President’s Page

This will be my first eastern conference that I will be kicking off as President of SARA. It has been a rewarding first year as your president, attending SARA West, HAMcation and HAMvention. The Stanford team provided a venue that the western conference thrived in (not to mention the "ready room").

We will expand our presence at HAMcation next year and have expanded our presence at HAMvention. Our team at HAMvention included members from the Radio Jove and The Inspire Project teams. As we doubled our space we also doubled our ability to reach out to the public - and the additional effort paid off! SARA will also have a booth at the 2016 USA Science & Engineering Festival in Washington DC.

We just completed our sixth Western conference at Stanford in March. The SARA members out west appreciate these events and they plan to keep on supporting these meetings. With folks like Whit Reeve, Dave Westman and Keith Payea organizing these conferences, I know they will continue to be a great success.

With the efforts of many volunteers, SARA has 456 members from all over the world. As SARA grows, we fund more grants. I hope SARA will continue to have money for this program and never have to tell a student or teacher that we cannot help them with a radio astronomy grant project.

This year your dues funded grants for Radio Jove kits, Itty Bitty Telescopes and SuperSID systems. These grants went to students and teachers around the world.

May your noise figure be small!
Ken Redcap
KR5ARA
Editor’s Notes

We are always looking for basic radio astronomy articles, radio astronomy tutorials, theoretical articles, application and construction articles, news pertinent to radio astronomy, profiles and interviews with amateur and professional radio astronomers, book reviews, puzzles (including word challenges, riddles, and crossword puzzles), anecdotes, expository on “bad astronomy,” articles on radio astronomy observations, suggestions for reprint of articles from past journals, book reviews and other publications, and announcements of radio astronomy star parties, meetings, and outreach activities.

If you would like to write an article for Radio Astronomy, please follow the Author’s Guide on the SARA web site: http://www.radio-astronomy.org/publicat/RA-JSARA_Author’s_Guide.pdf. You can also open a template to write your article http://www.radio-astronomy.org/publicat/RA-JSARA_Article_Template.doc

Let us know if you have questions; we are glad to assist authors with their articles and papers and will not hesitate to work with you. You may contact your editors any time via email here: editor@radio-astronomy.org.

I will acknowledge that I have received your submission within two days. If I don’t, assume I didn’t receive it and please try again.

Please consider submitting your radio astronomy observations for publication: any object, any wavelength. Strip charts, spectrograms, magnetograms, meteor scatter records, space radar records, photographs; examples of radio frequency interference (RFI) are also welcome. Guidelines for submitting observations may be found here: http://www.radio-astronomy.org/publicat/RA-JSARA_Observation_Submission_Guide.pdf

<table>
<thead>
<tr>
<th>Issue</th>
<th>Articles</th>
<th>Radio Waves</th>
<th>Review</th>
<th>Distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jan – Feb</td>
<td>February 12</td>
<td>February 20</td>
<td>February 23</td>
<td>February 28</td>
</tr>
<tr>
<td>Mar – Apr</td>
<td>April 12</td>
<td>April 20</td>
<td>April 25</td>
<td>April 30</td>
</tr>
<tr>
<td>May – Jun</td>
<td>June 12</td>
<td>June 20</td>
<td>June 25</td>
<td>June 30</td>
</tr>
<tr>
<td>Jul – Aug</td>
<td>August 12</td>
<td>August 20</td>
<td>August 25</td>
<td>August 31</td>
</tr>
<tr>
<td>Sep – Oct</td>
<td>October 12</td>
<td>October 20</td>
<td>October 25</td>
<td>October 31</td>
</tr>
<tr>
<td>Nov – Dec</td>
<td>December 12</td>
<td>December 15</td>
<td>December 20</td>
<td>December 31</td>
</tr>
</tbody>
</table>
News

Mark Your Calendar

Science at Low Frequencies II ~ First Announcement

Albuquerque, New Mexico ~ Wednesday December 2 ~ Friday December 4, 2015

Workshop Location & Date
The University of New Mexico is organizing an international meeting highlighting recent scientific discoveries at low frequencies. The meeting will take place in Albuquerque, New Mexico at the Phillips Technology Institute building on Alamo Road, conveniently located just minutes from the Albuquerque Airport and UNM. The meeting will run from December 2 (Wednesday) through December 4 (Friday), with an optional tour of the new LWA station on the Sevilleta Wildlife Refuge on Saturday. This workshop follows a similar format to the 2014 meeting in Tempe, Arizona. This workshop will precede the MWA and Canadian SKA meetings in Toronto the following week.

Scientific Rationale
There are a large number of new low-frequency radio telescopes including the MWA, PAPER, LOFAR, LWA, VLA/VLITE, GMRT, CHIME, and 21CMA. These instruments are producing a wealth of scientific results on topics ranging from planetary magnetospheres to cosmic dawn. Featured topics will include preliminary results pertaining to the search for redshifted 21 cm signatures from the cosmological epoch of reionization and Dark Ages, large sky surveys of the Galaxy and extragalactic sky, pulsars and transients, and space weather and solar imaging. This meeting is meant to provide a forum to share results as well as software and analysis techniques.

Sponsors
This meeting is sponsored by the University of New Mexico and the National Radio Astronomy Observatory.


Important Dates
- April 22, 2015: First announcement
- July 1, 2015: Second announcement, with details on logistics, costs, and registration
- Sept. 1, 2015: Third announcement with invited speakers, scheme of scientific program available (just topic of the various sessions)
- Nov. 1, 2015: End of Registration
Call for Proposals for Long Wavelength Array -- Cycle 6

We invite applications for observing time with the Long Wavelength Array (LWA1) Radio Observatory and invite interested people to attend the Low Frequency Science Meeting, 2-4 December 2015, in Albuquerque, New Mexico.

At this call the first station of the Long Wavelength Array (LWA1) offers up to four independently steerable wide-band beams and two all-dipole modes (denoted transient buffer wide, TBW, and transient buffer narrow, TBN). Each beam supports two independent tunings over the LWA1 frequency range from 10 to 88 MHz with a full-width, half-maximum (FWHM) ranging from 15° to 2°. We expect to schedule approximately 1,500 beam-hours and 200 TB-hours between 15 December 2015 and 15 September 2016.

