COMSAT-RSI's plant in Mexia, Texas in late May. After finishing work, the collar truss, dome and back-up structure will be shipped to Arecibo for the beginning, in early July, of the dome assembly on a 100 ft. x 100 ft. platform that has been constructed in the bottom of the bowl over the primary reflector. The complete secondary reflector will be installed in the dome prior to its scheduled lift in December. The 8-m tertiary reflector will be installed after the dome is lifted to the feed arm.

Drive Systems:

The "new" telescope will have six drive systems: the azimuth drive with four driven wheels on each side of the feed arm, the dome and Carriage House I elevation drives, the feed-room turret drive, the two-axis tertiary reflector control system, and the system for controlling the tension in the three vertical "tie-down" cables that will hold the platform horizontal and at a constant height as the temperature varies and as the partly uncompensated 90-ton weight of the dome moves in azimuth and elevation.

A contract has been let for the azimuth and dome elevation drives with an option, depending on the availability of funds, to include a new Carriage House I drive system. NAIC will be installing the system. The specifications for the positional accuracies with which the azimuth and dome encoders can be positioned corresponds to 1.5 arc seconds on the sky. This should allow an overall pointing accuracy of close to 5 arc seconds.

The turret, tertiary, and tie-down control systems are being designed and constructed by NAIC personnel. Turret motion will be possible at any time with a positional accuracy of 0.5 mm at the radius of the focus corresponding to a turret pointing accuracy of < 1 arc second. The tertiary will be movable in the symmetry plane of the tertiary and secondary reflectors. Continuous control of the tensions in the tie-down cables will hold the platform horizontal and at a constant height to a design specification of 1 mm to allow good baseline subtraction in the presence of a platform/reflector standing wave.

S-Band Transmitter:

Continental Electronics has completed construction of the 1-megawatt 12.6-cm wavelength transmitter at their plant in Dallas, and the system is currently being debugged. The only serious problem to date has been defective 1-megawatt dummy loads. It will take approximately four months to procure replacements and this will delay the final full-power factory acceptance tests. The current plan is to ship the transmitter to Arecibo in time to commence installation in January, shortly after the scheduled lift of the Gregorian dome to the platform.

Technical issues related to the effect of a transmitter crowbar short circuit delayed the procurement of the 2.5-megawatt turbine generator needed to provide the prime power for the transmitter. These difficulties have been resolved and an order has been placed with Solar Turbines for the generator. Delivery will be in late '95/early '96.

Schedule:

COMSAT-RSI's current schedule calls for the lift of the Gregorian dome in December 1995 and completion of all remaining tasks in May 1996. NAIC will have beneficial access to the dome starting in January, allowing us to install support equipment, horns, receivers, etc. The tertiary reflector is scheduled to be installed in March and the drive systems in April. Under this schedule, "first light" should be in late April/May of next year. Installation of the S-Band transmitter should be completed in May, with final acceptance tests late in that month.

Atmospheric Science Highlights

Craig Tepley

Studies in the atmospheric sciences at Arecibo since the last Newsletter consisted of several investigations that ranged from high to low altitudes. At the upper end of our observational capability, Sixto González (NAIC) measured the topside ionosphere in late December of 1994. Jonathan Friedman (NAIC) supplemented these radar results with neutral-wind measurements at the base of the exosphere using Fabry-Perot interferometer observations of the atomic-oxygen 630-nm emissions. They coordinated the observations with similar measurements at the Millstone Hill Observatory in Massachusetts and the incoherent scatter radar facility located in Kharkov, Ukraine.

The Arecibo topside observations were of O^+, H^+, and He^+ concentrations, as well as temperatures and ion velocities. Additional photometric observations of Hα emissions were made during this period providing key neutral-hydrogen concentrations of the exosphere to compare with the proton distribution throughout this region. The investigators plan to compare these experimental results with the theoretical predictions made by the Sheffield, U.K. model of the upper ionosphere. The topside observational program continued through early 1995 with the April participation of Bob Kerr, Xiangqun He, John Noto, and Genene Fisher (Boston U.) who monitored the seasonal behavior of ion distributions for this solar-minimum period.

