ALMA U.S. DESIGN AND DEVELOPMENT

MONTHLY REPORT
MONTH END JULY 2000

1 Executive Summary

The month of July continued to see excellent progress for the ALMA project. For each of the areas of the Work Breakdown Structure, work continues on the dual fronts of preparing for the arrival of the prototype antennas at the VLA site and, in parallel, beginning development of production versions of the hardware required for the construction phase. For more detailed reports of the progress in each of the WBS Level-1 areas, see the Technical Progress Reports below.

The performance of Vertex, the vendor for the prototype antenna, has met our expectations to date. Following a successful PDR in June, Vertex has provided acceptable responses to the items noted at the review requiring additional clarification. We anticipate a successful CDR this fall. To accommodate scheduling constraints, the CDR date was moved from October 31 to November 15, 2000. Maintaining the very aggressive schedule is a positive indication of the good working relationship enjoyed by the Vertex and NRAO antenna team.

A major step forward for the test interferometer was the completion in July of the prototype helium compressor. The compressor, currently undergoing tests, will be used to cool the evaluation front ends on the prototype antennas. This sophisticated compressor was designed to meet all the requirements of operating in the environment of Chajnantor including 50 Hz power, temperature extremes and low atmospheric pressure. It is completely instrumented and interfaced to the standard ALMA control bus.

The rapid progress of the photonic LO reference developed for ALMA has led to the adoption of this novel technique by other organizations. The AmiBA project in Taiwan and the Australia telescope have decided to adopt this technique. While the NRAO is not currently involved in any of these programs, it is hoped that collaboration among the programs will further accelerate progress in the area.

Budget pressures, particularly for the 2001 budget, continue to challenge the construction phase schedule. Maintaining the schedule has required the planned use of all design and development phase budget contingency which will require extremely careful planning in 2001. Additional funds prior to the start of construction, as requested from the NSF, would significantly reduce the budget risk as well as allow additional tasks to be started that would further reduce the remaining construction phase schedule risk.

2 Programmatics

2.1 Financial Statement

[NOT INCLUDED]

2.2 Personnel

The ALMA U.S. Project staffing full-time equivalent employees was 46.5

A new position has been opened to recruit a senior level Systems Engineer to lead the Systems Engineering and Integration group. This follows the recommendation of the MMA Oversight Committee to enhance this group.

3 Meetings

The following ALMA meetings were held during the month of July 2000:

ALMA U.S. Division Heads Meetings - July 5, July 10, July 17, July 24

ALMA/NSF Meeting - weekly teleconferences

ALMA Joint Division Head/Team Leader Meeting - July 31
Minutes are distributed to all Division Heads and Team Leaders via email

ALMA Joint Receiver Design Group Meeting - July 25
Minutes are available at URL: http://www.alma.nrao.edu/committees/jrdg/index.html

ALMA Scientific Advisory Committee Meeting - July 10, 2000
Minutes are available at URL: http://www.alma.nrao.edu/committees/ASAC/index.html

ALMA Imaging and Calibration Meeting - weekly teleconferences

ALMA Executive Committee Meeting - weekly teleconferences

ALMA Holography Teleconference - July 25, 2000

The following meetings are planned for the month of August 2000.

ALMA U.S. Division Heads Teleconferences - August 7, August 14, August 21

ALMA Site Development Teleconference - August 16

ALMA Executive Committee Meeting - face to face meeting in Charlottesville, VA
August 24; weekly teleconferences

ALMA Joint Division Head/Team Leader Teleconference- August 28

4 Technical Progress Reports

4.1 Antennas

During the month of July, the principal task of the ALMA U.S. antenna division has been continued management of the Vertex prototype antenna contract. ALMA personnel were present in the contractor's facility in Duisburg, Germany, on 12 July. As a result of a PDR Issue the contractor made a significant change to the antenna pedestal design to bring the path length stability performance into specification. Another important contractor activity was the continued testing of approximately 40 samples of Carbon Fiber Reinforced Plastic (CFRP) in order to determine the optimum material for fabrication of the reflector backup structure (BUS).