The deadline for applications is midnight MDT on 4 September 2015. The complete call for proposals, including a cover page, can be found on the LWA website, along with more information about the capabilities of the LWA1. An introduction to using the LWA1 is also available. We invite proposals from all communities wishing to use this instrument.

Support for operations and continuing development of the LWA1 is provided by the National Science Foundation under grants AST-1139974 and AST-1139963 of the University Radio Observatory program.

For questions regarding this call for proposals, please email lwa@unm.edu.
The LWA Users Meeting, "Science at Low Frequencies II," will be held 2-4 December on the University of New Mexico campus. No registration fee is required, but please send an email to Greg Taylor to hold a space as attendance is limited. All LWA users and potential users are encouraged to attend.

Webpage: https://aas.org/posts/opportunity/2015/05/call-proposals-long-wavelength-array-cycle-6

Do you have an event to share with SARA members? Send information to editor@radio-astronomy.org to be included in the next issue.

Letter of Thanks to SARA

June 12, 2015

Dear SARA Management:

The Radio Jove team would like to express thanks to the Society of Amateur Radio Astronomers for the generous $2500 grant given at the 2014 SARA meeting. We want to take this opportunity to thank SARA and to let you know how the grant is being used. This money has mainly funded Jim Sky’s programming work in support of several Radio Jove projects which include:

• Enhancements to RSS – the Radio Spectrograph Software. In particular RSS now supports inexpensive RTL dongles with the development of RTL Bridge. This allows observers to generate useful spectrograms of both Jovian and solar radio noise bursts over a bandwidth of 2.4 MHz.

• Free RSS - The SARA grant has made it possible for RSS to remain free software – available without charge.

• Full Polarization Measurements - Within the Radio Jove program several observers operate wide band spectrographs. Historically these instruments have been used to make measurements in a single polarization. RSS control software has been developed to drive a polarization switch and display both right and left hand polarization records. Dual polarization records will be of importance in discriminating between Jovian emission sources, greatly increasing the scientific value of the observations.

• Archive for Science Community - Considerable time and effort (solely funded by the SARA grant) have been put into making Radio Jove observations compatible with, and available to, both the French Virtual Observatory and the Planetary Data System (PDS). This effort is particularly gratifying as our data is being considered as being of high enough quality to be of use to the science community. SARA’s mission of promoting amateur radio astronomy as science is well served by this.
Once again we want to thank SARA for this generous grant. Without these funds Radio Jove would be unable at this time to make our observations available to the scientific community, and we would not be developing new measurement capabilities—both for experienced and beginning observers.

We also want to again express our gratitude for the many participants in Radio Jove who have been beneficiaries of your grant program.

Thanks to all SARA members for the encouragement of and involvement in citizen science. If only we could measure the inspiration you have sown.

The Radio Jove Management Team

NOAA Announcement

Hello World Magnetic Model and Enhanced Magnetic Model users,

This is a message from NOAA's National Centers for Environmental Information (formerly National Geophysical Data Center) to alert you that a new release (2015) of the Enhanced Magnetic Model (EMM) is available today. You received this email because you opted for notifications related to the World Magnetic Model (WMM) or Enhanced Magnetic Model (EMM).

Differences between the WMM and EMM:

**WMM**: Operational Main Field Model to degree and order 12, resolving the magnetic field at 3000 km wavelength, includes software, test values, online calculators and a Technical Report. Low CPU and RAM requirements. WMM2015 is valid from 2015-01-01 to 2019-12-31.

**EMM**: Non-operational main and crustal field model extending to degree and order 720, resolving magnetic anomalies at 56 km wavelength, includes software and test values. The higher resolution of the EMM results in significantly improved pointing accuracy. Higher CPU and RAM requirements. EMM2015 is valid from 2000-01-01 to 2019-12-31.

The EMM2010 expired on Dec 31, 2014. The EMM2015 model was compiled from satellite, marine, aeromagnetic and ground magnetic surveys. It includes data from the European Space Agency's Swarm satellite mission. This constellation of satellites represents the best source of data about the current evolution of the Earth's main magnetic field.


Comments & suggestions? Contact us at geomag.models@noaa.gov
In the News

Physics Today ~ The Dayside : Seeing the light:
http://scitation.aip.org/content/aip/magazine/physicstoday/news/the-dayside/seeing-the-light-a-dayside-post

Physics Today ~ Remarkable gravitational lensing by the galaxy cluster Abell 3827:

ECN ~ A cold cosmic mystery solved (until a better explanation is thought up):
http://mnras.oxfordjournals.org/content/450/1/288

Product Design & Development ~ World's Largest Telescope Construction Timeout Extended:

We have not forgotten the European space probe Philae, nor has it forgotten us: Product Design & Development ~ Comet Lander's Measurements Weaken Space Magnetism Theory:

Scientific Computing magazine ~ How Do 'Black' Auroras Do That:

Eos, Earth & Space Science News ~ Why Does the Aurora Flare Up?:
https://eos.org/features/why-does-the-aurora-flare-up


An Introduction to Radio Objects That Can Be Detected by Amateur Radio Astronomers:
http://www.dmradas.co.uk/new%20files%20dec%202011/RAG%20site%20pdfs/Radio_Sources.pdf

EOS, Earth & Space Science News ~ Hubble (Spacecraft) Turns 25: https://eos.org/features/hubble-turns-25


JHelioviewer ~ Solar data (including SOHO and SDO) visualization software: http://www.jhelioviewer.org/

Eos, Earth & Space Science News ~ Mercury’s Secrets Revealed by Soon-to-Crash Spacecraft (note: Messenger crashed on 30 April; see next item): https://eos.org/articles/mercury-secrets-revealed-by-soon-to-crash-spacecraft


Free online astronomy course ~ Explore the evolution of the universe, the future of astronomy and the role technology plays in new discoveries. Astronomy: Discovering the Universe (IntAstro): https://www.open2study.com/courses/astronomy-discovering-the-universe-through-science-and-technology

Amateur Radio Interferometry ~ Low frequency interferometry, VLBI, software defined radios: https://sites.google.com/site/amateurradiointerferometry/

48 MHz Phase Switched Interferometer: http://wavelab.homestead.com/48MHz_index.html


Pay Attention to Space Weather Now...:
Link to submit public comments: https://www.federalregister.gov/articles/2015/04/30/2015-10113/national-science-and-technology-council-national-space-weather-strategy


Redhat Developer ~ *Five Different Ways to Handle Leap Seconds with NTP*: [http://developerblog.redhat.com/2015/06/01/five-different-ways-handle-leap-seconds-ntp/](http://developerblog.redhat.com/2015/06/01/five-different-ways-handle-leap-seconds-ntp/)

SARA Booth at 2015 Hamvention, Dayton, Ohio
The "G" in GOES Is What Makes It Go
Ethan Siegel

Going up into space is the best way to view the universe, eliminating all the distortionary effects of weather, clouds, temperature variations and the atmosphere’s airflow all in one swoop. It's also the best way, so long as you're up at high enough altitudes, to view an entire 50 percent of Earth all at once. And if you place your observatory at just the right location, you can observe the same hemisphere of Earth continuously, tracking the changes and behavior of our atmosphere for many years.

