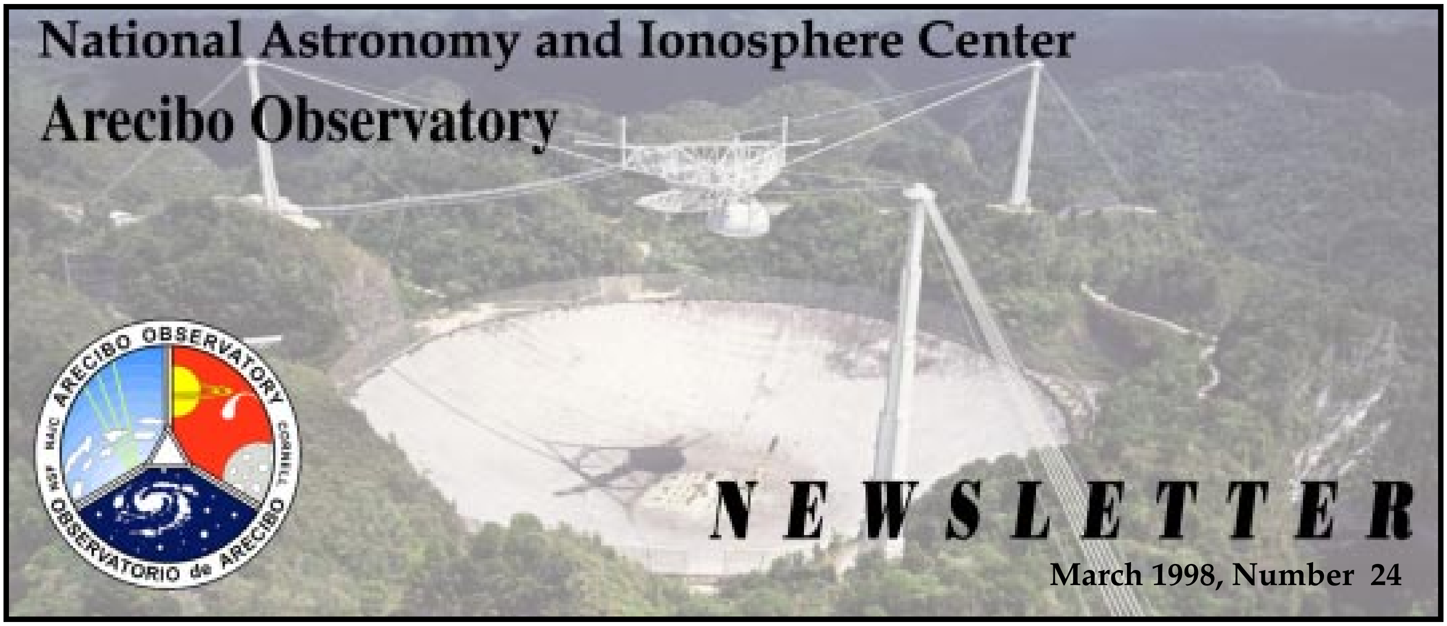

The Upgrading Project

Don Campbell

This should be the last newsletter that discusses construction activity related to the upgrading project for the telescope. Over the past several months we have been working on several alignment tasks which were either not completed by the contractor or are remedial. The shimming of the elevation rails and rack gear and the alignment of the masts and booms of the new platform tie-down system were completed last October. This allowed the platform to be lowered to close to its focal height and for some observational programs to begin. The height alignment of the azimuth rails was completed in December and preparations were begun for the difficult and time consuming tasks of adjusting the radii of the azimuth rails to their design value and centering the eight azimuth trolleys. Adjusting the radii of the azimuth rails was finished in mid-March and work on the centering of the trolleys is expected to be completed by late April.

Over the past five months the telescope has been used for a mix of commissioning activities and observations at night and on week-ends, with the alignment work taking most of the day time. Since January we have been limiting azimuth motion to about 720° per day because of concerns about stresses in the azimuth system due to the radial misalignment of the azimuth rails. Available receiving systems were the Carriage House 430 MHz line-feed system, and the 430 MHz, 1400 MHz, 2380 MHz (room temperature) and 5 GHz systems in the Gregorian Dome. Data from pointing observations, input to a pointing model, resulted in rms pointing errors at L- and S-bands of less than 7 arcsecs. Radio astronomy observations have concentrated on confirmation of

The Arecibo Observatory sodium resonance lidar's laser and telescope frame the luminous cloud from a TMA release during the Coquí II sounding rocket campaign in February-March. See the article on page 4.

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The NAIC is operated by Cornell University under a cooperative agreement with the National Science Foundation.

Photographs by Tony Acevedo.

Above and left, two views of our hard working and brave maintenance crew during the adjustment of the azimuth trolleys.

pulsar suspects from previous search observations, on pulsar timing, and on VLBI observation in conjunction with HALCA, the Japanese orbiting VLBI satellite. In atmospheric sciences, there have been a number of world day runs, observations related to the Leonid meteor shower, an ionospheric modification campaign in January using the HF Facility and 430-MHz incoherent scatter radar, and an eight week series of observations in support of a NASA rocket campaign in February and March. The S-band planetary radar system was used bistatically with the 70-m NASA/JPL Goldstone antenna in an attempt to detect Titan and two small near earth asteroids, 1997 UL and 2102 Tantalus. The first monostatic observation was in March, an attempt to detect another near earth asteroid, 1988EG.

With the completion of the alignment of the azimuth system, the telescope will return to full operation at frequencies up to S-band (2380MHz). Commissioning activities will dominate the schedule in May and, hopefully, scheduled observations will dominate it in June and thereafter. Operational receiver systems are expected to be the cooled 430MHz line-feed system of the Carriage House and cooled 430MHz, L-band and S-band systems in the Dome.

The implementation of short wavelength operation (6 cm and shorter) is dependent on more precise focusing of the telescope optics via 1) dynamic control of the height and attitude of the suspended structure using the tie-down system; 2) a small correction to the orientation of the Dome to better align the optical axis and 3) dynamic control of the tertiary reflector position. The tie-down system is currently used to set the height of the suspended structure and is close to being fully operational. Its control still needs to be integrated with the telescope's pointing system. Preparations are underway to adjust the orientation of the Dome, which was designed to allow this to be done. Dynamic control of the tertiary reflector is not essential for short wavelength operation but will make the focusing task much easier. Control of the tertiary is planned for the late summer.

Proposals & Commissioning

Daniel Altschuler & John Harmon

As reviewed in the previous article, surveying of the azimuth track and trolleys was recently completed and showed that we needed to adjust the radial alignment of both of these, simultaneously performing some modifications to the mounting of the rails. This work is already well underway, and the alignment of the rail is complete.

In addition, our initial commissioning measurements have shown that, while we are close to our design sensitivities at L- and S-band, we are presently below the anticipated efficiency at C-band. One factor contributing to this is an incorrect pitch setting for the new Gregorian dome. We have been investigating a variety of possible fixes; these include either repositioning of the tertiary reflector or installation of a modified mounting system for the dome that will allow both its pitch and roll to be adjusted. It is likely that we will implement the findings of this study to improve the dome alignment soon, although this may be deferred until the summer, to allow L-band observing to start in May. We also need to work on holding the focus of the Gregorian more accurately constant over the full elevation range. The good news from recent commissioning measurements is that the pointing of the telescope is already close to the design goal of 5 arcsec.

As soon as the alignment work is complete, the second phase of commissioning will commence and is expected to consist of about 3 weeks of measurements with the L-band, S-band and Gregorian 430-MHz receivers. Work by our staff will concentrate on measurements of pointing, and system performance, including the various backends and the new control software. We hope to begin scheduled observing in late May.

Proposals:

We received 55 proposals for the special Dec. 15, 1997 deadline and these were duly sent for refereeing. Referee comments are now in. The subsequent Feb 1, 1998, deadline yielded 28 proposals, which have gone for refereeing. In addition, we still have 40 active 430-MHz, line-feed, proposals pending from the Feb 1, 1997, deadline.

A total time request of about 2600 hours was received for the Dec 15 1997 deadline. A similar amount of time from previous deadlines are also being considered concurrently for scheduling. It is our intention to start scheduling a number of the proposals from Dec 15, 1997 and Feb1, 1997 (CH 430-MHz) deadlines as soon as possible providing as much lead time to observers as feasible given the telescope work detailed above. Any proposal originally submitted for the 430-MHz Carriage House feed can be moved to the Gregorian 430-MHz system, if so desired by the proposer; no formal resubmission or notification is required. After June 1, we will also schedule proposals from the Feb 1, 1998 deadline. After Dec. 15, 1998, we will no longer schedule the remaining Feb 1, 1997, and Dec 15, 1997, proposals. Feb 1, 1998, proposals will remain active until Feb 1, 1999.

An exception to the above timetable are Long-Term Proposals, which have their initial observations before the above cutoff dates. These can remain active for up to two years, providing a progress report is submitted to the Observatory Director prior to 10 months after the first observations. Please take this opportunity to send us your feedback which will contribute to improving our procedures.

Daniel R. Altschuler - Director: *daniel@naic.edu.*

John K. Harmon - Assistant Director: *harmon@naic.edu.*

The HF Campaign in the Winter of 1998

Mike Sulzer

This January and February was the last chance for many years to perform a winter solar minimum HF campaign and the first chance to do it with the upgraded HF facility. In these experiments we study the development of large-scale density and temperature cavities, the production of airglow, and the thermal balance of the ionosphere. The small ionospheric electron densities which occur in solar minimum winter allow the largest electron temperature enhancements and thus the best conditions for these experiments. Both the 430 MHz radar and the HF facility performed nearly flawlessly during the entire campaign which began in the second week of January and lasted until early February. Optical equipment belonging to both the observatory and visitors collected data over most of the interval.

