The INSPIRE Journal

VOLUME 20 SPRING / SUMMER 2013

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 and submissions for The INSPIRE Journal should be emailed to Eva Kloostra: Editor@TheINSPIREProject.org

© 2013. The INSPIRE Project, Inc. All Rights Reserved.

BOARD OF DIRECTORS

Phillip A. Webb, Interim President
Rebekah Hutton, Secretary and Treasurer

BOARD MEMBERS

Fatima Bocoum, International Telecommunication Union
Rick Chappell, Vanderbilt University
Ellen McLean, Fairfax County Public Schools
Jim Palmer, Space Telescope Science Institute
Paul Schou, University of Maryland Baltimore County

ADVISORS

Lou Mayo, Goddard Educational Advisor
Goddard Space Flight Center
Tim Eastman, Goddard Science Advisor
Goddard Space Flight Center
Dennis Gallagher, Space Plasma Physics
NASA Marshall Space Flight Center
Leonard Garcia, Space Physics Advisor
Goddard Space Flight Center
David Piet, Northwestern University PHD Program
Alma Smith, Grades 6-12 STEM Educational Advisor
Julia Martas, Grades 6-12 STEM Educational Advisor
Eva Kloostra, Space Ad Agency, Educational Program Coordinator and Journal Editor

CO-FOUNDER/EMERITUS

William E. Pine

IN MEMORIAM

Kathleen Franzen, President 2005 - 2010
Jack Reed, INSPIRE Board Member 1992 - 2009
Jim Ericson, INSPIRE 1st Vice President 1981 - 2006

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.

From the Managing Editor

Eva Kloostra
INSPIRE Advisor and Managing Editor

As many of our INSPIRE Project friends, colleagues and partners are aware, the past two years have been challenging but very rewarding for the organization. In October 2010, INSPIRE's President Kathleen Franzen passed away unexpectedly. It was a huge loss to the INSPIRE organization and to the many people who knew and admired her. Kathleen's passion for life and her dedication to continuing her late husband William Taylor's vision of engaging our youth in the STEM (Science, Technology, Engineering and Mathematics) areas was unbridled and infectious. In the five years I had the privilege of working with Kathleen on a weekly and often daily basis, I saw firsthand the positive impact she made on thousands of students, educators, STEM professionals and the Capitol Hill community.

The momentum that Kathleen and William generated continues to propel INSPIRE's mission. Below are some of the highlights and accomplishments from the past two years:

- In November 2011, INSPIRE launched its fourth generation VLF (Very Low Frequency) radio receiver kit with an improved circuit board design and updates based upon input from kit users and assembly suggestions that have been submitted, analyzed and reviewed over the past 5 years. The new board design has many unique features such an internal battery / external battery connection and stereo audio plugs for listening to the VLF signals between 300 Hz up to 20 kHz. The updated receiver kit has similar functionality but the new design allows for improved ease of assembly and usage. The kit is made to be compact and simple to show both the wonders of radio receivers and give students inspiration for even greater ideas. To date over 3,000 INSPIRE radio receiver kits have provided students around the world the opportunity to experience the sounds of space firsthand and the interest in VLF kits has continued to increase both nationally and globally. INSPIRE's VLF kit has been incorporated into numerous university Physics and Astronomy curriculum including Tel Aviv University in Israel, Virginia Tech in Blacksburg, VA and the University of Texas at Brownsville, TX.

- In 2008, the William Taylor Memorial Scholarship expanded to partner with NASA Goddard Space Flight Center (NGSC) to sponsor Internships with Mentors to give undergraduate and graduate students a hands-on opportunity to work in the sciences. Over the past 2 years, INSPIRE has awarded 12 NASA GSFC internships, compared to 1 during the previous three year period. One of INSPIRE's interns, a female graduate student from Howard University, was one of only ten interns invited to join the Maryland Space Business Roundtable and was recently asked to serve as a Graduate NASA Ambassador for Howard University's Computer Science program. Another intern was asked to continue his research project through the fall 2012.

- INSPIRE's Space Academy for Educators and Students Scholarship Program is in its fifth year and has dramatically grown in popularity. Last year, INSPIRE received over 140 applications for the 2012 program compared to 37 the prior year. 100% of INSPIRE's Space Academy for Educators past scholarship recipients have utilized materials and knowledge acquired via the weeklong program in Huntsville, AL in their classrooms - directly impacting 2,750 students at a total of 198 DC area schools. Recipients have represented INSPIRE at workshops and programs as Ambassadors and continue to be actively involved in the organization.

- A Space Academy for Educators scholarship recipient was so inspired by the educational experience in Huntsville, that he along with Kathleen Franzen, conceived and executed a Solar System Competition with 8 middle schools, 80 students and 8 educators. Each school did a research project on one of the planets and presented it at NASA Headquarters Visitors Center in Greenbelt, MD to a full house. The Competition was dedicated to William and Kathleen *(see page 18).*

On behalf of the INSPIRE Team, I would like to thank our corporate partners, Ambassadors, Board of Directors, and the many of you who donated your talents and energy to enable INSPIRE to keep moving forward with our Mission.

A special thanks to Dennis Gallagher and Leonard Garcia for technical editing; Jay Friedlander for the cover image; and to all who contributed to this issue of The INSPIRE Journal.

Remembering Kathleen Franzen

A Tribute to INSPIRE's Former President and "Fearless" Leader

Anne Taylor

Anne Taylor was Kathleen's longest and dearest friend and she continues to keep William and Kathleen's vision alive via her support of The INSPIRE Project's educational programs. Anne is a graduate of Hollins College (now Hollins University) and has worked at the Council on Governmental Relations, an association of research-intensive universities, for 35 years. She and her husband have lived on Capitol Hill in the District of Columbia since 1976. Anne has owned her own business, The Loft at Meadowbrook – a tack shop located at Meadowbrook Stables, since 1990.

Kathleen and I met in an elevator in 1975 while going for the same job interview in an office building on K Street in Washington, D.C. As we exited the elevator on the same floor and proceeded to the same office I was a little wary of what was going on, but Kathleen just smiled and struck up a conversation. Turns out we were each qualified and one position turned into two – we were both hired. And so began a 35-year friendship between two diametrically opposed personalities as different as night and day and yet perfectly matched. We became fast friends and would play hooky from work every once in a while. One memorable afternoon found us at The Carvery at The Mayflower Hotel talking and eating omelets until the early evening.

After leaving Washington in the late-70s to move to California for William's job at TRW-Long Beach, Kathleen worked in advertising for a brief period, but then followed her first love and started her catering business. On one of my trips to visit, I was met at LAX by someone I did not know, put in the back of a car to finish decorating the wedding cake, and then driven to a venue to bartend the reception. Such was life with Kathleen! After that she became a partner in her first restaurant, *The Lemon Tree*, in Torrance. It was there I fell in love with Gorgonzola. Once again when I came to visit and help with the restaurant I was put to work stirring an enormous vat of Gorgonzola cheese sauce for the pasta special that day. I never knew how good this could be, but Kathleen knew. She also knew she wanted to branch out on her own so *Kathleen's* on Pacific Coast Highway was opened. She gathered people to work with her who were creative and shared her passion for bringing fresh ingredients together. So a successful enterprise was begun. (And I still have a reminder of those times at *Kathleen's*. When she and William moved back to D.C. in the late-80s, the Bev Air refrigerator she had in the front of the restaurant for water, iced tea, etc. made the trip with them, but with no place to put it in their house, it came to live with us. And even though it is close to 50, it is still running to this day.)

One thing Kathleen truly loved about California was the house on Camino del Campo she and William purchased. It had avocado trees on the side and lemon and orange trees in the back. William could pick fresh fruit for his breakfast from his own trees and often did. The garage at the house was barely large enough for William's car, *Big Red* – a 1965 Cadillac red convertible – and Kathleen's Volkswagen Rabbit. But William made them fit. He had a habit of hanging sand filled pouches from the garage ceiling and when your windshield hit one, you were far enough in the garage to shut the door! And it was at this house that true love blossomed – Smudge came into their lives. Tossed on the front lawn as a small kitten, Smudge would be the center of attention for almost eleven years.

In 1988, William and Kathleen came back to Washigton, DC and purchased a home on Capitol Hill. It was here that Kathleen became very involved with the local economy with her firm *Woman Friday*, a concierge service to handle just about anything and everything that needed doing. She was President of the Capitol Hill Association of Merchants

and Professionals (CHAMPS) and stayed connected to many CHAMPS associates until her death. But it was William's death in 2005 that shifted her world irrevocably.

I received the call from Kathleen on a bright Saturday morning that William was at George Washington University Hospital. It appeared he had had a massive heart attack – he was gone. When I arrived at the hospital Kathleen and I went to see William for the last time. I left them alone and waited for her outside in the hall. Everything after that – calling colleagues, family and friends with the sad news, getting in touch with the funeral home – all things you have to do, but don't want to were done. In October of that year Kathleen had a celebration of William's life that drew people from as far away as Europe, India and Russia. The event was, pardon the expression, truly "kick ass". The outpouring of love and support empowered Kathleen to pursue the next phase of her life – the continuation of INSPIRE, William's passion. (I remember one evening not long before his death when he donned headphones and had his transmitter in hand while he prowled the back alley behind the house just listening for anything he could. Since he was wearing his knee braces as well, the picture was one of that crazy uncle on your Mother's side we all know we have.)

Kathleen at the AGU National Conference in San Francisco

Kathleen dove into INSPIRE with a dedication and commitment that was unshakeable. She put together a group of equally dedicated individuals to push INSPIRE into the future, expanding its programs, getting grants to fund these programs and encouraging greater participation in Space Camp, her pride and joy.

Maybe it was this drive that proved too much. On September 27, 2010 Kathleen had asked me to go to her doctor's appointment – she wanted someone else to understand what was happening to her health. I met her at the appointed time and within hours we were in the George Washington University Emergency Room after a sonogram had discovered a blood clot in her leg. After that it was over. By October 14 she had been transported by ambulance to hospice care where she died at 2:35 a.m. the following day.

It is said that some people collect things and some people collect people. Kathleen collected people. All kinds, shapes and sizes were welcome in her embrace. She made friends and loved her two girls, Elizabeth and Josephine, the kitties after Smudge, and her William. Whether or not you believe in Heaven or some form of the hereafter, I think that Kathleen and William are where they should be – together again.

I miss her terribly, but my life is enriched by our friendship and I wouldn't have missed the journey for anything!