Three sets of World Day observations were scheduled during the early part of 1995, but one set of February experiments did not take place due to a disconnected waveguide. For the other two periods in late February and late March, we made good, fundamental ionospheric measurements even though the pointing was restricted to a single look direction. Optical observations filled in the gaps in the radar measurements.

Deeper into the atmosphere, Qihou Zhou's (NAIC) meteor observations focused on two key areas. His first concern was to make fine-range-resolution observations of meteor echoes and, secondly, to observe these echoes using multiple filters to help resolve existing measurement ambiguities. The fine-range-resolution meteor data will be used by graduate student Kyle Hunter (Penn State) to test a generalized radar equation that he developed for part of his doctoral work.

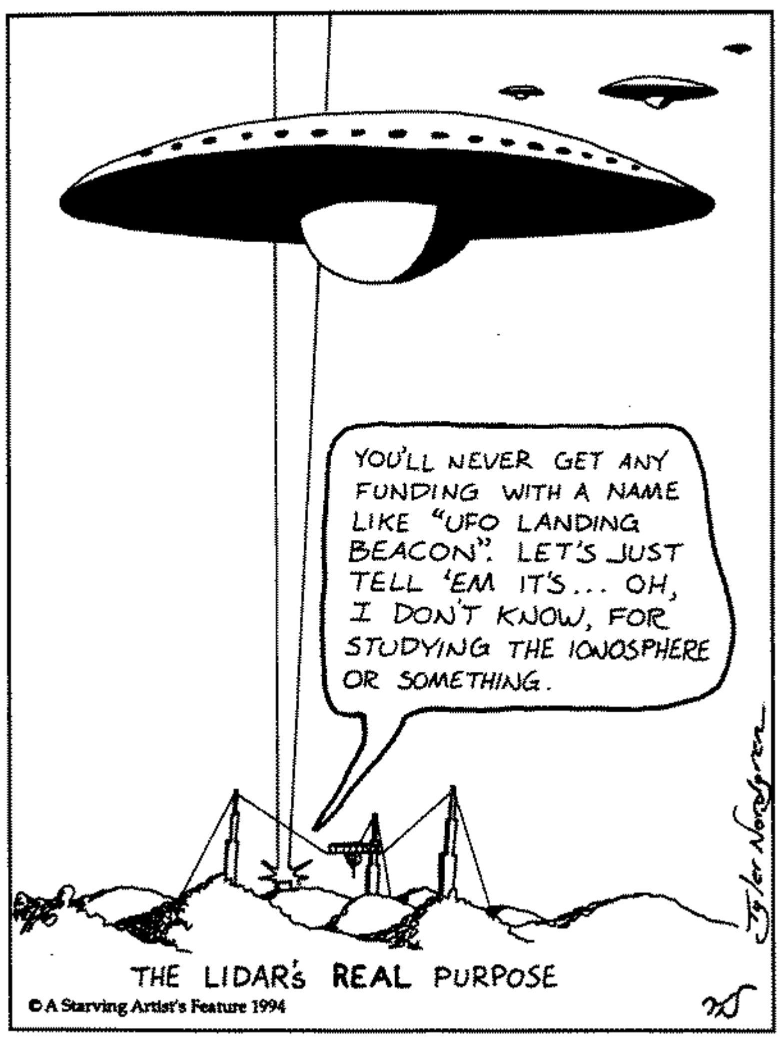
During late February and early March, Qihou also observed E-region power profiles for several nights to support Gregory Earle's (SAIC) rocket campaign from Wallops Island, VA. The Arecibo measurements provide a low-latitude anchor to the study that will help place the mid-latitude rocket observations in proper context. These special E-region ionospheric results, with the World Day experiments conducted during the same period, provide an interesting data set for investigations of intermediate-E layers of ionization. These data also relate to the more conventional tidal ion layers that are ever-present in the lower E-region and D-region of the ionosphere.

