klimov & Bill Womack, SEPAC*

The plans of the further joint works were planned. At this time in the Soviet Union there has come epoch of Perestroika and Glasnost, which not look on its democratic orientation, has resulted in curtailing mutual relation USSR and USA, including in the field of space researches.

Following my meeting with Bill there was held during General Assembly of URSI (the International Union of Radio Science), taking place in Kyoto 25.08-03.09.1993. 26.08. H. Matsumoto invited the Beer Restoran Tengu "wave company" B. Taylor, D. Gurnett, and R. Anderson (with wife). There are perfect photos of this "session" made by H. Matsumoto. Here for mug of beer the discussions of opportunities of the further joint works proceeded and I for the first time heard about INSPIRE.

## Participation in the INSPIRE Program (1995 – …)

During preparation of my trip in USA for participation in Fourth International Conference on Tethers in Space (Washington, D.C. 10-14 April 1995) we have exchanged with Bill the necessary information. Upon termination of my stay in Washington the protocol on cooperation was prepared within the framework of the program INTMINS (INTerball-Mir-INSpire). In May, 1995 this protocol was signed by the chiefs INSPIRE, IKI, and RKK ENERGIYA. From this moment began my official participation in the INSPIRE program, as coordinator from the Russian party.

That the INSPIRE program is very interesting and is useful from the point of view of attraction of the schoolboys to space researches I was evidently convinced, participating in spring session INSPIRE, taking place in Washington, DC February 7-9. On this session I for the first time have met with Bill Pine.

The INSPIRE Project has allowed also to get acquainted with original nonprofit by the enthusiasts of space researches. Especially it is pleasant, that some of them are not the professional researchers, but their participation very actively and at times forces on another to look at tasks of the educational programs.

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During July 7-9, 2000 of meeting in Washington, DC With Bill Taylor and Bill Pine we continue discussion of the further works under the programs INSPIRE and POETRY.

The long absence of contacts between us (2000-2003) does not mean, that I have forgotten about INSPIRE. In different occasions I recollected you, but as the concrete questions did not arise. A thank for the INSPIRE Journals, which I and Yuri receive regularly.

*Bill Taylor, Stas Klimov and Bill Pine enjoying breakfast in July 2000 in Washington, DC.*

## Some Information on Our Space Activity

1. The physical interpretation of the data of the project INTRBALL (Tail Probe) as volume of the data practically of continuous work for 1995-2000 years large proceeds. Our new representations about physical processes in various magnetosphere regions and in a solar wind are published in a number of magazines, the new publications prepare also.

2. The methodical and physical interpretation of the data of scientific-educational Russian-Australian micro-satellite «Kolibri-2000» was carried out. These data are submitted in a number of the reports at conferences, the new publications, including in common with the schoolboys prepare also. The special interest submit data April 17-24, 2002. It is the period of the very disturbed Sun. For this period there are data with about 10 space vehicles and number ground observatory. «Kolibri-2000» (total mass 12.5 kg) was operated to enter in atmosphere.

3. Now we have preparation of experiment "OBSTANOVKA" (English "ENVIRONMENT") on International Space Station Russian Segment (RS ISS). In this international experiment I'm the Principal Investigator. The short information on experiment you can receive in IKI website: http://iki.rssi.ru/obstanovka/eng/index.htm. Now we have the contract with RSK "Energia" on manufacturing Flight model. The beginning of experiment onboard RS ISS is planned by the end of 2010. In this experiment we plan to decide and educational tasks:

    a. Joint work with INSPIRE. In experiment "OBSTANOVKA" we shall investigate electromagnetic radiation from a few Hertz up to approximately 15 MHz (we have dipole 3 m tip to tip). So here we research also range of INSPIRE frequencies. As we repeatedly discussed with you, it would be interesting to have onboard RS ISS the INSPIRE-receiver.

    b. A part of the information we assume to transfer from onboard RS ISS in a radio amateur range (145 MHz and 435 MHz) in which a number of school radio amateur stations operate.

4. On base the «Kolibri-2000» micro-satellite we plan to realize the Program of the Scientific - Educational Micro-Satellite "Chibis-M" (total mass 40 kg). The short information on the program you can receive in applied in IKI website. This program is international and I would like to find out from you - whether you see an opportunity of participation in it and American schools.

# INSPIRE'S First Years

*Bodo W. Reinisch*
*Environmental, Earth, & Atmospheric Sciences Department*
*Director, Center for Atmospheric Research*
*University of Massachusetts, Lowell*

The first years of the INSPIRE project coincided with the activities of the Radio Plasma Imager (RPI) on NASA's IMAGE satellite which was launched in March 2000. Dr. William Taylor, the co-founder and first president of INSPIRE, Inc., was also one of the drivers for the IMAGE/RPI experiment which for the first time made it possible to transmit VLF signals in the magnetosphere and receive echoes from distant plasma regions. RPI used 500 m tip-to-tip dipole antennas to transmit and receive pulsed radio signals in the band from 3 kHz to 3 MHz. The transmitter power was only 10 W, and even less power was radiated at the very low frequencies (3-100 kHz) by the dipole antennas because in spite of their substantial length they were still much shorter than half a wavelength. When William saw the first plasmagrams recorded by IMAGE/RPI he got excited. The example in Figure 1 shows an annotated plasmagram displaying for each frequency the signal strength versus pulse propagation delay $t_D$. Actually, the vertical axis shows the "virtual range R" (in units of earth radii Re) where $R = \frac{1}{2} c\, t_D$ (c = speed of light). Seeing the FAP (field-aligned propagation traces) William concluded that these signals have propagated over thousands of km and he immediately raised the question whether it would be possible to receive the RPI transmissions on the ground using INSPIRE receivers.

*Figure 1. Planning RPI-INSPIRE campaigns in Bill and Kathleen's home.*

Ivan Galkin and I met with William at his house in Washington DC (Figure 2, Ivan took the picture) to discuss the feasibility of ground observations of the RPI transmission.

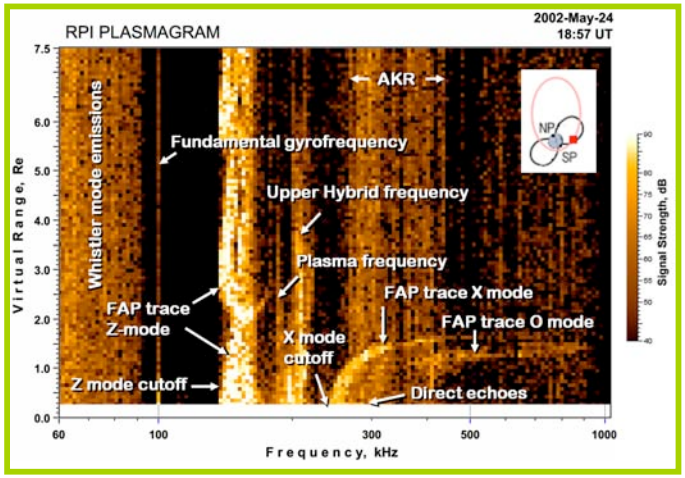


*Figure 2. IMAGE/RPI plasmagram. The insert shows the position of IMAGE (red square) on its orbit (red ellipse).*

Several RPI campaigns were organized in 2000-2004 for INSPIRE VLF receivers at Dunedin, New Zealand that operated in the 300 Hz to 20 kHz band. The RPI VLF program had a repeating pattern of transmitting for 0.125 seconds and then pausing for 0.375 seconds. The transmission started at 5 kHz, with 4 pulses at each frequency, and then jumped to 7 kHz, then 9 kHz, and then 15 kHz. The entire frequency ramp took 12 seconds. The 12-sec runs continued for 4 minutes, then two passive reception programs ran, taking 3 minutes. Then the 4 and 3 minute programs repeated. Total running time of this schedule was 35-40 minutes during opportune times when the IMAGE footprint was close to Dunedin.

Unfortunately our experiments were not successful. The operators in Dunedin were never able to receive the RPI transmission. We were not too surprised since we knew that the leakage of VLF signals through the ionosphere is very small, and more powerful transmitters are required. "If you don't try you can't succeed", William stated.

# DC Space Grant Consortium on The INSPIRE Project

*Richard Berendzen, Director*
*Eric Day, Program Manager*
*Megan Kemble, Assistant Director*

The INSPIRE Project, Inc. became an affiliate member of the NASA District of Columbia Space Grant Consortium shortly before we joined the consortium in the late 1990s. Then-President Bill Taylor welcomed us from the very start. He was an integral, positive force who never saw anything as impossible, and was the first to volunteer to help when we took over the management of the consortium the following year. It is altogether fitting that his life's work was called "INSPIRE." Thankfully his wife (and current President) Kathleen Franzen picked up Bill's torch and ran with it. We are very excited that INSPIRE has branched out over the past few years and begun to offer internships and scholarships in addition to its VLF activities and research. INSPIRE's contributions to STEM teacher training and workforce development in the DC area are enormous, and our consortium owes a lot to INSPIRE's insight, contributions, and partnership. We can't wait to see what the next twenty years will bring.