INSPIRE's NASA Goddard Summer Interns Report on Research Projects

INSPIRE partnered with NASA Goddard Space Flight Center, District of Columbia Space Grant Consortium and other sponsors to offer paid internships at Goddard. This competition is open to college and graduate level students and is ongoing. During the past two years, INSPIRE has awarded scholarships to thirteen NASA GSFC interns. Each intern is paired with a mentor and works on a STEM research project. Below are their *INSPIRE Journal* submissions:

EO-1 HYPERION MISSION

Jamaal Gray, Howard University College of Engineering, Architecture and Computer Sciences

This summer, I worked on the EO-1 (Earth Observing 1) Hyperion Mission. EO-1 is participating in a broad range of investigations, demonstrating the utility of imaging spectroscopy in applications relating to forestry, agriculture, species discrimination, invasive species, desertification, land-use, vulcanization, fire management, homeland security, natural and anthropogenic hazards and disaster assessments and has provided characterization for a variety of instruments on EOS platforms. I was initially tasked with correcting non-working batch files, processing, retrieving and sub-setting site data, creating regions of interest for various sites, generating spectral libraries for these sites, and preparing site data to be executed in ACORN and FLAASH—in order to expedite the ACORN, ATREM, FLAASH Atmospheric Correction comparison process. I primarily used ENVI software throughout this project. My mentor believed my work to be very good, and as a result, the department used it as a template for future corrections.

Satellite Remote Sensing of Snow Covered Sea Ice in the Arctic and Antarctica – Observations and Analysis

Aditi Shenoy, George Washington University

I am a rising sophomore at The George Washington University and Physics major. This summer is my fourth internship at NASA GSFC, and I feel extremely fortunate to have had such educational and fascinating experiences during the time that I interned. This summer, I worked in the Cryospheric Sciences Branch. My research involves correlating the area of Arctic multiyear sea ice floes with time. Sea ice forms when ocean temperatures drop below 271.4 K. It forms in the ocean, and it is unattached to land. When the sea ice does not melt after one season, it is called multiyear sea ice. In December 2007, a large multiyear sea ice floe left the Arctic sea ice pack. In May 2008, it broke apart into a large floe and a smaller floe. They both melted in June 2009. It was tracked for eighteen months by AMSR-E (Advanced Microwave Scanning Radiometer -Earth Observing System), which is an instrument on the Aqua satellite. MODIS (Moderate Resolution Imaging Spectroradiometer), another instrument on Aqua, detected the ice floes, and collected the images of them over the eighteen months. I used a Matlab script to filter out the images that did not contain the floes, and I used ENVI, a software for analyzing and processing geospatial imagery, to open, reproject, and classify each image. The images need to be reprojected to ensure that all the pixels in the image had the same area. Each image was taken when MODIS was at different angles to the surface of the Earth, which results in the images having pixels that cover a larger area at the sides of the image than the area the pixels cover in the center of the image. After reprojection, all the pixels are 250 m x 250 m. The images are then classified. Classification essentially color-codes the pixels that make up the image. Each color in the image will refer to a certain range of brightness values. This is useful in situations where, for example, it is unclear whether the gray area at the tip of a floe is truly ice or is merely slush, and when there are pieces of ice surrounding the floes, but is not part of the floes. Since this research focuses on determining the area of the floes over time, it is important to include all parts of the floes that are multiyear ice, but not pieces of ice that may surround the floes. These extraneous pieces of ice are not pertinent to the area calculation. After the images are classified, a Matlab script was used to count the number of pixels in the floes. The area of the floes as a function of time is graphed, and the trend can be correlated with the surface temperatures during the time period that the floes were observed. I learned several things during my internship that I would not have known otherwise. I learned how to use ENVI and Matlab, and I learned about the different aspects of a workplace. These skills will be useful to me in the future. I attended seminars and lectures, and I was able to see more of what NASA has to offer. I was able to understand how sea ice plays a significant role in the environment and the climate. Sea ice reduces the amount of solar radiation absorbed at the Earth's surface, which affects albedo. When sea ice melts, the ocean absorbs the solar radiation, instead. This warms the ocean, which in

turn leads to more sea ice melting. This positive feedback loop amplifies changes in the environment. Researching sea ice and its effects on the Earth and climate change increases our awareness of environmental issues in the world we inhabit. I would like to thank my mentors, Dr. Ludovic Brucker and Dr. Thorsten Markus, and my program leader, Dr. Leonard Garcia, for their support and guidance this summer. I would also like to thank The INSPIRE Project Inc. Dr. Bill Taylor Memorial Scholarship Internship for allowing me to participate in this internship.

Safety and Occupational Health (Code 350) and GROVER (Goddard Remotely Operated Vehicle for Exploration and Research)

Mariel Rico, George Washington University

INSPIRE GSFC Summer Intern Lunch (left to right) Aditi Shenoy, Mariel Rico, Mohammad Akhavannik, Dr. Leonard Garcia (NASA GSFC), INSPIRE President Phillip Webb, Derssie Mebratu and James Kelly

Although I have had experience in the work force, I have never had an internship. So when I received an internship at NASA this summer, I had no idea what to expect. I am pleased that my experiences here have been both educational and memorable. I had the opportunity to work under two different departments during my stay. My first internship was under Frank Coleman, a safety engineer in Safety and Occupational Health (Code 350). In Code 350, I learned what precautions are taken in order to keep the Goddard campus safe. I researched several of the most common close calls and mishaps, and then used that knowledge to write bulletins that raise awareness of potential hazards to the Goddard community. I also had the opportunity to go on building audits, and experience what safety engineers look for in order to keep the work environment safe. Code 350 taught me to never overlook small details, because they could lead to bigger complications. My second internship was to work on the mechanical engineering aspect of GROVER, an autonomous robot that will be used to explore Greenland. During this internship, I worked with a team of student mechanical engineers to brainstorm, design, and then build parts for GROVER to fix the problems that occurred during its first test run. During this time, I applied my knowledge from my safety engineering internship to stay safe, especially when using potentially dangerous power tools, such as a mill or chop saw. This project allowed me to apply the engineering concepts I learned in the classroom to an actual group project. It was a lot of fun to share different design ideas with a group, and then see drawings materialize into contraptions that were actually used on the robot. I am extremely grateful to be a part of the NASA family this summer. These experiences have definitely taught me how to be a better engineer, and I look forward to using what I have learned on whatever the future might bring.

This summer at NASA GSFC I wrote articles for Earthzine online magazine (www.earthzine.org) For example, I wrote about the Aquarius launch, how satellite imagery can aid disaster management, and the SERVIR program. I loved working for NASA and enjoyed being able to incorporate science and technology with an international perspective. The experience of working at Goddard felt like a dream come true. Through NASA I was able to network with many scientists and engineers, have an experience of working in a technology-based environment, and learn more about space.

Wanda Archy, Georgetown University
Technical Writing NSA GSFC Intern

Memes from a Robotic Perspective

Mohammad Akhavannik,
George Washington University

I am a rising senior studying Electrical Engineering at The George Washington University and have been researching memetic learning algorithms at Goddard this past summer. While at NASA, I explored autonomous robotic systems and their ability to act independently and adapt in dynamic and uncertain environments. In order for the robots to work together as a team, I researched memes – a unit of information exchange – and their imperative role in instructing robots on evolving their behavior. Memetic information involves evaluating models, examples, and patterns which a robot observes; robots which possess the ability to observe and intelligently imitate the behavior of others are able to participate in memetic learning. Although robots and autonomous systems are already at work in NASA's Mission Directorates, myself and my research group at NASA are extremely enthusiastic about the use of memetic learning algorithms in such systems in the future. With my research and experiences at Goddard, I have made a commitment to furthering NASA's goals while also pursuing my interest with robotic systems and their complex decision making abilities. I hope to further explore this field as I believe that such robots can adopt various roles and responsibilities and such systems will bring significant progress to the scientific community in the near future.

Dynamics in Solar Prominences

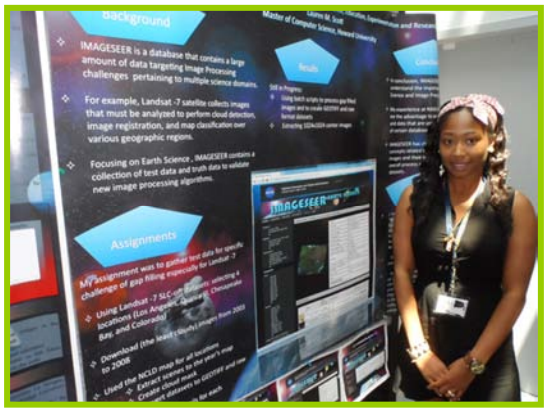
James Kelly, George Washington University

I'm studying physics with a minor in mathematics and graduating in the class of 2013. After graduating, I plan to attend graduate school for physics with hopes of combining my scientific background with interpersonal skills and going into fields such as the public understanding of science or medical physics. My internship at NASA has been everything I'd hoped it would be and then some. It has made this summer one of the best I've ever had. Not only did I work with an extremely knowledgeable PhD in solar physics who was more than happy to answer my questions and talk about the life of a scientist, but I also met many of her colleagues and was exposed to the kind of high caliber research they do. I now have a better understanding of the methods and processes for analyzing data, as well as how researchers collaborate to find answers. Difficult problem solving is what initially attracted me to physics so seeing, firsthand, work from the explanation of solar prominences to the construction of the James Webb Space Telescope has shown me the broader purpose of my coursework. I now have a new and enhanced appreciation for the kind of work I could one day be doing. The NASA Goddard Space Flight Center has been an incredible place to work – packed with interesting, friendly scientists and showing me there is no limit to the knowledge one can obtain.