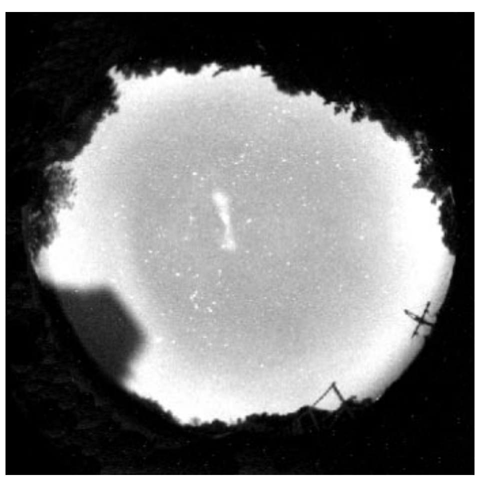


Image courtesy of Ludmilla Kagan

All-sky CCD image showing sporadic E structure in the OI (557.7 nm) airglow emission excited with the HF on 26 January, 1998.

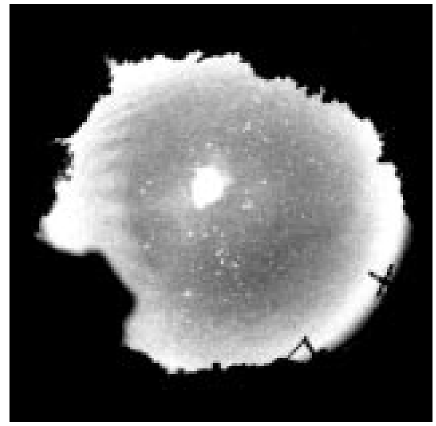


Image courtesy of Ludmilla Kagan

All-sky CCD image showing strong heater-induced enhancement and gravity wave structure in the OI (557.7 nm) airglow emission during a blanketing sporadic-E event on 22 January 1998.

The higher power of the upgraded HF facility made a big difference in these experiments. The airglow results showed the largest improvements over previous campaigns. Large red line enhancements occurred almost routinely while spectacular green line emissions occurred simultaneously with sporadic E. We now have remarkable green line images showing the striated structures which occur in the F region during illumination by the HF.

Preliminary results from these experiments and the ones from last summer will be discussed in the Santa Fe ionospheric interactions workshop which begins on April 19.

Atmospheric Sciences Highlights

Craig Tepley

Visitor and in-house initiated research in the atmospheric sciences at Arecibo gained some momentum during the last few months as we ramp up to full operation. There were two sets of World Day observations through the end of 1997. The first investigation took place between 20 and 23 October to study the dynamic effects of sub-storm related phenomena and their influence on the ionosphere over a wide range of latitudes. The second World Day experiment, a topside ionospheric run, occurred during 2-4 December, and was designed to study the distribution of light ions, such as H^+ and He^+, in the plasmasphere. For both of these observations we operated with the radar beam fixed in the vertical direction, and only during the night. Nevertheless, radar data from both experiments were of high quality and are currently being compared with similar results obtained from other incoherent scatter radar facilities.

During these two World Day periods, and for many additional days during the dark moon period in November, we also observed several airglow emissions from the upper atmosphere with our optical instrumentation. The observations consisted of thermospheric wind measurements by observing the Doppler shifts of the $O(^1D)$ 630.0 nm emission, intensity measurements of $O(^1D)$ and $O(^1S)$ at 557.7 nm using our photometers, and spectrophotometric observations the O_2 (0-1) and OH(6-2) rotational bands. Analysis of O_2 and OH emissions yield the neutral temperature of the atmosphere near approximately 95 and 85 km, respectively. For all of this time, the visiting Cornell Imager was operated remotely from Ithaca by several EE graduate students collecting interesting data on wave phenomena of the mesosphere and thermosphere.

In December, John Meriwether and his student Jonathan Wrotny of Clemson University installed a narrow field-of-view photometer in the Optical Lab. To make up for the reduced cone angle, their instrument uses a large aperture front-end provided by an 8-inch Cassegrain telescope to increase the sensitivity. This instrument is intended to be operated unattended making intensity measurements of the 630 nm oxygen line, as well as nearby OH lines from the Meinel 9-3 band. In December, this mode of operation was tested and the Clemson photometer was made ready to participate in the January 1998 heating campaign.

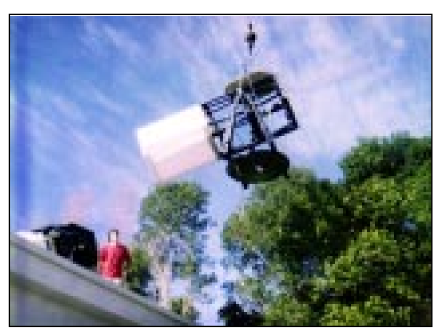
Details of the HF studies that took place during the January heating campaign were discussed by Mike Sulzer in a the previous section. Here we note the additional optical support for three of the experiments conducted by Frank Djuth (Geospace Research), Paul Bernhardt (Naval Research Lab), and Bob Kerr (Scientific Solutions Inc. and Boston University). Bernhardt fielded his own imager, and, together with Djuth for two of the studies, measured the effects on the atomic oxygen 630.0 and 557.7 nm airglow due to the presence of accelerated electrons generated by the interaction of HF radio emissions with the background ionosphere. On a few rare occasions, we observed large enhancements in the lower thermospheric "green-line" (557.7 nm) as the HF radio waves were reflected from strong sporadic layers of ionization in the vicinity of 100 km altitude (see images accompanying previous article).

For these HF experiments, we also ran the Clemson photometer (as noted above), our own photometers with high time resolution to provide calibration to the visiting instruments, and our red-line Fabry-Perot interferometer (FPI) to measure the neutral winds of the thermosphere. Bob Kerr, on the other hand, reconfigured our second FPI to observe exospheric H_α for a few nights in January. With Sixto González and Mike Sulzer, they were looking for a signature that would indicate the possible "heating" of neutral hydrogen due to resonant charge exchange with H^+ that has interacted with the HF radar energy distributed along the magnetic field lines at high altitudes.

We made a big push to observe the Leonids meteor shower in November. Several nights of radar and lidar time were allocated and additional visiting instrumentation were fielded at Arecibo. John Mathews (Penn State) and Qihou Zhou (NAIC) operated both the 430 MHz and 47 MHz radars to look for signatures of meteor trails, while Jonathan Friedman (NAIC), Steve Collins (Cornell), and Brent Grime (Penn State) used the sodium resonance lidar for the same purpose. (Due to near full moon conditions at this time, we did not use our wider-bandwidth airglow instruments.) While clear meteor signatures were observed in the radar data at both frequencies, evidence for meteor trails were not so conclusive in the lidar results. These require further inspection, and Brent Grime is performing this analysis as part of his Masters' thesis work.

In addition to the operation of the Cornell Imager mentioned above, Lyle Broadfoot, Jim Gardner, and Kalynnda Berens of Arizona State brought an imaging spectrograph to Arecibo to participate in the Leonids campaign. Due to the added convenience of more working space, they set up and operated their spectrometer from our new Lidar Lab, effectively christening the Lab with a maiden set of airglow observations before its actual dedication. Our lidars were not moved to the new lab in time for the Leonids observations, so the prize for the first set ofobservations from the lab goes to our visiting investigators. The Arizona group returned again in January to participate with Paul Bernhardt in his heating experiment.

Following the Leonids campaign, we began the big move of equipment to the Lidar Lab. Steve Collins began to work on the alexandrite laser, which had suffered badly in the not-so-friendly environs of the Grease Pit Laboratory. Nearly every optic showed signs of permanent damage due to condensation. Fortunately, the laser rods and pump chambers had spent those idle months at the factory for refabrication. By Christmas, both laser systems and their receivers were moved and becoming operational.



Lowering a lidar telescope onto the new lab.

The Coqui-II Rocket Campaign

Craig Tepley & Jonathan Friedman

Starting mid-February, the first set of rockets of the NASA/NSF Coqui-II Campaign were readied for launch from a temporary site in Vega Baja on the north coast. Eleven rockets will be launched in all, and all but one will study the turbulence and ionization layers of the lower ionosphere. One rocket will fly through our HF beam to study ionospheric "turbulence" at higher altitudes. Three launch windows are planned, and rockets will be launched in six separate salvos.

At the time of this writing we have completed the first two launch windows and only four rockets remain. The studies addressed by the first seven launches were: investigations of diffusion and turbulence near 100 km altitude, the occurrence and development of sudden atom layers, studies of the distribution of intermediate layers of ionization in the E-region ionosphere, and studies of ionospheric structure due to the interaction of the HF radar transmissions. Four rockets flew only instrumented payloads, while three released trimethyl-aluminum (TMA) which, as shown in the photo on the first page, forms a visible cloud as it burns in contact with the air. Photographic tomography, using strategically distributed ground-based cameras, is then employed to map out the upper altitude winds.

