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Journal of the Society of Amateur Radio Astronomers

(SARA)

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Contacting SARA

The Society of Amateur Radio Astronomers is an all-volunteer organization. The best way to reach the Officers, Directors or Committee Chairs is through e-mail.

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~ Green Bank Telescope ~



Figure 1: GBT at Sunset (Photo credit: Harry Morton, NRAO)

Get Ready, the Conference is Nigh! Page 7

~ The President's Page ~

Hope everyone had a great winter full of successfully completed projects. Spring has almost sprung. So as gardening and outside projects take over, try to find time to get the radio astronomy antennas online as well. Then let us know what you're seeing.

Everyone should be getting in the habit of checking SARA's website periodically for the latest in conference details and general news [http://radio-astronomy.org]. With the move to an all-electronic Journal, our turn around time and amount of information in the Journal will improve. But it's still slow compared to web based.

The annual conference at Green Bank is fast approaching. The dates are June 29 through July 2, 2008. So be making your vacation plans to return to NRAO Green Bank, for your yearly fix of big radio astronomy.

As you've probably guessed by now, the western SARA meeting still hasn't come together. We really keep "overshooting the runway." What we need really is some buy-in by the staff at the VLA, Owens Valley, or DSN (some place interesting). That seems essential to making a conference plan come together. Publicity and vacation planning take time. So we've not had time to get the notice of tentative dates into member hands early enough to get a reasonable turn out. Rodney Howe has been trying to orchestrate the VLA meeting. But at present, we're setting our sights toward next fall at the earliest. Watch the website for further details.

Charles Osborne K4CSO

Note: Conference Registration Fee (adapted from the SARA Website)

The fee for the 2008 Conference has been set at $145 US for SARA members in good standing, as well as dues-current members of SARA Affiliate Societies (European Radio Astronomy Club, Society of Amateur Scientists, and SETI League); $155 US for non-members. This fee includes Conference registration, one copy of the published Conference Proceedings (to be distributed at the meeting), morning coffee breaks, afternoon snack breaks, evening refreshments, and eight meals, as indicated below. The fee for spouses, children, companions, or other non-participating persons accompanying registered Conference attendees is $80, which includes morning coffee breaks, afternoon snacks, evening refreshments, and meals. The cited fees, calculated on a break-even basis, apply only to advance registrations. To avoid late registration, your remittance-in-full must be received by the Treasurer *no later than* May 30, 2008. All registrations received after that date, including walk-in registrations, will be incur an additional 15% late registration fee. Contact the SARA Treasurer, Tom Crowley (see page 2).

~ From the Editor's Desk ~

Your feedback is important to me and again, I will encourage you to submit (email blurbs to academic papers; hands-on project tips to analytical tools; etc.). Submission Guidelines are posted on the SARA website: [http://radio-astronomy.org/publicat/authjrnl.htm].

***

In this issue, you will find NRAO's outreach with Cosmic Radio and a preview to the 2008 annual conference, including our key note speaker and his related field of interest on cosmology and biology—the Anthropic Principle. Bruce Randall shows us how to map the radio skies at 408 MHz. A 23-cm LNA in the Radio Astronomers' Toolbox from ERAC members and a possible application to measure Sun noise from Joe Martin should be something interesting to amateur radio operators, as well as to radio astronomers. Also, there is an annotation from an interesting article on Maxwell, Planck, and Hubble in the History of Science section. Solar Radio Astronomy Miscellany points out a remotely accessible 12 GHz system in Japan and a follow-up article expounds on the currently available IBT Manual, written by Jon Wallace/Kerry Smith. And this issue's Member in Profile is Jim Hardy.

***

Charles Osborne had mentioned our efforts for a Western Regional Conference in *The President's Page*. Many had fervently worked to make such a conference happen this year, but the logistics were just too daunting. Efforts are underway to make this happen in the future. Any suggestions or assistance would be greatly appreciated. Please direct your suggestions to the officers of SARA, [officers@radio-astronomy.org].

***

Please welcome our new member, Gene Radice of Bloomburg, PA

John C. Mannone, Editor

~ Cosmic Radio ~

A New Radio Show to begin Airing in January 2008:

NRAO and Allegheny Mountain Radio are pleased to announce the launch of a new radio show designed to bring the space-age science of radio astronomy down to earth. We call it "Cosmic Radio". The short programs (there are 26) cover a wide range of topics, from notable events in the history of radio astronomy to fundamental concepts, to recent and exciting discoveries. Within the next couple of weeks we will be distributing the complete Cosmic Radio series on CD to over 500 NPR affiliated stations. We have also developed a website, which will be updated weekly with a new program. Check it out and listen to our [current] show at [http://www.nrao.edu/cosmicradio/].

Funding for Cosmic Radio was provided to Allegheny Mountain Radio by the Corporation for Public Broadcasting. The concept is modeled after the venerable "StarDate" program, with the exception that it will be broadcast weekly rather than daily.

Our goal is to increase public awareness of radio astronomy, and the NRAO, and we hope it is a huge success! You can help, by making radio stations in your area aware of the series. Contact your favorite radio station and tell them you want Cosmic Radio on the air. Although we are targeting NPR affiliates, commercial stations are also welcome to run the program on a sustaining basis, but cannot sell advertising sponsorship. And, it's free! Station managers can contact us through the website.

Editor's Note: Current and archived podcasts (December 17, 2007-March 23, 2008) are downloadable from the NRAO website, [http://www.nrao.edu/cosmicradio/archive.php]:

Episode 1	Welcome to Cosmic Radio
Episode 2	How Radio Astronomy Began
Episode 3	Recipe for Radio Waves
Episode 4	Cosmic Yardstick
Episode 5	The Radio Sky
Episode 6	The GBT
Episode 7	Galileo and the Sun
Episode 8	Cassiopeia
Episode 9	Our Place in the Milky Way
Episode 10	Galaxy Building Blocks
Episode 11	The Very Large Array

Sue Ann Heatherly, Education Officer, NRAO

SARA 2008
Annual Conference ~

Conference contributors, please be advised SARA has solicited a call for papers for the SARA Conference (June 29-July 2, 2008) at NRAO, Green Bank, WV.

Abstracts on radio astronomy hardware, software, education, research strategies, and philosophy have been received by the required deadline, March 1, 2008. The Vice President thanks all the contributors.

Please note: first-draft manuscripts must be received no later than April 1, 2008.

Accepted papers must be camera-ready by no later than May 1, 2008.

See *Guidelines for Submitting Papers*, as well as other helpful details, in the link below. They can be found on the official SARA website, Please visit and make your New Year's resolution now: [http://radio-astronomy.org/meetings/cfp2008.htm].

It is important that we all comply with the timetable so that we can have a successful conference and proceedings!

~ 2008 SARA Conference Keynote Speaker ~

The Society of Amateur Radio Astronomers (SARA) is pleased to announce the selection of Dr. Steven J. Dick, chief historian of NASA, as Keynote Speaker for its annual technical conference, being held from 29 June to 2 July 2008 at the National Radio Astronomy Observatory, Green Bank, WV. Dick's presentation, "Cosmology and Biology," dealing with the Anthropic Principle and the search for life in space, is scheduled for Monday morning, 30 June 2008.

Before joining NASA in 2003, Dr. Dick worked as an astronomer and historian of science at the U. S. Naval Observatory for 25 years. He obtained his Bachelor of Science in astrophysics (1971), Master of Arts and Doctorate (1977) in history and philosophy of science from Indiana University. He is a well-known expert in the field of astrobiology and its cultural implications. He spent three years at the Naval Observatory's Southern Hemisphere station in New Zealand. Dick served as the first Historian of the Naval Observatory, as well as Acting Chief of its Nautical Almanac Office.



Figure 2: Steven J. Dick, NASA Historian

Dick served on the panel to examine the societal implications of possible life in the Martian rock. He received the NASA Group Achievement Award, "For initiating the new NASA multidisciplinary program in astrobiology, including the definition of the field of astrobiology, the formulation and initial establishment of the NASA Astrobiology Institute, and the development of a Roadmap to guide future NASA investments in astrobiology." He is also the recipient of the Navy Meritorious Civilian Service Medal and the 2006 LeRoy E. Doggett Prize for Historical Astronomy of the American Astronomical Society. He has served as Chairman of the Historical Astronomy Division of the American Astronomical Society, as President of the History of Astronomy Commission of the International Astronomical Union, and as President of the Philosophical Society of Washington. He is a corresponding member of the International Academy of Astronautics.