# Bill & Bill

*Jill Marshall*
*Science & Mathematics*
*University of Texas, Austin*

I first met Bill Taylor and Bill Pine and became introduced to the INSPIRE project through working on the SEPAC (particle accelerator) experiment on the ATLAS 1 Shuttle mission. My interaction with the INSPIRE fueled a budding interest in education and outreach that ultimately led to a redirection of my career from trying to understand the mysteries of the upper atmosphere, in particular the aurora, to trying to understand the mysteries of how people, students in particular, develop an understanding of how the physical world works, and what motivates them to do that.

Early on INSPIRE was a model project, incorporating much of what has since been learned about best practices in project based science learning. Novice learners interacted with professional scientists around authentic science problems of local interest. It is true that the mechanisms of ionospheric radio emissions are fairly well understood, and in a sense not new problems, but the state of the ionosphere at any given time is often unknown and largely unobserved. INSPIRE enabled students to make genuine, real-time discoveries about what was going on in the atmosphere above them. INSPIRE also anticipated the current movement toward engineering education at the pre-college level, encouraging students to build and test their own electronics and design their own observing and documentation systems and procedures. Finally, INSPIRE encouraged and facilitated students "going public" with their data through the INSPIRE Journal and other venues, in what we now recognize as a critical culminating step in science learning.

Bill Taylor and Bill Pine were both very special colleagues, with lifelong dedication to the science education of young people, and especially to the INSPIRE project. I have no memory of Bill Taylor in which he was not smiling, cheerful and excited about what he was doing. Once he had offered to meet me while I was in Washington on for a meeting. We had planned to meet in the lobby of the hotel where I was staying. This was in the days before cell phones and when my flight was delayed by several hours, I had no way to let him know I would be late. As the shuttle from the airport approached the hotel I was considering how I could ever explain, but on entering the lobby, there was Bill, looking up and smiling. He had waited well over an hour, but assured me it was no problem because he had brought work (plans for a Girl Scout INSPIRE rally) with him. Likewise, Bill Pine once flew to San Antonio to help me administer an INSPIRE workshop on one of his precious school holidays (a fact that I appreciate more and more as a teacher.) I count both of these remarkable men as friends as well as colleagues, continuing sources of guidance and inspiration to me as a physics educator. They left the enduring stamp of their influence on the INSPIRE project, even as it made its mark on so many others, students and professionals alike.

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# A Couple of Memories of Bill

*Dr. Scott Boardsen*
*NASA Goddard Space Flight Center*

Bill loved his jaguar, which was always in the repair shop. I remember one day when Bill had just got his jaguar back from the shop and had it parked in the building 26 Lot. A colleague George bumped the jaguar's fender while parking his pickup truck, putting a small scratch in it. Immediately ratted George out to Bill. Bill, keeping a smile on his face, said that he would let it slide, because George has an old guy and Bill didn't want to stress him out. Bill was very kind and gracious.

Bill always seemed to be picked out of the crowd and given special attention by security. For example, in the summer of 2000 after the successful launch of the IMAGE spacecraft, Bill, Jim Green, Shing Fung, Leonard Garcia and I were traveling to Lowell, Mass. to visit Bodo and company. All of us passed successfully through airport security, except Bill. I remember Bill standing there wearing his suspenders arms and legs spread out, while security was passing the wand over him. We all were laughing, after about 5 minutes they let him through.

*IMAGE pre-launch, March 2000*

## Memories from INSPIRE's Youngest Goddard Intern

**David Robinson**
***Yale Law School***
***Class of 2012***

It's a pleasure to think back on my summer at Goddard, and Bill's remarkable generosity in taking a chance on me at such an early stage. I'm not sure how my story fits in, given that Bill did very much inspire me, but did so outside the framework of the INSPIRE program.

What I remember from that summer is that Bill brought a sense of adventure, possibility, and even glamour to the science he worked on and the team he led. Goddard could, on some days, seem like quite the lumbering bureaucracy. Bill's gift of leadership was to cut through all that, and to let each of us, down to the youngest interns, understand ourselves and our work as part of NASA's mission of discovery.

*In the summer after his freshman year in 1997 David Robinson was INSPIRE's youngest Goddard Intern. It turned out to be a very positive successful model to INSPIRE's mission of advancing education and public outreach.*

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# INSPIRE Educational Programs & Opportunities

## DR. WILLIAM W.L. "BILL" TAYLOR MEMORIAL SCIENCE SCHOLARSHIP COMPETITION

**Scholarship Awards: $5,000 per recipient**

In honor of The INSPIRE Project, Inc.'s Dr. Bill Taylor, The INSPIRE Project, Inc. with its partners at the DC Space Grant Consortium, NASA/Goddard Space Flight Center and other science and technology organizations established this annual science scholarship competition. Scientifically oriented undergraduate and graduate college students and high school seniors who will be attending a DC metro area college or university in Fall 2010 are encouraged to apply.

### Competition Objectives

This competition seeks to encourage students to conduct individual or group research that will focus on Space Physics, Astronomy, Meteorology, Geology and other Earth Sciences. While designing projects identify how it has a connection to INSPIRE's Very Low Frequency study of natural or manmade phenomena. Judging of research projects based on the criteria below:

- Creativity and design of the project
- Clear project goals and the methods used to accomplish those goals
- Analysis of project results and their relationship to project goals
- Clarity and quality of the project's written report
- Clarity and quality of the project's presentation (finalists only)

*Complete information and application are available on the INSPIRE website.*

## THE INSPIRE PROJECT, INC.
## PAID NASA INTERNSHIP PROGRAM

**Internship Awards: $5,000 per recipient, plus travel stipend**

With support from NASA Goddard Space Flight Center, The District of Columbia Space Grant Consortium, Aries Scientific and Woman Friday, LLC, The INSPIRE Project, Inc. in conjunction with the Dr. Bill Taylor Memorial Science Competition is proud to offer the Paid NASA Internship Program.

### Internship Description

The INSPIRE Project, Inc. is sponsoring part-time, paid internships at NASA Goddard Space Flight Center. Two (2) part-time paid internships are available.

Students will be paired with a mentor at NASA Goddard Space Flight Center. Each student will work with their mentor to design a project that they will work on throughout the duration of the internship. Internships at NASA Goddard Space Flight Center will be focused on science and engineering research.

### Hours & Compensation

Interns will work approximately 15-20 hours per week, and will be paid $5,000 after successful completion of the internship. Additionally, interns will receive a $400.00 travel stipend to aid in their commute to NASA Goddard Space Flight Center.

**For complete information on INSPIRE opportunities, events and programs, please visit: www.TheINSPIREProject.org.**

*Questions? Email Kathleen Franzen at president@TheINSPIREProject.org or call 202.547.1364.*

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## The INSPIRE Project, Inc.

# SPACE ACADEMY FOR EDUCATORS SCHOLARSHIP PROGRAM

### JULY 2010 NASA Marshall Flight Center, Huntsville AL

### Application Deadline: June 1, 2010

The INSPIRE Project Inc. has teamed up with the NASA Marshall Space Flight Center, U.S. Space & Rocket Center in Huntsville, AL, and Washington Space Business Roundtable and is offering 6 full scholarships to Space Academy for Educators.

Space Academy for Educators is a 5-day program offered every summer in July for teachers from around the world to come and participate in 45 hours of intensive classroom, laboratory and training time, focusing on space science and space exploration. Teachers also take part in astronaut-style training and simulations, as well as activities designed to promote life-long learning in a classroom setting. All lessons and activities link to National Science and Math Standards and are ready to use in the classroom.

**Workshop topics/activities include:**

- Engineering Design Challenges
- Rocket Construction
- Math Workshops
- Living and Working in Space
- Orion Spacecraft and Ares Launch Vehicles
- Space History
- Hydroponics
- Mars & the Moon

Teachers participate in two simulated Space Shuttle Missions, simulate walking on the Moon and working in the frictionless environment of space on Astronaut Simulators, and weather permitting spend an afternoon at Aviation Challenge simulating parachute landings and helicopter rescues in the water.

**INSPIRE Scholarship Includes:**

- Roundtrip airfare from the DC metro area
- 6 Nights lodging & meals
- Meals (Monday breakfast through Friday dinner)
- Program materials, flight suit, t-shirt and tote bag
- Transportation to/from
- the airport

For more information on the Space Academy for Educators program,
visit: http://www.spacecamp.com/educators/profdev/weeklong/eduacad.php.

***INSPIRE educational opportunities and programs are made possible through the generous support of the following organizations:***

# THE INSPIRE PROJECT HOSTS EDUCATOR WORKSHOP

## *Teaching Science with an Enthusiastic Attitude*

On 2 October 2009, The INSPIRE Project teamed up with the State Office of Career and Technical Education, Office of State Superintendent of Education (OSSE), DC Space Grant Consortium, and Gallaudet University to host Teaching Science with an Enthusiastic Attitude Educator Workshop. The daylong workshop, hosted by Gallaudet University, was very attended and received by middle and high school educators and administrators from the Washington metropolitan area.