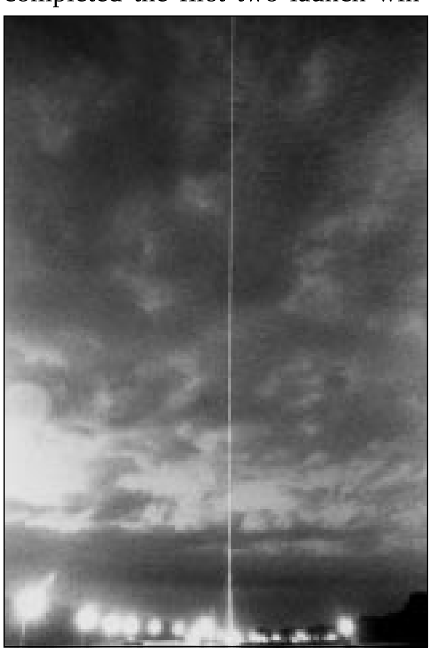


Photo by Jonathan Friedman

A time exposure of the launching of a test rocket prior to the March 11 launch of Mike Kelley's (Cornell) HF rocket.

Some 14 organizations participated in Coqui-II, including NASA, NSF, NAIC/Arecibo, the Aerospace Corporation, Clemson, Cornell, Colorado State, and Utah State Universities, the Universities of Illinois, New Hampshire, Texas/Dallas, and Puerto Rico at Mayagüez, plus the Centre National de la Recherche Scientifique (CNRS) in France. Portable radar and optical equipment were fielded throughout Puerto Rico. The University of Illinois VHF radar, fielded by Steve Franke and Erhan Kudeki, Jim Hecht's (Aerospace) imager, and Miguel Larsen's (Clemson) cameras were located at the National Guard facilities at Camp Santiago in Salinas. At another National Guard site, Fort Allen in Juana Díaz, PR, Christian Hausein of CNRS set up an HF radar to study the lower ionosphere during the launches. At the Aguadilla site of the UPR-Mayagüez/NAIC MF radar, Wes Swartz fielded the Cornell University Portable Radar Interferometer (CUPRI). Finally, Miguel Larsen set up additional cameras at Roosevelt Roads Naval Station and outside the Lidar Lab at Arecibo to triangulate on the TMA releases.

At Arecibo, we operated our 430 MHz incoherent scatter radar, Na resonance lidar, and additional optical equipment to support Coqui-II. Both radar and lidar measurements were used chiefly to establish launch criteria by examining ionospheric and neutral atom layer conditions, respectively. All radar and optical observations were also used as a diagnostic to help sort out the details of the various science objectives. For example, we are trying to understand what triggers the sudden occurrence of large enhancements in thin neutral atom layers, such as sodium or potassium, at heights where radiative (ion-electron) recombination processes are expected to be extremely slow. Lidar scatter from these neutral species, radar measurements of the background electron concentration, as well as its enhanced layers of ionization, radar and optical observations of winds (the latter through TMA or Fabry-Perot 557.7 nm observations), and in-situ rocket measurements of the chemistry and energetics, all contribute pieces to the puzzle.

Radar Astronomy

Don Campbell

The first tests of the S-band plan etary radar system were begun in late October after the lowering of the telescope's suspended structure to close to the focal height and the development of a preliminary pointing model giving approximately 15 arcsec pointing accuracy (at S-band). Initial measurements indicated a gain of about 8 K/Jy (72.4 db), approximately 1db less than the design value but significantly higher than the 6 K/Jy of the old system. The lower than expected gain is thought to be due to a slight (and correctable) mis-focusing since the gain at 1.4 GHz is close to the design value. As a test of the transmitter and antenna, bistatic observations of Titan were made on October 20-21 and 28-29 and November 2 with Arecibo transmitting and the NASA/JPL 70 m Goldstone antenna being used to receive the echo. Similar bistatic onservations of two small near earth asteroids, 1997 UR and 2102 Tantalus, were made on 30 October and 20 December, respectively. The new transmitter worked well putting out between 800 and 900 kW of S-band power. Unfortunately, it suffered an arcing problem in a klystron filament transformer during the Tantalus observations necessitating removal of the klystron from the transmitter to repair the transformer. No detections were obtained, which was not completely surprising since all three objects were very marginal targets. However, the Goldstone radar also failed to detect 1997 UR and 2102 Tantalus, indicating that at least some of these very small near earth objects are either smaller than deduced from their optical reflection properties or have very low density surfaces making them poor radar wavelength reflectors.

Over the past several months there has been a significant effort to get the new planetary radar system operational. A dual channel, cooled HEMPT front end amplifying system has been built and was installed in early April. The phase centers of the separate transmitter and receiver horns are only 16 inches apart so there was considerable concern about coupling transmitter power into the receivers. Measurements of the coupling gave -73 db, a very high isolation but not quite enough to protect against the 1 MW transmitter power. A remotely controlled mechanical shutter to cover the mouth of the receive horn and interlocked with the transmitter's RF drive signal was constructed at NAIC's Ithaca laboratory. The shutter provides -57 db of additional isolation.

Full computer control of the system has always been one of the design goals. This is especially important for observations of near earth asteroids or comets where the round trip light time is less than one minute. Automatic transmit/receive switching requires control of the pointing, the turret floor to change horns, the shutter over the receive horn, the transmitter drive signal, the time reference of any transmitter modulation signal, Doppler shifting of the transmitted signal or the receiver local oscillator, and data acquisition. With the exception of final tests on the new 20 MHz bandwidth radar

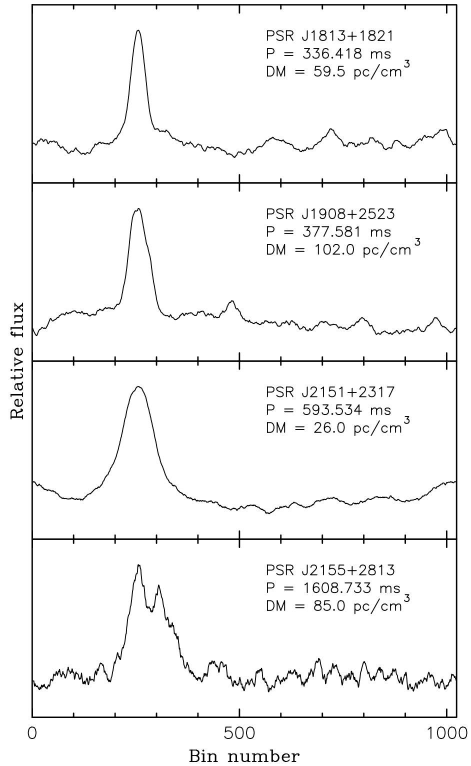


Fig. 1: The 430-MHz pulse profiles of 4 of the pulsars discovered from the PSU/NRL upgrade drift search. (Courtesy of Alex Wolszczan).

decoder, all of these systems have been tested and we are in the process of integrating their control. The next set of observations are planned for May when much of the system should be fully operational.

Radio Astronomy Highlights

Kiriaki Xilouris & Chris Salter

The Arecibo telescope recovered full tracking in early October 1997, marking the beginning of the post-upgrade recommissioning phase. On November 7th, 1997, following the establishment of satisfactory pointing models for both the Gregorian Dome and Carriage House by NAIC staff, the first post-upgrade external astronomy users were scheduled. The projects performed to date have all been in the pulsar subfield, and have included the confirmation of candidates found during the upgrade drift-scan (and other) pulsar searches, timing measurements, and high time resolution pulsar studies.

A number of groups have attempted confirmation of candidates from their respec-

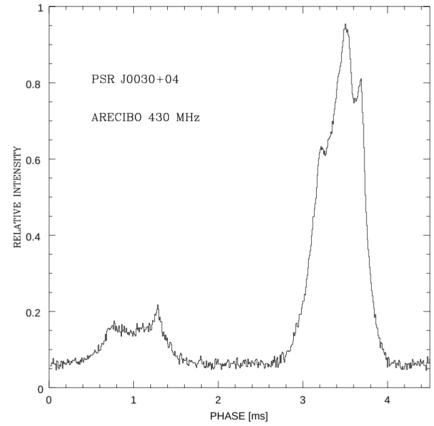


Fig. 2: The 430-MHz pulse profile of the 4.8-millisecond period pulsar, PSR J0030+0454, discovered from the Berkeley/Cornell upgrade drift search. (Courtesy Don Backer).

tive upgrade drift-scan pulsar searches. Most used the Penn State Pulsar Machine (PSPM), made available as a User Owned Public Access Instrument by Alex Wolszczan (Penn State). The PSPM is a 2 x 128 x 60-kHz filter-bank, and in search mode samples the data at 80 microsec intervals. Wolszczan himself succeeded in confirming 5 new pulsars from the PSU/NRL search (see Fig. 1). Likewise, Andrea Somer and Don Backer (Berkeley) confirmed a further 3 objects (PSRs J0030+0454, J0711+0933, and J1312+0932) using the candidate list assembled by Alex Zepka (Hitachi) from an analysis of the data from the Berkeley/Cornell search. Of these objects, J0030+0454 has a 4.8-millisecond rotation period (Fig. 2). A further 21 candidates were also

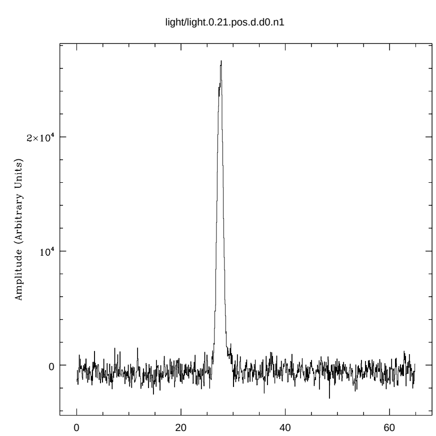


Fig. 3: The 430-MHz pulse profile of the 65-millisecond period pulsar discovered from the Caltech intermediate-latitude search. (Courtesy of Stuart Anderson).