He is on the Editorial Board of several journals, including the *Journal for the History of Astronomy*, and is an associate editor of the *International Journal of Astrobiology*. He was Chairman of the Historical Astronomy Division of the American Astronomical Society (1993-1994) and President of the History of Astronomy Commission of the International Astronomical Union (1997-2000). He has also served as President of the Philosophical Society of Washington.

He was the editor of the following publications:

Many Worlds: The New Universe, Extraterrestrial Life and the Theological Implications (2000)

Risk and Exploration: Earth, Sea and Stars (NASA SP-2005-4701 (Washington, D.C., 2005) (coeditor with Keith Cowing)

Dick has authored more than 100 publications, including:

Plurality of Worlds: The Origins of the Extraterrestrial Life Debate from Democritus to Kant (Cambridge University Press, 1982)

The Biological Universe: The Twentieth Century Extraterrestrial Life Debate and the Limits of Science (Cambridge University Press, 1996)

Life on Other Worlds (1998) (*Translated into four languages*)

Sky and Ocean Joined: The U. S. Naval Observatory, 1830-2000 (Cambridge University Press, 2002) (*A history of the Naval Observatory, received the John Lyman Award of the North American Society for Oceanic History for best book in 2002 in Science & Technology. It also won the Naval Observatory's Captain James Melville Gilliss Award for extraordinary dedication and exemplary service.*)

The Living Universe: NASA and the Development of Astrobiology (Rutgers University Press) (*Co-author with James Strick*)

His latest books are the co-edited volumes with Roger Launius:

Critical Issues in the History of Spaceflight (NASA SP-4702, 2006)

Societal Impact of Spaceflight (2007)
At our 2008 gathering, Steve Dick will be helping SARA to celebrate our club's 27th Anniversary. Members and guests are invited to participate in our annual Conference. If you would like to present a paper yourself, please see our Call for Papers on the SARA website.

~ The Anthropic Principle ~

(*Editor's Note: Adapted from* Wikipedia*, the free encyclopedia*)

In physics and cosmology, the Anthropic principle states that humans should take into account the constraints that human existence as observers imposes on the sort of universe that could be observed. Originally proposed as a rule of reasoning, the term has since been extended to cover supposed "super laws" that in various ways require the universe to support intelligent life, usually assumed to be carbon-based, and occasionally to be specifically human beings. Anthropic reasoning involves assessing these constraints by analyzing the properties of universes with different fundamental parameters or laws of physics from the current one. And has [been] frequently concluded that essential structures, from atomic nuclei to the whole universe, depend, for stability, on [the] delicate balances between different fundamental forces; balances which occur only in a small minority of possible universes — so that ours seems to be fine-tuned for life. Anthropic reasoning also attempts to explain and quantify this fine-tuning. Within the scientific community the usual approach is to invoke selection effects from a real ensemble of alternate universes, which cause an anthropic bias in what can be observed; competing strategies, occasionally also called anthropic, include intelligent design.

The anthropic principle has led to more than a little confusion and controversy, partly because several distinct ideas carry this label. All versions of the principle have been accused of providing simplistic explanations that undermine the search for a deeper physical understanding of the universe. The invocation of either multiple universes or an intelligent designer are highly controversial, and both ideas have been criticized by some as being presently *untestable*, and therefore not within the purview of contemporary science.



Figure 3: Steven Dick, Associate Editor of
the International Journal of Astrobiology
[http://www.anthropic-principle.com/index.html]

~ 2008 Conference Paper Abstracts ~

(*in order of presentation: dark red for Monday, dark blue for Tuesday, dark green for miscellaneous*)

Cosmology and Biology (*Keynote Lecture*)
Dr. Steven J. Dick, Chief Historian, NASA (Monday 9:30 am)

Even as astrobiologists search for life in the universe, scientists and philosophers alike are pondering the possibility of a deep and profound relationship between cosmology and biology. The universe appears in its very essence to be biocentric, in that the laws of nature and the physical constants are finely tuned for life, giving rise to what has been termed the "Anthropic principle." Exactly 20 years ago, in his book, Infinite in All Directions, physicist Freeman Dyson speculated that the prospects are bright for a future-oriented science, joining together in a disciplined fashion, the resources of biology and cosmology. In such a "cosmic ecology," life and intelligence would play a central role in the evolution of the universe.

FFT Simplified
Bruce Randall, WD4JQV 9 (Monday 11:00 am)

The FFT is often used in signal processing of radio astronomy data. This paper is a simplified look at what an FFT does and how it does it. No math beyond high school level is used in the explanation. Calculus is intentionally avoided. It starts with a definition of frequency and works up to deriving frequency information from a time record.

A Remotely Accessible Amateur Radio Astronomy Observatory
Charles Forster, WA9ACI (Monday 11:30 am)

The E. B. Seti group in conjunction with the Society of Amateur Radio Astronomers "Old Timers" (SARA-OT) special interest group presents a remote controlled observatory for use by beginning amateur radio astronomers. High school students or science groups will be given priority for using the observatory. The goal of the proposed experiments will be considered in an effort to help provide a reasonable opportunity for success. Cost to the user will be approximately $20/month or less.

Innovative Experiments for the Radio Astronomy Classroom
John C. Mannone, Hiwassee College (Monday 12:00 pm)

Various experiments and demonstrations that effectively introduce radio astronomy are reviewed, with an emphasis for High School and College physics students. Innovative

experiments with the popular IBT microwave radio telescope will be discussed: (1) Analysis of Geosynchronous Parallax: A Problem in Geometry, (2) The Lunar Microwave Signature (3) Observing Microwave Emission from the Galactic Plane, (4) A Microwave Probe of Ionosphere Using Digital Satellites and Ionospheric Scintillation, and (5) IBT Tracking of the Sun with a Telescope Mount to Study Microwave Emission as a Potential Precursor to Solar Flares.

Characterizing a Microwave Radiometer for Solar Plasma Observations
Rodney Howe and Jamie Riggs (Monday 2:00 pm)

A research project is contemplated that seeks to observe solar plasma motions, by monitoring amplitude changes over time in the Sun's microwave emissions. A small Ku-band radio telescope is employed as a total-power radiometer. However, before meaningful measurements can be accomplished, it is necessary to characterize the radio telescope itself. Circuit instabilities, local oscillator drift, and thermal changes can cause the radiometer's gain to fluctuate over time, and its output amplitude to vary, independent of the phenomenon being observed. In the present effort, those variations are quantified at two different frequencies, and two orthogonal polarizations, by using the radiometer to observe, for several hours, a radio source of assumed constant noise temperature (a group of trees subtending the antenna's beamwidth). The resulting data are statistically analyzed to determine system mean output and variability over time for all four observation channels, as well as cross-correlations among channels. These parameters will validate the system for subsequent solar observations.

The Biggest Offset Dish in the World
Charles Osborne, K4CSO (Monday 2:30 pm)

Amateur radio microwave enthusiasts have put surplus Dish Network and Direct TV 18” dishes to good use for many years. But at the other end of the size extreme is the world's largest fully steerable offset fed dish, the NRAO Green Bank 100 meter Telescope (GBT). Taking over a decade to build, the GBT stands as a monument to human engineering skills.

Ku-band Microwave Radio Astronomy Interferometry Laboratory
David Fields and Bill Lord, Tamke-Allan Observatory;
Alan E.E. Rogers, Preethi Pratap, and Phillip Schute, MIT (Monday 3:00 pm)

Tamke-Allan Observatory is a laboratory site for introductory Astronomy labs. We have been using Ku-band dishes (including the SARA Itty Bitty Telescope) and LNBs as small antennas for radio astronomy simulations and experiments. More recently, we have constructed a two-axis intensity interferometer that acquires and tracks selected sources and permits characterization of the source as to angular size and temperature. Laboratory experiments have been devised to introduce basic radio astronomy concepts.

TAOSON - Tamke Allan Observatory Solar Observation Network
Bill Lord, Melinda Lord, David Fields, Tamke-Allan Observatory (Monday 4:00 pm)

Tamke-Allan Observatory Solar Observation Network (TAOSON) is a local network of observers who share observations in pseudo real-time to permit comparisons of simultaneous data taken in different locations and at different frequencies. Each antenna/receiver constitutes a node of the network. Observations are archived using SkyPipe software performing automatic uploads to a common server. Events detected at one node of the network may be immediately compared to signal logs from other notes. If desired, digital records may be downloaded. Active TAOSON sites are TAO, Skynet, Solway and Chattanooga.

Searching for Earthlike Planets
James Van Prooyen, N8PQK (Monday 4:30 pm)

The search of earthlike planets is a growing branch of astronomy with over two hundred extra-solar planets discovered so far. Current methods work well for finding planets, but do not give a lot of information as to the character of each planet. If a planet is earthlike then it may have weather like earth. One of the major features of earth's weather is storms with electrical activity, such as thunderstorms. This report will describe a method using radio telescopes and signal processing to search for earthlike planets using the detection of lighting.