IMAGESEER (IMAGEs for Science, Education, Experimentation and Research)

Lauren Scott, Howard University College of Engineering, Architecture and Computer Sciences

The research project I was able to work with was NASA IMAGESEER (IMAGEs for Science, Education, Experimentation and Research), a database that contains a large amount of data that targets Image Processing teaching and validation for multiple science domains (i.e. Earth, Astrophysics, Heliophysics and Planetary). The objective of this research is to build a database of images to test or validate image-processing algorithms using truth data and information about the application domains. The 2 main components of IMAGESEER are: (1) a database containing multiple image datasets along with relevant information on missions, bands, locations, truth data and acquisition time, and (2) a website presenting all this information in a user-friendly manner. Creating this website has made things easy to find, display and download any data that are wanted, for all kinds of users, especially teachers, students and researchers in the Image Processing field. My assignment was to gather test data for the specific challenge of gap filling, especially for Landsat-7. The Landsat-7 satellite collects images that must be analyzed to perform such tasks as cloud detection, image registration, and map classification over various geographic regions (e.g., mountains, urban, coastal, and agricultural areas). In May 2003, the Landsat-7 satellites scan line corrector (SLC) failed. Without the SLC, one of Landsat's instruments cannot correct for the forward motion of the satellite, resulting in a zigzag pattern with gaps as the instrument captures data. Using Landsat-7 SLC-off datasets (i.e., datasets acquired without the SLC), I selected four locations (Los Angeles, Quincy III, Chesapeake Bay, and Colorado) and downloaded the least cloudy images from 2003 to 2008. Using the National Land Cover Data (NLCD) maps for all four locations, I was able to extract scenes close in time to the map's years of creation, create the cloud masks, convert the datasets to GEOTIFF and raw formats, and create thumbnails for each scene. At this time, I am still working on using batch scripts to process the images downloaded for the gap filling application, to create GEOTIFF and raw format datasets, and also to extract 1024x1024 centered images. My work acquiring images for IMAGESEER has helped me to understand the importance of Earth Science and Image Processing, as well as the benefits of satellite imaging and sensing, which uses the principles of electromagnetic energy that is detected to record visible light, radio waves, heat, ultraviolet and x rays. My experience at NASA Goddard has given me the advantage to work with techniques and data that are used in the development of certain databases. IMAGESEER has challenged me to learn concepts related to gap filling for scientific images and their importance within the overall process of analyzing NASA Science datasets.



Lauren Scott (above) and Hilary Melroy (below) at the NASA Poster Session in July 2012. Interns present their research projects to the scientific community and the other NASA GSFC Interns

Autonomous Path Planning

John Donahue, George Washington University

The purpose of autonomous path planning is to allow a robot to navigate through terrain relying solely on sensors built into the rover without human interference. In previous years, interns at NASA Goddard Space Flight Center have worked with the Personal Exploration Rover (PER) to develop an Adaptive Sensor Fleet to enable the rover to explore and collect data efficiently in various terrains. In order to accomplish autonomous driving the group incorporated a compass into the rovers as well as a Precision Asset Location system. The summer objective was to create an algorithm for the PER to navigate through a Mars-like terrain without any data regarding the environment. We were able to successfully create an algorithm for a PER to navigate through a Mars yard autonomously. The final program consisted of two Java classes, a basic path planning system and an obstacle avoidance system. The path planning system was able to incorporate the Bug and Ant Colony Optimization algorithms to become the "Cerebellum" of our program. Information from the PAL system and the compass enabled the system to determine the best direction for the rover to travel. The obstacle avoidance system, or "Cerebrum", was able to guide the rover around an obstacle and move back to the path planning system. The path planning system continued until the rover was within two feet of the destination, due to a margin of error for the PAL system.

John Donahue (left) and INSPIRE Advisor Dr. Leonard Garcia, NASA/GSFC/Wyle Information Systems, (right) at the NASA Poster Session in July 2012

To read John Donahue's full project summary, visit: www.TheINSPIREProject.org (NASA Goddard Internships section)

Ocean-Atmosphere Sensor Integration System (OASIS) Summer Ocean Field Deployment

Richard Landa, University of Maryland

I am a junior at the University of Maryland studying mechanical engineering. I have had an interest in robotics for a long time and my education at UMD has allowed me to pursue my interests while working at NASA. During the summer of 2010 I was offered a position at NASA Goddard Space Flight Center working on an autonomous rover for an arctic environment. While at GSFC I was able to put to use engineering theory that I picked up at school and put it to use while designing the chassis and propulsion system for "Grover". The final product is powered by alternative energy and is used to autonomously take measurements in a variety of locations with ground penetrating radar to send ice shelf data to scientists remotely operating the robot. While demoing this robot at Goddard day last summer I was able to network and meet with a scientist from NASA Wallops Flight Facility (WFF) where I worked as a part of the INSPIRE Project.

While at WFF I was involved in the Ocean Atmosphere Sensor Integration System (OASIS) project. The OASIS was to produce an autonomous surface vehicle to collect a wide variety of real time ocean atmosphere data and relay it to scientists via Iridium satellite, cell or radio. The platform is also designed to be able to house a large array of sensors that may be easily installed on the platform and connected to the computer. This feature allows OASIS to be useful in a number of applications including the study of harmful algal blooms, oil spill tracking, storm forecasting, obtaining low cost ocean samples, Cal/Val for RSD, electronic fencing, and surveillance.

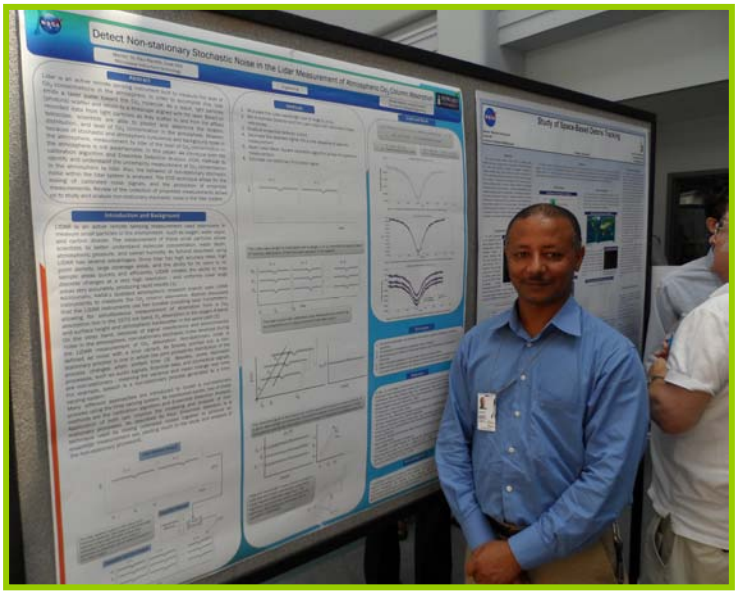
I created an electronics package to house components that include the sensor computer, guidance control and navigation computer, cell, iridium and radio modems as well as remote control relays and an AIS transceiver in a waterproof environment. The package controls both the rudder and motor on the platform and will be able to track location via an onboard GPS transceiver. My experience at WFF was very enlightening and I was able to glean a lot of new skills and knowledge from my mentor, John Moisan. I am very appreciative for all of the opportunities provided to me and I believe that my experience has reinforced my drive to obtain an advanced degree in a robotics field after graduating with a Bachelors' in mechanical engineering from UMD.

RADAR Instrument Development

Derssie Mebratu, Howard University College of Engineering, Architecture and Computer Sciences

I have been working at NASA/Goddard since last summer's INSPIRE internship and will continue working in the spring. In addition, NASA GSFC offered me a 2013 summer intern position. I am working the same branch and also plan to defend my dissertation in the coming fall.

I work at NASA/Goddard Space Flight Center in the Microwave Instrument Technology Branch to analyze and filter non stationary stochastic noise which comes from Lidar measurement of CO^2 absorption line. In general, Lidar is an active remote sensing instrument built to measure the level of CO^2 concentrations in the atmosphere. In order to accomplish this, Lidar emits a laser pulse toward the CO^2 molecule. As a result, light particles (photons) scatter and return to a telescope aligned with the laser. Based on recorded data from light particles as they scatter to and from the affixed telescope, scientists are able to predict and determine the location, distribution, and level of CO^2 concentration in the atmosphere.



Derssie Mebratu pictured at NASA Poster Session in July 2012. Derssie is serving as a NASA Student Ambassador for Howard University. His first priority is to create engineering based design contests to inspire and motivate students to consider the study of STEM

However, because of stochastic and atmospheric turbulence and background noise in the atmosphere, measurement by lidar of the level of CO^2 concentration in the atmosphere is not ascertainable. Therefore, our research group introduced both the calibration algorithm and Ensemble Detection Analysis (EDA) methods to identify and understand the uncertainty measurement of CO^2 concentration in the atmosphere by lidar. The EDA technique allows for the mixing of calibrated noise signals, and the production of ensemble measurements. Review of the collection of ensemble measurements allows us to study and analyze non-stationary stochastic noise in the lidar system.

I would like to thank my sponsor NASA Goddard and the INSPIRE Project. I would also like to warmly acknowledge my mentor, Dr. Paul Racette, for his guidance, encouragement, and support throughout the process of this research without whom, none of the accomplishments achieved would have been possible. I also thank Mr. Martin Perrine, who gave me the opportunity to work at NASA Goddard.

To view Derssie Mebratu's Poster Presentation, visit: www.TheINSPIREProject.org (NASA Goddard Internships)

Derssie was nominated to serve as a NASA Student Ambassador for Howard University. To read his Ambassador profile, visit: https://intern.nasa.gov/intern/content/ambassador-listing/ambassador-profile/ambassador_id858.html

The INSPIRE Project would like to thank NASA Goddard Space Flight Center and the District of Columbia Space Grant Consortium for their support of this program; the NASA GSFC Education Office for the facilitation of the scholarship awards; and the dedicated Mentors whose inspiration and guidance are helping to ensure the next generation of space scientists.

Finally, a special thanks to Dr. Leonard Garcia at NASA Goddard Space Flight Center for his assistance with the implementation of this program throughout each summer. Dr. Garcia serves as a Space Physics Advisor for The INSPIRE Project.

Visit TheINSPIREProject.org for Complete Program Information

INSPIRE Educational Programs and Opportunities

Dr. William W.L. "Bill" Taylor Memorial Science Scholarship Competition

Scholarship Awards: Up to $4,000 per recipient
DC Undergraduate and Graduate College Students
In honor of The INSPIRE Project's co-founder Dr. Bill Taylor, INSPIRE with its partners at the DC Space Grant Consortium, NASA/Goddard Space Flight Center and other science and technology organizations established this science scholarship to help ensure our next generation of space explorers. Scientifically oriented undergraduate and graduate college students, and high school seniors who are majoring in a STEM discipline and will be attending a District of Columbia college or university, are encouraged to apply.

NASA Goddard Space Flight Center Internship Program

Internship Awards: $6,000 per recipient ~ DC Undergraduate and Graduate College Students
With support from NASA Goddard Space Flight Center, District of Columbia Space Grant Consortium and other partners, the INSPIRE Project is proud to offer paid internships at NASA Goddard Space Flight Center in conjunction with the Dr. Bill Taylor Memorial Scholarship. Students are paired with a mentor at NASA Goddard Space Flight Center. Each student works with their mentor to design a project that they work on throughout the duration of the internship. Internships at NASA Goddard Space Flight Center are focused on STEM research. Full-time and part-time internships are available.