The underlying goals and objectives of the workshop were to explore strategies and techniques for explaining science concepts and teaching in fun motivating ways, help prepare students for postsecondary success in STEM areas. Participants received INSPIRE VLF (Very Low Frequency) Radio Receiver Kits to utilize in their classrooms giving students the opportunity for a hands-on science experience. Below is the program:

**Partners:**
Julia Martas, State Office of Career and Technical Education - Office of State Superintendent of Education (OSSE)
Dr. Henry Snyder, Acting Physics Department Chair, Gallaudet University
Eric Day, DC Space Grant Consortium

**Teaching Strategies: What Do You Currently Enjoy About Teaching Science?**
Kathleen Franzen, President, The INSPIRE Project

**NASA's Radio Jove Project: Interactive Hands-On Observation and Analysis of Natural Radio Emissions of Jupiter, the Sun, and Our Galaxy**
Dr. Leonard Garcia, Heliospheric Physics, NASA/Goddard Space Flight Center Jay Friedlander, Senior Multimedia Specialist, NASA Goddard Space Science Visualization Studio

**Space Science in the Classroom & Educational Outreach Programs**
Dr. Lou Mayo, Planetary Scientist, NASA Goddard Space Flight Center

**Preparing Students for Postsecondary Success in STEM Areas**
Carolyn Ng, Co-Manager, NASA Sun-Earth Connection Education Forum Team & Earth and Space Education
Specialist, NASA Goddard Space Flight Center

**INSPIRE Pilot Course Overview: Chasing Lightning: Sferics, Tweeks and Whistlers & Very Low Frequency (VLF) Radio Receiver Overview**
Paul Schou, Research Analyst/Teaching Assistant, University of Maryland, Baltimore County (UMBC)

**South Pole Experience & Science Educational & Public Outreach**
Dr. Robert Benson, Astrophysicist, NASA Goddard Space Flight Center

**Space Camp for Educators Program Overview (Huntsville, AL) – Professional Development & Implementation Strategies**
Ellen McLean, Physics, George C. Marshall High School
(INSPIRE 2009 Scholarship Recipient)
INSPIRE Space Camp Scholarship Opportunities
Kathleen Franzen, President, The INSPIRE Project

**INSPIRE would like to thank all of the partners and guest lecturers for their very creative and motivating presentations and participation!**

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# An Analogy Between Architecture Study & Electromagnetic Waves


*Dr. Paolo Trovanelli*
*INBEAX Radio Amateur, Trento, Italy*


*Sagrada Família in Barcelona, Spain*

## Preamble

*Dear Ms. Franzen of The Inspire Project,*

*You asked me if, in my opinion, there exists an analogy between my architecture study and the electromagnetic waves. Let me say upfront that I got a degree in architecture (after a 5 year program of studies) with a specialization in history of architecture and urbanism. My research thesis dealt with the district of Battery Park City in lower Manhattan, New York.*

*Honestly I do not see many correlations between architecture, and more in general urbanism, and the passion for electromagnetic waves… Did I make a bad choice about my career? (The answer is yes). Now that I think about it, I should have been a telecommunication engineer and pursue my young passion: electronics.*

*I believe a good architect should be able to think in three dimensions so that he can represents volumes in two-dimensional sheets of paper. But there aren't many people who can claim to possess this 3D mentality (I am not one of them for sure). For example, the architect Fuksas gets inspiration from the shape of clouds to create fantastic architectural projects. Maybe he would be able to be inspired by a VLF spectograms which are made of many whistlers, tweaks, chorus, and create original skylines or new fancifully shaped buildings, skyscrapers, and constructions nobody has ever seen before.*

*When an architect does not have this 3D skill, he or she generally becomes a good graphic designer, works in advertising, creates interior design projects, choreographies, paintings; I have tried them all, with no success. I do have a good and firm hand, but I prefer to design radios, electronic circuits, antennas, etc.*

*Anyway, regrets are not useful, so now I just enjoy my radio amateur certificate and I keep pursuing my ancient passion for electronics, and in general, radio waves. I try to keep on studying, researching and building simple circuits and electronic radio kits (one of those is the very beautiful US VLF-3!).*

*Paolo Trovanelli*

Among all ancient civilizations, the ancient Egyptians are probably the ones who built structures not only for an ordinary pleasure, but with a thought about life after death. The pyramids, for example, an artistic splendor admired by many tourists nowadays, because of their dynamic shape, appear more likely to be launch pads for the soul of the pharaohs then simple honorary thumbs… Something similar to antennas transmitting thoughts beyond our present life in the hope of reconnecting with our celestial origin among the stars.

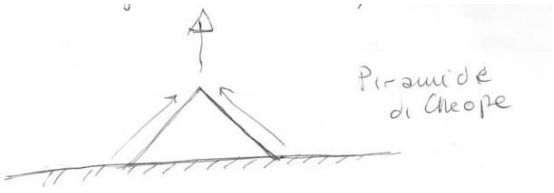


*Figure 1: Cheope Pyramid*

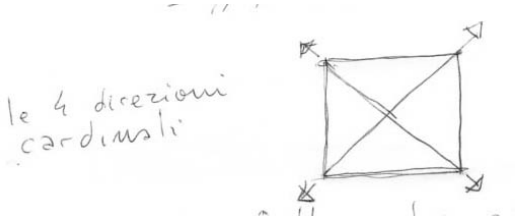


*Figure 2: The 4 cardinal directions. The pyramid seen from above.*

Perfect shapes, designed to challenge the flow of time, to remain eternal in the future! In the defunct chamber of the pharaohs there are 5 virtual chambers that appear to have no function other than unburden the structure. In my opinion though, their function is merely symbolic. Like the radiators of a Yagi antenna whose function is to transmit along a precise direction and re-direct the electromagnetic waves, the Cheope pyramid is intended to direct the soul of the pharaohs towards the Paradise.

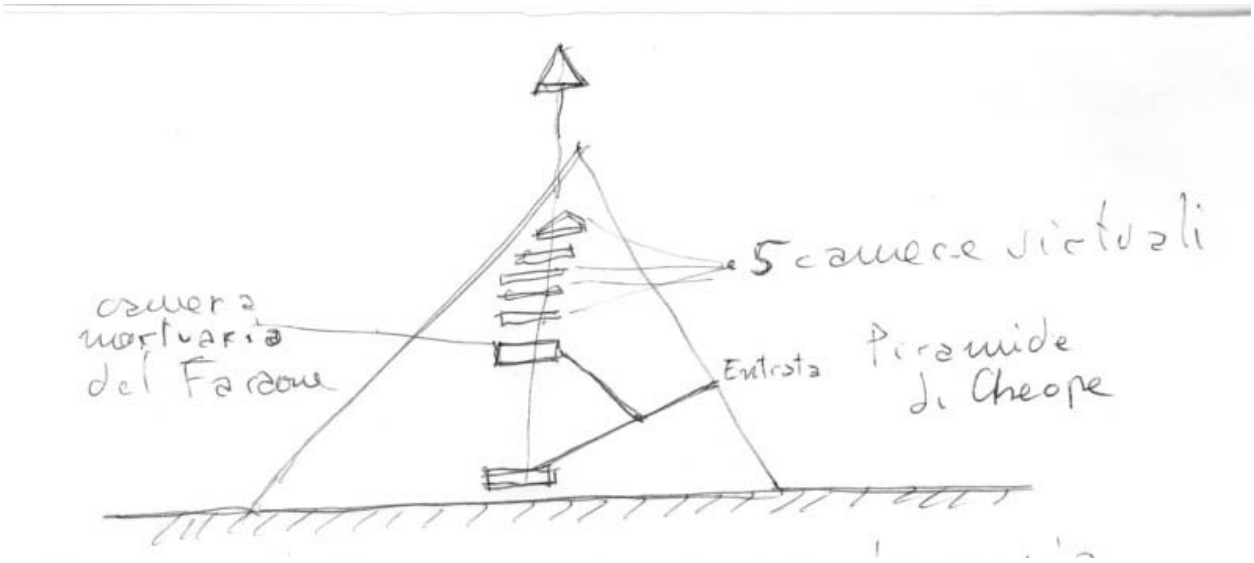


*Figure 3: (Left) Chamber of the defunct pharaohs (Right top) Five virtual chambers (Right center): "entrata" = entrance; "Piramide di Cheope" = Cheope pyramid*

If my theory is correct (according to the Egyptian Zed) the Egyptians, expert in life beyond the life, could have already discovered, more than 5,000 years ago, that they lived in the 7th dimension. Indeed, the chamber where the pharaohs are buried is located on the 7th level – and that the total number of dimensions in our life is 12. In this context, the number five would represent the number of levels necessary to reach the Heaven. This would explain the existence of the five virtual chambers (one for every existential dimension) above the chamber where the pharaohs was buried. The first chamber represents the lowest level which attracted the profaners and from which the Egyptians aimed to escape. But if this is the case, there should be 5 additional chambers in between the lowest chamber (the first) and the pharaohs' chamber. These are totally unknown to us:

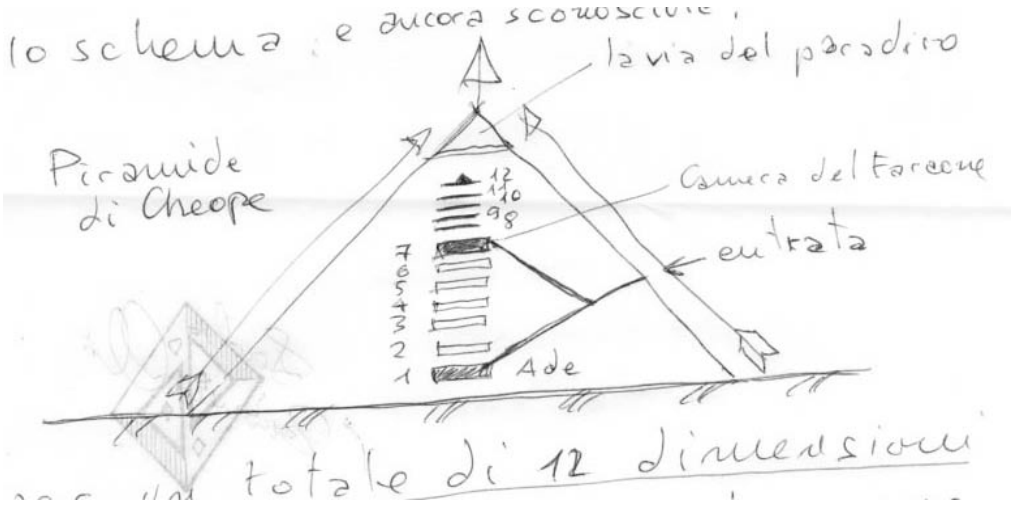


*Figure 4: (Left) Pyramid of Cheope (Right top) The way to Heaven (Right center) Chamber of the pharaohs & entrance (Right bottom) "Ade" = Hell*

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The diagram explains the configuration of the 12 chambers and corresponds to a total of 12 existential dimensions. Maybe these virtual chambers do not exist, maybe they exist and they are either full or empty.

The Egyptians did not know the electromagnetic radio waves, but with their architecture they attempted to transmit their thoughts towards the Universe, maybe in search of their origin or depart from their souls towards the Heaven?

Because of its design, the pyramid itself is considered by many as an instrument to transmit our thoughts towards the unknown in search for our most ancient origin among the stars. Aren't the pyramid lines similar to the branches of a modern ground-plan antenna?

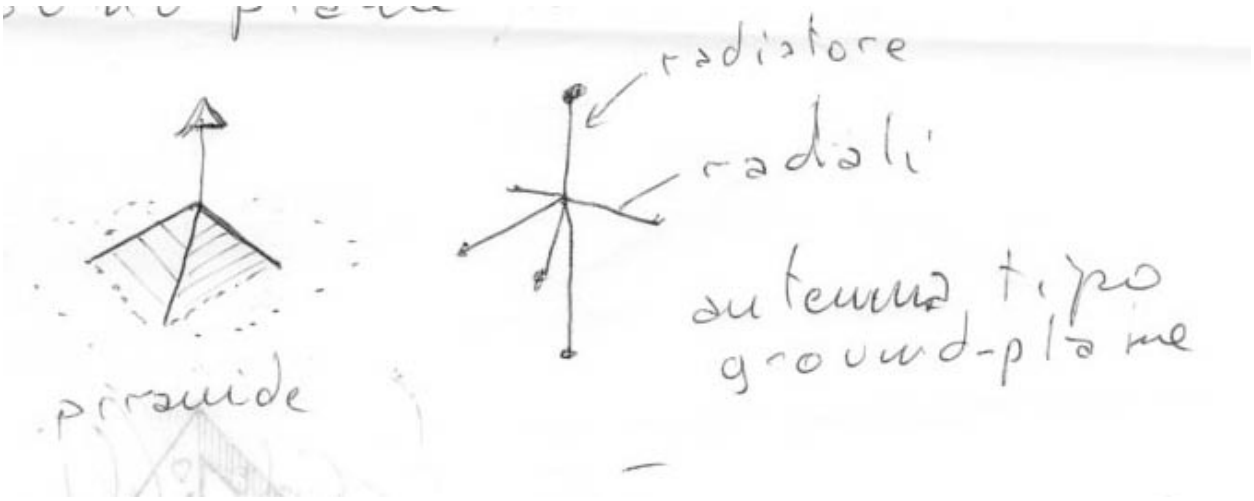
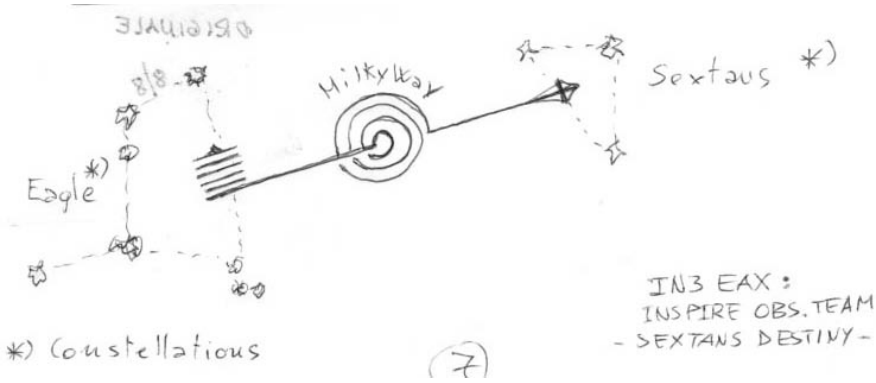



*Figure 5: (Left) Pyramid (Right) Ground type antenna*

I am intrigued by the fact that the electromagnetic waves can be considered as a record of our history, like a journal dating back to the primordial origins (back-ground cosmic radiation or cosmic noise back-ground) or a black-box used to register the events of an airplane crash, containing the history of our universe from the big bang to the present times.



# How to Assemble and Use the VLF-3 Receiver During the ISU Summer Sessions

*Joachim Köppen*

Every year, the International Space University holds a two-month summer school for students and professionals from all over this Earth who are interested to learn more about all aspects of space exploration and activities. They come from all disciplines and backgrounds. During this period they attend lectures and workshops, and all of them work together on one of several projects. Part of the time they join a 'department' of their choice and pursue activities therein. Since 1992, one of the regular activities in the Physics Department has been for the students to assemble a VLF receiver and record and analyse the sounds of natural radio. This teaches them how to build an apparatus which permits them to hear sounds they have never heard before, some of which come from space! In this article I discuss our ways of using the INSPIRE kit and report some of our experiences which might be helpful for similar activities.

## Preparations

Usually, we have about 10 participants – in 2009 we had 22 – so we use 10 kits, kindly procured and brought to the site by Dr. Jim Green, who also gives lectures at the school. Thus, the kits and our box with tools are ready at the start of the activity…

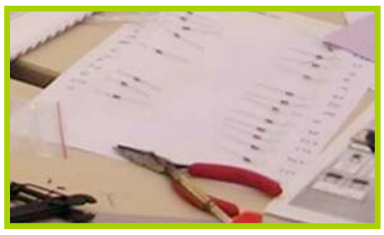
The first thing is to prepare the workspace: it is very useful to group the students around a large table, with the power sockets for the soldering irons in the middle, along with some tools and material which they can thus easily share. Facing each other also offers them the possibility to chat, discuss problems and ask questions to each other. Of course, the size and shape of the room, the position of the power outlets on the wall, availability of extension cables, and the size of the tables dictate the arrangement of the tables. The tables should also be placed such that each seat has free access, so that the instructor can easily reach any workspace to help the student.

Another, separate table can be set up with any additional material, such as test instruments and spare parts. Sometimes, we also have a separate station with a more powerful soldering iron for any repair work.

*The tables are set.*

Each work place is provided with a table-mat, to protect the table's surface against drops of hot solder and dirt – we usually place old journals there. Then there is the kit, the assembly instructions, and soldering iron with its stand. In the center, there are communal tools, such as wire strippers, small pliers, diagonal cutters, and the yellow wet sponges to clean the soldering iron's tips.

One important item is a sheet of paper on which all the resistors are fixed with a strip of scotch tape and labelled with their value. Since it is not the primary aim of the workshop to teach the resistor's color code to our participants (and most of them will never be faced with it again in their life), we do not want them to spend their time decoding the resistor values. However, we also provide a list of the resistors with their colors, just in case…



*Labelling the resistors by their values facilitates assembly.*

All other components are left in their bags. The explanations and identifications as given by the VLF-3 Assembly Instructions are found to be completely adequate. A good magnifying lens can be very helpful to read the very small numbers and letters on some capacitors!

Finally, it is very useful to have one assembled receiver which shows the participants how the finished product would look like and how the components are placed.