Observing a Lunar Eclipse at 12 GHz
Paul Oxley (Tuesday 10:30 am)

On February 20, 2008, a Total Lunar Eclipse was visible in most parts of the U.S. During this eclipse, the author made observations at 12 GHz to verify that the Moon's RF radiation is predominantly caused by the thermal heating of the moon, not from the Sun's reflection. Observations were made on four polarities Vertical, Horizontal, Right and Left Circular. The paper describes the setup and techniques used. Results are presented that compare an eclipsed moon with one that is fully illuminated. The paper concludes that the 12 GHz radiation from the moon is of thermal origin.

Improvements to a Digital Baseband Four-Channel Receiver
Paul Oxley (Tuesday 11:00 am)

This paper presents a set of improvements that were made to the author's four-channel receiver. The improvements include both hardware and software changes. The hardware changes improved the isolation between the four channels as well as the isolation of the local oscillator PLL boards from the desired signals. The software improvements include an automatic triggering feature that can perform analysis either on a timed basis or in

response to a break in trend from the data being collected. In addition, the automatic ranging algorithm was improved to set the voltage range on each channel independently.

Size Does Matter: Solid State Spectral Imager (SSSI) on a Chip and the Search for Extraterrestrial Life
Thaddaeus Hannel and Robert A. Lodder, University of Kentucky (Tuesday 11:30 am)

The current understanding of physics limits our ability physically to explore other galaxies in a human lifetime. The use of nano and micro technologies, however, may allow humans to explore places that are currently thought to be unreachable. The implementation of small-scale devices creates a need for complex communication strategies where smaller wavelength radio waves, such as terahertz, are necessary. This paper aims to explore the possibility of a micro-SSSI for use in deep space exploration and the communication strategies needed for such a device. There will also be a discussion of the design and implementation of the algorithms used to identify extraterrestrial life.

Introducing a New Radio Astronomy Software Application
Shad Nygren, KD7WMX (Tuesday 12:00 pm)

At the suggestion of Tom Crowley during the SARA 2007 conference, I have been developing a new software application specifically for amateur Radio Astronomy. The software is designed to work with modern Windows and Linux operating systems and to work with hardware commonly available to amateur radio astronomers such as SpectraCyber, SDR-14 and HP Digital Storage Oscilloscopes. The software is designed to have high accuracy, support professional data formats such as FITS, SDFITS, XML, KML and CSV and interoperate with other applications for further data processing.

NASA Space Exploration and Radio Astronomy
John C. Mannone, NASA/JPL Solar System Ambassador (Tuesday 3:30 pm)

NASA space exploration missions of the solar system are reviewed in the context of radio astronomy. Historical, present and future missions are discussed. Radio astronomy mission objectives for solar system exploration, distilled to three areas, will be addressed: (1) basic research of astrophysical processes, (2) imaging using radar and very long baseline interferometry, and (3) communications using the Deep Space Network. International agencies are also considered.

Exploring VLF Space with the Gyrator 2
Linda Fippin, Tamke-Allan Observatory (Tuesday 4:00 pm)

The neophyte in amateur radio astronomy may choose from a variety of entry points. Example entry-level projects might include using the SkyPipe software and Jove radio. Another valuable entry project involves constructing and using a VLF receiver. This presentation will chronicle constructing and using the Gyrator 2 to explore and begin to quantify VLF radio events. Challenges that will be discussed include those of selecting, assembling, using, and taking data with the Gyrator 2. Example events and their interpretation will be presented. The next stage of applying the Gyrator 2 will be automated data digitization and archiving of summary data using the TAOSON server.

A Low Cost Pulsar Machine
James Van Prooyen, N8PQK (Tuesday 4:30 pm)

A pulsar machine (or pulsar detection system) is used at many of the large radio observatories around the world. Some of these pulsar machines are well known for the work that has been done such as the Penn State Pulsar Machine at Arecibo. Others are just coming on line, such as PuMa, located in the Netherlands. This paper presents a low cost Pulsar Machine for use at smaller observatories just entering the field of pulsar research.

Sputnik and SETI: Uniting East and West
Professor H. Paul Shuch, N6TX (Time permitting)

The realization of spaceflight technology and the birth of modern SETI science were contemporaneous and interdependent developments. The impact of early Soviet space accomplishments upon Western society is well documented. Less well known are the parallel strides in the modern Search for Extra-Terrestrial Intelligence, made by Eastern and Western scientist in the years following Sputnik. This short paper presents one Western scientist's perspective on how the Space Age and the Age of Interstellar Contact over the past half century have brought our world closer together.

Interferometry of the Sun at 4 GHz
W. Thresher, M. Wheatley, & E. Budding
New Zealand Radioscience Group (Proceedings only)

Two 2.5m f/0.3 sat-TV dishes have been set up, using commercially available receivers, to form an analog microwave interferometer on an 8m E-W baseline. This article reports steps in experimental procedure, the logging of data and its preliminary analysis using Fourier analysis techniques. It is shown how an observed interferogram's 'visibility', having predominant lateral ('u') angular frequencies of order 100-1000, can be interpreted in terms of coronal structure on the order of 10s of arcminutes.

~ Conference Schedule ~

(Downloaded March 17, 2008)

Day	Time	Speaker	Title
Sun	12:30 PM	Jeffrey Lichtman, moderator	Radio Astronomy Beginner's Session
Sun	3:00 PM	Tom Crowley	40 Foot Radio Telescope Familiarization Workshop
Sun	5:15 PM		**Dinner** in NRAO Cafeteria
Sun	6:30 PM	Tom Crowley, Treasurer	Registration and Payment of Conference Fees
Sun	7:00 PM		**Social Hour** and Impromptu Presentations in Drake Lounge
Mon	7:45 AM		**Breakfast** in NRAO Cafeteria
Mon	9:00 AM	H. Paul Shuch, Vice President	Introductions and Opening Remarks
Mon	9:15 AM	Charles Osborne, President	SARA Announcements
Mon	9:30 AM	Dr. Steven J. Dick	**Keynote Speech**: "Cosmology and Biology"
Mon	10:30 AM		**Coffee Break** and poster sessions
Mon	11:00 AM	Bruce Randall, WD4JQV	FFT Simplified
Mon	11:30 AM	Charles Forster, WA9ACI	A remotely accessible Amateur Radio Astronomy Observatory
Mon	12:00 PM	John C. Mannone	Innovative Experiments for the Radio Astronomy Classroom
Mon	12:30 PM		**Lunch** in NRAO Cafeteria
Mon	1:30 PM		**Group Photo** (location to be announced)
Mon	1:45 PM	Charles Osborne, President	**Call for Nominations** of Directors and Officers

Mon	2:00 PM	Rodney Howe, Jamie Riggs	Characterizing a Microwave Radiometer for Solar Plasma Observations
Mon	2:30 PM	Charles Osborne, K4CSO	The Biggest Offset Dish in the World
Mon	3:00 PM	David Fields N4HBO	Ku-band Microwave Radio Astronomy Interferometry Laboratory
Mon	3:30 PM		**Snack Break** and poster sessions
Mon	4:00 PM	Bill Lord et. al.	Tamke Allan Observatory Solar Observation Network
Mon	4:30 PM	Jim Van Prooyen	Searching for Earthlike Planets
Mon	5:15 PM		**Dinner** in NRAO Cafeteria
Mon	7:00 PM		SARA Board of Directors Meeting
Mon	8:00 PM		**Social Hour** and Impromptu Presentations in Drake Lounge
Tue	7:45 AM		**Breakfast** in NRAO Cafeteria
Tue	9:00 AM	Charles Osborne, President	SARA Elections
Tue	9:30 AM	TBD (Incoming President)	SARA Business Meeting
Tue	10:00 AM		**Coffee Break** and poster sessions
Tue	10:30 AM	Paul Oxley	Observing a Lunar Eclipse at 12 GHz
Tue	11:00 AM	Paul Oxley	Improvements to a Digital Baseband Four Channel Receiver
Tue	11:30 AM	Thaddaeus Hannel	Solid State Spectral Imager (SSSI) on a Chip
Tue	12:00 PM	Shad Nygren, KD7WMX	Introducing a new Radio Astronomy software application
Tue	12:30 PM		**Lunch** in NRAO Cafeteria
Tue	1:45 PM	Sue Ann Heatherly	**NRAO High-Tech Tour**

Tue	3:00 PM		**Snack Break** and poster sessions
Tue	3:30 PM	John C. Mannone	NASA Space Exploration and Radio Astronomy
Tue	4:00 PM	Linda Fippin	Exploring VLF Space with the Gyrator 2
Tue	4:30 PM	Jim Van Prooyen	A Low Cost Pulsar Machine
Tue	5:00 PM	H. Paul Shuch, Vice President	2009 Conference Plans
Tue	5:15 PM		**Dinner** in NRAO Cafeteria
Tue	6:30 PM		**Flea Market** in Dorm Parking Lot
Tue	7:00 PM		**Social Hour** and Impromptu Presentations in Drake Lounge
Wed	7:45 AM		**Breakfast** in NRAO Cafeteria
Wed	10:00 AM		**Conference Ends** (pay room bills in NRAO Business Office)

~ Retirement Announcement ~

I just received an email (March 16) from our Director Emeritus, Jeff Lichtman concerning the retirement of Becky Warner, a very pleasant person at NRAO who has always been gracious to SARA. I'll reproduce part of it below.