For complete information and to apply online, visit the NASA Internship Site: https://Intern.NASA.gov (Apply under INSPIRE Project Internships)

NASA Marshall Flight Center, Huntsville AL

Kathleen Franzen Memorial Space Academy for Educators and Students Scholarship Program

Teachers/Administrators, Middle and High School Students
The INSPIRE Project teamed up with the NASA Marshall Space Flight Center, US Space and Rocket Center in Huntsville, AL and Washington Space Business Roundtable and is offering full scholarships to Space Academy for Educators and Students.

Space Academy for Educators is a 5-day program offered for teachers to 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 classroom ready.

Space Camp for Students is an action packed 6-day program for students that promotes teamwork, problem solving, communication skills and builds self-confidence. Students take part in astronaut-style training and simulations, as well as STEM activities to ensure our next generations of space science and technology explorers!

A Special Thanks to INSPIRE's Educational Program Sponsors, Supporters, and All of the Volunteers!

NASA | DC Space Grant Consortium | Washington Space Business Roundtable
US Space and Rocket Center | International Launch Services | Space Ad Agency

Reception of Natural Radio Emissions in the ELF Band

Dr. Gabriele Cataldi and Dr. Daniele Cataldi
The Radio Emissions Project (Cecchina, Italy)

The Radio Emissions Project (www.ltpaobserverproject.com) is an Italian independent project of scientific research established on February 2009 by Dr. Gabriele Cataldi and Dr. Daniele Cataldi, involved in the study of Seismo-Electromagnetic Precursors (S.E.P.) through geomagnetic background monitoring.

Historical Introduction

Scientists say that during some earthquakes (before generally, but sometimes also during the seismic activity) are emitted electromagnetic (E.M.) signals. This type of data have appeared in the literature for several decades (Parrot e Johnston, 1989; Park, 1993; Park, 1996; Johnston, 1997) and refer to a wide range and exceptional electromagnetic phenomena observed in the bands ELF, SLF, ULF, VLF e LF (0,001 Hz – 300 kHz).

For example, Gokhberg (1982) and Yoshino (1991) observed an increase in the amplitude of the radio signal at 81 kHz some time before (from minutes to hours) the occurrence of earthquakes at distances of hundreds of kilometers, and have attributed this phenomenon to a predictive meaning: seismo-electromagnetic precursors (S.E.P.).

The **first scientific use** of S.E.P. occurred in Greece (Varotsos, 1993a; Varotsos, 1993b) where low frequency waves of amplitude 20 mV/km were observed for several minutes using a dipole antennas of different lengths. Currently, their mechanism of generation is subject of debate (Lighthill, 1996; Pham, 1999).

Fifteen minutes prior to the great earthquake of 1960 in Chile (Warwick, 1982), radio emissions at 18 MHz were recorded on multiple receivers.

- The majority of S.E.P. were recorded serendipitously by radio detection systems used for other purposes.
- Early long term observations were made in Greece (Varotsos, 1993), Japan (Uyeda, 1998) and the United States (Johnston, 1989; Park, 1991).
- To allow easy monitoring of electromagnetic background, the Department of Geophysics, of Stanford University, California, has designed and built a transportable system for the registration of radio-anomalies (Summer 2000).

Possible physical explanations of the nature on ELF (Extremely Low Frequency) anomalies have been proposed by Draganov (1991), Fenoglio (1995), and Merzer and Klemperer (1997). It's almost certain that this type of emissions can be recorded at any point on the earth surface because of the limited attenuation that has been observed (M.E.M. project, I.N.G.V. - National Institute of Geophysics and Volcanology[1], L'Aquila, Italy). Propagation properties are different for emissions in the VLF band (Telford, 1990, Chp. 6), LF, MF, HF and so on.

Reception of Natural Radio Emissions in the ELF Band

The reports conducted in recent years have revealed that S.E.P. extend over a wide range of frequencies, to megahertz and above. Johnston and Mueller (1987) observed changes in the magnetic field of the geomagnetic background during the earthquake that occurred in 1986 in North Palm Springs (Southern California near the San Andreas fault), Johnston (1994) observed changes in the magnetic field of the geomagnetic background during the earthquake that occurred in Landers (in the same region) in 1992.

In the ELF band (precisely between 0.01-10 Hz), Fraser-Smith (1990) recorded anomalous fluctuations of the magnetic field of the geomagnetic background some time before the earthquake of October 17, 1987, with magnitude 7.1, which razed Loma Prieta in central California. In particular, an increase was observed in the amplitude of the electromagnetic background two weeks before the main shock, and continued to increase up to three hours before the earthquake.

Other abnormal ELF emissions possibly related to earthquakes have been recorded several hours before the magnitude 6.9 earthquake that razed Spitak, Armenia, on December 7, 1988 (Molchanov, 1992; Kopytenko, 1993). Other geomagnetic anomalies were observed between two weeks and few days before the earthquake magnitude 8 that was recorded in Guam, August 8, 1993 (Hayakawa, 1996).

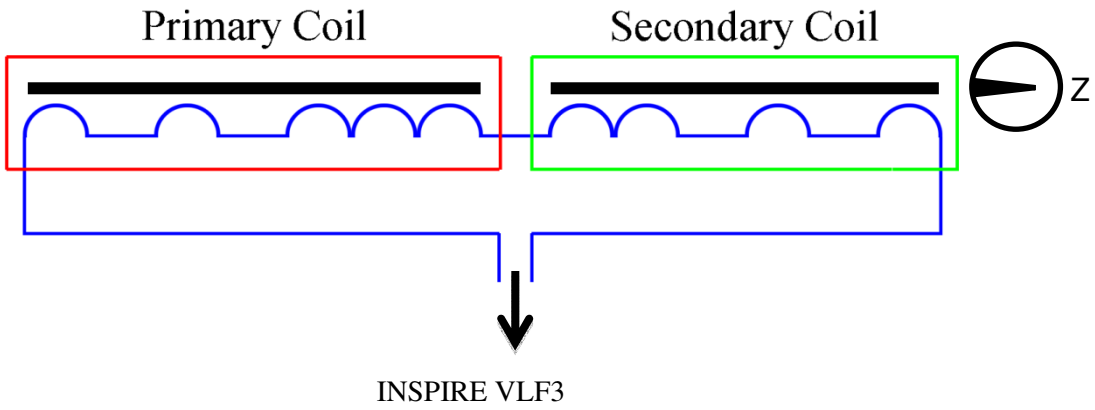
[1] http://www.progettomem.it

The Radio Emissions Project's Monitoring Station

The heart of our project is represented by a computerized radio-receiver that operates continuously and is specifically designed to monitor Earth's geomagnetic field at frequencies between 1 and 0.0013 Hz, with a resolution of 1.3 mHz. The geomagnetic pulsations (Pc1-5) are, in fact, observed in our receiver at frequencies below 5 Hz.
To achieve this purpose, the station uses a special antenna (magnetic sensor) which is formed by two inductors constructed with multiple overlapping spirals (multilayer), wound on a ferromagnetic core, connected in series and containing a total of 80,000 (60,000 + 20,000) turns and aligned with the vertical axis (Z axis). The total inductance of the antenna, greatly increased by the magnetic permeability of the ferro-magnetic cores used[2] (5.000x for 60,000 turns coil and 1.000x for 20.000 turns coil), exceeds 375,000 Henry (375+0,7 kH).

Structure of Primary Coil: The Axial inductor is made with 0.1 mm diameter enameled copper wire and that is wound on a core of tempered iron (produced specifically for components of large industrial power supplies, often 7.5 cm and 22.3 cm long). At the center of this core is a 14.4 cm long coil , divided into two 7.1 cm wide sectors separated by a layer of rubber with a thickness of 2 mm. To reduce the "distributed capacitance" of the coil, the windings have been divided into 2 areas for a total of 60,000 turns. The resulting inductance (ferromagnetic core relative magnetic permeability = 5.000x) is the 375 kHenry.

Structure of Secondary Coil: Axial inductor is made with 0.315 mm diameter enameled copper wire, wound on a ferromagnetic core (soft iron) with a diameter of 0.6 cm and length of 100 cm. The coil has been wound in the central part of the iron core for a length of 30 cm. To reduce the "distributed capacitance" of the coil, the windings have been divided into 3 areas for a total of 20,000 turns. The resulting inductance (ferromagnetic core relative magnetic permeability = 1.000x) is 700 Henry.



Simplified scheme of the magnetic induction sensor used for geomagnetic monitoring

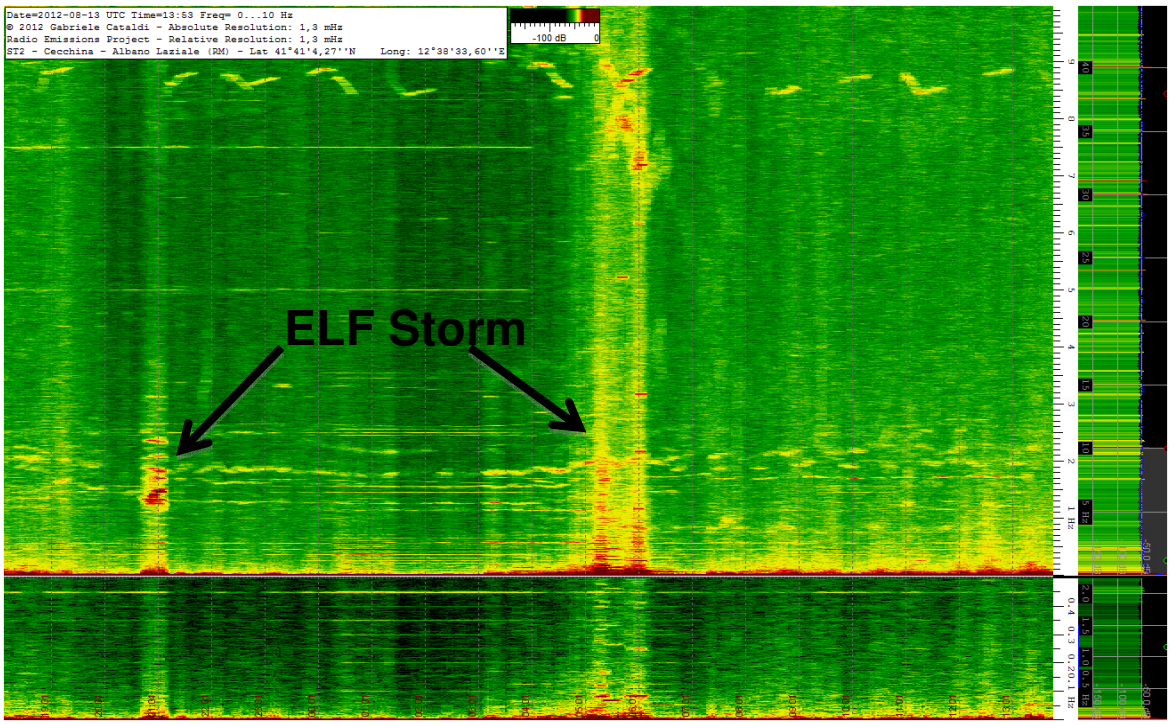
The natural radio waves classified as Geomagnetic Pulsations have a frequency between 5 and 0.002 Hz and a wavelength of between 60,000 and 300,000,000 Km. An omnidirectional, loop or Marconi antenna should be large to be useful at these frequencies. The problem can be solved easily using a coil antenna with high inductance. Our antenna, having an inductance of 375,700 Henry (calculated through the Wheeler's formula), is able to be sensitive to an electromagnetic wave which has a minimum frequency of 1.165 mHz.

