

The Deep Space Exploration Society 2018 Annual Year End Report

The Deep Space Exploration Society 2018 Annual Year End Report by Bill Miller

First Things First - DSES BOD Nomination and Election Notice: It is once again time to nominate and elect or retain three new Board of Directors in rotation for the 2019- 2020 period. Those board positions up for replacement or retention for the two year term completing now are: Floyd Glick; BOD At Large, Dave Molter; BOD At Large and Bill Miller; Vice President & Interim Secretary. Nominations shall close by the 25th of February 2019 and election ballots will be sent out shortly after. Please send the names of any member that you would like to nominate for the BOD now by emailing to the board at the web site address plishner.info@gmail.com . The process to elect these nominees will be outlined to members in a separate email shortly.



Figure 1: Paul Plishner Radio Astronomy and Space Science Center

The 2019 Membership Drive: has now started. Dues continue to be \$50 / year for voting members and \$20 / year for non-voting members. Primary and secondary school students can join at no cost with application. Please renew your membership now. We welcome new members as well. Send payment to Myron Babcock with PayPal or send check to;

**Deep Space Exploration Society
4164 Austin Bluffs Pkwy. #562
Colorado Springs, CO 80918-2928**

2018 Year in Review Summary: The Deep Space Exploration Society operating the Paul Plishner Radio Astronomy and Space Science Center near Haswell, Colorado had an excellent year for 2018.

A number of infrastructure projects at the science center/observatory were undertaken including power and wiring trenching and installation from the utility pole, telephone lines, call-in radio/intercom, underground bunker repairs, Ham Radio KØPRT site club station and antenna, dish control and pointing systems, maximum Az/EI movement limit switches, Antenna Feed Systems, LAN connections, toilet facilities, fencing to keep out tumble weeds,

trenching for RV park with power, retaining wall, and sump pump improvement were all completed.

A core team of about 15 individuals consistently worked on these important projects to raise the operational level of the observatory to a true scientific and educational facility. We are accomplishing a great deal with a very small budget and a very talented group. This group has put in thousands of volunteer hours and mileage. Thanks to everyone who came out and gave time and money to the site build up. We welcome additional member participation moving forward. If you would like to participate in some of the infrastructure work and science sessions, please see the web site for the meeting and site schedule and come out to participate. This is an excellent opportunity to learn something new and help improve this unique facility and its systems for even greater future endeavors.

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DSES organization activities increased in 2018. There are now; one engineering/operations meeting on the 2nd Monday of each month, one science meeting on the 4th Monday of each month, one general observation trip on the 3rd Friday of each month and one operational/engineering work trip on the 3rd Saturday of each month. In addition to these normally scheduled events there are additional work trips and SETI related observation trip every month. As stated before, please see the web site for the meeting and site schedule and come out to participate.

January 2019, Treasurer's Summary Report from Myron Babcock:

OUTFLOW		INCOME	
Electric Installation Expenses	\$2,415.21	CASH DONATIONS	\$900.00
above the initial utility installation.			
Construction Material	\$315.78	Total Membership Dues for 2018	\$2,150.00
Electric Utilities	\$770.86		
Telephone Utilities	\$164.86	Equipment Sales	\$1,340.00
AT&T Hot Spot (Internet)	\$276.00	Total Income	4,390.00
\$23/month X 12 months	\$276.00		
		Beginning of 2018 year account ballances	
		Checking	\$717.67
Annual Recurring Expenses	\$557.88	Savings	\$6,729.38
		End of year 2018 account ballances	
		Checking	\$1,825.97
Total Expenses	\$4,500.59	Savings	\$5,734.61

Specific 2018 Accomplishments:

Rural Power Service: To start the 2018 year off, president Steve Plock had worked on several proposals for funding and projects in late 2017. In one of these Skip Crilly of the Greenbank WV, Observatory made a very generous donation to install the rural power line into the Radio Observatory site. Not only did this vastly improve the site operation but it freed up a great deal of personnel time and resources that had been going to keep the generator and solar systems maintained. Many new operational and science endeavors could then be undertaken. We cannot thank Skip Crilly enough!