`

In 2009 we had twice as many students as we had kits, so we asked them to work in pairs, and placed them at the corners of the table. Here we had also covered the tables with brown paper for extra protection:

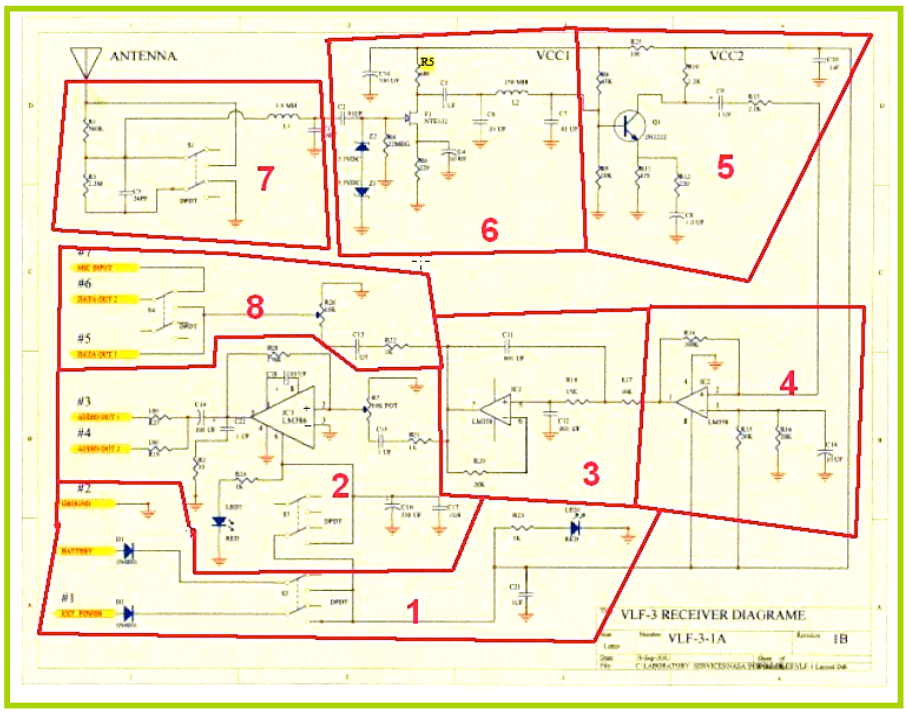
## The Assembly

*Four teams share a table and help each other.*

After a presentation of VLF techniques and sound examples, we start with assembly. However, we prefer to do it in a somewhat different sequence than described in the VLF-3 Instructions, because it greatly facilitates testing and an eventual fault-finding: The circuit is divided into eight sections, and:

- Every section is assembled and tested before proceeding to the next one: in this way it is easier localize any malfunction.
- The circuit is built starting at the output end: testing is done by listening to the output. As the other sections are added, the receiver becomes progressively more sensitive, and this can also be verified.
- We also emphasize to our students that the workshop is not a speed contest, and everyone should do it at one's own pace and do a careful job! If needed, extra time to continue the work can be arranged!

The different sections are identified in the circuit schematic:




*Sections of the VLF-3 receiver circuit*

We start with Section 1, which is the placement of the battery holder and make the connections which supplies power to the circuit board. This first step we do all together, with the instructor identifying the various components, explaining where and how to place them, and giving detailed advice to each student. The test is simply to put in the battery, turn on the receiver power switch, and see the associated LED lighting up. Either they enjoy a splendid and encouraging success, or we have to fix a small problem …

`

Section 2 is the final audio amplifier, the Audio Level control and the Audio Power switch. We make a provisional connection to the Audio Output socket, using two of the wires. This is practical, as we shall need to listen to the output in all the next tests. And we make sure that we install the IC socket in the correct orientation… The test is to connect an earphone or a small loudspeaker with amplifier (one of our test equipment), turn up fully the Audio Level control, and touch pin 2 of the LM 386 IC or the "hot" solder lug of the potentiometer with the finger or a screw driver. One should hear a hum from the mains supply or at least a click when the screw driver touches.

Sections 3 and 4 are the audio preamplifiers which serve as low-pass filters. Since both sections deal with the same IC, it is best to complete them together. By now, the students acquired a good competence and confidence that they complete this part without problem.

The test is to touch pin 2 of the LM 358, which should give a much louder hum or noise.

Section 5 is the low-noise amplifier stage, with the transistor Q1 already in place. The test is to touch the centre pin of the transistor, or the point where R8 and R9 meet, and the hum should be even louder. Often, it suffices to approach this point with the finger, and a faint, airy or 'spacey' hum would be heard.

Section 6 is the high-impedance front-end amplifier with the FET F1, already in place. As test we may touch the 'hot' end of the back-to-back Zener diodes, or merely come close to this section to hear the mains hum. If someone has a quartz-controlled wrist watch whose pointers are moved with a small electromagnet (like a SWATCH), holding it next to the FET will let the second ticks be audible in the earphone. This crucial test shows that the receiver has attained its proper sensitivity.

Sections 7 (the switch close to the antenna.terminal) and 8 (Data Level control and the Mic./Data switch) finish the assembly of the circuit board. Testing will be done after the board is attached to the front panel and all connections are done: now the antenna terminal should be as sensitive to the touch by a finger as the previous test of Section 6. One follows the Assembly Instructions for placing the circuit board to the front panel and making all the connections. This integration may be a bit tricky, but with some gentle push things do slide in place.

As antennas we usually attach a suitably stiff wire to the antenna terminal, and instruct to always firmly touch the BNC socket or the face plate, as to provide a good earth connection. From another activity, we had multi-stranded copper wire to make dipole antennas. A 40 cm long section of this wire is sufficiently stiff to keep reasonably straight. This length suffices to pick up natural radio waves, if one holds up the receiver.

*Marta listening to tweeks on Mt. Hamilton (with our last VLF-2)*

## Experiments for Tests

When the first receivers are finished and an antenna is fitted, we do some testing inside the room, listening at various sources of electric noise: computer screens, fluorescent lamps, the power lines in the walls, the liquid crystal display of portable phones and personal organizer emit funny sounds when activated … Listening to these noises and identifying their sources can make up one interesting exploration of its own. Here, students can realize how our electric and electronic-based civilisation pollutes the electromagnetic spectrum, which is a valuable resource!

Then, we step outside the building, and even the adjacent car park can be sufficient to pick up sferics … and hum from street lamps, of course. But also, one can hear one's footsteps while walking: the friction of the shoe soles with the pavement which is of a different material causes the build-up of electrostatic charges with subsequent discharges. Tiny as these may be, the VLF receiver is sensitive enough to clearly pick them up. Even noisier is it to walk over dry grass!!!

A good test position to listen to sferics is an open space, at a good distance from buildings – with all their electric noises – but also away from trees and large bushes; as these water-bearing structures absorb radio waves. Approaching a tree or standing under its branches lets all the sferics disappear, and one hears only the hiss of the receiver's internal noise. All these tests verify that the assembled receiver works as it should be.

`

## Our Experiences

With the preparations and our assembly procedure, we find that the students complete and test Sections 1 and 2 within about two hours, some of them proceeding to Sections 3 and 4 at the end of the first half day. In Beijing in 2007, the session was in the afternoon, and one student got so excited and taken with her job, that we continued after dinner, and finished that evening! At the end of the second session, almost all finish their assembly, some of them only need to tighten the screws and do final testing. The complete assembly takes about 7 hours for everyone. Some common problems were noted:

As tools we found useful:

- A box with an audio amplifier driving a small loudspeaker. This is convenient for the tests during assembly, allowing several persons to hear the outcome. It is connected with an audio cable to the receiver's output socket, which is attached to the circuit with two wires in a provisional way.
- A digital and an analogue multi-meter to check voltages and resistor values.
- An instrument to measure the sensitivity of audio devices (to be described in a forthcoming article). While this is not absolutely necessary, we have found it helpful to quantify each receiver's sensitivity, as a significant variation of the performance had been noticed between individual sets despite the absence of any obvious difference in the finished device or the workmanship.
- Tweezers are very helpful especially when pulling a component from the board. It allows a secure and firm grip of the component lead while reheating the nearby solder joint, but without burning the fingers. Also it serves well when pushing a lead through the solder-filled hole on the board when replacing a component.
- A steel sewing needle with a wooden handle is a great tool to re-open a solder-filled board hole: while the solder pad is reheated, one inserts the needle and keeps it moving until the solder cools off. As the needle is of steel, solder will not stick to it.

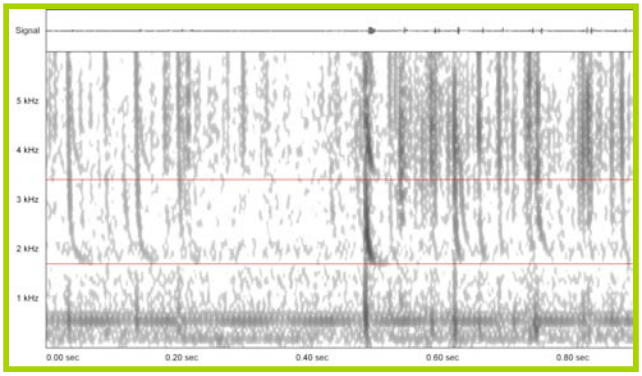
Another technique of removing solder from a pad and re-open the hole is the 'earth-quake' technique: heat the solder pad, until the solder is well liquid, then rapidly and forcefully bang the board against the table-mat! Very effectively, this will remove all solder from the pad except for a thin coat. Of course, one has to make sure that this somewhat brutal method does not bend or damage anything on the board!

*Reopening a solder filled pad can demand serious concentration.*

As a result of careful preparations, continuous testing, and the concentrated and dedicated work of the students, each of the receivers worked properly and everyone could start listening to the signals of Radio Nature. Time permitting, in a final presentation the sound analysis software (Spectrogram by R.S. Horne) is demonstrated by sound examples and using a microphone to whistle and sing.