The software used to produce spectrograms is "Spectrum Lab", the famous free FFT software that can be downloaded at http://www.qsl.net/dl4yhf/spectra1.html.

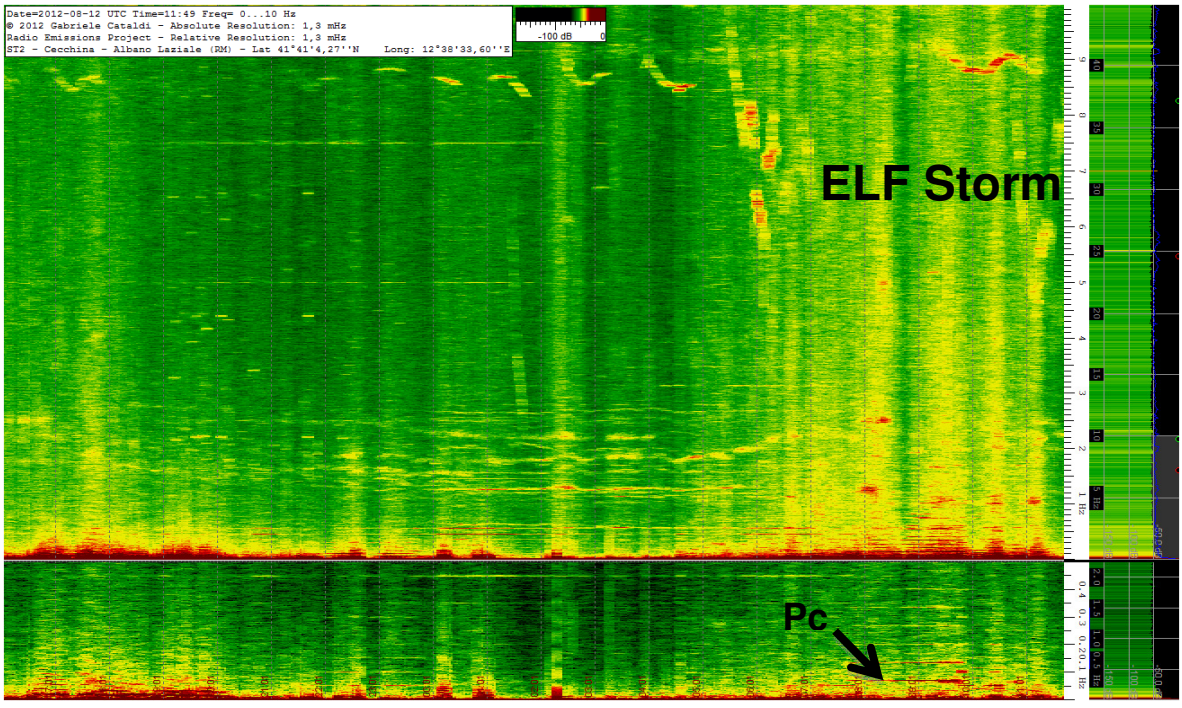
The spectrograms are a representation of time (X axis) of the intensity of the electrical signals transduced by the coil antenna and sent to the PC; in relation to their emission frequency (Y axis). The color of the signals changes in function of their intensity expressed in decibell (dB) (from black to dark red). Spectrum Lab, normally, is able to display electrical signals across a 180 decibell intensity range (180 orders of magnitude), but it is possible to choose a smaller range.

Another important feature of "Spectrum Lab" is the opportunity to choose the level of resolution (in Hz) that best suits the spectrograms. This is possible because the software is able to exploit the capabilities of the PC sound card directly, acting on the oscillator quartz. For monitoring the geomagnetic background it is necessary to reach a resolution of some mHz.

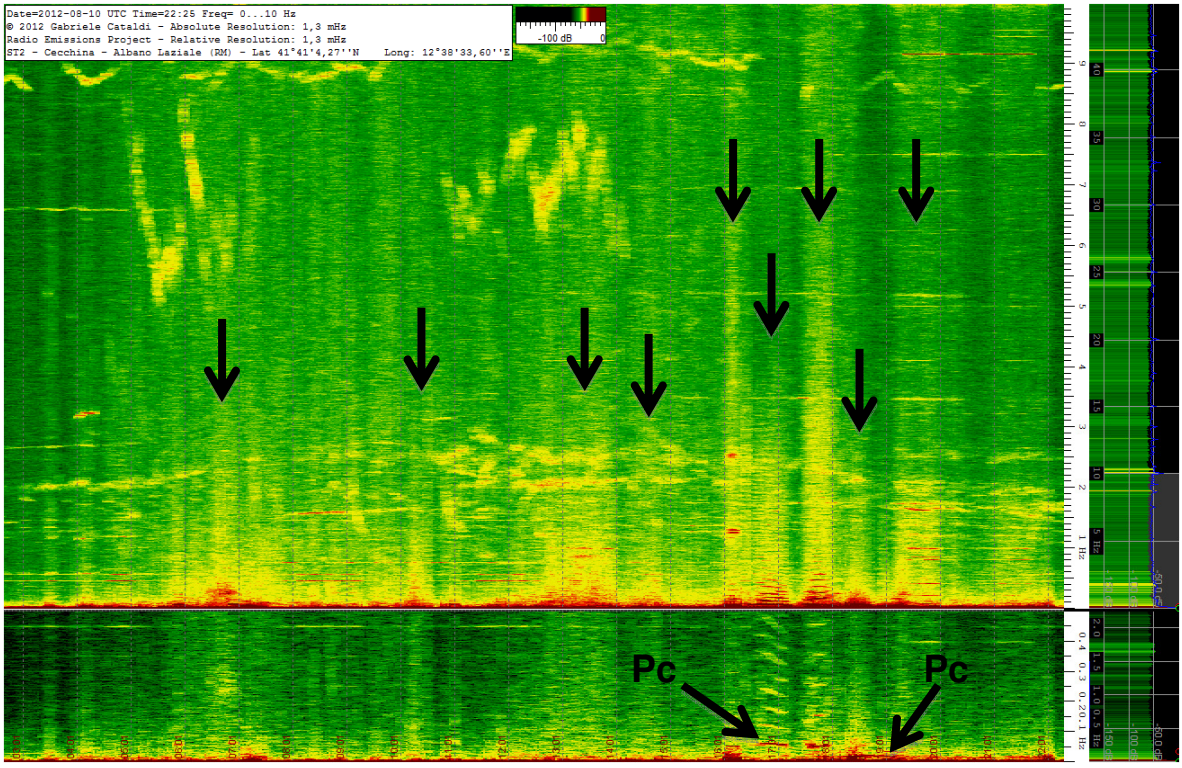
[2] For 60.000 turns coil: Steel used for the manufacture of electrical transformers. For 20.000 turns coil: Soft iron.



Typical Modulation of a Geomagnetic Background – August 12-13, 2012



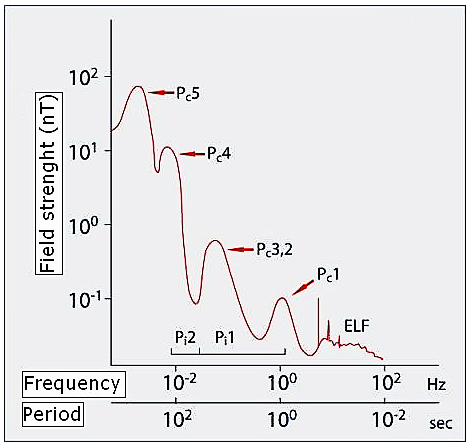
Big ELF (Extremely Low Frequency) Storm in Geomagnetic Background – August 12, 2012



Other ELF Storms (black arrows) – August 10, 2012

Using the INSPIRE VLF3 Receiver for Exploration of the ELF Band

The Geomagnetic Pulsations and the Geomagnetic Background represent natural emissions, prevalently with a magnetic component. The coil antenna can capture, with better efficiency, these emissions because it is significantly permeable to magnetic fields. The INSPIRE VLF3 is available to study the VLF emissions, with a reported range of operating frequencies between 0 and 15 kHz with a gain of about 15 dB. Our studies have established that the INSPIRE VLF3 is able to amplify, with good intensity, radio signals that are located in the ELF band. This can be demonstrated by comparing the observations obtained with the VLF3 and those made by major geomagnetic observatories (HAARP, Kiruna, Licksele, Tromso), or from satellites GOES/ NOAA. If it were not so, it would be impossible to produce spectrograms compatible with the real modulation of geomagnetic activity. Another important thing to consider is the high intensity of the geomagnetic background feature, which makes it possible to be detected by the INSPIRE VLF3 and other types of receivers designed to be used primarily for the study of VLF emissions. The intensity of Pc5 Pulsations reaches the strength (100-300 nT or 100-300 g) of Italian power line interference (220V/50Hz), which is detectable in a house located in the countryside (The intensity of the Pulsations Pc5 is indicated by I.A.G.A. classification of Geomagnetic Pulsations). The ELF storms visible on spectrograms are related to important variations in solar activity (changes in proton and electron density), changes in the interplanetary magnetic field (IMF) and variations of the Kp-Index. The spectrograms included above are an example of this. An example of this can be found between 10 and 13 August 2012, when the Earth's magnetic field was impacted by an intense burst of solar wind that caused major changes in the geomagnetic field (www.noaa.gov). Moreover, geomagnetic activity undergoes diurnal variations in relation to the Earth's rotation: this variation can be observed on spectrograms (an overall reduction of geomagnetic background at night).