The trick, believe it or not, was worked out by Kepler some 400 years ago! The same scientist who discovered that planets orbit the sun in ellipses also figured out the relationship between how distant an object needs to be from a much more massive one in order to have a certain orbital period. All you need to know is the period and distance of one satellite for any given body, and you can figure out the necessary distance to have any desired period. Luckily for us, planet Earth has a natural satellite—the moon—and just from that information, we can figure out how distant an artificial satellite would need to be to have an orbital period that exactly matches the length of a day and the rotational speed of Earth. For our world, that means an orbital distance of 42,164 km (26,199 miles) from Earth's center, or 35,786 km (22,236 miles) above mean sea level.

We call that orbit geosynchronous or geostationary, meaning that a satellite at that distance always remains above the exact same location on our world. Other effects—like solar wind, radiation pressure and the moon—require onboard thrusters to maintain the satellite's precisely desired position above any given point on Earth's surface. While geostationary satellites have been in use since 1963, it was only in 1974 that the Synchronous Meteorological Satellite (SMS) program began to monitor Earth's weather with them, growing into the Geostationary Operational Environmental Satellite (GOES) program the next year.

For 40 years now, GOES satellites have monitored the Earth's weather continuously, with a total of 16 satellites having been launched as part of the program. To the delight of NASA (and Ghostbusters) fans everywhere, GOES-R series will launch in 2016, with thrice the spectral information, four times the spatial resolution and five times the coverage speed of its predecessors, with many other improved capabilities. Yet it's the simplicity of
gravity and the geostationary "G" in GOES that gives us the power to observe our hemisphere all at once, continuously, and for as long as we like!

Image credit: National Oceanic and Atmospheric Administration, of the first image ever obtained from a GOES satellite. This image was taken from over 22,000 miles (35,000 km) above the Earth's surface on October 25, 1975.
Mapping Radio Galaxies
3C 348 and 3C 353

By Dave Thomas

During the SARA conference at Green Bank, West Virginia, on July 15, 2013, a group of four SARA members, including myself, used the 40 foot radio telescope to map radio galaxies 3C 348 and 3C 353 as they crossed the meridian. This article will address how we obtained the data and assembled it to produce 2D and 3D charts.

We worked as a team from 1640 to 1741 LST operating the 40 foot radio telescope. The data was recorded on a paper chart. **Steve Tzikas** operated the telescope while **James Thompson** coordinated each individual scan and I kept track of the Local Sidereal Time. **Dave Cohen** made notations on the paper chart and kept a log of each individual scan, of which there were a total of 66.

The first scan was started at -5 degrees declination and ended at +10 degrees. This took about 60 seconds, and then we scanned from +10 degrees to -5 degrees, which took another 60 seconds. This sequence was repeated until 1741 LST, after both objects had crossed the meridian.

**Steve Tzikas** at the 40 Foot Controls

**James Thompson**, Coordinator

(40 Foot Control room photos provided by **Steve Tzikas**)
The following evening we photographed the chart, in sections, to study and extract data for the 2D and 3D charts. We planned to take the data home with us and build charts from the data we had collected.

The four of us each used the data from the paper chart to make charts of different styles and resolution to represent the movement of the galaxies as they crossed the meridian. The data was assembled using several different applications.

The data was extracted from the chart using the black channel chart of the signal level. The signal level at the beginning of the run, at -5 degrees declination, was noted by counting the minor chart divisions from the bottom of the chart. The next level was taken by moving one or two minor divisions horizontally on the chart and noting the number of minor divisions from the bottom of the chart at that point to the graphed line. This was repeated until the numbered transition on the chart which begins the next scan from +10 degrees declination to the next transition at -5 degrees declination. This process is continued until the final numbered transition.

Since each scan covered 15 degrees in declination, I used 15 data points per scan, for a total of about 900 data points, to make the tables for the charting application. Others, depending on the resolution they desired, used more or less.

The following shows how each person approached the generation of the charts made from the raw data:
Radio Sky plot by Dave Cohen

3D Plot by Dave Thomas using data by Dave Cohen
2D Plot by James Thompson

3D Plot by James Thompson
3D Plot by Dave Thomas

Plot by Steve Tzikas
Dave Thomas lives in Lynchburg, VA with his wife of 49 years, Remona. He retired from AT&T in 2004. His hobbies are amateur radio and astronomy, both optical and radio. He is 73 years old.
Situated on the south shore of New Jersey's Shark River lies 37 acres of land known as Camp Evans. On April 1, 2015, I was privileged to attend the dedication ceremony celebrating Camp Evans' becoming one of only 2532 locations in the United States designated as a National Historic Landmark.
Camp Evans, originally known as the Belmar Receiving Station, is rich in history:

- In 1912, Gugliemlo Marconi and his company, the American Marconi Company, constructed the Belmar Receiving Station which became part of the wireless girdle of the earth.
- In 1917, the site was acquired as part of the Navy’s World War I “Trans-Atlantic Communication System.”
• In 1941, the Army Signal Corps purchased the property to construct a top-secret research facility, and it was renamed Evans Signal Laboratory which later became Camp Evans Signal Laboratory.

• Following a visit in late October, 1953, Senator Joseph McCarthy described Camp Evans as a “house of spies.” Following an investigation that spanned 1953-1954, not one single employee was prosecuted.