New Dish Antenna Feed: Steve Plock had constructed a 1420MHz feed for the 60 ft. dish and successful installation and tested this new Hydrogen Frequency Feed. Skip Crilly made this more effective with a low loss analog fiberoptic signal link from the dish to the comm. trailer and a number of additional items for signal conditioning, detection and storage to match the Greenbank 40 Ft dish he had been working on.

Equipment and Infrastructure :

Gary Agranat set up the KOPRT club station using the Yaesu radio and vertical antenna donated by the estate of our late member Kirby Stafford. We thank the family for this generous donation.

Ed Corn made many new wiring changes and additions to the Underground and the rest of the site.

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Dave Molter secured the donation of several 10 and 12 foot satellite dishes for our future use.

Ed Corn and Steve Plock converted one of the metal rail road buildings into a toilet facility near the dish pedestal.

Glenn Davis purchased and installed an NTP time sever which will be used to improve the accuracy of the pointing systems and synchronization of observation data.

Ed Corn purchased an electric milk house heater to heat the new outhouse near the Dish Pedestal.

Bob Haggart supplied the materials and built a very much improved and safer staircase and landing for the comm. trailer.

Paul Berge, Ed Corn and Steve Plock installed the coax cables and fiber optic cables to the dish feed.

Paul Berge fixed the dish drive circuit breakers and also rebuilt and installed the limit switch system.

Ed Corn and Gary Agranat constructed a 40 ft Rohm 25 antenna tower above the underground.

Glenn Davis, Jon Richardson and Dave Molter made further progress on the System 1 position controller and Ed Johnson and Bill Miller made significant progress on the System 2 controller. Dave Molter and Bill Miller fixed a major noise problem in the elevation encoder.

Bill Miller procured conduit and wire and installed an 18 wire link from the comm. trailer to the upper decks of the dish mount to hookup the synchro pairs in the dish mount. This will provide a secondary fault proof display of the antenna Az/EI position independent of the computer controls.

Trips and Seminars:

Several members were able to travel to the national radio observatories to attend conferences, training and tours. In April Bill Miller and his wife, Regina visited the Greenbank Observatory, stayed there in the residence hall and got a VIP tour of the facility by the technical staff. Dr. Rich Russel attended the Casa SW workshop for a week in May at the VLA in New Mexico to learn how to do data mining on the datasets available from the national observatories. Rich and Ray Uberecken attended the Eastern SARA conference at the Greenbank Observatory in West Virginia from June 10th thru 13th.

2018 Publications and Papers: A number of publication and papers were written and submitted for publication by DSES members in 2018.

Milky Way Rotation Rate and Mass Estimation Using HI Measurements, R. Russel, Radio Astronomy, November-December 2018, pp.77-83, radio-astronomy.org

Dark H1 Cloud Observation using the Deep Space Exploration Society 18-Meter Dish with the RASDR4, T. Bigbee, R. Russel, S. Plock, Radio Astronomy, September – October 2018, pp. 64-76, radio-astronomy.org

SpectraCyber Neutral Hydrogen Measurements using the Deep Space Exploration Society 60-foot Antenna System, R. Russel, G. Agranat, Radio Astronomy, September – October 2018, pp. 58-63, radio-astronomy.org

The Deep Space Exploration Society 2018 Perseid Meteor Shower Open House, B. Miller, G. Agranat, F. Royo, R. Russel, Radio Astronomy, September – October 2018, pp. 10-21, radio-astronomy.org

Earth's Orbital Position Using Galactic HI Interstellar Medium Velocity Measurements, R. Russel, Proceedings Society of Amateur Radio Astronomers Eastern Regional Conference 2018, radio-astronomy.org

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Galactic Navigation Position Data Using HI Interstellar Medium Velocity Measurements, R. Russel, Proceedings Society of Amateur Radio Astronomers Western Regional Conference 2018, radio-astronomy.org

SETI Geographically-spaced Synchronized Signal Detection System – Simultaneous SETI Observations Oct 2017 to Nov 2018, Skip Crilly, Society of Amateur Radio Astronomers Western Regional Conference 2018, radio-astronomy.org and other forums.