Field strength of Geomagnetic Pulsation Credits: National Institute of Geophysics and Vulcanology (I.N.G.V.), L'Aquila, Italy

Classificazione IAGA delle pulsazioni geomagnetiche				
	Nome	**Durata**	**Frequenza**	**Intensità**
Continue	Pc1	0,2-5s	0,2-5 Hz	1 nT
	Pc2	5-10s	0,1-0,2 Hz	3 nT
	Pc3	10-45s	0,022-0,1 Hz	10 nT
	Pc4	45-150s 00:45-02:30	7-22 mHz	< 300 nT
	Pc5	150-600s 0230-10:00	2-7 mHz	300 nT
Irregolari	Pi1	1-40s	0,025-1 Hz	10 nT
	Pi2	40-150s 00:40-02:30	2-25 mHz	100 nT

I.A.G.A. Classification of Geomagnetic Pulsations

From a graphical point of view, a Geomagnetic Storm can be seen as an overall increase of the magnetic signals that appear in the ELF band. The intensity of the increase is inversely proportional to the frequency of the signals, maximizing at the lowest frequencies observed.

In *"THE INSPIRE VLF-3 RECEIVER Theory of Operation"*[3] it was specified that:

> *The inter-stage low pass filter of NASA INSPIRE VLF3 receiver, consisting of inductor L2 and capacitors C6 and C7. These components are located in the signal path between F1 and Q1. The inter-stage filter is needed because the input stage is broadband and capable of amplifying signals in the LF, MF and HF bands in addition to the VLF band. Even though the antenna circuit provides some filtering to reject signals in the MF and HF bands, a strong signal (for instance from an AM broadcast station) will get through and be audible in the receiver output. The low pass filter has an upper cut off frequency of about 12 kHz and strongly attenuates signals above about 20 kHz.*
>
> *The fifth stage of VLF3 receiver is the 2nd audio amplifier/filter. This stage uses ½ of the LM358 integrated circuit (IC2) as an amplifier with a gain of about 15 dB and its frequency response is flat from about 300 Hz to well over 100 kHz. This is followed by the second part of the LM358 configured as a Sallen-Key second order low pass filter. This filter had unity gain and its frequency response is flat from about 300 Hz to approximately 20 kHz.*

The VLF3 receiver uses a second order low pass filter to cut off the signals that have a frequency lower than 300 Hz. In theory, a second order low pass filter causes attenuation of radio signals corresponding to 12 dB/octave (40 dB/decade). Furthermore, that the receiver's documentation indicates that the "frequency response is flat from about 300 Hz," referring to the LM358 integrated circuit.

In fact, we have been able to verify that the filters do not cause such a high attenuation of radio signals with a frequency <300 Hz, because the Italian power line interference (220V/50Hz) is always visible! The second order low pass filter should lead to an attenuation slightly less than 20 dB of radio signals having a frequency of 50 Hz and an attenuation of 40 dB at a frequency of 3 Hz (at 0.001 Hz the attenuation is 46 dB). The question then is how to explain the presence of the Italian power line interference (220V/50Hz)? This interference is not visible when the coil antenna is unplugged from VLF3 receiver. Thus, we know that the VLF3 receiver, is able to amplify frequencies < 300 Hz.

The spectrograms we have attached to this article contain traces of Geomagnetic activity that have an amplitude of -30 dB and -70 dB (dark green for -70 dB, dark red for -30 dB), for a total of 40 orders of magnitude. The color scale of the spectrograms can be modified to allow to view spectrographic traces that have a difference in amplitude corresponding to 180 dB or more. This feature allows view very weak spectral features in the observed signal.

Editor's Note: In summary, the INSPIRE VLF-3 receiver is being used to support the authors' effort to explore the connections between observed radio noise and geological and geophysical phenomena, an interesting pursuit worth following as advancements may be made. A special thanks to Dennis Gallagher, INSPIRE Advisor, for making editorial changes in language usage to improve readability.

[3] http://theinspireproject.org/downloads/pdf/inspire%20Theory_of_Operations.pdf

INSPIRE VLF Recordings Premiere at International Experimental Music and Sound Art Festival in London

Richard Whitelaw and Jacob Kirkegaard

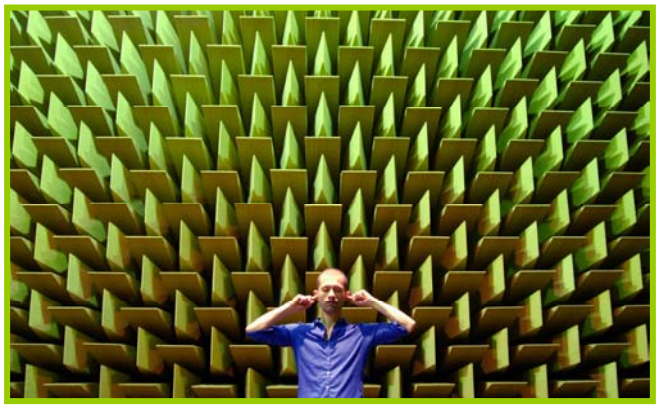
Cut and Splice celebrated international festival of experimental music and sound art produced by Sound and Music and BBC Radio 3. The annual three-day exploration is presented both live and broadcasted on BBC and is held in Wilton's Music Hall, one of London's most atmospheric spaces and the last surviving and oldest grand music hall in the world.

"Transmission" was thematic focus of the 2010 event held November 4th through 6th exploration of the avant garde's use of radio as a dramatic stage and a performance instrument. Radio, powerful mass communication tool and invisible link between innumerable real and imaginary places, has transformed the habits of listening culture, extending the reach of the human ear towards an infinitely distant vanishing point. At first used as a site for broadcast performance, a generation of artists led by John Cage dragged the radio receiver itself on stage and gave it voice as a source of indeterminate electronic noise. The example of this appropriation of the voice of power and the shift from passive reception to active interaction are more relevant than ever in today's culture of media overload.

Jacob Kirkegaard premiered ***Celestial Road,*** a collaboration with BBC and The INSPIRE Project. The 30-minute piece is created of recordings via INSPIRE's VLF Radio Receiver of Northern Lights, also called the Solar Winds or Natural Radio - VLF.

Jacob Kirkegaard previews Celestial Road in Wilton's Music Hall at the Cut and Splice Festival in London

To listen to Celestial Road (30 minutes), visit: http://www.fonik.dk/works/celestialroad.html



About Jacob Kirkegaard

Jacob Kirkegaard is a Danish artist who focuses on the scientific and aesthetic aspects of resonance, time, sound and hearing. His installations, compositions and performances deal with acoustic spaces and phenomena that usually remain imperceptible. Using unorthodox recording tools, including accelerometers, hydrophones and home-built electromagnetic receivers, Kirkegaard captures and contextualizes hitherto unheard sounds from within a variety of environments: a geyser, a sand dune, a nuclear power plant, an empty room, a TV tower, and even sounds from the human inner ear itself. Based in Berlin, Kirkegaard is a graduate of the Academy for Media Arts in Cologne, Germany. Since 1995, Kirkegaard has presented his works at exhibitions and at festivals and conferences throughout the world. He has released five albums (mostly on the British label Touch) and is a member of the sound art collective freq_out.

NASA Space Academy Scholarship Program

Inspiring our Next Generation of Space Scientists and Explorers

Eva Kloostra, Space Academy Program Coordinator

In 2007, INSPIRE's past president Kathleen Franzen launched a new educational scholarship program for DC educators – NASA Space Camp for Educators. The INSPIRE Project teamed up with the NASA Marshall Space Flight Center, the U.S. Space and Rocket Center, Washington Space Business Roundtable, DC Space Grant Consortium, Patriot Training Center, EADS North America, International Launch Services and other partners to send DC educators to the 5-day workshop at the US Space and Rocket Center in Huntsville, Alabama offered every summer for teachers from around the world to participate in 45 hours of intensive classroom, laboratory and training time, focusing on space science and exploration. This hands-on program equips teachers with knowledge, activities and curriculum materials to excite, engage and attract elementary, middle and high school students to the STEM disciplines. In INSPIRE's annual survey of past participants (school year 2011-12), **100% of Space Academy for Educators scholarship recipients reported that they have utilized materials and knowledge acquired via the program in their classrooms directly impacting 2,750 students in 198 DC area schools.** Recipients represent INSPIRE at workshops and programs as Ambassadors and continue to be actively involved in the organization. In 2010, a second program was established in response to numerous inquiries by students that learned about the program through past educator participants. The Kathleen Franzen Memorial NASA Space Academy scholarship program, renamed in 2011 in honor of its founder, is in its fifth year and continues to grow in popularity.

INSPIRE Space Academy program sponsor, Washington Space Business Roundtable, invited past scholarship recipients to attend their April 2013 event with Dr. Lance Bush of the Challenger Center. To read article: http://www.examiner.com/article/stem-education-needed-to-fill-21st-century-jobs
Pictured above (left to right): Julia Martas, Thurman Jones and WSBR Secretary and Education Chair Janice Starzyk

Space Academy for Educators

Thurman Jones, President
Patriots Technology Training Center

I received a scholarship to attend Space Academy for Educators in August of 2010. Upon returning from Huntsville, Alabama, INSPIRE's president, Kathleen Franzen, and I had a meeting that inspired the development of a Solar System Competition to create interest in the solar system from a hands-on perspective for Washington DC area middle school students. The concept was that 9 teams of 10 students would complete a research project for a selected planet in the solar system. The project would include a five-page research paper, a brochure, a web page, poster board display and an oral presentation, to be given at an awards reception at the Visitor's Center at NASA Goddard Space Flight Center in Greenbelt, Maryland on the day of the event. A panel of STEM professionals would judge the competition and the winning team of 10 students would receive full scholarships to attend Space Camp for Students at the U.S. Space and Rocket Center over the summer. Kathleen's and my vision became a reality on May 12, 2011 thanks to a generous donation to the INSPIRE Project in memory of Kathleen who sadly passed in late 2010, and other corporate sponsors including the Washington Space Business Roundtable and the Maryland Space Business Roundtable. The Solar Competition was a standing room only event with 180 guests and was dedicated to INSPIRE's late founders Bill Taylor and Kathleen Franzen. The opening dedication video can be viewed at: http://www.youtube.com/watch?v=2XP3n6C9W6c. The 3rd Annual Solar System Competition will be held in May 21, 2013 and this year's research project topic is NASA Centers around the country.