But perhaps Camp Evans’ most interesting – and surprising – place in history begins with a small, informal research project taking place on a parcel of land in the Camp’s northeast corner. The ramifications of this project would ultimately give birth to the Space Age, lead to the development of the US Space Program, and start the Cold War.

Following the end of WWII, American scientists at Camp Evans continued their investigation into whether the earth’s ionosphere could be penetrated using radio waves – a feat that had been studied prior to the end of the War but had long been believed impossible. Project Diana, led by Lt. Col. John H. DeWitt, Jr., aimed to prove that it could indeed be penetrated. A group of radar scientists awaiting their discharge from the Army modified a radar antenna – including significantly boosting its output power – and placed it in the northeast corner of Camp Evans.

On the morning of January 10, 1946, with the dish pointed at the rising moon, a series of radar signals was broadcast. Exactly 2.5 seconds after each signal’s broadcast, its corresponding echo was detected. This was significant because 2.5 seconds is precisely the time required for light to travel the round trip distance between the earth and the moon. Project Diana – and her scientists – had successfully demonstrated that the ionosphere was, in fact, penetrable, and
communication beyond our planet was possible. And thus was born the Space Age – as well as the field of Radar Astronomy.

By mid-1958 the United States had launched the Television InfraRedObservation Satellite (TIROS) program designed to study the viability of using satellite imagery and observations as a means of studying the Earth and improving weather forecasting. As part of this effort, the original “Moonbounce” antenna was replaced with a 60-foot parabolic radio antenna dish which would serve as the project’s downlink Ground Communication Station.
On April 1, 1960, NASA successfully launched its TIROS I satellite and the “Silent Sentinel Radio Dish” at Camp Evans began receiving its data being sent down to earth.
The resulting images were so astonishing and groundbreaking that the first photos received from TIROS I were immediately printed and flown to Washington where they were presented to President Eisenhower by NASA Administrator T. Keith Glennan.
The TIROS program would go on to be instrumental in meteorological applications not only because it provided the first accurate weather forecasts and hurricane tracking based on satellite information, but also because it began providing continuous coverage of the earth’s weather in 1962, and ultimately lead to the development of more sophisticated observational satellites.\[^{[1]}\]

In addition to serving as the downlink Ground Communications Center for the TIROS I and TIROS II satellites, this same dish has also tracked:

- **Explorer 1**, America’s first satellite, in January, 1958 (pre-dates the launch of TIROS I), and
- **Pioneer V Space Probe**.

Sadly, by the mid-1970s, the technology within the TIROS dish (officially named the **TLM-18 Space Telemetry Antenna**) had become obsolete, and it was retired. Camp Evans was decommissioned and closed in 1993 and its land was transferred to the National Park Service. But in 2012, Camp Evans was designated a National Historic Landmark, and thus began a new, revitalized era for this immensely significant site. In addition to the TIROS Dish and the InfoAge Science History Learning Center and Museum, Camp Evans is also home to:

- **The Military History Museum**;
- The Radio Technology Museum;
- The National Broadcasters’ Hall of Fame.

The Apollo Guidance Computer, Just One of the Many Historical Exhibits on Display at the InfoAge Science History Learning Center and Museum at Historic Camp Evans [photo: Robert Raia Photography]
DISH RESTORATION

In 2001, InfoAge stepped in and began preserving and restoring the mechanical systems of the TIROS dish. In 2006, a donation from Harris Corporation allowed the dish to be completely repainted and preserved.

Norman Jarosik, Senior Research Physicist at Princeton University and Daniel Marlow, PhD. and Evans Crawford 1911 Professor of Physics at Princeton, as well as countless volunteers from the University, InfoAge, Wall Township (NJ), and the Ocean-Monmouth Amateur Radio Club, Inc. (OMARC) have provided the engineering/scientific knowledge and sweat-equity required to refurbish and update the inoperative radio dish. The original vacuum-tube technology has been replaced with smaller electronic counterparts. Rusty equipment has been replaced. Seized/inoperative motors have been reconditioned and rebuilt. And system-level software controls have been added. The TIROS dish has been transformed into a truly modern, state-of-the-art Radio Astronomy Satellite Dish and Control Center.
The TIROS Dish as it Appears Today [photo: Nancy J. Graziano]
On January 19, 2015, scientists from Princeton University pointed the dish skyward toward the center of our galaxy and detected a clear peak at 1420.4 MHz, the well-known 21 cm emission line originating from the deepest recesses of the Milky Way – the dish was working!

FUTURE PLANS
After almost 15 years of restoration and nearly 40 years since it last listened to the sky, the TIROS dish is once again operational, is detecting radio signals from the universe, and is well on its way to be used for science education.

Work continues on renovating Building 9162, the original TIROS Control Building, to convert it into the InfoAge Visitor Center. Plans include a NASA-style control room with theater seating for 20-30 students, a full-scale model of the original TIROS I satellite, and other exhibits dedicated to the history of Project Diana, the TIROS program, and the scientific impact these projects have had on our daily lives.
Future activities being planned using the dish include a Moonbounce experiment, communicating with NOAA weather satellites, performing real-time satellite imaging, viewing the Milky Way in the radio spectrum, and tracking deep space pulsars. If you are interested in visiting the InfoAge Science History Learning Center and Museum at Historic Camp Evans, they are open to the public on Wednesdays, Saturdays, and Sundays, from 1-5pm. Still want to learn more? Click on any of the links provided in this article, or visit the following sites:

- [TIROS Satellite Dish at InfoAge Science History Museum](#)
- [NASA Missions: TIROS](#)
- [NOAA Library Collections: TIROS](#)
- [TIROS I and TIROS II: Ground Station at the Camp Evans Project Diana Site](#)
• **TIROS Control Room and Exhibit Concept**
• **Marconi 1914 Belmar Station**

About **Nancy Graziano**
Nancy Graziano is a technical writer with 25 years writing experience. She earned a Bachelor of Science degree in Electrical Engineering from Rochester Institute of Technology, Rochester, NY, and currently resides in New Jersey. You can contact her through her website **Galaxy Media Services**.

This article appears courtesy of **Universe Today**.