SETI Work:

With Skip Crilly's resources and guidance, a number of SETI related observations were made. About

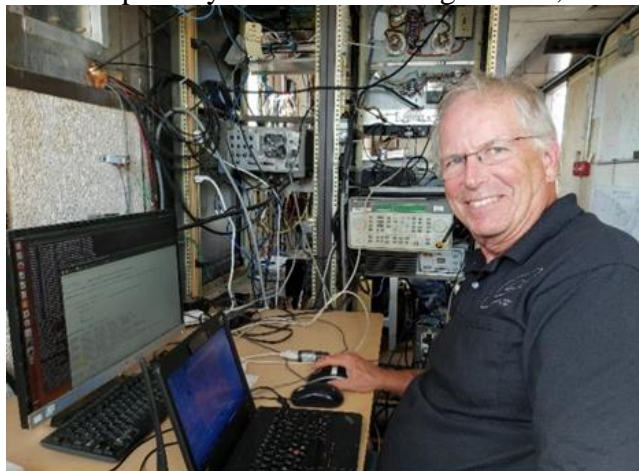


Figure 1: Skip Crilly with the SETI system

every other month Skip and Steve Plock made simultaneous radio observations from the 10 meter dish at the Greenbank observatory in West Virginia and the 18 meter dish in Haswell, Colorado. Using GPS time coding to match the signals and the long ~1300 mile baseline between sites, they were able to make observations and eliminate terrestrial and earth orbit signals from the data set. See the plots [Greenbank & Haswell plots of simultaneous observation of NRAO 5690](#), a catalogued supernova remnant (SNR) on August 15, 2018 and the plot below.

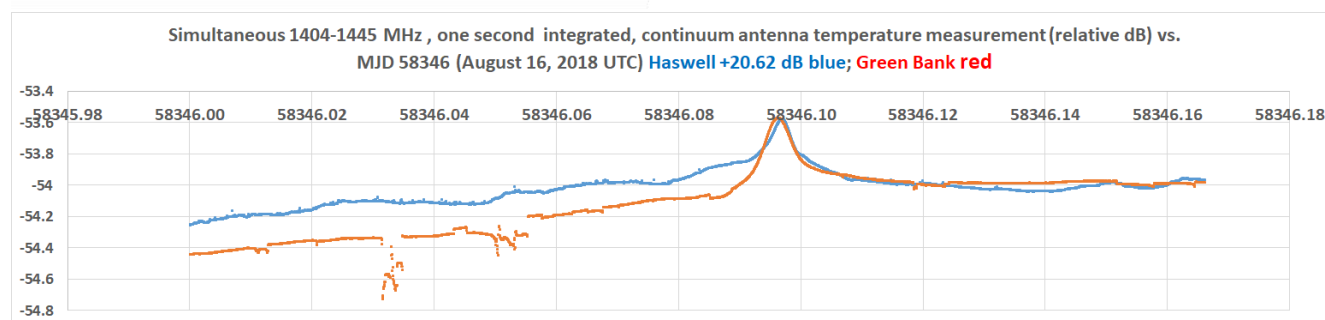


Figure 2: Amplitude corrected Greenbank & Haswell plots of simultaneous observation, Aug 16, 2018.

Open House:

The DSES memorial Paul Plishner Radio Astronomy and Science Center open house was held on the weekend of August 11, 2018 to coincide with the Perseid Meteor Shower. While this is an annual report, the activities of the open house are a culmination of much of the DSES activities for the year so is highlighted here.

- Educational topics in Science, Astronomy, Engineering and Radio were offered.
- Demonstrations and radio experiments utilizing the 60 Ft. Radio Dish were undertaken.
- Ham Radio operation and the club station, KØPRT were demonstrated.
- Radio Astronomy, and Optical Astronomy were demonstrated. Solar Telescopes were available to view the sun during the day and optical telescopes were available during the evening hours. The annual Perseid meteor showers were observed when conditions permitted.