## Observations

During the two months of its duration, the summer sessions are already filled up with many interesting but also demanding activities, including the students' team projects. Hence, the students cannot devote much time to intensive listening with their receivers. A few years ago, the time frame for the departmental activities was reshaped into a tighter layout. Thus, now there is little time for regular, extensive, and systematic observations which would be the key to detect whistlers. But we make it the point to arrange for a listening session during an excursion. Also we take up any other chance to go out in small groups, and spend some time together, listening, make recordings, and perform experiments. In 2009 we were hosted by NASA Ames Research Center, where the car park just outside our building provided an ideal testing ground, sufficiently low in hum to let everyone hear spherics, showing the decreasing hum as we walked away from the building, with some trees under which the spherics became inaudible, noisy street lamps, and lawns nearby to hear the crushing sound of our footsteps. One evening, some of us went




*Tweeks recorded, the two horizontal lines mark 1.7 kHz, near the ionospheric cut-off, and 3.4 kHz.*

`

to the baseball fields and enjoyed a loud concert of tweeks. Later, we found that we could easily locate underground power cables. An evening trip to Lick Observatory gave all the students the opportunity to hear tweeks. One recording is shown below.

Interestingly, we caught a very strong tweek which also shows up in the first harmonic (at 0.5 sec), weaker ones but also with harmonic (at 0.05 and 0.15 sec), and a pair of tweeks (at 0.65 sec) which differ in their slope, evidently coming from two different distances! Below about 600 Hz, the mains hum – here on the top of Mt. Hamilton – was as strong as in the car park back at our campus!

Below, our student Yuhua wrote up her impressions of her work in the 2007 SSP in Beijing:

### *An Interesting Receiver*

*On July 26th, 2007 I was very happy, because I finished my department's work - assembly of the VLF-3 receiver kit, and using my receiver I heard many kinds of radio noise from electrical equipment. This is not an easy work, usually it may need two days to finish: It contains 30 resistors, 22 capacitors, 4 diodes, 4 switches, 2 integrated circuits, 2 transistors, 2 inductors, 2 LEDs, and connectors, wires etc. But I worked very hard, with Prof. Joachim Köppen's help; I completed it within the afternoon and evening.*

*Joachim required us to do our assembly step by step. This receiver consists of eight sections. The first section is the power supply and one LED. By following the schematic diagram I finished that work in about one hour. Then we tested it: I turned on the switch, it worked properly. This encouraged me! I worked continuously without a rest, and I finished the assembly of the circuit board just before dinner time. Right after dinner, we started the mechanics work on putting the board onto the faceplate and in the box. There was some difficulty in my work, but we finished all the work at last!*

*With Joachim's help, I first heard the radio noise from the fluorescent tube - this is my first time to hear the sound of a lamp. When the antenna comes near the lamp, the sound becomes louder. Then I put my mobile phone near the antenna, and I heard its radio noise. If you dial, the sound becomes loud. The fire detector, the computer... all emits radio noise! Joachim explained to me why I could hear the sounds. They come from the electromagnetic emission of the source, which the receiver converts into audible sounds.*

*Then we walked back to the dormitories while listening to the receiver all the time. On the way through the campus, the first interesting sound was my shoes. As the shoes scrape the ground, radio noise is produced. The second sound was made by all the streetlamps - every type of lamp has its own sound; the brighter the lamp is, the more noise it makes. As we were talking about the reason for the noise, a very loud sound came out of the receiver. It was just like a truck passing by - in fact it was just a bike passing by: the tyres scrape the ground, and thus make electromagnetic noise. But not all bikes make noise, because their wheels are not the same.*

*I used the receiver to test my portable computer, my reading lamp, the air conditioner, the water heater ... every electric device has its own electromagnetic sound. Using the receiver you can discover and listen to many interesting sounds. It is an interesting receiver.*


### Acknowledgments

*It is with really great pleasure that I thank my friend Jim Green for having 'infected' me with the VLF virus, and for the inspiring and smooth collaboration to run these workshops.*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# Field Observations *Trento, Italy*

*Dr. Paulo Trovanelli*

Saturday 25 April 2009.

My brother Carlo and I left Trento at 10:00 a.m. and arrived in Vason, a place about 15 km from Trento, at the Monte Bondone Ski Resort. From Vason, we hiked about 1 hour with our equipment until we reached our listening point. It was at the edge of a ridge on a cliff that overlooked the valley of the Adige River, about 1800 meters above sea level. Despite the dangerous site, there is a beautiful panoramic view of the city of Trent surrounded by the crowns nearby mountains (see photo).

My brother and I quickly set up the radio station which consisted of the antenna, VLF-3 receiver and line-side. The site chosen had the qualities of a very good reception area because at the high altitude. The altitude combined with the difference between the plane of the Adige valley, acted as a "ground floor," and the position of the post right on the crest of the cliff, allowed the signal to increase its vertical extent in its virtual length, resulting in the strong enhancement of radio signals received.

Last winter the Alps were covered in snow, over 2.5 meters of snow on Bondone. In fact, the location of our listening post still had snow on the ground. But during our time here the sky was bright and clear. The cumuli, altocumulus and cirri clouds all painted a fantastic, serene portrait in the sky!

Typically there are flocks of ravens in the high mountains, vaulting in the high altitudes between neighboring steep cliffs. But today the sky was sold to the weekend sports fans, this was apparent to many of us. The paragliders, which passed over our heads emitted a hissing sound with their wings and were perhaps looking at our radio antenna, trying to communicate with us on some channel of the aeronautical band in vain. After a while we welcomed the beating of their wings and left.

Saturday was very unusual and unexpected because even in the high mountains we were never alone! What a crowd! It was truly beautiful!

## Amateur Radio Technical Notes

I for the first time experience on this occasion for the first time the second line of the entry of my VLF-3 receiver, through the clamp screw on the front of the VLF-3 receiver and that I have NOT connected to the antenna BNC as per original schedule.

With a switch to two-way lever is switched on the clamp screw, connect directly to the gate of the Fet line of antenna #2 and on the position at BNC cone filters in series and LORAN Broadband, in the original line antenna input of VLF-3.

In series to the line of antenna # 2 (see photo), I added a stiffness of about 3 Henry with the goal of lowering the scope below 100KHz around the resonance frequency of the antenna itself.

Also for the new line of antenna # 2 I have also completely removed the resistance R4 22 Mohm, used as protection and for the polarization of the gate of the Fet. Unexpectedly, the receiver also works equally well and with an exceptional sensibility (I assume that the gate of the Fet is still polarized dall'altissima resistance of the junction of the two zener Z1 and Z2), always removing the line for antenna # 2 then the capacitor C2 from 0.01 pF in series at the Fet is still significantly increases the sensitivity input of the receiver, especially at frequencies more low, to receive very good static electric field!

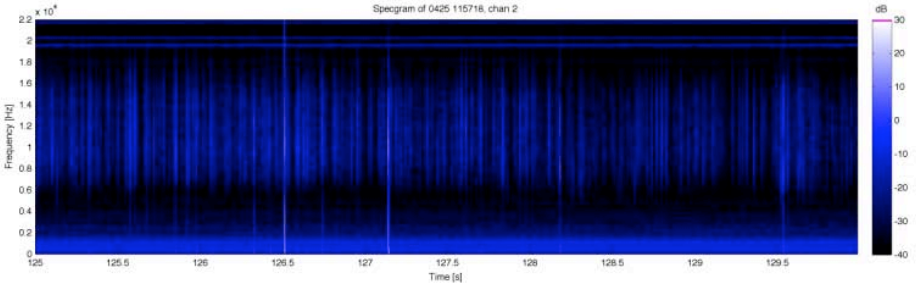
I have protected the antenna input of the VLF-3 by the electrical surge and spikes from some type unloaders Siemens gas between the clamp screw and the mass for the # 2 but also on the BNC input of the d ' I have an antenna inserted to drain the gas mass. I left as polarization and protection for the gate of the Fet the two opposing zener Z1 and Z2.

`

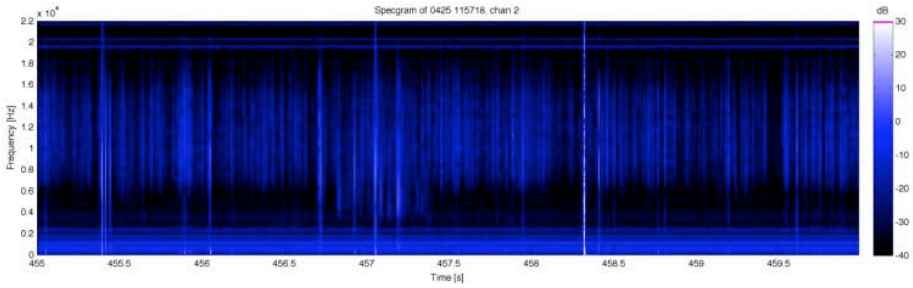
I believe that in the presence of strong local thunderstorms and lightning and/or the presence of strong network hum at 50Hz (60Hz for the U.S.) it is recommended to always use the line input in the original pattern of VLF-3 and the taking of land always well connected.

With this configuration (# 2) the receiver proved too sensitive to the static electric field to capture the buzz of the network cable cabin of arrival of the chair lift to more' than 100 meters away (see photo) and the knob of the sensitivity 'of the line output for the recorder to almost zero (see photo). Incomprehensibly, April 25 I received ancient static, despite the clear skies, a prelude of flooding and violent storms that hit the north of Italy in the days following!