Hi Jeff,

I wanted to let you know that I will be retiring effective March 31st. I have enjoyed working with you over the past several years…One of my dreams is to do a recipe book. If you have some favorite recipes I would really appreciate you sharing them with me. My favorite thing has always been to collect recipes. Thanks. Becky

Please join me in wishing Becky the best and I encourage you all to share some of your favorite recipes with her. In fact, I challenge you all to submit some recipes and I will publish a few in the next issue of the Journal. Gastronomy doesn't just apply to Optical astronomers! (You can send the recipes to the Editor, editor@radio-astronomy.org, and to Jeff jmlras@mindspring.com, who will get them to Becky. Thanks.)

~ Sky Map at 408 MHz ~

By Bruce Randall, WD4JQV

One can easily search the internet and find a map of sky brightness at 400 MHz. Making your own map is an educational experience all its own. This map was made using the following equipment:

- A 10-foot dish that once was used for satellite TV reception
- A 408 MHz feed for the dish
- A homebuilt 408 MHz receiver with a Dicke switch front end.
- A voltage to frequency converter (VFC) included in the receiver
- An electricity metering billing recorder
- A home computer

The data was acquired by setting the antenna at a fixed declination and allowing the earth's rotation to scan the sky for a week or more. One sidereal day would have been long enough if interference and instrument drift could have been eliminated. The declination was moved in 10° steps. Dodging the sun in the sky was another problem. The sun needs to be at least 40 degrees off the antenna beam to avoid solar interference. Multiple scans of declinations crossed by the sun were necessary. These were separated by several months requiring the data to be collected over a 3-year period.

The dish feed was described in the July/August 2003 issue of the SARA Journal. With the 10-foot dish, the half-power beamwidth is about 17 degrees. This arrangement resulted in an antenna with much lower side and back lobes than the Yagi antennas (attempted earlier). The dish declination was set using manual adjustment with wrenches. A carpenter's angle measuring gadget from Home Depot was used to verify the declination.

The electricity billing recorder was available from my employer's scrap pile. This device records the number of pulses in each 5-minute interval in the total recorded time interval. The VFC produces a pulse rate proportional to its input voltage, which came from the receiver's DC amplifier output. This is effectively a 12-bit ADC with each sample being an average of a 5-minute time interval, with the selected VFC scale factor. This also forces the integration time to be 5 minutes.

I wrote a Pascal program that takes the billing recorder output file in civil time and converts it to sidereal time. Another program allowed me to chop the best sidereal day out of a file. The program output is a numerical 2-column text file. Microsoft Excel can easily handle these files. All organization of data was done in Excel, because I find it easy to use. I was not happy with the Excel contour graphing facilities, so MathCAD7 was used to produce the output map. I could not figure out how to make an x-axis that increased from right to left as the right ascension is shown on a sky map. I finally

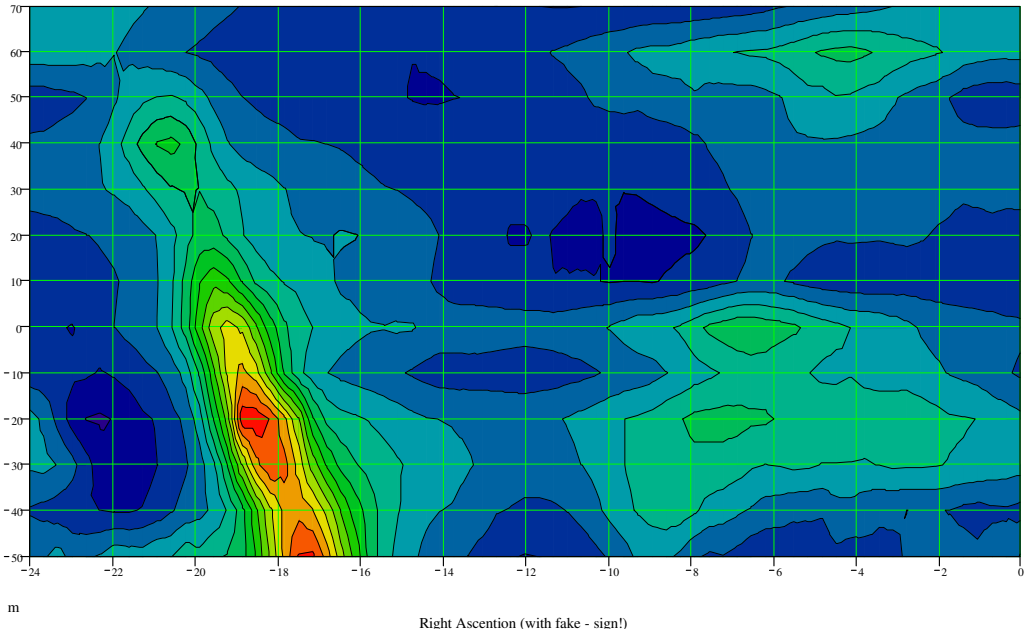


Figure 4: The 408 MHz Sky Map (*MathCAD7*)

accepted a negative sign in front of the right ascension. (Maybe some MathCAD wizard can fill me in on how to fix that.)

At 408 MHz, the predominant signal received from the sky is synchrotron radiation. The shape of our galaxy shows up very well. The area around 16 to 18 hours is dark with many interesting objects in visible light. This area is very bright at 408 MHz because the center of our galaxy is there and the radio waves are not blocked by the dust clouds, while visible light is blocked. The tilt of the galactic plane relative to the earth's equator is also very noticeable. The red map level (radio rightness) is about 200K brighter than the dark blue map level. The absolute levels are hard to define, but the dark blue is estimated at 30K.



Figure 5: The Antenna Used



Figure 6: The 408 MHz Receiver

~ Radio Astronomy Toolbox: Eavesdropping "Across the Pond": A Conversation on a 23 cm LNA ~

By Marko Cebokli, S57UUU, et al

(*Editor's Note: Annotated from [discussion@eracnet.org] Oct 12-18, 2007. Contact Marko Cebokli, Marko.Cebokli@mors.si or "Anja", Anja@rescue-online.de for further information concerning Subject: "23 cm LNA & some links". The speaker is in red bold type after the excerpt.*)

Concerning an L-band LNA (for the ones who would like to build their own), it is (relatively) easy to get below 1dB. With a reasonable amount of sweat, you can get below 0.5dB. Getting to 0.25 will require a little of black magic :-)

The best I have done until now (with some confidence) is a little below 0.4dB. Actually, it is easy to get NEGATIVE numbers on an HP8790 – measuring a very low noise figure is a black art in itself.

Usually, the variation among amateur constructions projects (of the same design) is greater than the difference between different transistor types, so it is not THAT important which transistor you use, if it is in the same (similar) package and of the same technology (HEMT, GaAs FET). You will have to tweak anyway to get the lowest NF. Also, on L-band, it is not that important whether your transistor is declared 0.35 or 0.45 dB at 12 GHz!

The air inductor, as the input [impedance] match for a microwave FET on L-band, was pioneered by S53MV in his GPS preamp (see below). This was published in *UKV Berichte* (*VHF Communications*) in the mid 80's. Later, DB6NT used that trick in his LNAs (published in DUBUS) where he used a PCB and a piece of wire at the input.

If I build my own L-band LNA, I prefer to use Matjaz's original design, which uses no PCB and can be built in one afternoon from scratch. (Scroll down to the "Two stage L-band LNA" in [http://lea.hamradio.si/~s53mv/navsats/analog.html].)

This little gem was mostly overlooked by the HAM community; I guess most people were skeptic because it is so simple and probably because it would be hard to simulate it on a computer! But with a HEMT (just pluck one from a discarded satellite LNB) as the first stage, a NF of under 0.5dB is achievable. Its only weakness, especially if you use HEMTs in both stages, is its tendency to oscillate (but that can be said of most amateur designs!)