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- Hot dogs were served for lunch and homemade Brunswick stew and jalapeno corn bread was served after 5PM. Breakfast was served on Sunday morning and coffee, ice water and lemonade were available throughout the event.
- Overnight camping was permitted, and RV/trailer power hookups were available for a small donation fee.

Upgraded Dish Control and Receiver Capability:



Figure 3: Bill and Rich operating the dish controls and SpectraCyber

computer.

Both systems use the Azimuth and Elevation 12 bit absolute position encoders on the dish and the development of both systems are mostly comprised of software written by Glenn and Ed. Both systems are nearing at fully operational state in their development and improvements are ongoing.

Radio Astronomy Receiver Use and Development



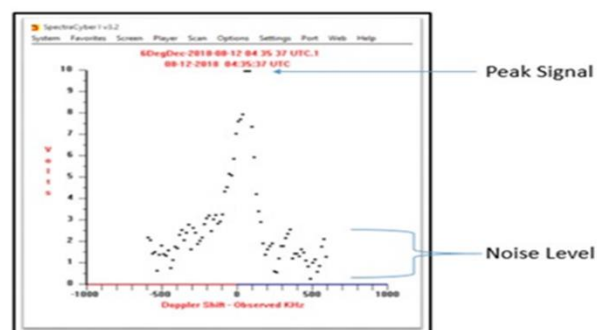
Figure 4: Dr. Rich Russel operating the Spectracyber HI Receiver on the 60 ft Dish

During the open house the dish drive control worked well for the first public event and several receivers were tried on Steve Plock's new 1420MHz dish antenna feed. These were demonstrated to all interested participants and public at the event.

There are two control systems under development. System 1 developed by Glenn Davis and Dave Molter uses a Raspberry Pi micro controller to read the dish position and communicate over the LAN to the control computer.

System 2, developed by Ed Johnson, Ray Uberecken and Bill Miller uses a commercial data acquisition module to control the dish and communicate over the LAN to the control

The SpectraCyber was sent back to the factory for repairs in 2018 and new observations were started at the open house event. The SpectraCyber instrument is a



Passing the Galactic Plane RA: 19hr 5 Min, Dec: 6 degrees 0 Min

Figure 5: Spectra Cyber observation of HI emission while passing the galactic plane.

software controlled narrow band (± 600 KHz), frequency stable spectrum analyzer centered about the neutral hydrogen spectral-line that measures 1420.406 MHz. Dr. Russel has continued to use the SpectraCyber with the dish monthly, compiling a radio object profile catalog for a number of objects. He is also compiling a doppler shift or rotation rate database of objects moving out from the center of our galaxy. He compares this data to the known rotation rate curves established by the professional observatories. He is writing SARA papers on both of these data sets and observations.

RASDR4 (Radio Astronomy Software Defined Radio Gen 4) Receiver Successful Observation of Hydrogen Absorption Line



Figure 6: Tony Bigbee operating the RASDR 4 on the 60 ft Dish while Ed Corn, Paul Berge, and Bill Miller look on.

Sagittarius Star Cloud Messier 24, with a colder hydrogen cloud in the line of site that absorbs the background hydrogen line signal. The results were stellar! The neutral hydrogen frequency absorption/redispersion could be clearly seen as a V notch in the spectral curve of the background source emission. The 60ft. Haswell dish was moved to lead the passing object several times and the notch could clearly be seen *growing in depth* coming to maximum and back to nothing over about a 7-degree drift scan showing the smaller foreground cloud moving though the larger background emission area. Tony will publish a SARA paper on this observation.

Tony Bigbee used his RASDR4 on the 60-foot dish to observe this hydrogen absorption line at RA: 18.15hrs, Dec: -20 deg. Tony installed a RASDR 4 system using the Lime SDR HW and the SW that he developed. His experiment goal was to replicate results obtained using the NRAO 20-meter dish and RASDR2 achieved in 2014 as well as compare results with a recent survey involving the Parkes 64-meter dish system in Australia to see the hydrogen line energy absorption of the