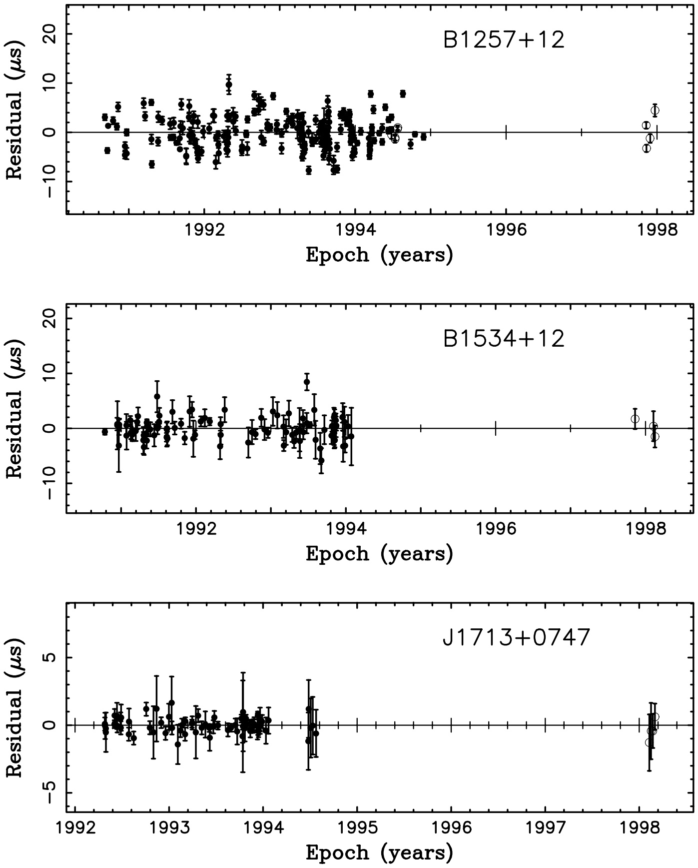


Fig. 4: Pre- and post-upgrade pulsar timing residuals for three "classic" millisecond pulsars. Excellent agreement is found between the post-upgrade pulse arrival times, and the expectations from pre-upgrade ephemerides. (Courtesy of Alex Wolszczan).

observed by these same observers, and analysis is proceeding for these. In addition, Xilouris (NAIC) and Andy Fruchter (STScI) took data on 10 candidates from the STScI/NAIC upgrade drift-scan search. It is estimated that the present total of confirmed pulsars resulting from the upgrade drift-scan searches now stands at 67, with many more discoveries expected over the coming months.

The primary 430-MHz drift-scan pulsar searches themselves received no observing time between early October and December 22nd, 1997. Nevertheless, due to on-going upgrade-related engineering work, search data with the PSPM were acquired on 47 days between December 22nd and March 8th, 1998. Much of this data was essentially radio-frequency interference free. During these measurements, the Carriage-House pointing was good to better than 30 arcsec. The upgrade searches have now completed coverage of over 70% of the Arecibo sky. Stuart Anderson and Rick Jenet (Caltech) have confirmed a bright new 65-msec pulsar (Fig. 3), plus five slower pulsars, found from the records of the pre-upgrade Caltech intermediate-latitude survey. Also within the classification of pulsar search, in this case via a post-upgrade proposal, Xilouris used full tracking to place stringent upper limits on the flux density of the Geminga X-ray pulsar at 47 and 430 MHz. These limits are of especial importance in view of recent claims of a detection of this object near 100 MHz by Russian astronomers. Previous to these measurements, the 47-MHz system had been completely revamped by obsevatory technicians Antonio Nolla and José Rosa, in collaboration with Xilouris. Finally, Jim Cordes and Zaven Arzoumanian (Cornell) acquired data on 12 candidates from the pre-upgrade piggyback pulsar search using the recently commissioned Arecibo Observatory Fourier Transform Machine (AOFTM; see AOFTM article in this issue) as backend.

Post-upgrade pulsar timing has been initiated by several teams, with observations being undertaken both from the Carriage House at 430 MHz, and from the Gregorian Dome at 430 MHz and L-band. In November 1997, Wolszczan timed three pulsars which had been regular timing targets before the upgrade, finding excellent agreement between the measured pulse arrival times and the values extrapolated from pre-upgrade ephemerides (Fig. 4). Included among these was PSR B1257+12, the pulsar with its own planetary system. Wolszczan and Anderson found similar good agreement between the new observations and the existing ephemeris for the 4.6-msec pulsar, PSR J1709+23, discovered in the early days of the PSU/NRL drift-scan search. They also confirmed the 23-day binary-orbit model derived previously for this object. These observers used the PSPM in timing mode. With its user-friendly interface developed by Anderson and Brian Cadwell (NRL), this machine makes for simplicity in observing sessions, irrespective of whether these are local or remote.

Somer and Backer used the Arecibo-Berkeley Pulsar Processor (ABPP) to refine period parameters and determine accurate dispersion measures for the three newly discovered pulsars from the Berkeley/Cornell drift-scan search, (see above). Their preliminary conclusion concerning the new millisecond pulsar, J0030+0454, based on its apparent negative period derivative, is that the pulsar is in a long-period binary system. A recent complementary VLA observation determined astrometric parameters for J0030+0454. Observations of PSR J0631+1036 indicated that the pre-upgrade timing model is still accurate. Their observations used a combination of the 430-MHz Carriage-House receiver and 1400- and 1660-MHz tunings of the L-band receiver in the Gregorian dome. Although monitor and control of the telescope, receiver and ABPP are still under development, the observations were straightforward, highly successful and demonstrated the agility of the "new" telescope and associated hardware for pulsar research (Fig. 5). The ABPP is a 32-channel, coherent-dispersion-removal, integrating backend for precision timing and polarimetry. Channel bandwidth is selected based on dispersion over a range from 4 MHz down to 0.125 MHz in steps of "root two". If you are interested in use of this system please contact Don Backer at:

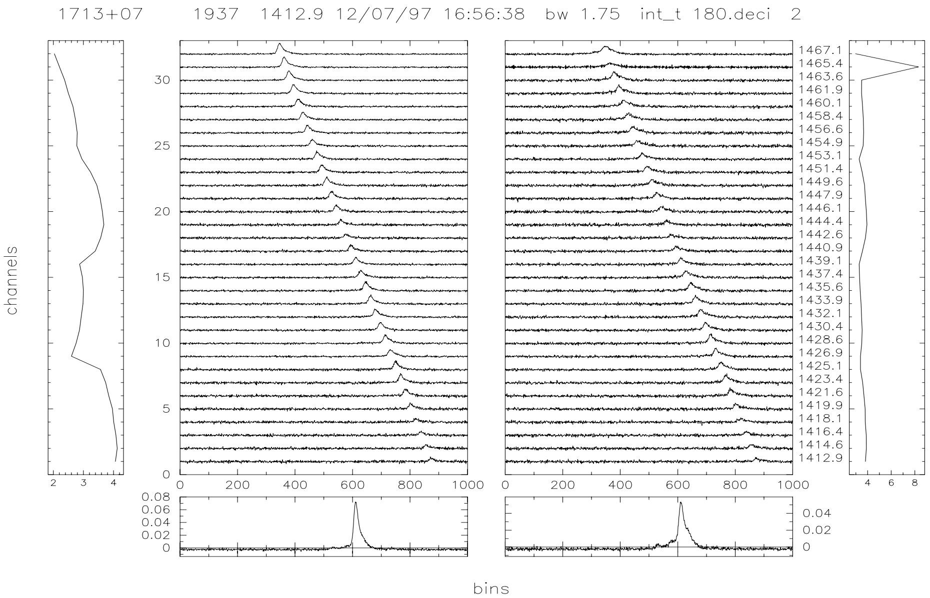


Fig. 5: An L-band integration on PSR J1713+0747 using the Arecibo-Berkeley Pulsar Processor (ABPP). (Courtesy Don Backer).

dbacker@astro.berkeley.edu
and look at:
http://astro.berkeley.edu/~mpulsar.

The Caltech pulsar group has successfully installed, and started regular timing observations with, the Caltech Baseband Recorder (CBR). This instrument is capable of sustained dual-polarization 10-MHz, 2-bit, baseband observations. Based on a fast flexible digitizer board, observations at twice this bandwidth or with 4-bits are possible for up to 20 minutes until the disk storage fills up. The recording system is based on a SUN workstation with a set of disk drives to buffer the data prior to writing to 2 DLT-7000 tape drives. The data acquisition software has been written to accommodate variable numbers of disks and tape drives to allow increased bandwidth observations as faster recording technology becomes available. In addition, the acquisition software de-stripes the data as it is transferred from disk to tape to allow for off-line analysis of the data on systems which have only a single tape drive. Based on the same data acquisition and monitoring software as the PSPM, the operation of the CBR allows for real-time diagnostics and remote monitoring.

The Caltech pulsar group, in collaboration with the group at Berkeley, has also installed the first 50% of a wide-bandwidth digital filter-bank — the Berkeley Arecibo Caltech Swift Pulsar Instrument (BACSPIN). Based on the same hardware as a similar instrument running at Nancay (the NBPP), this instrument will be capable of ~200-MHz bandwidth observations when installation is completed in the spring of 1998. Both BACSPIN and the CBR are hosted by the same Sun computer and are capable of acquiring data simultaneously. It is planned to tightly couple these two instruments in the future. For example, it should be possible to use the real-time broadband capabilities of BACSPIN to steer the CBR to record only the bright scintillation peaks of a given pulsar. For plots of the "first noise" observations with the CBR and BACSPIN, see:
http://www.srl.caltech.edu/personnel/sba/instruments/pulsar.