As we continue to keep Bill and Kathleen's dream alive, I can always recall Kathleen's energy and dedication to help get minority students involved in space science.

Florentia Spires, M.Ed., STEM Curriculum Developer/Educator
Howard University Middle School of Mathematics and Science
2013-2014 Albert Einstein Distinguished Educator Fellow

I immensely enjoyed and benefited the learning that I acquired through the interactive hands on and minds on activities at Space Academy. It afforded me the opportunity to delve deeper into understanding of the nuts and bolts of space exploration. As a Space Academy graduate, I have incorporated numerous activities into my lessons on Earth, space and physical science content. My students have developed a greater appreciation for space exploration due to the hands on and minds on activities afforded to them resulting from my intellectual growth from Space Academy. Following Space Academy, I was selected by the U.S. Space and Rocket Center to serve as a Space Camp Ambassador promoting the opportunity to community events, school and parent bodies in the DC area. The initial work students encountered resulting from my Space Academy experience was to learn the history of space exploration globally starting from 428 B.C. to present. As a team, each group has designed space exploration patch depicting them as astronauts and their awareness of space through their design. The patch included an illustration of experiment(s) that their team would like to see launched in space. They have conducted engineering projects to design, collaborate, construct and test their vessels. They also performed components of redesign and tests in hope of better results in an effort to implement lessons learned. Students enjoy the lessons immensely as they have adjusted to open-ended critical thinking and problem solving for a task at hand. The engineering design projects that the students executed were space rockets, moon landers, rovers, and solar water heaters. The students have developed into science and engineer leaders to interpret their scientific concepts and share the application in order to assist other teams to understand the science behind their approach to critical thinking thus problem solving for real world innovations.

Florentia Spires conducting a professional development workshop for teachers on NASA lightening towers for spacecrafts. Teachers learn how to implement STEM activities in the classroom with their students. Objective: Build the Tallest Lightening Protection System

Florentia Spires was selected as a 2013-2014 Albert Einstein Fellow, one of the most elite opportunities for advanced professional development for STEM educators. She will work full time in the National Science Foundation.

Alma Smith in Mission Control at Space Academy

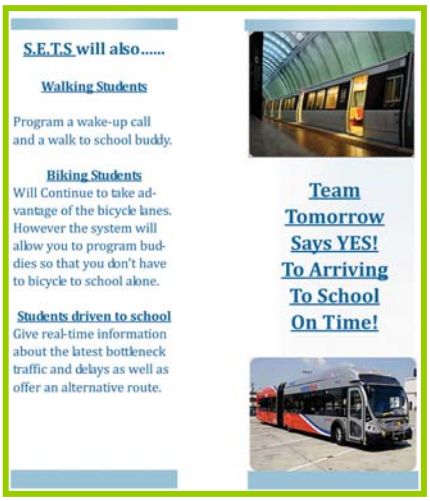
Alma Smith, HS Chemistry Teacher and BioMedical Coordinator
Bladensburg High School

To have the opportunity to collaborate and exchange teaching strategies and cultural differences in the classroom with colleagues from Australia, Morocco and China was fantastic! We are planning an international teleconference focusing on the sciences in the upcoming school year to allow our students to exchange ideas and expand their learning in the classroom. I have incorporated changes that can occur in the human circulatory, heart and muscle system due to the environment when scientists are travelling in outer space into my BioMedical curriculum and participate numerous middle school STEM fairs annually, wearing my flight suit from Space Academy, to excite and attract students to the STEM disciplines.

Jacqueline Fernandez, High School STEM Teacher
Latin American Youth Center Academy Public Charter School

Thanks to the all of the information gathered and resources gathered at Space Academy for Educators at NASA Marshall Space Flight Center in Huntsville, Alabama I was able to implement more interactive STEM lessons in my classroom. I am very excited that I hear more of my students talking about science and some of them have mentioned that they would want to pursue engineering and others have mentioned they want to be astronauts. I look forward to the second part of Space Academy for Educators and hope to learn more about how to continue empowering my students to pursue STEM careers.

Dr. Alesia Slocumb-Bradford, Mathematics Educator
Jefferson Academy Middle School



Since attending Space Academy in 2011, I have shared the curricula acquired with other STEM teachers; expanded the mathematics and Robotics curricula to incorporate more space exploration activities; and developed an elective class, Project AIM (Activities Involving Mathematics), designed for students to have an opportunity to learn STEM disciplines in an innovative yet fun way. Project AIM students have participated in STEM competitions and fairs locally and nationally. Two Project AIM teams (four students per team) won the state awards for the District of Columbia in the US Army's eCYBERMISSION national competition designed to inspire students interest in STEM. Administered by the National Science Teachers Association, the competition challenged students in grades 6 through 9 to develop solutions to real world problems in their communities. *Team Tomorrow: Say Yes to Arriving to School on Time!* won 1st place for its phone app to help students get to school on time and *Team Say No More to School Shooting Fatalities* won 2nd place for its solution to making schools safer (www.ecybermission.com). The Project AIM teams also won awards at the Earth Day STEM Fair at Union Station in DC; the Robotics Team won 2nd Place in the Alliance Division at the Botball Competition; and *Team Say No More to School Shooting Fatalities* won 1st place at the DC STEM Fair, where I received the Sheikh Zayed Outstanding STEM Educator Award. Below is the student nomination letter that provides a brief overview of what I have been doing for the STEM disciplines:

Dr. Slocumb-Bradford is a teacher leader among leaders. Dr. Slocumb-Bradford works very hard to have all of her students involved in everything that has to do with STEM. She is an outstanding mathematics teacher; her approach to teaching is to involve the students with an interdisciplinary mix of STEM components! I have a twin brother, and we both just love STEM activities! Dr. Slocumb-Bradford has inspired so many of us to appreciate what STEM education has to offer! She stays on the cutting edge of providing her students with opportunities that might not otherwise come their way! Last year, Dr. Slocumb-Bradford and her Robotics Team won first place for the Middle School Division at the Botball Competition (www.botball.org). In addition, Dr. Slocumb-Bradford had a hands-on exhibition booth entitled, "All About Mars" last April at the 2nd Science and Technology Festival held at the DC Convention Center. And at the end of the school year, she arranged for West Point Mobile STEM workshop to come here to DC to offer students from around the city a 2-day hands-on workshop of STEM activities. And if this wasn't enough, already this year, we have done the following: All of my classmates in the 8th grade which consists of 96 students took a field trip entitled, TIDES (Transformative Innovation for Development and Emergency Support) (www.star-tides.net) at Fort Meade that included 13 interactive stations that utilized STEM activities from a solar cooker, bikes (seamless solar solutions), shelter-box, HTI water, rotary robotics, and more which Dr. Slocumb-Bradford sponsored! On Saturday, September 29, Dr. Slocumb-Bradford drove me and several of my classmates to the Senior Solutions Expo that featured exhibitions using STEM disciplines to solve problems affecting the elderly. We had so much fun! Dr. Slocumb-Bradford has a course she titled, Project AIM (Activities Involving Mathematics) which is designed to involve the STEM initiatives. In this course, we learn how to fly airplanes, learn complex mathematics, design, build, and program robots to perform a specific task(s), build Ferris Wheels, and learn about DNA. We have participated in 2 STEM competitions thus far, which focused on solving community problems and issues. We are currently getting our projects ready for the DC STEM Fair in a few weeks. At the end of the month, Dr. Slocumb-Bradford, is making it possible for us to attend the March "Robotics" Madness at the DC Convention Center to see the high school robotics competition! We are also working on our robots for the Botball (Robotics) competition in April! Dr. Slocumb-Bradford writes grants to ensure that we have the necessary tools we need to participate and learn STEM information and education. She won a Best Buy grant several years ago and purchased the laptops we are using today! I can say so much more, but I think I should stop there!

Dr. Alesia Slocumb-Bradford (center) at the U.S. Space and Rocket Center with fellow INSPIRE Space Academy scholarship recipients

Overview ~ A Week with INSPIRE at Space Academy

INSPIRE's DC teacher and student crews blasted off for their six-day educational journey to Huntsville, Alabama the first week of August. The Space Academy program at the U.S. Space and Rocket Center is truly an "out of this world" experience for the 34,000 students and teachers from around the world who attend each summer. While in-flight to Huntsville, INSPIRE asked the students to write down the one thing they most wanted to do at Space Camp. The most popular response was "to taste space food". The students had no idea what they were about to experience.

When the INSPIRE students landed they were taken to the shuttle-shaped "Space Habitat" building where they bunked for the week; educators are housed at the nearby University of Alabama. Upon arrival both educators and students are assigned to teams, appropriately named after astronauts, and all activities require and reinforce the importance of teamwork. Participants reported for breakfast at 7:30am each morning and would not return to their quarters until 9 or 10pm each night. For both groups, the action-packed week included defying gravity in the *Astrotrek* astronaut-style training facility where participants tumbled and spun in the Multi-Axis Trainer, floated on air in the 5-Degrees of Freedom Chair, walked like Apollo astronauts in the 1/6 Gravity Chair, and experienced a world without friction in the Manned Maneuvering Unit (MMU) Simulator.

During the weeklong program, all team members participated in a minimum of two Space Shuttle Missions in the simulator area. The complexity of the missions is program and age-specific and covers an extensive array of core STEM areas. In mission training participants learn about space exploration, space physics, and even get an interactive space history lesson with a NASA astronaut. Once training is completed, teams are ready for the mission simulations where they get to "fly" the space shuttle, walk "in space" on an EVA (Extra Vehicular Activity), repair the Hubble Space Telescope, live and work in space on the International Space Station, and communicate with Mission Control. The students and teachers solely conduct their Shuttle Missions with USSRC instructors and guests watching from a viewing area. Aside from the astronaut-style training, Space Shuttle Missions, simulated parachute landings and helicopter rescues in the water, the real attraction of the Space Academy program is its ability to engage and excite students and educators 12+ hours a day in science, technology, engineering and mathematics in an environment that encourages teamwork, problem solving, communication skills and building self-confidence.

At the end of the week, an elaborate graduation ceremony is held and the astronaut trainees receive diplomas. Graduation is concluded with a group "Grip It, Rip It and Flip It" ritual whereby participants remove their name badges off their flight suits (which have been upside down all week), flip them over and place them right side up on their suits – just like in actual NASA astronaut training. No detail is omitted in this amazing program. Space Academy for Educators graduates are equipped with knowledge, activities and curriculum materials to promote life-long learning in a classroom setting. From "Math on Mars" to hands-on engineering projects, all lessons and activities link to the National Science and Math Standards – all of which are ready to use in the classroom to help create our next generation of space scientists and explorers.