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This 16th-century engraving may seem amusing to modern eyes but in the Middle Ages there were many fantastic ideas about the nature of the universe which were at the time found acceptable. In this drawing a man thrusts his head through the vault of the heavens to see the complicated mechanism of cogs and wheels which moves the stars.
Dish Update at Leon Mow Radio Observatory, Australia
Clint Jeffrey – Section Director
Astronomical Society of Victoria – Radio Astronomy Section

The presence of Radio Astronomy at Leon Mow Dark Sky Site has been moving along at a steady pace since 2008. The Leon Mow Radio Observatory, LMRO, is located about 1.5 hours north of Melbourne near the central Victorian town of Heathcote: [http://www.lmro.org.au/](http://www.lmro.org.au/)

Like optical astronomy we want the best telescope to give us the best way of looking at the sky to achieve with some satisfaction what we want to do, whether that is looking at the spectacular Crab Nebula or just being able to see the rings of Saturn.

We have been on the lookout for a large parabolic dish antenna for some time. Out of all opportunities that have come and gone, just under our noses—a little less than a 90-minute drive from our observatory-- was one such antenna ready for the taking.

On 10 February 2013 our Dish antenna arrived at LMRO on the back of a ute and a tandem trailer with the hub and 12 sections that make up the parabolic shape of its reflecting surface. A Kennedy design type 749 model 1091, its 8.5 m diameter weighs in at 1.5 tons. The focal length is 3.658 m and the f/d ratio is 0.43 with a gain of 35.5 dBi (isotropic reference) at 900 MHz.

Given the frequency of operation anywhere between 400 MHz to 10 GHz the antenna has a collecting area of 7 m² allowing several radio sources to be observed at a starting frequency of 1.4 GHz.
We hope to detect some of these sources as a ‘bucket list’ to start us off.

TAURUS A 3C144 supernova remnant (SNR), 875 Jy
CYGNUS A 3C405 RADIO GALAXY, 1495 Jy
W51 3C400 NEBULA, 710 Jy
W44 3C392 SNR, 171 Jy
M87 3C274 VIRGO A RADIO GALAXY, 198 Jy
SAGGITARIUS A EAST CTB37B, 100 Jy at 1 GHz
CENTAURI A CTA59, 1330 Jy
M42 3C145 ORION A NEBULA, 520 Jy
M17 (W38) NEBULA, 1060 Jy
M20 NEBULA, 360 Jy

Other projects will be Pulsar detection through to reception of Telemetry signals from NASA and ESA probes at 8.4 GHz.
We have now placed plans and details about the Dish to Local Council and are awaiting a green light (Planning and Building Permits) to start building the foundation and support structure for the Dish which we consider stage one of the project.

Above is the general design concept of a rolled steel tubular section atop a bolt cage which will be immersed into 16 m$^3$ (about 38 500 kg) of concrete. Even though the surface of the Dish is of square mesh design, calculations have assumed a solid surface so a little ‘over engineering’ has insured a stable foundation. It should be possible to “re-surface” the Dish if we ever wanted to do that.

ASV members Peter McGowan and Eddie van den Berg have applied their professional engineering skills to the design and drawings, thereby reducing overall costs. We even have a neighbour who has a crane that should be ideal to help us lift the tower section and eventually the Dish into place on top of the slewing bearing, another cost saving to the project.

Stage 2 will see the installation of the slewing bearing and Hub mounting ring to the bearing which is hinged to allow the Dish to tilt from zenith to horizon. Next, we will be fit the Dish to the top of the tower section.
Stage 3 will see the installation of azimuth and elevation drive motors and power supply system which can be discussed in future update article.

Only a few months ago we fitted the fibre glass struts to the Dish. The lads above then relaxed playing a game of Cricket traditionally played on Dish Antennas for checking if the Coordinates aren’t on NASA settings! (Ref to the Film “The Dish”)

This is a short video of the Strut installation in May 2015: https://www.youtube.com/watch?v=4Zi0TTFSJtc

When we’re not ‘doing’ Radio Astronomy the Society has an Amateur Radio License whose call sign is VK3EKH. We hope to conduct radio transmissions to reflect signals off the Moon and to arrange two way contacts with other Amateur stations around the world. Just reflecting a signal off the Moon will be an exciting experiment.

The Dish will be quite usable between the frequencies of 400 MHz to 10 GHz. There is a lot of Radio Astronomy that can be achieved within that range given modern RF low noise amplifier technology and computer weak signal processing techniques. There are some exciting times ahead for the Radio Astronomy Section.
The Grosse Pointe North High School Radio Telescope: A Friendship Resonator
Ruben Gomez

On March 26, 2015, Ken Redcap, Tom Hagen, and I visited Ms Ardis Herrold and the students of the Astronomy Club, the “Ratz (Radio Astronomy Telescope) Club” (see below), of North High School in the Grosse Pointe Public School system in suburban Detroit, Michigan. Although this was my first time meeting Ms Herrold, both Ken and Tom had met her before on a previous trip to the high school. She had called upon them to get help in fixing the school’s ailing radio telescope. Ms Herrold has had an Astronomy Club in the school since about 1989 when she built her first radio telescope. By self-admission, Ardis has very little expertise in electronics or radio engineering, but she has a lot of chutzpah and a lot of good friends who have helped her along the way. When one thinks of astronomy in a high school, radio telescopes do not readily come to mind. One usually thinks of optical telescopes, of kids out in the middle of the night looking through the
telescopes, or one thinks of craters on the moon. So how did Ardis come to radio astronomy? The answer is in Greenbank, West Virginia and the National Radio Astronomy Observatory.

Back in 1989 Ardis organized an educational outreach outing to the National Radio Astronomy Observatory in Greenbank, West Virginia. She took a bunch of high school kids on a 12-hour bus ride from the streets of Detroit to the hills of West Virginia. The students were so pumped up by the experience that Ardis and her students decided to build their own radio telescope at their school upon returning home. Ardis networked with some other high school teachers, as far away as Indiana, and with their help, Ardis and her students built their first radio telescope. You have to realize that in 1989 communication consisted of telephone land lines and snail mail. Social media did not exist and was probably considered a sexually transmitted disease. By enlisting the help of Ms B.J. Harper, a fellow high school teacher from Northrop High School in Fort Wayne, Indiana (this is the same high school that our own Tom Hagen attended), Ardis was able to build and set up her radio telescope. Over the years, the radio telescope has undergone several transmutations. First, the telescope had to be moved from one site to another when the high school moved. Then a very heavy wind storm demolished the first telescope and Ardis had to start afresh building another one. The telescope that Tom and Ken are trying to troubleshoot is this second telescope that she has at the present site. Unfortunately, the present telescope is not working and may be beyond repair. In addition to the physical condition of the radio telescope, Ardis has had to deal with the high school system idiosyncratic rules regarding computer security on campus. She has had trouble downloading programs and transferring data from her site to other sites such as the Stanford University SID program site, for which her astronomy club would be an ideal candidate.
As seen above, the present radio telescope is a homebuilt 18 foot foot dish. The feed horn has had to be removed in order to rebuild the support structure. Note the handsome figures in the foreground: Ken Redcap and the author. We see Richard, one of the high school members of the The Ratz Astronomy club up on the ladder inspecting the equipment. To the right, details of the aluminum ribs and hardware cloth reflecting surface are seen.