Paul Castleberg (Cornell) and Jonathan Friedman made a series of Rayleigh lidar observations during this period while continuing to optimize the system and improve upon its performance. In addition, they made considerable advances in the analysis of the lidar data. They compared, for the first time, density fluctuations recorded by the lidar with wind fluctuations measured simultaneously by the 430-MHz radar. These results were complemented with San Juan weather-balloon data that identified a significant temperature depletion at the tropopause, a feature that persisted for an entire night. During the remainder of 1995, we plan an aggressive observing schedule using both the lidar and radar, and expect to compare the winds measured by both instruments.

In other areas of atmospheric instrumental improvements, the Grease Pit Lidar (GPL) facility is nearing completion. Personnel of the Facilities Department have done an excellent job constructing a temporary facility (located over the old automotive grease pit near the tape storage area) that will meet our initial needs for resonance lidar work. The GPL is an interim laboratory until a proper lidar facility can be built. The lab consists of two surplus army shelters and modest work space captured from the tape warehouse. The shelters, cooled with surplus air conditioning units, are modified to accommodate a laser transmitter and an 80-cm-diameter receiving telescope. Soon we expect delivery of a tunable alexandrite laser that will be used as the transmitter for the resonance lidar.

Other work continues near the current Optical Laboratory. Raúl Garcia and José Cruz (NAIC) completed the construction of three towers and assembly of the Yagi antennas provided by Miguel Larsen (Clemson) for the 430-MHz Spatial-Domain Interferometry Receiver (SDIR), while John Cho (NAIC) performed an initial series of tests on the antennas. A successful follow-up test took place in the end of May after the arrival of the receivers and data acquisition system built by Bob Palmer and Perry Howell (Nebraska). The SDIR will measure the vector field of the winds of the lower atmosphere, which is a quantity not well observed by the 430-MHz radar because of its slow beam steering. This project is a collaboration among researchers at Nebraska, Clemson, and Cornell Universities, and Arecibo staff.

Finally, Marlene Colerico and Josh Semeter of Michael Mendillo's group (Boston U.) installed an all-sky imaging system at Arecibo to begin long-term monitoring of ionospheric conditions. This instrument records the horizontal distribution of airglow emissions from atomic oxygen at wavelengths of 557.7, 630.0, and 777.4 nm. With it they hope to see similar intensity depletions and other structures in the airglow as they did during the January 1993 extended observational period when their equipment was last at Arecibo. This stand-alone imager



will be operated in concert with the Los Alamos Total Electron Content receiver throughout the summer. These instruments are both fully automatic and require only minor attention by Arecibo personnel.

Radio Astronomy Highlights

Chris Salter

The Arecibo Upgrade has now entered its phase of maximum impact upon astronomical observations made with the telescope. For much of this year, structural work on the telescope platform has rendered tracking unavailable to observers. Often, NAIC has had no control over the positions at which the azimuth arm and the carriage house have been fixed, these being set by the requirements of the upgrade contractor. This has not only led to the five upgrade pulsar searches being unable to confirm candidates discovered in their drift surveys, but often to their having to retrace the same declination strip on many occasions. Up to a point, this is not a totally redundant operation since both interstellar scintillations impressed on the pulsar signals during propagation, and the intrinsic variations of the pulsars themselves, can change the source intensity significantly from day to day, making multiple passes of the same strip of sky a worthwhile venture. Of course, the return per pass reduces as the number of coverages increases. The current count of new pulsars from the four upgrade-search groups that were able to confirm some suspects before the loss of tracking is 55, six of which are new millisecond-period field pulsars. On average, each of the upgrade searches has acquired data from well over 1000 deg^2 of sky, representing a total coverage to date approaching one half of the complete area visible from Arecibo.