Late last year, Ingrid Stairs (Princeton) re-installed the Princeton Mk-IV pulsar backend at Arecibo, following the machine's extended stay at Jodrell Bank. The Mk-IV is designed to increase pulsar timing precision by implementing the technique of coherent dedispersion in software over large bandwidths. A fast analog-to-digital converter samples quadrature components of the received voltages in two orthogonal polarization channels, allowing 10-MHz bandwidth with 2-bit sampling or 5-MHz bandwidth with 4-bit sampling, and producing a continuous throughput of 10 MB/s. The resulting data stream passes through a SPARC-20 computer, on to DLT-7000 tape drives and/or a 108-GB disk array. Data analysis is performed off-line by a fast (1.25-Gflop) parallel processor. The effects of dispersion are removed by filtering the data time-series with the inverse of the interstellar medium "chirp function". Cross-products are formed from the dedispersed signals, and then can be folded modulo the pulse period. In this fashion, full Stokes parameters are obtained for every observation. Narrow-band radio-frequency interference can be excised as part of the coherent signal-process-

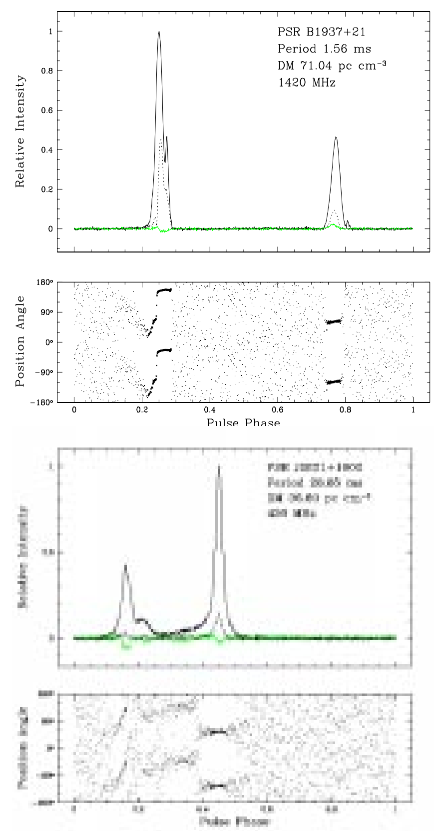


Fig. 6: Full-polarization pulse profiles for PSR B1937+21 at 1420 MHz (top), and PSR J0621+1002 at 430 MHz (bottom). The upper panels show total intensity (heavy solid line), linear polarization percentage (dotted line), and circular polarization percentage (light solid line), while polarization position angles are shown in the lower panels. The data were taken with the Princeton Mk-IV backend. (Courtesy Ingrid Stairs).

ing task, while time segments contaminated by broad-band noise are deleted. Preliminary results from the Mk-IV include L-band observations of the fastest millisecond pulsar, PSR B1937+21, yielding timing uncertainties of less than one-fifth of a microsecond, (a full-polarization pulse profile from these 1420-MHz observations is shown in Fig. 6 top) and observations of PSR J0621+1002, a neutron star-white dwarf binary pulsar discovered by the Princeton group during their upgrade survey (a 430-MHz profile is shown in Fig. 6 bottom). Princeton timing work will initially be centered on "shaking down" the new instrumentation and connecting new observations to pulse-timing models developed before the upgrade.

A unique development was pioneered recently by Xilouris and Bill Sisk (NAIC). It is now possible for the different pulsar research groups to tap off of the same I.F. during observations, using as many as five independent backends to collect data simultaneously. This provides remarkable potential for collaboration between observers. In early 1998, a consortium of observers from Berkeley, Caltech, Jodrell Bank, MIT, NRL, Penn State, and Princeton began regular timing observation of standard millisecond pulsars. To date (March 29th), six sessions, spaced roughly weekly, have been observed, the data being taken by Xilouris. This has covered some half a dozen targets, using 4 or 5 separate pulsar backends. The initial results indicate that the timing residuals achieved at L-band by the various backends are unprecedentedly small, the many innovations in data-taking hardware providing significant improvements over the system available pre-upgrade. This, plus the excellent signal-to-noise already achieved at L-band, allows timing residuals below 100 nanoseconds, an accuracy that opens new scientific horizons to pulsar timing. Such observations provide an extremely powerful tool when searching for pulsar companions with masses as low as asteroids, can probe the differential acceleration caused by the Galactic disk, yield sensitive measures of the structure of the interstellar gas, and approach the precision needed to study long-period gravitational waves.

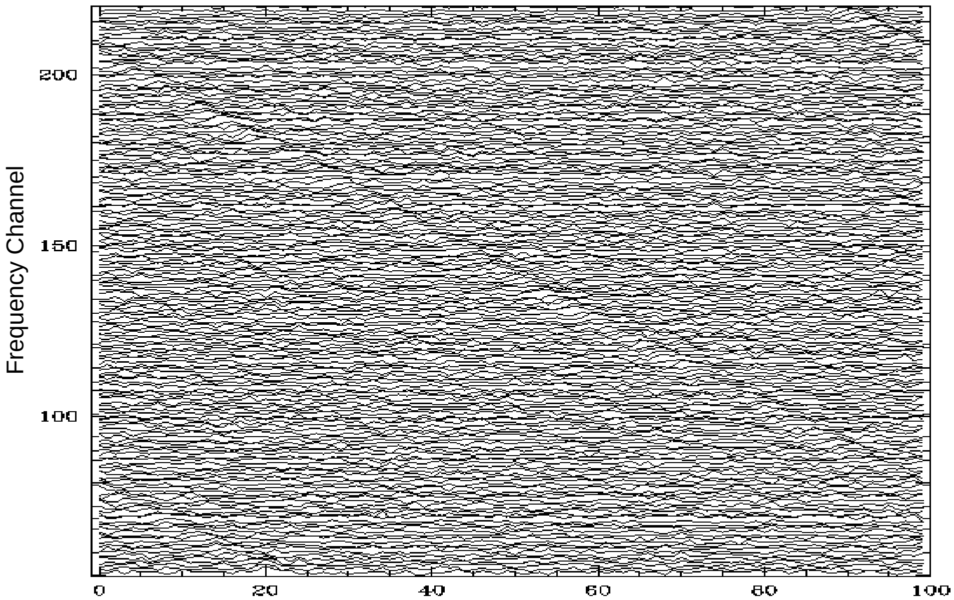


Fig 7: The dynamic spectrum of PSR B0834+06 at 47 MHz made with the AOFTM. The folded pulsar profile is analyzed into 165 frequency channels. The observing parameters were: dt=0.1024 ms, p=1273.67259 ms, total time=599 s, bw=1.830859 MHz.

In addition, coordinated timing measurements using the different pulsar backends that share the Arecibo I.F. help determine the role that instrumentation plays in delimiting the timing precision at the sub-microsecond level. Further, it is now possible to switch between 430 and 1420 MHz in about 30 seconds, which can be used to yield sensitive measures of the structure of the interstellar gas, and also permit the removal of interstellar effects from timing.

The Arecibo Observatory Fourier Transform Machine — (AOFTM) — An NAIC Facility Pulsar Backend.

Zaven Arzoumanian, Maura McLaughlin, Jim M. Cordes (Cornell)

The Arecibo Observatory Fourier Trans form Machine (AOFTM) is a new NAIC facility instrument, ideally suited for pulsar-search and single-pulse studies. Shake-down and testing of the 10-MHz, 1024-channel, Fourier transform spectrometer is nearly complete, as is the web-based documentation for the hardware and data-acquisition control software. Quick-look and data-handling software are also provided. The spectrometer and sampling system allow useful trade-offs between channelization and time resolution — the default configuration is for 1024 channels and 102.4 μs sampling (2 bits), yielding a maximum data rate of 2.5 MB/sec. The shortest available sample interval, for 16 channels across 10 MHz, is 16 microsec. Data output options include a 9-GB disk (capacity limited to 50 minutes of observations at the full data rate), standard 8mm "Exabyte" tape (limited to maximum data rates of 0.5 MB/sec), or 8mm Exabyte "Mammoth" tape, the storage medium of choice for full-data-rate applications with the AOFTM. The AOFTM's features will significantly improve search sensitivity to fast, highly-dispersed pulsars over that attainable with existing data-acquisition systems at Arecibo. For a description of the expected gains in sensitivity, visit:
http://www.naic.edu/~aoftm/sensitivity.html.
For single-pulse studies, the AOFTM provides good dynamic range through 8-bit sampling in 256 channels over 2.5 MHz.

During test observations through December 1997, nine known pulsars were successfully observed at three frequencies (47, 430 and 1420 MHz). For an example of a dynamic spectrum of pulsar PSR B0834+06 made at the very-low frequency of 47 MHz via the AOFTM (see Fig. 7). A set of summary pulse profiles can be viewed at:

http://www.naic.edu/~aoftm/detections.html.
In addition to the pulsars displayed there, the pulsars B0301+19, B0823+26, and B0919+06 were detected at 430 MHz; these objects are sufficiently bright that observations made with 2-bit sampling in 10-kHz channels suffer from saturation. Remaining work includes testing the timing properties of integrations triggered by the Observatory 10-sec tick and improving real-time diagnostic output.