However, with a GaAs FET (not HEMT) in the second stage and some CMOS foam or ferrite over the second stage, it is quite stable because it avoids capacitances to ground. (**Marko**)

The LNA posted by Marko seems quite interesting, so I had invested some time on gathering information on that.

So far, I found a page that shows the frequency-determined noise figure vs. gain. What seems most important is to drive the LNA with 8V instead of 12V, because this will result in lower noise and greater gain.
Here, I found it: [http://www.ien.it/~brida/LNAGPS.htm].

Well, I also had played around with my *Promax Satfinder*, and of course, I wanted a filter on 1420 MHz, after a brief search I found an easy to build/etch Bandpass Microstrip filter, perhaps it is interesting for some one out there :)
Here it is: [http://www.qsl.net/iz1bpn/SETI/1420BPF.htm].

And as you know, I had built my "simple interferometer." I also searched the web, and finally I found additional free Software called "Jupiter 2," not really for RA-proposes, but nice additional information on the Jovian system: cited from the original description, "*Jupiter 2.0* software is for the calculation of Jupiter's satellites ephemerae, with a graphical view of the Jovian system. It's based on Jean Meeus ephemeris. Besides, a representation of Jupiter's satellites around the planet, the software shows the satellites' shadows crossing Jupiter's disk, and satellites' eclipses into Jupiter's shadow." Here you'll get it: [http://astrosurf.com/rondi/jupiter/index.htm].
(**Anja**)

Just a few notes on Matjaz's LNA:

Despite its simplicity, it is a carefully designed RF circuit, so changing anything usually makes it worse— two things in particular:

1. The source blocking capacitors have to be leadless ceramic discs (sometimes called "trapez capacitors" in German) - multilayer SMD capacitors ARE NOT SUITABLE - many of the higher value types (1nF) have horrendous self-resonances starting below 1 GHz.

2. The box size has to be kept small, especially its cross section. This makes it a sub-critical waveguide at the frequencies below X-band where the gain is high. A bigger box resonant on just the "wrong" frequency causes wild oscillations.

Changing the supply voltage is no problem; it is just the lazy guy's way of setting the FET working points (originally, Matjaz suggests selecting the source resistors).

The thing that mostly determines at which frequency you will get the noise minimum is the length of the coil (wire) between the input and the gate of the first FET. If you have access to measuring equipment, this is the thing to tweak for lowest noise. One millimeter or less change can make a difference here if you are hunting for the very lowest noise. (**Marko**)

~ Sun Noise: Microwaves Bind Amateur Radio Operators and Radio Astronomers ~

(*Editor's Note: The following information has been extracted and summarized from [http://k5so.com/Using_sun_noise.html] on the website,* Moonbounce Amateur Radio and Radio Astronomy*, Joe Martin, K5SO, Espanola, New Mexico. I found it interesting and a possible application of the 23 cm LNB described in the previous article.*)

EME (Earth-Moon-Earth) operators use the microwave sun as a convenient high-level noise source to check their system performance routinely and/or to compare their system performance with other EME stations that have also made sun noise measurements. Traditional cosmic sources might require higher performance systems than are typically available to amateur radio EME stations.

It is desirable to investigate the use of the strongest signal source in our sky, namely our sun, to monitor system performance. Any operational EME station can easily measure sun noise with a reasonably high signal to noise ratio. The challenge in using sun noise as a calibration source is in developing a protocol that adequately accounts for the varying solar flux from the sun.

In a collaborative study (7/2005-9/2007), amateur radio EME stations routinely monitored their receive system performance regardless of specific system configuration. An empirical correlation between predicted sun noise values and microwave solar flux is developed utilizing an extension of the formalism developed the paper, "Antenna Calibration Using The 10.7cm Solar Flux," by Ken Tapping of DRAO. Download the 4.7 MB PDF here: [http://k5so.com/RadCal_Paper.pdf] for more details.

The family of curves shown in figure 7 below is for different dish sizes, the black ones are for standard sizes, while the red, blue, and green ones are the ones in the collaborative set-ups.

These curves are fitted to a logarithmic model,

$$SN = 10\log\left[\frac{0.72(SF - 64) + 47}{A}\right]$$

where SN is Sun Noise measured in dB above that measured for cold sky at 23 cm, SF is the 10.7 cm Solar Flux number. SF* was measured at the time the 23 cm Sun Noise measurement was made. The constant, A, specific to each station is determined preferably by a non-linear regression of multiple sun noise measurements (as opposed to a single one).

*Solar Flux measurements were made by the Dominion Radio Astrophysical Observatory (DRAO) in Penticton, BC, Canada). DRAO makes measurements17Z, 20Z and 23Z posted to [http://www.drao-ofr.hia-iha.nrc-cnrc.gc.ca/icarus/www/current_flux.shtml].

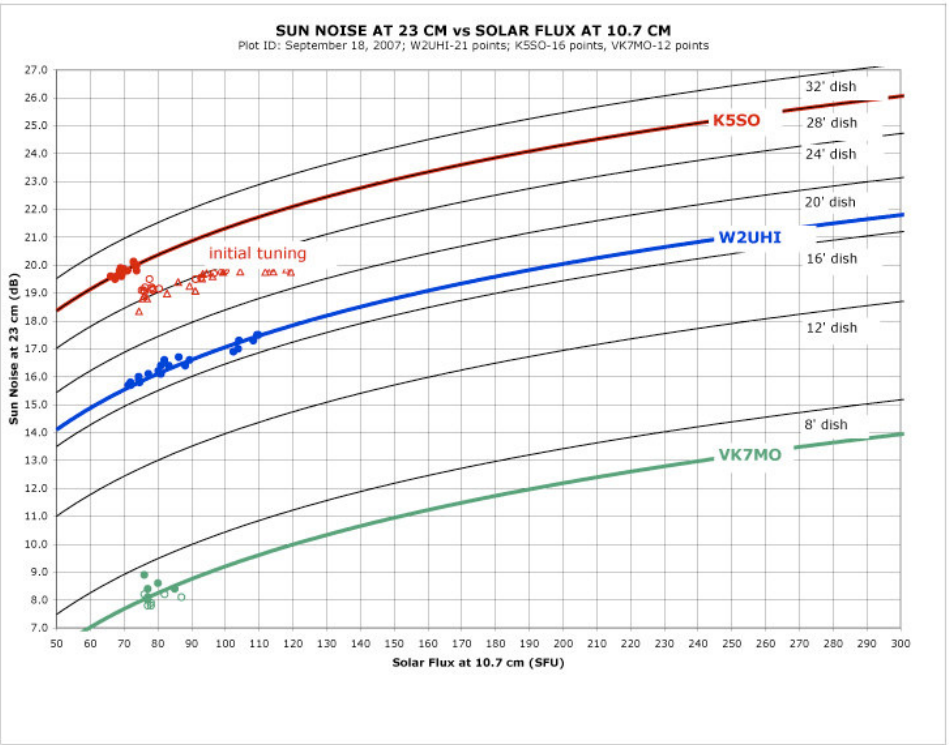


Figure 7: Sun Noise Correlation

Joe's site, [http://k5so.coml] also has other interesting projects, which utilize an impressive set-up of a 28-ft dish and the effective use of software-defined radio. Check out his 1420 MHz galactic rotation experiment.

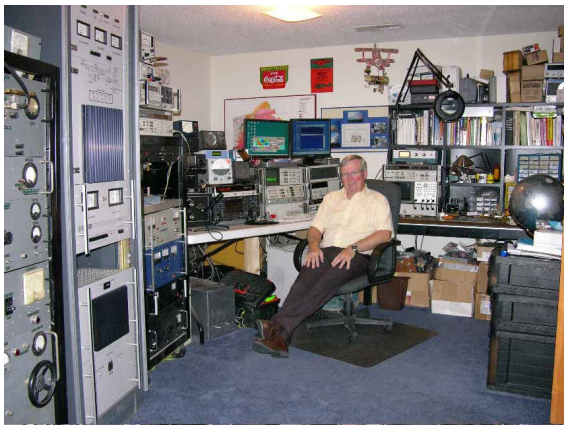


Figure 8: Joe Martin in his *Radio Shack*

~ History of Science: *Heat of Space* ~

Cautious Revolutionaries: Maxwell, Planck, Hubble

By Stephen G. Brush

Abstract

Three scientists exemplified the cautious behavior that we might like all scientists to display: indeed, they were so critical of their own ideas that they risked losing credit for them. Nevertheless they finally earned at least as much fame as they deserved, leaving historians to wonder about what they really believed. Maxwell initially rejected the kinetic theory of gases because two of its predictions disagreed with experiments; later he revived the theory, showed that one of those experiments had been misinterpreted, and eventually became known as one of the founders of the modern theory. Planck seems to have intended his 1900 quantum hypothesis as a mathematical device, not a physical discontinuity; later he limited it to the emission (not absorption) of radiation, thereby discovering "zero-point energy." Eventually he accepted the physical quantum hypothesis and became known as its discoverer. Hubble (with Humason) established the distance-velocity law, which others used as a basis for the expanding universe theory; later he suggested that redshifts may not be due to motion, and appeared to lean toward a static model in place of the expanding universe.