At the NRAO, work has consisted of computer modeling of various aspects of the Vertex design to check the predicted performance. In particular, detailed modeling of the thermal behavior of the BUS, another PDR Issue, was performed. Design work continued on various pieces of antenna equipment that NRAO has the responsibility to provide, including the subreflector nutator and the optical pointing telescope. Design work also progressed on the electrical infrastructure required for the ALMA Test Interferometer to be built at the VLA site.

During the next month we expect to see Vertex starting to order some of their long lead items such as the mold for BUS fabrication, the azimuth bearing, the material for the reflector panels and the azimuth and elevation position encoders. Procurement will also begin for VLA site infrastructure materials

4.2 Front End

4.2.1 Evaluation Front End

The effort to build the two Evaluation Front Ends, one for the U.S. antenna, the other for the European antenna continues.

The prototype helium compressor system for the Evaluation Front End has passed a comprehensive electrical testing and is presently undergoing helium gas and oil flow rate tests. This will be the first unit to be thoroughly tested under control and monitored by a CAN bus interface to a lab computer. The compressor system has been designed to withstand the harsh environment of 40 degrees Celsius at an altitude of 5000m. Although the Rutherford Lab is now responsible for the cryogenic systems to be used on ALMA, the problems found and solved in the development of this compressor will undoubtedly prove useful in the development of the final cryogenic system.

The optics design for the Evaluation Front Ends is complete and the necessary components are being fabricated at IRAM in Grenoble as part of our collaboration. The highly specialized polarization diplexers, needed for both the evaluation front ends and the production front ends have been produced (for the lower frequency bands) and will shortly be ready for the final drawings to be made. An optics design for the Evaluation

Front End has been set resulting in the mechanical design for the dewar proceeding at a fast pace. The stainless steel dewar drawings should be presented to the Greenbank workshop by the end the month.

A prototype Front End frame has been delivered by the University of Arizona workshop. A complete vacuum system is on hand and will be fitted into the frame along with the dewar environmental monitoring equipment. This frame will be used to work out the placement of all the electronics bins and modules associated with the Front End.

4.2.2 Production Front Ends

The joint effort between the U.S. and its European partners to produce a design for the ALMA production receivers is progressing well. The Rutherford Laboratory in the UK has produced an initial design for the Dewar and cryogenic cooler and IRAM, in France has designed the front end optics. The MPIfR in Bonn has initiated a research program involving the Gerhard Mercator University, Rutherford Laboratory and UCK to produce high frequency photo-detectors that may have application in an advanced local oscillator.

4.2.3 Front End Components.

Wafer fabrication for the 211-275 GHz sideband-separating, balanced mixer at UVA was completed, and 2 wafers were delivered. Fabrication of the mounting blocks commenced. The bias circuit wiring has been installed in the dewar. Design is also complete for various parts needed to install the mixer chip in the block, including waveguide probes, DC blocking capacitors, and a transmission line signal combiner for each balanced mixer; the capacitors are complete, and the other components are being fabricated on fused quartz from Nb/Ti/Au.

Work continued on the measurement apparatus for the prototype of the internal IF amplifier for 4-12 GHz to be used with an SIS mixer. This work has concentrated on performance of the isolated amplifier and the measurement apparatus used in the tests, with emphasis on good RF match that will result in accurate calibrations and noise measurements. A new amplifier body was designed which completely separates the mixer bias circuit from the rest of the amplifier. This amplifier was built and tested both without and then with the mixer bias circuit, and performed as predicted by the model; the next step is to attach the mixer and test the whole assembly.

Staff member Marian Pospieszalski (non-ALMA NRAO staff) is investigating the packaging and performance of these chips as a possible alternative to amplifiers built with discrete transistors for this band. A preliminary study of the effects of 1/f gain fluctuations in the HFET amplifier and in SIS mixer receivers was carried out; a tentative conclusion was reached that a straight total power receiver using HFET amplifiers for the 90-116 GHz band will not achieve the desired radiometric stability. A preliminary design of a fixed-tuned SIS mixer for this band, possibly going as low as 85 GHz, is being carried out with the objective of determining whether it is feasible to build such a wideband mixer with the required IF bandwidth.