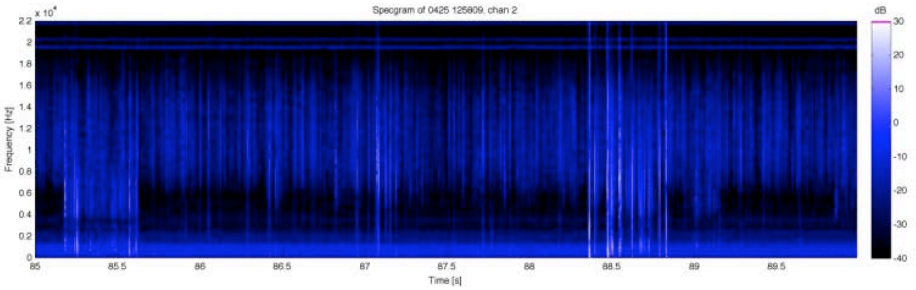
The listening session, 25 April 2009, with a line of antenna # 2, the receiver has received some powerful military radiotelescriventi from distant places, above the 16 KHz to beyond 21 KHz. Although the main filter is changed to low intermediate Pi-Greek, my VLF-3 receiver was not been modified by me in any way and we can see that the signal received from the antenna was really strong!



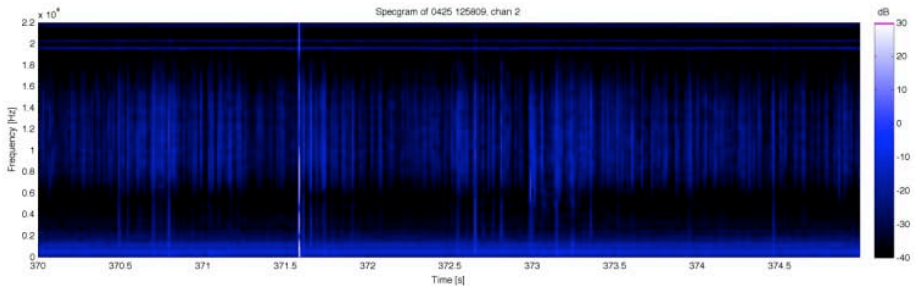

*Spectrogram 1*
*April 25, 2009, 1159 UT*




*Spectrogram 2*
*April 25, 2009, 1205 UT*




*Spectrogram 3*
*April 25, 2009, 1259 UT*




*Spectrogram 4*
*April 25, 2009, 1304 UT*

In conclusion, I am very grateful for that experience. The VLF-3 receiver from the field showed great sensitivity, with lower noise and distortion.

To achieve results from my VLF-3 receiver, I also used metal film resistors and capacitors, polyester film and aluminum high fixed thermal tested one by one. The digital recorder also proved versatile and easy to use and records linear from 20 to 40 kHz with low noise and up to a resolution of 24bit at a 96 KHz sampling rate.

I think my receiving station proved the VLF-3 receiver to be truly versatile and efficient. To improve the VLF-3 receiver, I would lower the frequency of resonance of the line antenna to fewer than 18KHz and implement a new experimental VLF receiver kit, with antennas and other accessories.

Perhaps the clouds and the late hour (13:00 local BST) were not very favorable and did not allow me to pick up radio signals of interest, such as: natural tweeks, whistlers, etc.

In fact, as everyone knows these signals are received especially better during the more cold hours of the morning and at dawn (6.00 am - 7.00 UT approx).

At home I have analyzed spectrograms on my computer and since I am interested in architecture I noticed similarities between spectrograms and architectural structures. For example, the various skylines of Manhattan, NY the Sagrada Familia of Antoni Gaudi in Barcelona are similar to the jagged vertical lines found in many spectrograms.

It is very interesting to note how often the boundaries between disciplines: for example the study of electromagnetic waves for radio amateurs and the architectural and urban design for engineers and architects are not so far away from each other!

Over time some famous architects and urban planners used various natural events for inspiration in designing their works. Thus, in the spectrograms of natural VLF waves we can catch a glimpse of some essential features that distinguish different architectural styles. We can learn to discern and recognize the existing and perhaps lead us to find new ideas and inspirations to create new models for architectural design and urban planning!

*Paul Trovanelli, amateur radio operator*
*Carlo Trovanelli, cameraman*

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INSPIRE
INTERACTIVE NASA SPACE PHYSICS IONOSPHERE RADIO EXPERIMENTS

# INSPIRE DATA SHEET

INSPIRE Observer Team: Sextans Destiny

Observation Date: 25/APR/2009 Receiver: VLF-3/1st. rev. antenna filters out.

Tape Start Time (UT): 11:57/12:58 Tape Start Time (Local): 13:57/14:58

Local weather: 57°F, bright weather, some cumulus, cirrus clouds, elevation is 5600 Ft a.s.l.

Code: M – Mark (WWV or Voice)
S – Sferics
T – Tweek
W – Whistler
A – Alpha
C – Chorus

Sferic Density: D: ___ Scale of 1-5 (1 – Very Low, 3 – Medium, 5 – Very High)

| | Time (UT) | Entry | Observer | | | |
|---|---|---|---|---|---|---|
| 1st rec. | 11:57 | M-WWV (M-V) S T C W | voice announcement | D: 3 | left channel |
| | " | M-WWV M-V (S) T C W | Hum noise from the | D: 3 | right channel |
| | " | M-WWV M-V (S) T C W | near telpher railway | D: 3 | " |
| | " | M-WWV M-V (S) T C W | plus some RTTY- | D: 4 | " |
| | " | M-WWV M-V (S) T C W | stations above | D: 4 | " |
| | " | M-WWV M-V (S) T C W | 18KHz. | D: 4 | " |
| | 12:13 | M-WWV (M-V) S T C W | end of recording | D: 4 | left channel |
| 2nd rec. | 12:58 | M-WWV (M-V) S T C W | voice announcement | D: 4 | left channel |
| | " | M-WWV M-V (S) T C W | Hum noise from | D: 4 | right channel |
| | " | M-WWV M-V (S) T C W | the near telpher railway | D: 4 | " |
| | " | M-WWV M-V (S) T C W | plus some RTTY-sta- | D: 4 | " |
| | " | M-WWV M-V (S) T C W | tions above 18kHz. | D: 4 | " |
| | " | M-WWV M-V (S) T C W | | D: 4 | " |
| | 13:12 | M-WWV (M-V) S T C W | end of recording | D: 4 | left channel |



Note: English is my second Language.

INSPIRE
INTERACTIVE NASA SPACE PHYSICS IONOSPHERIC RADIO EXPERIMENTS

# DATA LOG COVER SHEET

26 April '09

INSPIRE Observer Team: Sextans Destiny

Equipment: Receiver: VLF-3

Recorder: Edirol R-09HR, Digital Audio Stereo Recorder

Antenna: 60-inch rollaps. ant. elevated 18 Ft above groundlevel

WWV radio: –

Site description: Forest glade near village of Cavdriai

Longitude: 11 o 04 'E Latitude: 46 o 04 'N

Personnel: Paolo Trovanelli: antenna and receiver equipment
Carlo Trovanelli: camera-man, aide-de-camp