The receiver is a SpectraCyber2 model and the group is working with the supplier on a detector offset issue. In addition, an altitude and azimuth controller is needed for the present unit, since the hand paddle controller was damaged this winter. In the photo below, specific components can be seen: The
SpectraCyber2 consists of 2 white enclosures on top of the controller PC. To the right is the azimuth gear that rotates the entire equipment housing the dish itself.

But despite these obstacles and setbacks, Ardis is not daunted. Why? Because to Ardis the most important part of the radio telescope is not the pieces of metal and plastic that make up the shell of the telescope. The fancy computer platforms, software, or dongles really are not that crucial. To Ardis what counts is to bring her students together at the table of camaraderie and fellowship that an activity such as a radio telescope brings to her students. Most of the students with whom we spoke at this last interview were interested in the sciences. Few if any had an interest in the humanities, or at least did not want to admit it. Several of the students had an interest in engineering, one student wanted to study aeronautical engineering, another one wanted to study chemical engineering. One student wanted to study genetics. Another student wanted to study geology, planetary science, or earth sciences. But regardless of their interests, they all came together to talk to each other, to interact with each other, and to try to think together to try to solve problems, and just to plain
socialize and become social animals. To Ardis, this result is a success whether the radio telescope works or not.
Book Review

Title: Getting Started in Radio Astronomy
Author: S. Arnold
Publisher: Springer
ISBN: 978-1461-481560
Date published: 2014
Length: 208 pages, 3 page index
Status: In print
Availability: Paperbound 25 to 30 USD
Reviewer: Whitham D. Reeve

My first impression of Getting Started in Radio Astronomy was that it might be a book written for a young audience. It has limited scope, so the reader is not overwhelmed by jargon and terminology associated with the many complex facets of radio astronomy. Almost the entire first half of the book is spent on history, basic electricity and magnetism, atmospheres and ionospheres of some planets including Earth and electrical components used in the construction of radio receivers. The style is conversational but often wordy. Some descriptions seem to be written for elementary school students while others appeared written for middle school students (Jupiter’s moon Io is called a “flying pizza”). Much better introductory presentations on radio astronomy can be found elsewhere, particularly on NASA’s and some universities’ website. The book is illustrated with a few color and black-white images but the captions add little to the book.

Getting Started in Radio Astronomy is a member of The Patrick Moore Practical Astronomy Series, which by the beginning of 2015 contained 131 volumes. It is the only book in the series I could find on radio astronomy. The book’s prerequisites are minimal. In the chapter on basic electricity and magnetism, the author refers to current flow as “electrical pressure”, hinting of the old analogy of water flowing in a pipe to describe the flow of electrical current. Other analogies are used including comparing the transition of an electron from one energy state to another to Earth “jumping” from its present orbit to the orbit of Mars. These indicate the level at which this book is written.

What this book has to offer are detailed descriptions and dedicated chapters for SuperSID, Radio Jove, INSPIRE and radio detection of meteors. SuperSID is a very successful project originated by the Stanford Solar Center at Stanford University in California. SARA became involved in the project several years ago and now handles distribution and technical support. The SuperSID is a small receiver used in conjunction with a loop antenna and PC soundcard for monitoring sudden ionospheric disturbances caused by solar flares. Radio Jove is a very successful NASA outreach project originally designed to detect high frequency radio emissions at 20 MHz from Jupiter but it also detects solar radio bursts at the same frequency. A dedicated group of individuals, some SARA members, handle distribution of the Radio Jove receiver and dipole antenna kits and provide technical support. The Interactive NASA Space Physics Ionosphere Radio Experiments, or INSPIRE, dates back to 1989 and is another education outreach project. At the center of INSPIRE is the VLF-3 receiver kit, which is used to receive very low frequency natural radio. All of these projects are well documented and supported in their own right, and the associated electronics are easy to build and the software easy to use.
In the dedicated chapters on SuperSID, Radio Jove and INSPIRE, the author describes in detail his construction and application of the projects. I believe the author intended that these descriptions fill gaps in the original instructions or to serve as supplementary construction aids. However, there are so many errors and confusing statements that I think a reader would be far better off simply following the original instructions and then contacting the relevant support group if questions arise.

Flaws surface early in the book and continue throughout. The author says of the SuperSID: “It can be used in conjunction with the Radio Jove receiver, and by looking at the data it gives a good indication that a possible aurora is on its way.” While it is true that the SuperSID could be used to observe along with the RJ receiver, this statement inadequately describes why, what and how. The author provides no information on how to gather and actually interpret (“look at”) the data. I think he would have served his readers better by breaking down the phenomena and explaining how each may be detected and how the observations may be interpreted.

Additional problems are apparent in the Glossary at the back of the book. A resistor is defined as “a semiconductor ...” – a confusing misuse of the term. ARRL is called National Association for Amateur Radio instead of its correct name American Radio Relay League. On the other hand, Getting Started in Radio Astronomy has a few plugs for the Society of Amateur Radio Astronomers, SARA. The book does have a section in the back with a short list of references, which is very unusual in books written for the amateur market. Interestingly, I have reviewed many of the listed references in previous issues of the SARA journal, and readers may find some of these already on their bookshelves.

Flaws in Getting Started in Radio Astronomy are not limited to those described above. There are a number of technical distortions. For example, the author states the Sun has been “throwing out” the solar wind since nuclear fusion started in its core “millions of years ago”. Billions of years would have been a better choice of time frame.