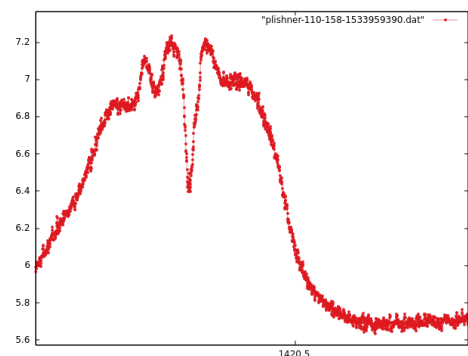


Figure 7: RASDR 4 Detection of the "Dark Cloud"

1296 MHz Beacon Observation using a RASDR2, Software Defined Receiver

During the open house **Bogdan Vacaliuc** and **David Fields** drove out from San Jose on the way back to Tennessee and tried their RASDR2 on the system feed. **Bogdan Vacaliuc** installed a RASDR2 onto the 60-foot dish and was able to observe **Ray Uberecken's** 1296MHz 1W beacon from 80 miles away and was at least 20dB over noise even though the dish feed is designed for 1420MHz.

This experiment also allowed us to center the signal by moving the dish back and forth in azimuth and at 0 deg elevation with both system 1 and 2. Both system 1 and system 2 pointing systems were found to be close to each other in Azimuth and Elevation with the RASDR2 and 1296Mhz beacon test described above. There is more work to do here on pointing accuracy.

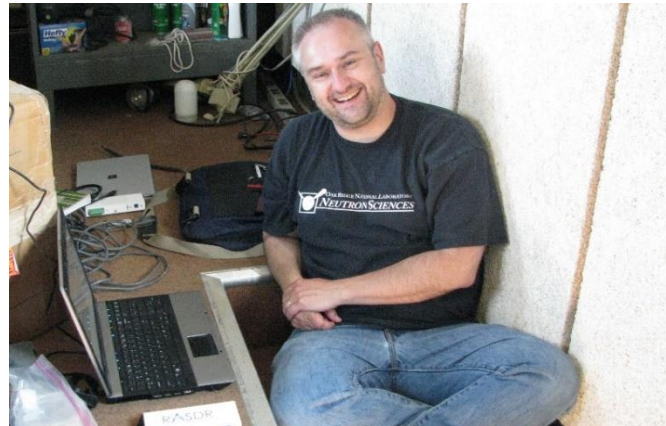


Figure 8: Bogdan Vacaliuc with the RASDR 2 installed on the 60 ft dish

60 ft. Dish Operation;

The two control systems that tell where the dish is pointing were exercised in the open house and both worked quite well. **Paul Berge** solved one of our dish drive motor problems in preparation for the open house. The mount brake solenoid circuit breakers had been tripping and he replaced them with time delay fuses and the system was solid during and after the open house event and yet to blow a fuse leading us to believe that the breakers were old and weak or improperly sized for the application. Paul also added a limit switch system that will prevent the accidental overwrap of the system cables and over rotation as the dish is moved in both axes.



Figure 9 Myron Babcock and Paul Berge Discussing the Dish Drive System

Ham Radio and Club Station Operations



Figure 10: Site Ham Station, KØPRT

Gary Agranat set up, operated and demonstrated the site ham station, KØPRT from the “Underground” bunker to all the visiting guests. He logged over 150 contacts. Over 60 contacts were on 20-meter phone. The rest were on 10, 15, 20, and 40-meter FT8. Gary advertised the special event station in the August QST, and at ARRL.org since May. Plus, while on the air the event was spotted on the DX cluster. Those ads and sightings brought in more contacts. Since installation 2 years ago Gary and the club have made over 600 radio contacts from the site. Gary suggests that in the future more of the members take a turn at the ham station. We could get many more contacts with more hours and operators and spread the load while giving other Hams a chance

to talk with more of us and learn more about the various aspects of what we do. In the future we could have 1 to 2-hour time slots scheduled for active members to share the responsibility

General Astronomy: We have several DSES members who are either teachers of general astronomy at local colleges or are involved with the subject professionally with business entities. This makes for a rich teaching and discussion environment on the subjects of space, astronomy and physics.