Team Leader Name: IN3 EAX - amateur radio Paolo Trovanelli

Mailing Address: Viale Rovereto #37

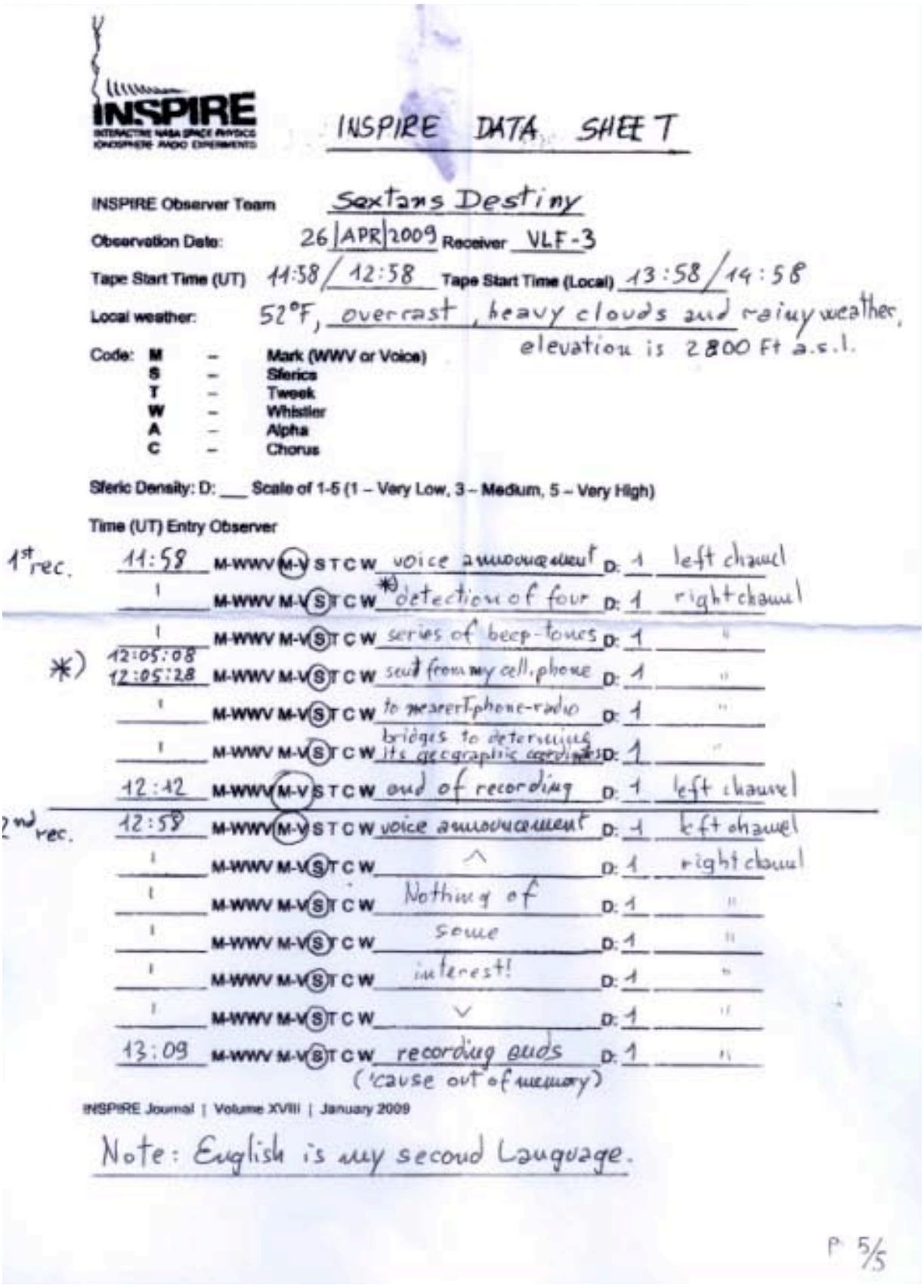
City, State, Zip, Country: - City of Trento, (North. Italy) - ITALY -

Email: PAOLOTRO@TELE2.IT

Local Time to UT Conversion Table

ITALY ST - 1 = UT
" DT - 2 = UT - Central European Time CET-

Note: English is my second Language.



INSPIRE

INTERACTIVE NASA SPACE PHYSICS IONOSPHERIC RADIO EXPERIMENTS

# INSPIRE DATA SHEET

INSPIRE Observer Team: Sextans Destiny

Observation Date: 26/APR/2009 Receiver: VLF-3

Tape Start Time (UT): 11:58 / 12:58 Tape Start Time (Local): 13:58 / 14:58

Local weather: 52°F, overcast, heavy clouds and rainy weather, elevation is 2800 Ft a.s.l.

Code: M – Mark (WWV or Voice)
S – Sferics
T – Tweek
W – Whistler
A – Alpha
C – Chorus

Sferic Density: D: ___ Scale of 1-5 (1 – Very Low, 3 – Medium, 5 – Very High)

| | Time (UT) | Entry | Observer | | |
|---|---|---|---|---|---|
| 1st rec. | 11:58 | M-WWV (M-V) S T C W | voice announcement | D: 1 | left channel |
| | " | M-WWV M-V (S) T C W | *) detection of four | D: 1 | right channel |
| | " | M-WWV M-V (S) T C W | series of beep-tones | D: 1 | " |
| *) | 12:05:08 12:05:28 | M-WWV M-V (S) T C W | sent from my cell phone | D: 1 | " |
| | " | M-WWV M-V (S) T C W | to nearest phone-radio | D: 1 | " |
| | " | M-WWV M-V (S) T C W | bridges to determine its geographic coordinates | D: 1 | " |
| | 12:12 | M-WWV (M-V) S T C W | end of recording | D: 1 | left channel |
| 2nd rec. | 12:58 | M-WWV (M-V) S T C W | voice announcement | D: 1 | left channel |
| | " | M-WWV M-V (S) T C W | ^ | D: 1 | right channel |
| | " | M-WWV M-V (S) T C W | Nothing of | D: 1 | " |
| | " | M-WWV M-V (S) T C W | some | D: 1 | " |
| | " | M-WWV M-V (S) T C W | interest! | D: 1 | " |
| | " | M-WWV M-V (S) T C W | v | D: 1 | " |
| | 13:09 | M-WWV M-V (S) T C W | recording ends ('cause out of memory) | D: 1 | " |

INSPIRE Journal | Volume XVIII | January 2009

Note: English is my second Language.

P 5/5

# Coordinated Observation Schedule

The Coordinated Observations will be held on the first weekend of October and the last weekend in April. This schedule will apply to all future Coordinated Observations. All data is welcome and should be submitted even if the conditions are quiet. Any data you can contribute is valuable. The procedure to use for coordinated Observations will be as follows:

1. Use the Data Cover Sheet and Data Log forms found at the end of the *Journal*. (Make copies as needed.)

2. Put a voice introduction at the start of each session indicating your name, your INSPIRE Team name, the date, local time and UT time.

3. Record for 12 minutes at the start of each hour that you can monitor on the specified days. Keep a detailed written 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.

4. 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.

5. Record at 8 AM and 9 AM LOCAL time.

6. 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).

7. 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.

8. Label all tapes and logs to indicate the sessions monitored and send to:

   The INSPIRE Project
   518 Sixth Street SE
   Washington, DC 20003
   Attn: Kathleen Franzen

9. Your tapes will be returned with spectrograms of your data. An article reporting on the results will appear in the next *Journal*.

10. 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).

# Field Observation Schedule

Field observations may be made according to the following schedule: ANY TIME!

In addition to an article reporting on the Coordinated Observations, will be an article on Field Observations. These observations may be made at any time and submitted for inclusion in the next *Journal*.

Use the same procedure as described for Coordinated Observations (previous page). Since field observations can be made any time of year, the following table is provided for conversion from local time to Coordinated Universal Time (UTC).

Sample Spectrograms:

Local Time to UT Conversion Table

EDT + 4 = UT
CDT + 5 = UT
MDT + 6 = UT
PDT + 7 = UT
EST + 5 = UT
CST + 6 = UT
MST + 7 = UT
PST + 8 = UT

Frequency _____

Range _____

Time _____

Scale _____

Frequency _____

Range _____

Time _____

Scale _____

This spectrogram is for two minutes using a frequency range of 0 - 22 kHz.

This spectrogram is for 30 seconds using a frequency range of 0 - 11 kHz.

`

INSPIRE
INTERACTIVE NASA SPACE PHYSICS IONOSPHERE RADIO EXPERIMENTS

# Data Log Cover Sheet

INSPIRE Observer Team _____

Equipment: Receiver _____

Recorder _____

Antenna _____

WWV radio _____

Site description: _____

Longitude: _____o _____.'W Latitude: _____o _____.'N

Personnel: _____ _____ _____

_____ _____ _____

Team Leader Name: _____

Mailing Address: _____

_____

City, State, Zip, Country _____

Email: _____

Local Time to UT Conversion Table

EST + 5 = UT EDT + 4 = UT
CST + 6 = UT CDT + 5 = UT
MST + 7 = UT MDT + 6 = UT
PST + 8 = UT PDT + 7 = UT

`

# INSPIRE Data

INSPIRE Observer Team _____

Observation Date: _____ Receiver _____

Tape Start Time (UT) _____ Tape Start Time (Local) _____

Local weather: _____

Code: **M** – Mark (WWV or Voice)
**S** – Sferics
**T** – Tweek
**W** – Whistler
**A** – Alpha
**C** – Chorus

Sferic Density: D: ___ Scale of 1-5 (1 – Very Low, 3 – Medium, 5 – Very High)

Time (UT) Entry Observer

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

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_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

_____ M-WWV M-V S T C W_____D: ___ _____

`

# INSPIRE VLF-3 Receiver Kit Order Form

*INSPIRE VLF-3 Receiver Kits can be ordered online at: www.TheINSPIREProject.org*
*Or please complete this order form and submit with payment to the address below.*

INSPIRE VLF3 Radio Receiver Kit ..... $120.00
(Includes assembly instructions, components and printed circuit board)

| **Item:** | **Quantity** | **Price** | **Subtotal** |
|---|---|---|---|
| VLF-3 Receiver Kit | _____ | $ 120.00 | $ _____ |
| Shipping Charge:<br>US & Canada - $12.00<br>All other countries $20.00 | _____ | _____ | $ _____ |
| Sales Tax<br>*(CA residents please add 7.75% sales tax, $9.30 per kit)* | | | $ _____ |
| | | **TOTAL:** | $ _____ |

**Ship To:**
*(Please allow 4-6 weeks for delivery)*

Name: _____

Address: _____

_____

City, State, Zip, Country: _____

Email: _____

*Payment may be made by check, money order or purchase order made payable to: The INSPIRE Project, Inc.*

Send orders to:

The INSPIRE Project, Inc.
518 6th Street, SE
Washington, DC 20003

Attn: Kathleen Franzen

*Questions? Email: CustomerService@TheINSPIREProject.org or call 202.547.1364.*

`

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Contact Kathleen Franzen for more information at 202.547.1364 or email President@TheINSPIREProject.org.

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