Annotated Summary

It is well-known that many successful scientists are very competitive. Having decided that their own discovery or theory is valid and important, they advocate it strongly and persistently, sparing no effort to get it published as fast as possible and to persuade everyone else to accept it. They may even exaggerate the strength of the evidence. Is aggressive behavior the only way to make your mark and win the rewards you deserve for your hard work? Is it true that -- as the saying goes -- you must blow your own horn no else will do it for you?

Scientists are also familiar with another kind of personality: the cautious researcher who checks and rechecks every data point and calculation before publishing it, and then eventually presents it in a rather tentative way not as a solid discovery, but a plausible hypothesis or experimental result whose ultimate significance remains to be determined. This kind of scientist may find great personal satisfaction in adding one more brick to the edifice of Scientific Knowledge, but rarely enjoys recognition by the public or great praise from other scientists. (Contrary to the egalitarian beliefs of some writers on science, only a small percentage of scientists do almost all the research that goes to form the core of established scientific knowledge.) Sometimes these scientists are so discouraged by the rejection or silence of the scientific community that they drop out of research altogether.

"Cautious" does not mean "non-competitive." The scientists I have in mind were certainly eager to make important discoveries and receive credit for them. They were cautious only in their public announcements. They would rather be right than first; their fear of being later found to have made a crucial mistake outweighed their fear of being scooped.

This paper deals with three exceptions to the above generalizations: scientists who presented their discoveries so cautiously that they might well have lost the credit for them to other, more aggressive scientists. Yet their publications did get cited, did arouse enthusiastic support from a few influential readers, and eventually earned for their authors at least as much recognition as they deserved. They probably did not think of themselves as "revolutionaries" but we may use that word when considering the impact of their achievements.

There is a common theme linking the ideas of Maxwell, Planck, and Hubble: the nature and significance of *heat in space*, called at various times since 1800 "infrared radiation," "radiant heat," "black body radiation," and, more recently, "cosmic microwave background radiation."

Scientists are often advised to be severely critical of their own theories and data, to find their defects before publication rather than suffer the embarrassment of having others find them. But once a discovery is published, it seems necessary to defend it vigorously, in order to preserve one's reputation and increase the chances of getting resources (grants, tenure) to do more research. Even worse than making a mistake, is the nightmare of seeing someone else get the credit for your discovery because you didn't publish it quickly or prominently enough. Worst of all, it might seem, is to publish an idea, then later announce that it is wrong, then even later, after your work has been forgotten, learn that it was really right after all!

Maxwell, Planck, and Hubble deserve our respect for following the rules of the game even when it was against their own short-term interests to do so — to insist on high standards of mathematical reasoning and empirical proof at the risk of losing the credit for their discoveries. Each story had a happy ending in the 20th century. Maxwell is generally acknowledged as one of the major creators of the kinetic theory of gases even though he didn't resolve the specific heats anomaly. Planck is widely regarded as the father of the quantum theory even though, as Frank Sulloway says, he was a "cautious laterborn" who "spent a lifetime resisting [his own] radical insights." Hubble is almost universally considered the founder of the expanding universe theory in spite of his reluctance to advocate it. Were they just lucky to get so much credit for these achievements?

Maxwell's case is a little different from the others because he saw fairly soon that the "refutations" he produced for the kinetic theory were either based on dubious data or affected only a small part of the domain of the theory; they don't affect the validity of the greater part of his work and the viscosity problem may even have inspired him, at least indirectly, to develop his more sophisticated formulation (not relying on the mean-free-

path approximation). Even if his early doubts had been more widely known, they would have had little effect on his reputation or his place in the history of science.
The Planck case is more controversial: he was perhaps initially more confused than cautious, become cautious later on in restricting quantization to emission. Kuhn's thesis met with strong resistance from physicists who felt that it was unfair to take credit away from Planck and give it to Einstein, who already had so much credit for relativity. Planck (unlike Maxwell and Einstein), did not have many other widely-recognized achievements: the quantum was his major claim to fame. One wonders how many physicists actually read Planck's 1900 papers before Einstein published his version of quantum theory in 1905, and whether his contribution would have been considered so important if Einstein, Bohr and others had not developed it much farther than Planck was willing to.

The persistence of the belief that Hubble advocated the expanding universe theory is puzzling, since his opposition to it was widely known in the astronomical community during his lifetime. A science journalist reported that the 1935 Hubble-Tolman analysis "which casts doubt on the reality of the expansion ... has come like a bombshell into the camp of the theorists and is providing a major topic of conversation among astronomers, cosmologists, mathematicians and other universe explorers." Several astronomers who knew Hubble, and historians who have examined the original sources, agree that he rejected the velocity interpretation of red-shifts and was skeptical about the reality of expansion. Yet this knowledge does not seem to have spread to the younger generation of astronomers and science writers.

Nevertheless, our three cautious revolutionaries do deserve the credit they now receive. Maxwell did discover that gas viscosity is independent of density, and he did lay the foundations for the modern kinetic theory. Planck did propose the first quantum theory (even if it was intended only as a mathematical fiction). Hubble was the first to support with solid evidence a velocity-distance law for nebulae.

Historians of science are now skeptical of the concept of "discovery" as a discrete event for which a particular person or persons should get "credit" or "priority." It is not the job of the historian to decide who should get credit for a discovery, but rather to study who does get credit and why. If in these three rather important cases credit was given to someone who actually followed the rules about how scientists should behave, by being cautious and self-critical about the validity of a result even after it was published, then perhaps we do not have to believe that credit always goes to the wrong person or that aggressive self-promotion and exaggeration is the best way to become a successful scientist. Maybe nice guys do not always finish last.

(**Editor's Comment: Dr. Bush, the author of this work. He is with the Department of History and Institute for Physical Science and Technology, University of Maryland, College Park, Maryland. This is an annotation and reformatting of his paper appearing in this citation:* American Journal of Physics *70(2), 2002, pp 119-127. It can be accessed electronically in its entirety at [http://www.punsterproductions.com/~sciencehistory/cautious.htm]*)

~ Solar Radio Astronomy Miscellany: Internet Accessible 12 GHz Solar Radio Observatory ~

(*Editor's Note: Cited from the newsletter of NASA's Radio JOVE Project, "Solar and Planetary Radio Astronomy for Schools": Radio Jove Bulletin, December 2007, Leonard N. Garcia (QSS Group, Inc.), Editor [http://radiojove.gsfc.nasa.gov]*)

"Have you ever measured the Sun's temperature? We launched the Internet Solar Radio Observatory (ISRO, [http://sun.kochi-ct.jp/]) to measure it by receiving solar radio waves in the 12 GHz band. This radio telescope can be controlled real time over the Internet. You can use it for 7 minutes at a time. To try it login with the guest account and password (guest, guest) at the URL: [http://sun.kochi-ct.jp/e/observatory.html]. The steps of the procedure to measure the Sun's surface temperature are given at the URL: [http://sun.kochi-ct.jp/e/explain.html]"



Figure 9: Imai Laboratory, Kochi National College of Technology, Japan

This site consists of two systems. The one is the radio telescope control system and the other is solar radio observation system. The radio telescope control system can be controlled by real time over the Internet. The solar radio observation system measures the intensity of the solar radio waves and also shows the real time chart of the data. Our radio telescope consists of two satellite antenna dishes, and a controllable rotator.