Receiver Status and Plans
Paul Goldsmith

The past few months have been a somewhat difficult time as we struggle to get receivers installed and calibrated. A great deal of work has gone on which should bear fruit in the near future.

The Gregorian and CH 430 MHz systems have been working quite steadily, and used extensively for pulsar timing and atmospheric radar work.

The 610 MHz system has been equipped with fairly narrow band filters defining the protected frequency band of only 6 MHz width, and excluding nearby harmful TV stations. The calibration system has also been assembled, and the whole system should be reinstalled before the end of March.

The L-narrow (1.3 - 1.45 GHz) system has been on the telescope, and used for pulsar observations. The L-wide system (1.15 - 1.75 GHz) is having a number of minor problems worked on. Both the system noise calibration and relative phase adjustment of the two channels will be carefully completed before it is reinstalled in the Gregorian. We have had a second L-band feedhorn built, which has just arrived in Arecibo. This will allow installation of BOTH L-band systems, and comparisons for use with RFI excision and other possible applications can be made. It is possible that we can operate both systems simultaneously, although the exact routing through the IF/LO system needs to be checked out. In any event, we do anticipate that we will be in a good position to support L-band operations both for on-going pulsar work and for spectroscopy.

A new S-band radar receiver has been assembled. It uses a turnstile junction, so its bandwidth is limited to about 100 MHz. It incorporates HEMT amplifiers, and although there is a stability problem with one channel, it is expected that this will have a straightforward cure. This system is expected to replace the maser amplifier previously used in this application.

The broadband S-band system is being completed in Ithaca. Circulators have been received that should ensure stable performance. A feedhorn has been fabricated. The newest member of our engineering staff, Donna Kubik, is working for the time being in Ithaca. She will work with Gene Lauria to complete the assembly and test of this system.

The 4-6 GHz C-band system has been reinstalled in the Gregorian. We expect to use it to make system tests in the months ahead.

A detailed analysis of the "suckout" in the 8-10 GHz receiver has been completed by Gene Lauria, and remedied by some remachining. When time and weather in Ithaca permit, this system will be retested.

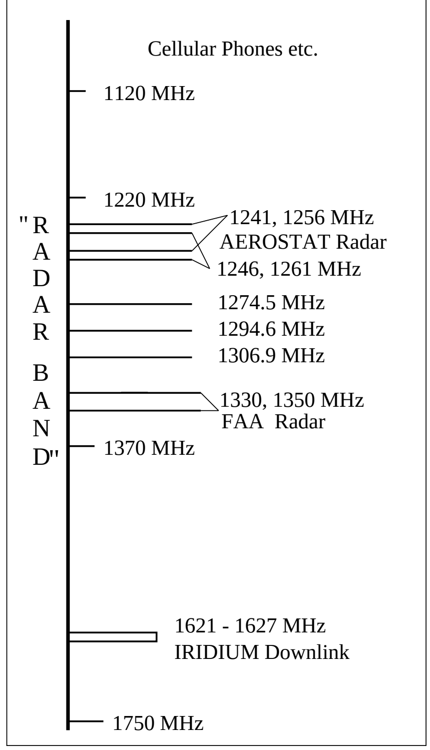
Other Efforts
Professor Jim Breakall from Penn State University is spending a sabbatical semester at Arecibo. He is working on different broadband feed designs for relatively low frequency systems (below 1.5 GHz) for the Gregorian. These may be useful for a system in the 327 MHz band and possibly for multi-frequency pulsar receiver systems down the road.

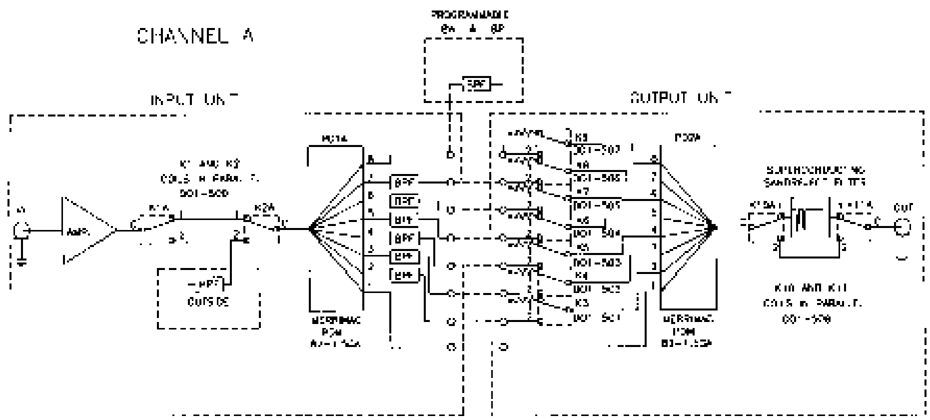
Innovative Filter Design Protects L-band Observations
Robert Zimmermann & Tapasi Ghosh

Radio astronomy observations are becoming increasingly difficult in a world of *global communication*. While the telescope itself must be sensitive to incredibly weak signals from other galaxies, it must also be able to withstand simultaneous strong earth based signals, often on adjacent signal channels! Such is the case for Arecibo L-band observations.

The new wide-band L-band receiver (L-wide) can cover a frequency range of about 1.0-1.9 GHz, albeit with slight degradation of the system performance towards the band edges. However, there are many other active spectrum-users in this range whose radiation field at the Observatory can cause gain-compression in the RF post-amplifiers of this receiver. From our round-the-clock, hill-top spectrum monitoring, and also from data gathered through the receiver in the Gregorian dome, it was indeed confirmed to be so. The elec-

L-band EM Environment at AO
(Schematic diagram)





Schematic diagram of L-Band filter bank.

tromagnetic environment at the Observatory within this range of frequencies can be schematically represented as shown in the L-band Environment figure, where ONLY the very strong radar/radio transmitters are marked.

In order to be able to use most of this wide frequency range, an innovative computer-controlled filter-bank system, plus a programable radar blanker are currently under construction.

A schematic diagram of the filter-bank circuitry is shown above. The radar blanker will be described in a future issue.

The filter bank will be located immediately following the cooled RF amplifiers and before the post RF amplifiers. The present status of various filters consituting the filter-bank is :

Catagory A

1. HPF1: 1370 MHz and above (wave guide filter); in place.
2. HPF2: 1640 MHz and above (wave guide); under construction.
3. HPF3: 1320 MHz and above (wave guide); available soon (this option may have to be used in conjuction with the radar blanker, blanking the two FAA radars at 1330 and 1350 MHz).
4. BPF1: 1150-1750 MHz; in place.
5. BPF2: 1120-1220 MHz; ordered.

Catagory B **-** Filters covering 1220 - 1320 MHz (radar) band: For these, the possibilities are:

1. A number of Band-pass filters of 25 MHz bandwidth, covering the above range, along with the radar blanker, called into action for blanking the approriate radars within the pass-band.

2. A bandpass filter similar to BPF2, but covering 1120-1265 MHz. This way, 1220-1265 MHz will be useable in conjuction with the blanker being used for just the two aerostat radars. However, this will also mean that 1265-1320 MHz will be very difficult to use, where one would need to employ the full potential of the newly designed blanker and might lose a lot of time to blanking.

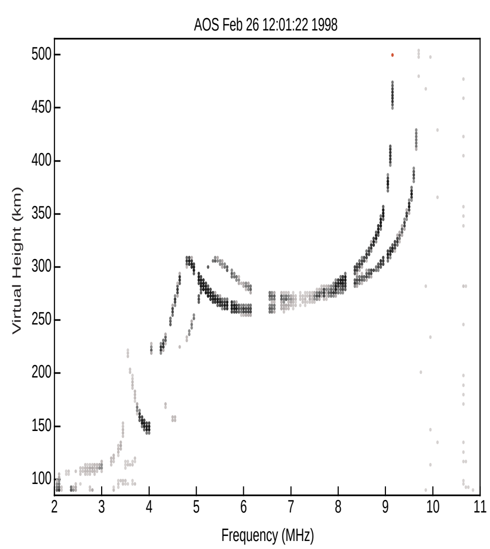


Fig. 8: A typical ionogram from our new sounder.

Catagory C **-** Special filter:

1. Superconducting band-reject filter to remove IRIDIUM down-link, between 1621.35-1626.5 MHz:
   The prototype filter, already tested at Superconductor Technologies, provides 55 dB suppression over this range, with much less than 1 dB loss in the radio astronomy band. It operates in a 70 K dewar.

We hope that this gives the users an opportunity to gather reasonably clean L-band data where software techniques can thereafter be applied to extract the cosmic signal.

The New Ionosonde Antenna

Robert Zimmermann

The Observatory's digital ionosonde has a new log-periodic antenna. Supported from a 30 meter tower, it provides a vertical gain of about 6 dB, allowing "textbook style" ionograms to be made under virtually any atmospheric conditions (see Fig. 8). The data is routinely used by the ionospheric group to support 430 MHz incoherent scatter radar observations. Also, the ionospheric information is used by radio astronomers to determine the anticipated "Faraday rotation" of linearly polarized signals within the ionosphere.

The antenna is actually a dual orthogonal log-periodic dipole array, designed and built by Penn State graduate student Nathan Miller under the guidance of Professor Jim Breakall. The ionosonde uses one of the antennas as a transmitting antenna, with the second to receive the signal reflected from the ionosphere (functioning like a small bistatic radar station).

The new facility saw its "first use" during the COQUI-II sounding rocket campaign. The rocket launching criteria were specified in terms of particular ionospheric conditions, in the diagnosis of which the ionosonde played an important role.