While many successful dish and radio experiments were going on during the open house the DSES was also providing educational demonstrations to visitors on general astronomy and science subjects. We

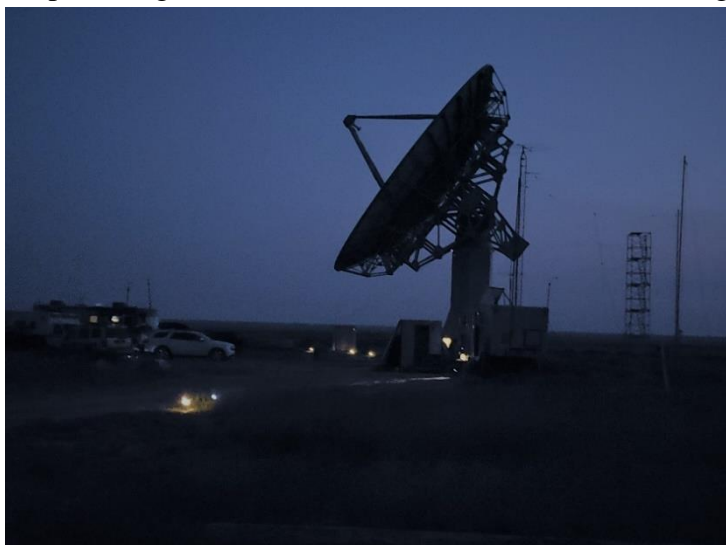


Figure 11: The Solar lights came on and the evening progressed with more optical and radio astronomy on into the night.

did a lot of visual astronomy. Rich, Bill, Myron, Floyd and several of the guests brought out mid-sized optical telescopes and shared viewing with all that were interested. The “seeing” for optical observation with no moon was very good except for the wild fire smoke on the western horizon. Solar observation was also provided by the telescopes during the day. We didn’t see too many meteors in the Perseids Meteor Shower, but this may be because the peak viewing occurred in the early AM hours. By then we were all exhausted and choose to sleep instead.

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Open House Food and Drink: We did a good job of keeping everyone fed and caffeinated. On Saturday and Sunday mornings Bill provided continuous coffee service. For Saturday Lunch Myron provided grilled hot dogs, fixings, potato and macaroni salads with chips and drinks.

Saturday evening Steve Plock provided his home-made Brunswick stew and Jalapeno corn bread in the underground prior to Skip's presentation. Everyone loved the stew.

On Sunday, Dave and Myron put on a grilled egg, sausage, hash browns and pancake breakfast that really hit the spot.



Figure 12: Myron Babcock and Dave Molter put out a Great Pancake Breakfast

Plans for the coming year: We have a number of plans for the coming year and welcome new ideas from members and newcomer. A few of the goals are as follows:

We are starting to do more scientific investigation and educational outreach programs and have more participation in the Society for Armature Radio Astronomers (SARA).

In March we plan to host a SARA tour after the Spring SARA Western Conference in Boulder. We hope to have a number of papers submitted for SARA publication.

We are expanding our annual open house and other activities at the observatory site.

We plan to expand our engineering capabilities and improve receivers, position control systems, and antenna feeds.

We plan to start new projects in galactic observations, moon bounce, SETI, Communications and Armature Radio and other related engineering and science subjects.

We plan to continue our build out and improvement of the Haswell site.

In 2019 we should recruit more local college and school interest and sponsor the Primary School Regional Science Fair.

So, there is no shortage of stimulating get-togethers, projects and trips in which members can participate.

To conclude 2018 was a great year for DSES accomplishments. We would like to hear more from our members on what you would like to see done in the 2019 calendar year and welcome your participation.

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Additional Pictures of Site Activity



John and Frances Royo Participating in the discussion



Ed Corn, ready for breakfast



Group Breakfast and Comradery



Skip Crilly, Entertaining Astronomical Story Telling at Breakfast



Floyd Glick and Guest, "That is One Big Ear !"

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In the Shade of Jay Wilson's Mobile Observatory



Dave Molter Building the Bunker Retaining Wall



Bascombe Wilson Selfie



Ray Uberecken and Guests Eating Steve Plock's Brunswick Stew in the Underground.



Skip Crilly, Presentation on SETI Project



New Outhouse Building Near the Dish