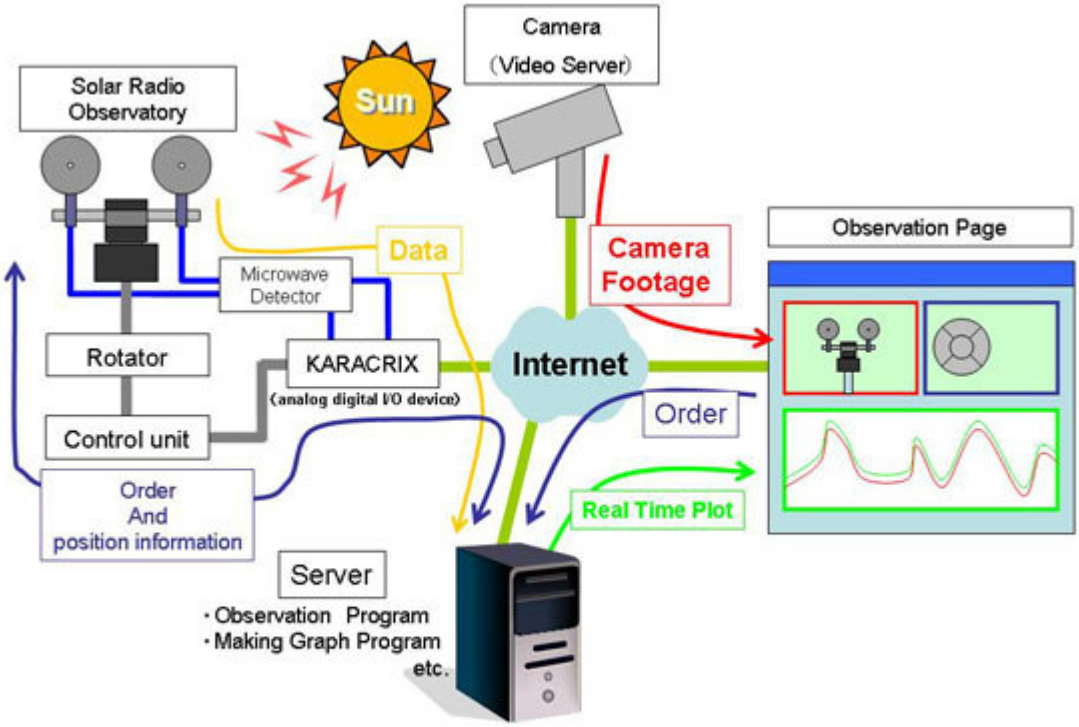


Figure 10: Block diagram

~ Navigator IBT and Radio Astronomy Materials ~

By Jon Wallace and Kerry Smith

After the SARA conference, Kerry Smith and I set out to make a manual of operation for the Itty-Bitty radio Telescope (IBT) and Enhanced Channel Master Meter (ECMM) that Kerry had designed for use with the Navigators. We have completed the project and it has been approved for distribution.

We ended up producing a two-disk set: One is a DVD with video clips created by Kerry to show you how to operate the ECMM and IBT. This is not a "professional" movie but it is intended to help you set-up and effectively use your ECMM and IBT – this it does very nicely! The other is a CD with a Manual for the ECMM and IBT (basically the video in hard copy with lots of pictures), advice on creating PowerPoint presentations, many PowerPoint presentations, advice on presenting radio astronomy to a group (including demonstrations and other materials), as well a few other goodies.

I set the disk up with a hyperlinked document called "Read This Document First." This document was created to link you with other documents on the CD and to offer brief abstracts of the various documents on the CD. To use this menu, simply click on the title/link and it will open the document you seek (you may have to press Ctrl-Click to access the link). The links are made assuming you are using the D-drive for CDs, if you are using a different drive you will need to change the hyperlinks. It would be easiest to do this by copying the files to a folder on your hard drive, opening this document again and right clicking on each hyperlink and Edit Hyperlink, browse until you find the file. (If you need help, contact me at fjwallace@snet.net).

The CD includes the following items:

ECMM/IBT Manual with Video Clips

- The Quick Start Guide
- Initial Set-Up of Your IBT
- Activities and Ideas for Your IBT
- Schematic and Parts Layout
- Parts Listing
- Contact Information
- Links

Presenting Radio Astronomy

This document provides many hints for presenting to groups and includes additional activities that could complement your ECMM/IBT demonstration. It includes the following:

- How I (Jon) give a radio astronomy presentation
- Hints – *dos* and *don'ts* of presenting

- Article on "Safely Observing the Sun" written by me for the Astronomical Society of the Pacific and observation sheet
- Amplifier/speaker applications and notes I developed to allow you to use the ECMM's amplified speaker for other applications/demonstrations
- Simple demonstration devices you can build – includes a great solar system to scale activity and some demonstrations you can use with your PowerPoint presentations

NRAO Navigators Presentation (*by Tom Crowley*)

- This PowerPoint details some of the goals, member qualities and equipment available to Navigators.

Making PowerPoint Presentations

This document details:

- The most common features of PowerPoint
- How to use the presentations I created to make your own, personalized presentation
- A few hints for better presentation creation.

PowerPoint Presentations

These are grouped to allow you to "pick and choose" your own sections to make a presentation tailored to your group's interest (or your own). Several of these presentations have sound clips, so be sure the links work. If you need help, contact me. These PowerPoints include (please be sure to use the title PowerPoint so you can give some credit to NRAO and SARA!):

- Radio Astronomy Title
- AAVSO Radio, Whistler Radio and Voyager
- Amateur Projects
- History
- Imaging Radio vs. Optical
- Interference and Radio Astronomy
- Telescopes
- What is Radio and Electromagnetic Radiation
- Why Radio and Observable Radiation
- Jon's Version of a Short Radio Astronomy Talk

Radio SkyPipe

Kerry included a copy of the installation program for SkyPipe. This program allows you to link your IBT and ECMM with the cable provided to your computer to record charts. These charts can then be smoothed (to remove some of the spikes you might get from AC power, etc.) and then downloaded to Microsoft Excel (using the Export to Delimited File choice under Tools) where you can create charts and analyze your data. (If you need help with this, contact Kerry or Jon.)

Other files on the CD

- The NRAO Navigator logo
- Sound clips for the PowerPoint presentations.

It is our hope that people who wish to share their love of radio astronomy will gain some useful information from these documents and will be more willing and able to do presentations. Again, if you have any questions or comments, or would like a copy of these two disks, please feel free to contact me (see address below). There is no cost for the Navigators and a modest $15 (includes shipping) SARA members.

Jon Wallace
111 Birden St.
Torrington, CT 06790
fjwallace@snet.net

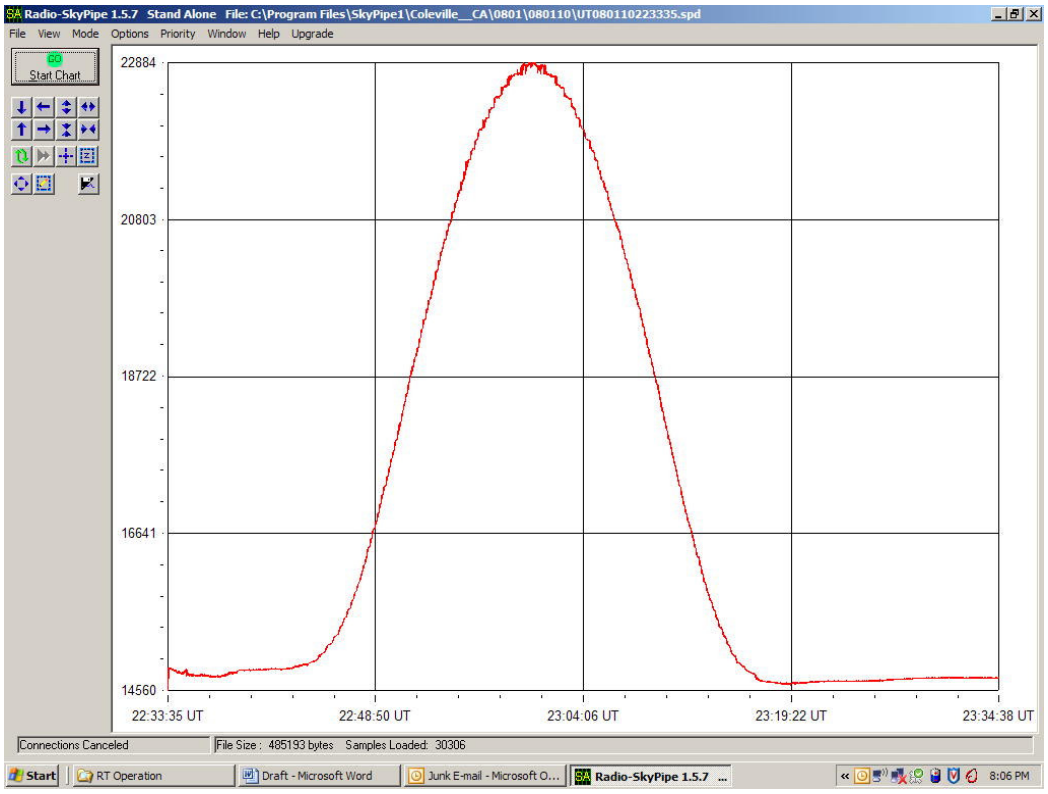


Figure 11: A typical solar drift scan with a converted digital satellite TV dish (very similar to the IBT) is displayed on Radio SkyPipe software, [http://radiosky.com/skypipeishere.html]. (Courtesy Mark Spencer, WA8SME, ARRL Education and Technology Program Coordinator)

~ Member Profile: Jim Hardy on Philosophy, Astronomy Advice and Interferometry ~

By Jim Hardy



Figure 12: Jim Hardy

I have always found the study of Astronomy and Radio to be the most fascinating part of the universe. For me, the universe is the *great out there*, somewhere and undefined, as it has no boundaries. We have a star in our backyard so to speak. It is the sun and a star among countless others. This same sun is at one day and time going to explode or expand and swallow this earth. Just maybe we ought to be looking a little closer at this object in the sky.