The chapter on meteor detection mentions “... a powerful space radar in the United States that monitors satellites and other objects ... in Earth’s orbit.” This most likely refers to the AN/FPS-133 US Air Force (formerly US Navy) space surveillance radar or “space fence”, which was shuttered in 2013 not long before Getting Started in Radio Astronomy was published. Meteor trail reflections from the radar’s transmitter required a receiver operating on about 217 MHz, but the frequency is not mentioned (and does not matter now, anyway). Many observers use distant FM or TV broadcast stations as the transmitting end of meteor trail reflections, but HF beacons and time service signals also work. The author fails to mention these common transmitters.

As I read the book I placed a sticky-note wherever I noticed a problem, as I often do when reading a book for review. When I finished, the book was full of colored notes. While none of the individual problems cripple the book, they do add up to a major annoyance and call into question the book’s overall usefulness – especially for newcomers who simply do not know they are reading the wrong explanation.

The author concludes the book by saying he hopes the “book dispels the idea that huge parabolic dish antennas are needed in the garden ....” However, like many books written for amateur radio astronomers, the front cover image of Getting Started in Radio Astronomy is, in fact, a large professional parabolic dish antenna. Why is
that? I have no idea. One must ask, if a huge dish antenna is not needed, why is there a picture of one on the book’s cover? By the way, even though large dish antennas are far beyond the financial and managerial means of most if not all amateur radio astronomers and their organizations, there is one notable exception as I write this review in mid-2015. The Astronomical Society of Victoria – Radio Astronomy Section is installing a re-purposed 8.5 m dish antenna at their Leon Mow Radio Observatory near Melbourne in Australia. Readers can read more about this project on page 33 of this Journal and also follow their progress on the ASV-RAS Yahoo group.

This is largely a negative review but the book has potential and plenty of room for improvements in a future edition. Does the book have value and is it worth 25 to 30 USD? I believe the value is the author’s focus on four specific projects. One of the most common questions I hear is, “What should I do to get started in radio astronomy?” Any one of the projects in this book will provide a good starting point to a newcomer. However, the cost of many books these days defies reason, and it is very rare to get your money’s worth in a book written for the amateur market. Unfortunately, Getting Started in Radio Astronomy is no exception.

Reviewer - Whitham Reeve presently is a contributing editor for the SARA journal, Radio Astronomy. He worked as an engineer and engineering firm owner/operator in the airline and telecommunications industries for more than 40 years and has lived in Anchorage, Alaska his entire life.
**Membership**

**New Members**

Please welcome our new or returning SARA members who have joined since the last journal. If your name is missing or misspelled, please send an email to treasurer@radio-astronomy.org. We will make sure it appears correctly in the next Journal issue. As of June 16, 2015:

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**SARA Membership Dues and Promotions**

Membership dues are $20.00 US per year and all dues expire in June. Student memberships are $5.00 US per year. Members joining from June to December of 2014 will renew their membership June 2015. Members joining January to June 2015 will renew June 2016. Or pay once and never worry about missing your dues again with the SARA Life Membership. SARA Life Memberships are now offered for a one-time payment of twenty times the basic annual membership fee (currently $400 US).
Journal Archives & Other CDs Promotion

The entire set of The Journal of The Society of Amateur Radio Astronomers is available on CD. It goes from the beginning of 1981 to the end of 2014 (over 5000 Tor of SARA history!) Or you can choose one of the following CD’s or DVD:* (Prices are US dollars and include postage.)

† SARA Journals from 1981 through 2014
† SARA Mentor CD, compiled by Jim Brown
† SARA Navigator (IBT) CD and DVD, compiled by Jon Wallace

Prices, US dollars, including postage

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*Already a member and want any or all of these CD’s or DVD’s? Buy any one for $15.00 or get any three for $35.00.

SARA Store (http://www.radio-astronomy.org/e-store)

SARA offers the above CDs, DVDs, printed Proceedings and Proceedings on CD and other items at the SARA Store: http://www.radio-astronomy.org/e-store. Proceeds from sales go to support the student grant program. Members receive an additional 10% discount on orders over $50 US. Payments can be made by sending payment by PayPal to treasurer@radio-astronomy.org or by mailing a check or money order to SARA, c/o Melinda Lord, 2189 Redwood Ave, Washington, IA 52353

SARA Online Discussion Group

SARA members participate in the online forum at http://groups.google.com/group/sara-list. This is an invaluable resource for any amateur radio astronomer.

SARA Conferences

SARA organizes multiple conferences each year. Participants give talks, share ideas, attend seminars, and get hands-on experience. For more information, visit http://www.radio-astronomy.org/meetings.
Facebook


Twitter

Follow SARA on Twitter #radio astronomy1

What is Radio Astronomy?

This link is for a booklet explaining the basics of radio astronomy. http://www.radio-astronomy.org/pdf/sara-beginner-booklet.pdf
**Administrative**

**Officers, directors, and additional SARA contacts**

The Society of Amateur Radio Astronomers is an all-volunteer organization. The best way to reach people on this page is by email with SARA in the subject line SARA Officers.

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<td><a href="mailto:stannelson@cableone.net">stannelson@cableone.net</a></td>
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<td><a href="mailto:vicepres@radio-astronomy.org">vicepres@radio-astronomy.org</a></td>
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Resources

Great Projects to Get Started in Radio Astronomy

Radio Observing Program

The Astronomical League (AL) is starting a radio astronomy observing program. If you observe one category, you get a Bronze certificate. Silver pin is two categories with one being personally built. Gold pin level is at least four categories. (Silver and Gold level require AL membership which many clubs have membership. For the bronze level, you need not be a member of AL.)

Categories include
1) SID
2) Sun (aka IBT)
3) Jupiter (aka Radio Jove)
4) Meteor back-scatter
5) Galactic radio sources

This program is a collaboration between NRAO and AL. William F Bogardus is the Lead Coordinator and a SARA member.