On the return flight home, INSPIRE asked the students what was the one thing they learned and will never forget about Space Academy. Notably the "taste of space food" did not make the list. Not only did the INSPIRE scholarship recipients have a blast at Space Academy, many relayed with sincerity, "It was an experience of a lifetime."

Space Camp for Students

Hannah C. ~ Student Commander, Space Camp 2012

Hannah (center) with fellow INSPIRE Space Camp scholarship recipients

Upon embarking to Space Camp, Nile, Jayenen, Frank, Cebra, and Sally all displayed an eager fascination with space travel. They were curious to learn how science and determination were able to overcome once seemingly insurmountable challenges such as gravity, outer space survival, landing safely, and navigation. They asked many questions like, "How long did it take to build the International Space Station?" and, "Exactly how does a space shuttle work?" We discovered that science is not only fun, it is also life changing. In Space Camp we learned about astronauts and experienced several facets of astronaut training through various missions that we were assigned. Even though each astronaut aspires to reach the stars, we learned that teamwork enables him or her to accomplish this goal. There are no "stars" in space; therefore, working together is an essential part of Space Camp. As a result of operating in different aeronautical positions each camper had a greater respect for one another. We enjoyed making new friends almost as much as learning! The INSPIRE campers left with the impression that science and engineering is more exciting than they previously imagined. Space Camp brought space exploration related fields even closer to home as one student reflected, "[it] helped me to have another career choice to keep in mind." We interacted with future astronauts, scientists, and engineers. The hands-on emersion into space exploration reinforced the importance of science in day-to-day life. We left Huntsville, Alabama with the realization that determination anything is possible.

Frank P. ~ "Promising Astrophysicist/Astrobiologist 'Astronomical' Life Experience at Space Camp 2012"

Space Camp is not like the average week of camp and lodging, but the ultimate adventure, an "astronomical" life experience. I am a 2012 Student Astronaut Trainee! Thanks to The INSPIRE Project, Washington Space Business Roundtable and its other partners, Space Camp has been the highlight of my summer, as I enjoyed many training activities and practiced in multiple simulators. The best part of Space Camp was the Lunar Mission and Shuttle Mission, where I was a Commander in the Orbiter, and Flight Director in Mission Control. The simulated space-station habitat was perfect lodging, since I plan to be in the forefront of future space habitation. Overall, Space Camp was one of the most rewarding life experiences I've had, and it greatly enhanced my life-long passion towards a career as an Astrophysicist / Astrobiologist, as I also pursue International Relations. With a keen interest in space life forms and human habitation, I would love to further my insight into space, with opportunities that become available. Again, I sincerely appreciate the many wonderful partners and team of INSPIRE.

On the return flight home, scholarship recipients answer the question below; following are some of the responses:

The one thing I will always remember about Space Camp is…

… how I landed the shuttle so perfectly. After completing the mission as commander, I could see myself having that job. ~ Khalil, 8th Grade
… the lifelong friendships I made. ~ Brea, 9th Grade
… how I fixed problems and told the public about them (CATO). I could see myself doing that as my profession. ~ Alfred, 8th Grade
… all of the cool facts about the pilots of the shuttles. I will never forget it because that is what I want to do when the time comes. Also, I will never forget my team mates. James ~ 8th Grade
… for the rest of my life, the amazing opportunity to hear "Hoot" Gibson talk about all of his experiences flying planes and it really inspired me to learn more about planes and aviation and now I really want to learn how to fly one. I won't forget this experience for the rest of my life. ~ Elianna, 7th Grade
… the Leadership Training. Here are a few things I will never forget: Communication is vital to every team because you have to spread information. Participation is vital because everyone has to work hard. ~ Alston, 9th Grade
… overcoming my fear of heights and the diverse friends I made and will never forget. ~ Chioma, 9th Grade
… I will remember the entire experience for the rest of my life. I can't pick a single moment out of this journey. This camp is one of those memories that I will cherish and tell stories to my children and grandchildren. Going to Space Camp has been a life changing experience. ~ Kowi, 10th Grade
… the history of our triumphs and failures in space travel. Those who forget it are doomed to repeat it. I shall not be one of those doomed. I will use our past to rocket into the future! ~ William, 7th Grade

INSPIRE VLF Receiver Technical Notes

Paul Schou
VLF Receiver Technical Advisor

Paul Schou presented INSPIRE's VLF Radio Receiver Kit to the Education Director at the U.S. Space and Rocket Center for possible inclusion in the Space Academy for Educators Curriculum and for a permanent, interactive exhibit in the space museum in Huntsville, Alabama

For the past 24 years, the INSPIRE VLF (Very Low Frequency) radio receiver kit has been designed with one underlying goal – to educate students about the sounds of space through hands-on experience. Building a kit enables one to take the journey from seeing a device made from parts to product and gives the student the tools needed to not only take science into their own hands to 'listen' to the electromagnetic world around them. It also removes barriers and complexities by showing how every electronic device is nothing more than an assembly of simple parts. Taking the step into the world of building one's own electronic device is a step forward to opening the world of scientific exploration and showing that this complex world is made up of many simple components working together.

In November 2011, INSPIRE completed its latest generation receiver kit with an improved circuit board design and design updates with the input from kit user and assembly suggestions that have been submitted, analyzed and reviewed over the past 5 years. The new board design has many unique features such an internal battery / external battery connection and stereo audio plugs for listening to the VLF signals between 300 Hz up to 20 kHz. The updated receiver kit has similar functionality but the new design allows for increased ease of assembly and usage. The kit is made to be compact and simple to show both the wonders of radio receivers and give students inspiration for even greater ideas. INSPIRE is confident that the new, user-friendly kit will attract, excite and inspire even more students of all ages to be part of our next generation of space explorers.

To date over 3,000 INSPIRE radio receiver kits have provided students around the world the opportunity to experience the sounds of space firsthand and the interest in VLF kits has continued to increase both nationally and globally. INSPIRE VLF receiver kits have been incorporated in higher education curriculums including University of Maryland in Baltimore, Tel Aviv University in Israel, University of Texas at Brownsville's Department of Physics and Astronomy and most recently Virginia Polytechnic Institute in Blacksburg who submitted a research proposal and was funded by NSF for using INSPIRE's new ELF/VLF receiver equipment and the SuperDARN radars to test of the extent to which ionospheric convection on closed magnetic field lines is symmetric between the hemispheres. New information will be obtained about inter-hemispheric coupling in the South Atlantic Anomaly region and the prevalence of inter-hemispheric field-aligned currents INSPIRE's VLF receiver will be incorporated as a teaching tool for a space science class.

Past Highlights

Great tips from kit users over the years may be found in our online *Journal* archives.
From the December 2009 issue submitted by Dr. Paulo Trovanelli:
http://theinspireproject.org/downloads/pdf/Journal Archives/INSPIREJournalVol19Dec09-20Years.pdf

"I have 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!"
[Read more of this article online]

To purchase a VLF Radio Receiver Kit online: www.TheINSPIREProject.org.

If You Would Like to Submit Observations or Kit Notes for Inclusion in The Inspire Journal, email Paul Schou:
CustomerService@TheINSPIREProject.org.

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 recordings, spectrograms will be made of any parts of the recording that you indicate.

4. Place a time mark on the log for the recording 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. When using tape 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 recordings and logs to indicate the sessions monitored and send to:

   Internet via DropBox or Google Drive:
   CustomerService@TheINSPIREProject.org

   Tape Cassettes:
   The INSPIRE Project
   107 S West Street PMB #425
   Alexandria, VA 22314-2824

   (Your tapes will be returned with spectrograms of your data.)

9. Include a write up accounting your procedure, location, and observations and an article reporting on the results will appear in the next *Journal.*

10. NOTE: If you are hearing whistlers, rotate the recorder after 12 minutes with a “Whistler” recorder unit 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, Field 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 = UTC	EST + 5 = UTC
CDT + 5 = UTC	CST + 6 = UTC
MDT + 6 = UTC	MST + 7 = UTC
PDT + 7 = UTC	PST + 8 = UTC

To verify your UTC browse to http://time.gov and click on the link titled UTC

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.

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

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

To verify your UTC browse to http://time.gov and click on the link titled UTC

INSPIRE Data

INSPIRE Observer Team _____

Observation Date: _____ Receiver _____

Observation Start Time (UT) _____ Start Time (**Local** Time) _____

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: ___ _____

_____ 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: ___ _____

INSPIRE VLF-3 Radio Receiver Kit Ordering Information

INSPIRE VLF-3 Radio Receiver Kits can be ordered online at: www.TheINSPIREProject.org
A printable form for mail orders is also available on the website.

INSPIRE accepts purchase orders for multiple kit orders. Discounts are available for non-profit organizations utilizing kits in middle and high school STEM curriculums.

For more information, contact Paul Schou at CustomerService@TheINSPIREProject.org

Invest Today for the Exploration of Tomorrow

The INSPIRE Project is committed to shaping and providing scholarships and awards to ensure the next generations of space science and technology explorers. We currently do fundraising through grants and corporate partners; however, the programs that we now offer have grown exponentially to fulfill our expanded Mission. INSPIRE is seeking additional forward-thinking partners and sponsors who understand the importance of providing opportunities to educators and students. INSPIRE's programs provide students the resources to pursue study in science, technology, engineering and math. We invite you to invest in our next generation of space scientists and explorers. All contributions are tax-deductible.

For more information on individual and corporate giving opportunities, please contact INSPIRE's Educational Program Coordinator, Eva Kloostra, at Editor@TheINSPIREProject.org.

Photography by Eva Kloostra, U.S. Space & Rocket Center in Huntsville, AL ~ August 2013

The INSPIRE Project, Inc. is a 501(c)(3) nonprofit educational scientific corporation. The INSPIRE Project, Inc. has both federal and tax exempt status (FEIN 95-4418628). All contributions are tax-deductible.

Subscribe Online TODAY

To sign up for a subscription to The INSPIRE Journal, visit: TheINSPIREProject.org

Contact The INSPIRE Project, Inc

The INSPIRE Project, Inc.
107 S West Street PMB #425
Alexandria, VA 22314-2824

INSPIRE VLF Kit Information, **Paul Schou**
CustomerService@TheINSPIREProject.org

The INSPIRE Journal Editor, **Eva Kloostra**
Editor@TheINSPIREProject.org