AO Computing News

Arun Venkatraman

Observers in the re-arranged Control Room will use a Sun UltraSPARC 170 workstation with 20" monitor, connected to the data acquisition ethernet and to the observatory fileserver over a new Fast ethernet link. A second workstation is available nearby for a co-observer. The UltraSPARC has over 20 GB disk for temporary data storage during experiments. Data will be periodically moved to the fileserver over the fast ethernet, and can also be backed up to a local 8mm tape drive.

Realtime displays in the Control Room include :

1. telescope pointing, status and other relevant information,
2. drive system and receiver status and,
3. real-time telescope data.

The User Interface for radio astronomy is based on the ADAM (Arecibo Data Acquisition and Monitoring) language specification. Although originally specified as a command-line system, the language now supports a graphical interface which simplifies common tasks via point-and-click widgets (the command-line interface is also available). Observers may use their own catalogs of sources formatted as described in the ADAM manual. The Observatory currently provides a standard source catalog, a standard line frequency catalog and a pulsar catalog. The experiment setup facility includes front-end (receiver selection, IF system configuration, selection of noise sources for calibration, Doppler correction), back-end (Continuum, Spectral Line, Pulsar, VLBI), procedures (position or frequency switching, mapping, simple on-offs, pointing checks, etc.), and utilities (catalog browser, file import). Observing files may be created in the ADAM language off-line, using either the graphical interface or a text editor. The run-time facility permits observing files to be queued while being edited.

A standard scheme to support visitor-supplied back-ends, including telescope status reporting and time synchronization tools, is under development.

Most observatory data will be taken on 8-mm tape media, although a 4-mm drive is available off-line to make copies. The 8-mm drive lineup includes Exabyte Mammoth (20 GB capacity) for data-intensive experiments. As in the past, tape cartridges assigned to observing projects are given AO numbers and remain at the Observatory, although visitors may copy the data to take with them. The Observatory's ANALYZ program (aged 20-something and still vigorous) is currently used for monitoring and displaying incoming telescope data. Limited support via a common file format is planned for other packages, including CLASS, Single Dish AIPS(++) and IRAF. The commercial packages IDL (from Research Systems Inc.) and MATLAB (from The Math Works Inc.) are already supported on the Observatory network, although no analysis software subsystem at the AO is based on them.

With the recent acquisition of 15 Sun UltraSPARC systems including an Ultra 30, the AO is equipped to handle computing tasks requiring 5-10 times more CPU speed and storage capability than provided by the previous generation of desktops. We look forward to new results from more sophisticated fitting techniques, longer FFTs and faster searches!

Coordination Agreement between NAIC and Motorola-IRIDIUM

Tapasi Ghosh

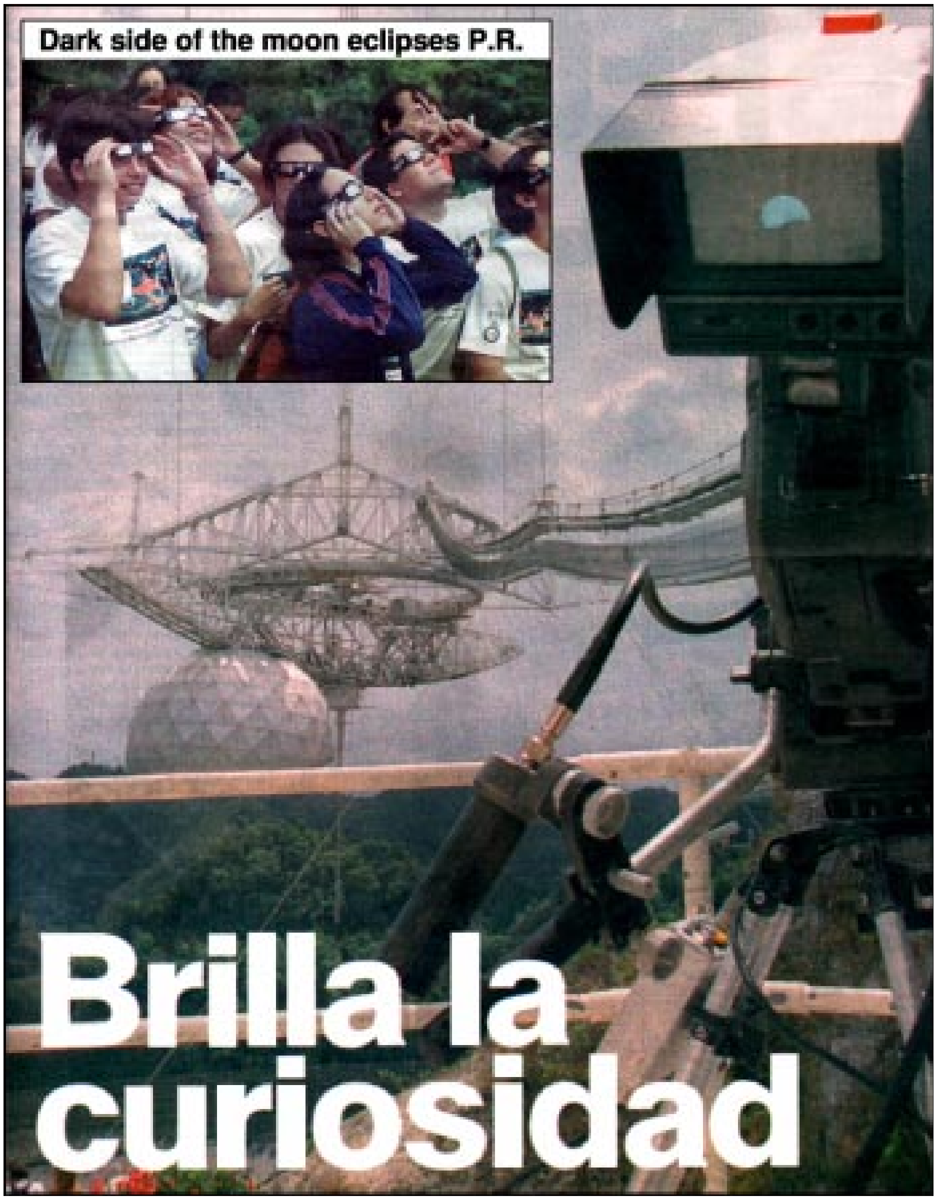
The National Astronomy and Ionosphere Center, which operates the Arecibo Radio Telescope, and Motorola Inc., which operates the IRIDIUM satellite system, have signed a Coordination Agreement between the IRIDIUM system and the Arecibo Observatory. The Agreement addresses potential interference produced by the communication satellite system with observations of the astronomically important 1612 MHz line of the OH molecule in the 1610.6 - 1613.8 MHz band. The Agreement guarantees that :

(a) during scheduled observations in this band, between 10 pm and 6 am Miami local time, IRIDIUM's out-of-band emission will be below the -238 dBW/m^2/Hz. level for all seven days of the week,

(b) during day time, up to 8 passes per year will be available for observations defined as targets of opportunity that could not be observed using a blanker provided by IRIDIUM. Such objects includes comets, supernovae and other celestial objects that are of unknown nature as yet.

We congratulate Drs. Willem Baan, Mike Davis, Paul Goldsmith, Thomas Gergely (of NSF) and Atty. Paul Feldman (Fletcher, Heald & Hildreth, P.L.C.), for this successful outcome of their persistent efforts in this negotiation process spread over several years. The major achievement for the astronomy community has been the inclusion of the level below which IRIDIUM has agreed to restrain their out-of-band emission. However, in order to perform observations outside the 8 hours at night, NAIC will have to install very expensive superconducting band-reject filter so that the effect of the downlink can be suppressed to a tolerable level at all times.

Nevertheless, Radio astronomers at NAIC are pleased that, after many years of effort, the ability to carry out this type of observation fully exploiting the unique sensitivity of the newly-upgraded Arecibo telescope will be guaranteed. At the final stage, the negotiations were facilitated by representatives of the Federal Communications Communication (FCC), the National Telecommunications and Information Administration (NTIA). NAIC is thankful to them.



Cover page of "El Nuevo Día" for February 27, 1998. It featured a photo of the activities at the Visitor Center titled, "Curiosity shines". We have inserted another photo which appeared in the San Juan Star of the same day.

The discussions during the long negotiating process have resulted in an increased awareness on the part of both radio astronomers and communications engineers of the need to coordinate spectrum usage very carefully. In particular, the placement in frequency of the satellite down link bands needs to be carefully evaluated.

Arecibo Observatory/Angel Ramos Foundation Visitor Center celebrates one year

Daniel R. Altschuler and José L. Alonso

Although it seems as if it were inaugurated yesterday, we recently celebrated the first year of operations of the Arecibo Observatory/Angel Ramos Foundation Visitor Center. It has been by all measures a very successful year surpassing by far our expectations. The number of yearly visitors has more than tripled, reaching over 125,000 for this first year, about one third of these being school children. Of greater importance is the fact that feedback from visitors indicates great satisfaction with their experiences. Many have written letters expressing their appreciation for the Observatory in respect to the educational work we are engaged in.

Improvements have already been made, including a new pedestrian access road with two shelters, a picnic area, a CCTV security system and a very popular hotdog cart. A new vehicle has also been purchased for the center.

With the new facility and its related human resources, we are now able to schedule 10-12 school groups per week, almost three times what was previously possible. More important is the fact that the visiting public, teachers, and students in particular are exposed to an active learning experience, making AOVEF a valuable teaching resource. Over 500 schools from all over Puerto Rico visited during this first year.