For more information: http://www.astroleague.org/programs/radio-astronomy-observing-program

The Radio Jove Project monitors the storms of Jupiter, solar activity and the galactic background. The radio telescope can be purchased as a kit or you can order it assembled. They have a terrific user group you can join. http://radiojove.gsfc.nasa.gov/

The INSPIRE program uses build-it-yourself radio telescope kits to measure and record VLF emissions such as tweeks, whistlers, sferics, and chorus along with man-made emissions. This is a very portable unit that can be easily transported to remote sites for observations. http://theinspireproject.org/default.asp?contentID=27
Sky Scan Awareness Project
When a meteor passes through the Earth's atmosphere, it ionizes the atmosphere which improves its ability to reflect radio waves. This allows you to briefly hear a far away radio station that you normally couldn't detect. In this project, you can install an antenna, use an FM radio receiver, computer software, and learn to observe meteor showers using this very simple radio telescope. For more information about this project, please visit http://www.skyscan.ca/getting_started.htm.

SARA/Stanford SuperSID
Stanford Solar Center and the Society of Amateur Radio Astronomers have teamed up to produce and distribute the SuperSID (Sudden Ionospheric Disturbance) monitor. The monitor utilizes a simple pre-amp to magnify the VLF radio signals which are then fed into a high definition sound card. This design allows the user to monitor and record multiple frequencies simultaneously. The unit uses a compact 1 meter loop antenna that can be used indoors or outside. This is an ideal project for the radio astronomer that has limited space. To request a unit, send an e-mail to supersid_at_radio-astronomy_dot_org
Education Links


Texas Instruments eBook, Analog Engineers Pocket Reference:  

Monitor space weather, HF propagation, aurora and other related stuff.  
Download POSEIDON:  
[http://markslab.tk/project-owmentos](http://markslab.tk/project-owmentos)

Free eBooks by Jet Propulsion Laboratories on many subjects including the Deep Space Network and space navigation:  


NASA Technical Reports Server (NTRS):  
[http://ntrs.nasa.gov/](http://ntrs.nasa.gov/)

Want to learn about radio propagation at all frequencies based on work in 1961? If so, go to Journal of Research of National Bureau of Standards, Section D: Radio Propagation:  
[http://www.nist.gov/nvl/journal-of-research-volume-65d.cfm#issue3](http://www.nist.gov/nvl/journal-of-research-volume-65d.cfm#issue3)

Free astronomy text and course:  

Brush up on modern measurement fundamentals with free DVD from Keysight Technologies:  

Texas Instruments, TI Precision Labs is the electronics industry’s first comprehensive online classroom for analog engineers. This free modular curriculum includes over 30 hands-on trainings and lab videos, covering analog amplifier design considerations with online course work:  

Anritsu  ~

Interference Hunting Tools:  
[https://www.youtube.com/watch?v=Of0rFegWex4](https://www.youtube.com/watch?v=Of0rFegWex4)

Making Interference Hunting Easier:  
[https://www.youtube.com/watch?v=zmsymfKZs4](https://www.youtube.com/watch?v=zmsymfKZs4)

Online Resources

British Astronomical Association – Radio Astronomy Group
http://www.britastro.org/baa/

CALLISTO Receiver & e-CALLISTO
CALLISTO data archive: www.e-callisto.org

Deep Space Exploration Society
http://dses.org/index.shtml

European Radio Astronomy Club
http://www.eracnet.org
GNU Radio
http://www.gnu.org/licenses/gpl.html
Inspire Project
http://theinspireproject.org
NASA Radio JOVE Project
http://radiojove.gsfc.nasa.gov
Archive:
http://radiojove.org/archive.html

National Radio Astronomy Observatory
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NRAO Essential Radio Astronomy Course
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http://www.setileague.org
SkyScan Science Awareness (Meteor Detection)
http://www.skyscan.ca/getting_started.htm
Stanford Solar Center
http://solar-center.stanford.edu/SID/

UK Radio Astronomy Association
http://www.ukraa.com/www/

SARA Facebook page
SARA Twitter feed
https://twitter.com/RadioAstronomy1
For Sale, Trade, and Wanted

SARA Polo Shirts

SARA has polo shirts with the new SARA logo embroidered. (No pocket) These are 50% cotton and 50% polyester, machine washable. Currently in stock:

<table>
<thead>
<tr>
<th>Size</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Small</td>
<td>Navy, Royal Blue, Lt. Blue, Lt. Pink</td>
</tr>
<tr>
<td>Medium</td>
<td>Navy, Royal Blue</td>
</tr>
<tr>
<td>Large</td>
<td>Maroon, Navy, Royal Blue</td>
</tr>
<tr>
<td>X-Large</td>
<td>Maroon, Navy</td>
</tr>
<tr>
<td>XX-Large</td>
<td>Black, Navy, Dark Green, Royal Blue</td>
</tr>
<tr>
<td>XXX-Large</td>
<td>Black, Navy, Royal Blue</td>
</tr>
</tbody>
</table>

Price is $15 with free shipping in the USA. Additional cost for shipping outside the USA. Other colors and sizes available; contact SARA Treasurer, Melinda Lord, at treasurer@radio-astronomy.org.

There is no charge to place an ad in Radio Astronomy; but you must be a current SARA member. Ads must be pertinent to radio astronomy and are subject to the editor’s approval and alteration for brevity. Please send your “For Sale,” “Trade,” or “Wanted” ads to editor@radio-astronomy.org. Please include email and/or telephone contact information. Please keep your ad text to a reasonable length. Ads run for one bimonthly issue unless you request otherwise.

For sale

Items listed below. Send request to SARA by email to supersid@radio-astronomy.org.

<table>
<thead>
<tr>
<th>Description, items for sale by SARA</th>
<th>Price (US$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>SuperSID VLF receiver (assembled)</td>
<td>$48.00</td>
</tr>
<tr>
<td>PCI soundcard, 96 kHz sample rate</td>
<td>$40.00</td>
</tr>
<tr>
<td>Antenna wire 24 AWG (120 m)</td>
<td>$23.00</td>
</tr>
<tr>
<td>Coaxial cable, Belden RG58U (9 m)</td>
<td>$14.00</td>
</tr>
<tr>
<td>Shipping (United States)</td>
<td>$10.00</td>
</tr>
<tr>
<td>Shipping (Canada, Mexico)</td>
<td>$25.00</td>
</tr>
<tr>
<td>Shipping (all other)</td>
<td>$40.00</td>
</tr>
</tbody>
</table>
For sale by Jeffrey Lichtman: Tektronix C-30A Oscilloscope Camera. Uses polaroid film. $35.00 plus $15 shipping for USA. Foreign shipping, email jeff@radioastronomysupplies.com