I would climb up on the roof of the barn, in my youth and stare at the stars in the dark night sky, pondering the meaning of it all. I still do not understand it. Matter, Energy, Mass, Gravity, everything is falling, yet in such an orderly and precise fashion. It is as if some intelligence must have been inspired to build the greatness of it all. The Cosmos is such a beautiful and diverse place. So unique are we just to be able to witness the wonders of it all. From the size of what we can see to that which we cannot see.

Some things I suggest to a newcomer are to become very familiar with the constellations and their locations with respect to the Earth, in particular, the right ascension and declination of the various objects of interest. Be able to tell when the portion of the galactic arm is passing overhead on the meridian. Know latitude and longitude and be able to convert it to decimal notation, something I'm very rusty at. (I have had a couple of strokes and it is really hard for me to do some things anymore, but I refuse to give up. I have received a lot of help from some of the SARA members. For that, I am extremely grateful.) Another thing, buy a planisphere and learn to use it. The planisphere shows the constellations and the galactic arm, the important stars and their relative position.

Here are some things to look out for. Make sure that the equipment is well grounded—all of it, from computers to the main dish. Avoid kinks and sharp bends in the coaxial cable. Use shielded cable for everything. Do not make shortcuts unless it is just for checking some piece of equipment. The reason for this is to be sure that when the calibration is completed, there will be no questioning the resulting reading. Be as competent on the computer as one can be. I cannot stress this enough. Learning the software and using it correctly may be my biggest problems. There is little help available when one needs it most.

Figure 13 below shows a view from my observatory window facing west. Note the Itty Bitty Interferometer Radio Telescope (IBIRT) in the foreground. It has one-meter spacing and is made of two surplus TVRO dishes and some copper water pipe with two plastic funnels that have been modified and covered with aluminum foil for feed horns. It cost less than $200.00 dollars to build. A mount has not been fabricated yet so it just sits where you see it. This is very much a learning experience for me as I have little knowledge of the subject of astronomy, but have a budding desire to learn. Even at my age and condition, some worthwhile astronomy can take place.



Figures 13 and 14: My Minnesota Rig



Figure 14 on the left shows the lowest pointing in the sky that I can record with IBIRT without getting trash pulses from the trees in the background. Ambient noise here is about one centimeter in height. I use a block of pinewood (one inch by two inches) that was left outside in ambient conditions all the time. It was placed in the focal point of the array ten feet in front of the interferometer. If the scan varies too much, then I would look for the problem. I find that the gain of the preamp has a lot to do with the signal to noise ratio. Right now it's max'd at a setting of 9:00 o'clock using the knob as a reference. The frequency I am using at the present is 12 GHz.

I have never done anything like this before. The closest I have ever been to a telescope was three inches—to look at the moon and stars with in the Nevada desert. Having come from Radio Engineering and Chemistry backgrounds, I needed something to do. Being disabled does not help me much here. All that you see is what you get. I have yet to figure out how to mount the interferometer on a portable platform (I would love some ideas here).

Below are some scans made with IBIRT in drift mode. I hope someone finds them interesting. The IBIRT is moved to a table and clamped into place for the scans. It's very hard to anchor things so that the wind cannot move them.

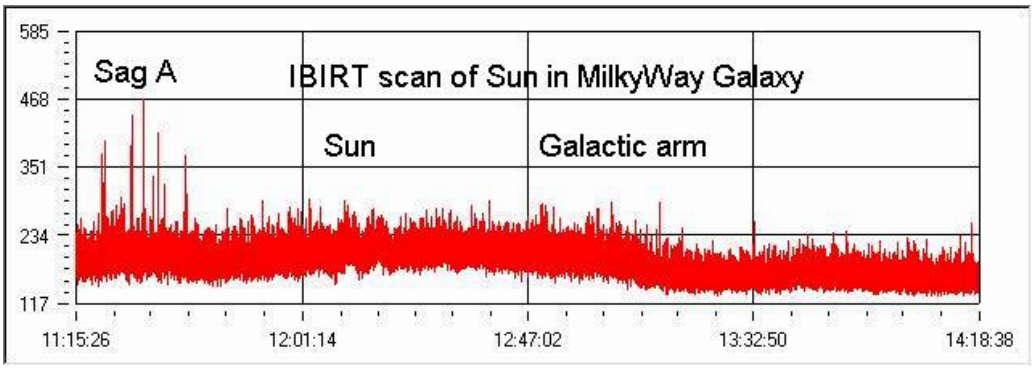


Figure 15: 12 GHz Drift Scan of the Milky Way

This is what a scan of the sun looks like made earlier this year while looking for HEP's. (high energy pulses from the sun). I have a wish that someone else will make an IBIRT and share data or even just compare data with me by e-mail maybe…any takers?

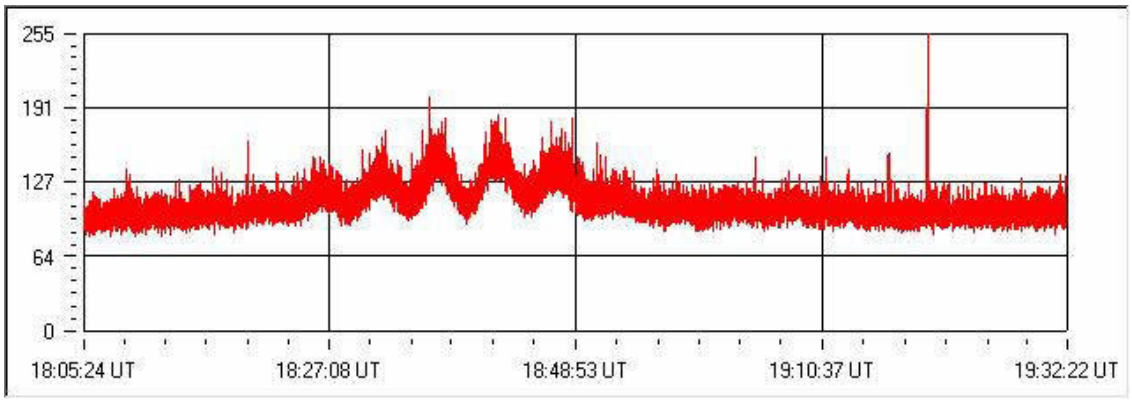


Figure 16: 12 GHz Drift Scan of the Sun with Fringes

Please email me with questions and suggestions. I'm very open to this kind of dialogue. I am in love with a hobby that has grown to be very important to me. I can actually scan and record things with a telescope, which I built from discarded scraps, and it works. I've had a lot of help from the people at SARA. Thanks a whole heap. I'm having fun in Minnesota. My web page is [http://personalpages.tds.net/~jahardy33].

~ Radio Astronomy Resources ~

SARA
http://radio-astronomy.org

Radio Astronomy Supplies
(Jeffrey M. Lichtman)
P.O. Box 450546
Sunrise, FL 33345-0546
(954) 965-4471 / jmlras@mindspring.com
http://www.radioastronomysupplies.com

Radio Sky Publishing
(Jim Sky)
PMB 242, Box 7063
Ocean View, HI 96737
(808) 328-1114
http://radiosky.com

National Radio Astronomy Observatory
http://www.nrao.edu

Tamke-Allan Observatory
(David Fields)
http://roanestate.edu/obs

Jamesburg Earth Station volunteer group
http://www.jamesburgdish.org
http://www.bambi.net/jamesburg.html

RF Associates
(Richard Flagg)
1721-I Young Street
Honolulu, HI 96826
(808) 947-2546

SETI League
http://www.setileague.org

European Radio Astronomy Club
http://www.eracnet.org/

Pisgah Astronomical Research Institute
http://www.pari.edu

Society of Amateur Radio Astronomers
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