In their upgrade search, F. Camilo, J. Schrauner, J.H. Taylor (Princeton), & D.J. Nice (NRAO) have discovered two interesting millisecond pulsars, PSRs J0621+10 and J1023+10. These are both unusual in that their spin periods are among the longest for millisecond pulsars, and the inferred masses for their binary companions are also the largest in the group of nearly circular orbit millisecond pulsars (~ 0.5 and 0.9 M_o respectively). This correlation is probably not a coincidence. In addition to the interest caused by its unusual spin and orbital parameters, PSR J1023+10 also displays very unusual pulse-profile shape variations on the time scale of tens of minutes (Fig. 1). While at present it is not possible to distinguish between various possible origins (such as free precession or magnetospheric effects), the observers have ruled out instrumental causes. Such an effect has never before been observed in a pulsar.

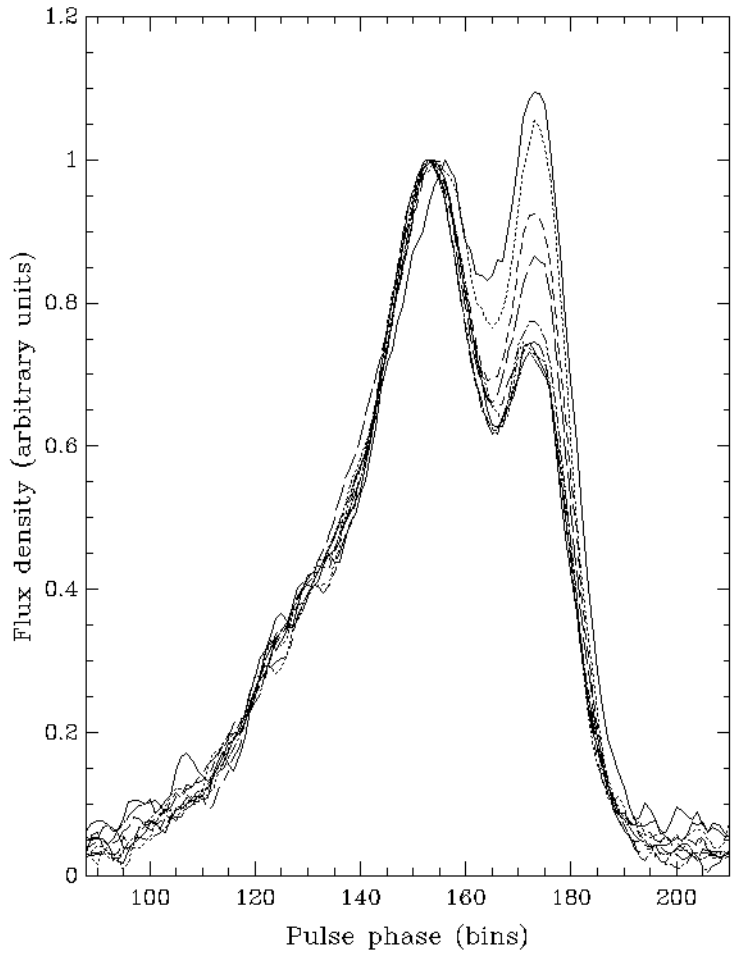


Figure 1. Pulse profiles of PSR J1023+10 at 430 MHz on Nov. 6, 1994. Each profile is a 10-min average. All are normalized to the first peak and aligned with the best-fit timing solution. The plot shows 25% of the pulse period, and had a resolution of 285 microsec. The earliest data, given as a solid line, was when the intensity of the second peak was at its highest. The ratio of the intensities of the second to the first peak decreased monotonically as shown by the dot, short-dash, long-dash, etc. traces.

A. Fruchter (STScI), J.A. Eder, A. Vázquez (NAIC), & M. Scheible (Villanova) report that among the eight pulsars they have discovered is an unusual object with a period of 25.7 ms. This pulsar has a dispersion measure of 34 cm^{-3} pc, and while the other pulsars which they have discovered (with $415 \leq P \leq 2220$ ms) have typical flux densities of order 1 mJy, this millisecond pulsar appears to have a flux density of tens of mJy.