A collaborative program between the Arecibo Observatory and the Arecibo Campus of the University of Puerto Rico allows science majors from the campus to be selected as Visitor Center tour guides. A group of 13 students were selected to work during this first year and we are currently interviewing a group of twenty new students. Participants receive on-site training about observatory operations, including technical aspects of the telescope and its related science.

During the summer, a *teacher in residence* developed a "School Visit Guide" which includes a set of key questions related to every exhibit, and the connections between the subject matter presented and the actual school curriculum. This guide helps teachers organize their school group visit to the Observatory more effectively.

The Visitor Center became a focal point during the February 26 partial solar eclipse and was visited by a large number of groups which participated in eclipse tours. During the eclipse, it was the source of live images transmitted by a local TV station. Over the year, the visitor center auditorium has been used for teacher workshops, press conferences, special lectures for visiting groups, and scientific symposia. In early April of 1998 we hosted a one day session (out of seven) of the "Tropical Workshop on Particle Physics and Cosmology" organized by the University of Puerto Rico, Rio Piedras. About 100 participants from outside Puerto Rico attended this meeting which featured lectures by over twenty speakers including Nobel Prize laureates Joseph Taylor and Sheldon Glashow.

We are pleased with our first year of operations and look forward to an equally fruitful second year.

(The May issue of Sky & Telescope will feature a nice article on our Visitor Center. - The Editors)

Comings and Goings

Hasta Luego, Willem

Chris Salter

After spending 15 years at Arecibo Willem Baan is leaving our group of staff scientists. Willem, a Senior Research Associate with NAIC, departed for Dwingeloo in the Netherlands at the end of January. There he takes up the position of Director of the Westerbork Synthesis Radio Telescope (WSRT). Great responsibilities await him in this job as Dwingeloo moves into a period of reorganization, and the WSRT emerges from its own upgrade.

Originally, Willem came to astronomy by a somewhat indirect route, having a degree in Engineering from the University of Delft. He then moved to the USA, and into astronomy, receiving both his M.Sc. and Ph.D. degrees from MIT. Following spells with the Institute for Advanced Study, Princeton, and Penn State, he joined the Radio Astronomy staff at Arecibo in September 1983. Whilst at Penn State, Willem had already used the 305-m telescope to detect the first OH "megamaser", in the form of broad-line OH emission from the starburst galaxy, Arp 220. Today, over 50 OH megamaser, and even gigamaser, galaxies are known, many discovered by Willem and his collaborators. These include the most distant example, IRAS 14070+0525 at z = 0.265, discovered at Arecibo in 1991. He was also responsible for showing that within the standard model of OH megamasers, with low-gain amplification occurring in a molecular disc around the galactic nucleus, the gas is pumped by far-infrared radiation and amplifies the nuclear continuum emission. Willem also established an additional member of the "maser zoo" when he identified the first extragalactic formaldehyde masers in NGC253 and Arp 220, later adding further examples through his Arecibo observations with the mini-Gregorian. Apart from his main field of maser emission from galaxies, Willem has shown his wider breadth of interest via his many other investigations of dense molecular gas in galactic nuclei, this aspect being exemplified by his excellent review of the subject (with Christian Henkel and Reiner Mauersberger); a 1991 publication in "A&A Review". He is also active in the study of galactic masers.

The name "Willem Baan" is also synonymous with the radio-astronomers' fight against the inroads of radio frequency interference (RFI). He is presently the Chairman of IUCAF, the Inter-Union Commission on Frequency Allocations for Radio Astronomy and Space Science, and therefore an ex-officio member of CORF (the U.S. Committee on Radio Frequencies). He also serves as a member of the Working Group 7D of the Radio Communication Sector of the ITU, takes an active part in both ITU-R Study Groups 1 (spectrum management) and 7 (science services), and protects radio astronomy's interests at ITU-R World Radiocommunication Conferences (WRCs).

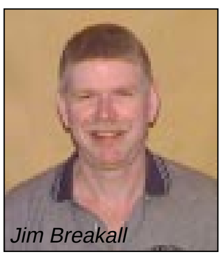
On a more local level, Willem has been involved in RFI work at Arecibo for many years. Apart from an array of individual successes during this time, he also took a major hand in establishing the Puerto Rico Spectrum Users Group (PRSUG). In Arecibo, his name will always be inseparable from the establishment of the recently implemented Puerto Rican Coordination Zone (PRCZ), through which a new license seeker intending to operate on the island below 15 GHz is required to present a copy of the technical details of his application to NAIC, who then have 20 days to consider the potential of such a system for interfering with observatory operations and to work out a mutually acceptable solution. (In cases of dispute, the FCC reserves the right to either withhold or grant the relevant licenses.) The setting up the PRCZ will certainly be of great long-term benefit to both the Observatory and its users; yet another guarantee that Willem will not be forgotten here.

Willem is leaving us for a position of high responsibility, and we wish him all the very best with the many challenges this represents. Nevertheless, we know that the fine match between the upgraded Arecibo telescope's performance and the demands of Willem's personal research will not go unheeded, and we expect to see him back here again and again. He certainly will be coming back in the near future, having declared his intention of helping with the re-commissioning of the 305-m telescope. In fact, as we wave Willem, Lydia and their three children goodbye, and wish them all happiness and success for the years ahead, we know that we are not really saying "Adios", but only "Hasta luego!"

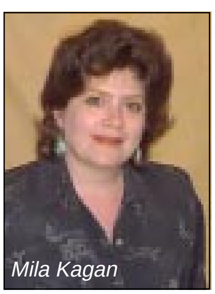
Visitors and N ew People

Joel Weisberg (Carleton College) Early this year, Arecibo had the great good fortune of a two-month sabbatical-leave visit from our old friend, Joel Weisberg, noted pulsar astronomer and Professor of Physics and Astronomy at Carleton College, Minnesota. Over the years, Joel has been one of our most regular (and popular) telescope users. His recent visit provided stimulus to all of us on the radio astronomy staff, and his sunny presence raised a smile with everyone in the Observatory. While here, Joel contributed considerably towards our preparations for a polarimetry capability with the upgraded telescope. It is only sad that his visit was not to include any observing this time around, although we are sure that this will be rectified in the near future. Joel, it was great having yourself, Janet, and little Ben down here in January and February. Come back soon — all three of you!

Jim Breakall (Penn State University) is spending a 4-month sabbatical and will be at Arecibo until May 1. He is working on the ionosonde antenna along with his graduate student, **Nathan Miller** (Penn State). In addition, he is working on low-frequency broadband antennas for the Gregorian system.


Jim Breakall

Ludmila Kagan (Radiophysical Research Institute, Nizhny Novgorod, Russia) - is working with Prof. Michael Kelley (Cornell) providing theoretical support on understanding ionospheric structures and disturbances using data from the Cornell all-sky imager. She holds a four month term as a visiting scientist.


Mila Kagan

Brent Grime (Penn State University) participated in the November 1997 Leonids experiment and then returned for the February-April 1998 Coqui-II campaign. Brent was a 1997 REU Summer Student at Arecibo as well. The lidar/radar data he is collecting and analyzing during these studies will be part of his Master's thesis work at Pennsylvania State University, where he works in Tim Kane's lidar group. He also recently received his Air Force Commission.


Pedro Torres

New Operations Technician

Pedro Torres, our new Operations Technician has a Bachelors degree in Physics Applied to Electronics from the University of Puerto Rico, Humacao Campus. He has worked as a Communications Technician, Music Instructor, Observatory Technician, Electronics Technician, and has done research in Pentium and Pentium Pro Architecture.

He is currently attending the Polytechnic University of Puerto Rico for a Masters in Management Engineering. He is a *Cuatro* player with the *Rondalla de Humacao, P.R.* He is also a volunteer in the *Oficina de Asuntos de la Juventud* in the *Grupo Asesor Federal de Programa de Justicia Juvenil y Prevención de la Delicuencia* at the *Oficina del Gobernador*. Pedro is an excellent acquisition to the Operations Department and the Observatory.

Jochen Meier is a student of electronics visiting us from Fachhochschule Augsburg, Germany. He will be here 20 weeks in all, from March 1 through July 19 to work on the design and construction of a radar blanking system for the receivers.

Rafael Mojica is a student in the computer science department at the University of Puerto Rico, Arecibo Campus. He is doing a 200 hour internship developing a maintenance database for use in the electronics department.

José Francisco Salgado, "Paquito" has been coming to the Arecibo Observatory since his undergraduate days at UPR Río Piedras as a summer student with Daniel Altschuler. Since then he has moved on to the graduate program in astronomy at the University of Michigan. Currently he is working on his thesis project, characterizing the distribution of ionized interstellar medium via observations of scatter-broadening of extragalactic sources with Chris Salter and Tapasi Ghosh. Paquito has now moved to the Observatory on a long-term basis. He is "under orders" to finish his thesis quickly. In his spare time he has taken on the responsibility of co-editor for the Newsletter. He is also a Mac "guru", and the new look of our Newsletter is his creation.

New Assignment

Angel "Guelo" Vazquez, long known in local circles as PC-Doc, has joined the Computer Department as Programmer. Angel is primarily responsible for configuration and upkeep of the 50+ and growing PC network at the Observatory. In addition to his knowledge of the ins and outs of Microsoft Windows and various PC-based software packages, Angel brings his broader "networking" skills as a ham operator and Web page designer.

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***address correction requested**

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Tapasi Ghosh, Jonathan Friedman & José F. Salgado, Editors

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