Preparation of the second closed-cycle dewar for measurement of the sideband separating, balanced 211-275 GHz SIS mixers continued. Measurements of square-law detector characteristics were made in a continuing investigation of the effects of nonlinearity on accurate measurement of receiver temperature. An improvement was made in the mixer bias voltage feedback loop to eliminate oscillation problems. The chopper wheel used for automatic optimization of mixer performance was made acoustically much quieter, improving the lab environment.

4.3 Local Oscillator System

4.3.1 Photonic LO

The ALMA baseline plan provides for a photonic reference signal that will be generated at the central station and distributed to each of the antennas by optical fiber. The major difference between this method and previous technology is that the reference can be made tunable so that the local oscillators at the antenna can be phase locked directly to the reference without extra electronics at the antenna. In addition, because widely tunable lasers are readily available, and very high frequency photomixers are being developed, the reference can now be sent at as high as 120 GHz. Higher frequencies are expected to be available soon. The higher reference frequencies take advantage of the fact that as much of the LO chain as possible can be in the phase-locked-loop and therefore immune to temperature effects.

For the Test Interferometer, the use of a photonic reference signal requires a frequency synthesis and distribution network at the central station. This will consist of a single master laser, and two slave lasers. The master laser is a single frequency non-tunable laser with an exceptionally narrow line width of 3 kHz. This laser serves a dual purpose: it provides LO reference signal power and it is the key component in the round-trip phase correction to the antennas. The 3 kHz line width is exceptional when one considers that the laser frequency is 193.5 THz. The short-term frequency stability is thus close to one part in 10^{11}. That indicates that the coherence length of the laser is longer than 50 km. We have used this to our advantage in developing an optical interferometer with which we have stabilized optical fiber lengths up to 25 km to within a single optical fringe (1.5 microns).

The slave lasers are then locked to the master laser in a synthesizer module. For the Test Interferometer, we are using conventional microwave harmonic mixers to do the phase locking to 120 GHz. For the ALMA array, the technique of optical phase locking using optical comb generators is being developed by our ALMA collaborators at the University of Kent at Canterbury.

The round trip phase correction for the Test Interferometer will consist of a module at the central station and one at the antenna, which will be duplicated for each antenna. Basically, the master laser signal undergoes a round-trip with a frequency shift added at the antenna, and then it is phase compared to the original signal at the central station in a photodetector / phase-detector. The output of the phase detector drives a fiber line stretcher that keep the overall fiber length locked onto an optical fringe. This technique has been successfully prototyped and design and construction of the modules for the Test Interferometer has begun.

At the antenna, the photonic LO reference is converted to a millimeter-wave signal in a high speed photomixer. A commercial chip was discovered to have exceptional performance, and it was measured and evaluated, with the result that it has not only enough RF power to serve as the LO reference, but also enough power to drive the SIS mixers directly up to at least 110 GHz (see ALMA memo #313). The measurement was done on a chip, and now the chip is being integrated into a package that will consist of a single mode fiber input and a fundamental mode millimeter-waveguide output. This work is being done in collaboration with Brian Ellison's group at Rutherford Appleton Labs.

The photonic reference is converted to a millimeter wave signal right at the receiver, and is an input into one of the LO Driver modules. These modules contain the LO source, and are mounted on the receiver itself to minimize the distance and RF loss between the LO and receiver. The LO Drivers for the ALMA array are being developed but because of the short lead time, the driver modules for the Test Interferometer, will be based on commercial Gunn oscillators.

In addition to the many ongoing photonic construction projects for the Test Interferometer, there are several ongoing development efforts for the ALMA array. The option of using a direct photonic LO has been kept open in case suitable high frequency photomixers can be developed. This is being worked on by our European counterparts at MPIfR who have funded a leading research institution to extend a mature 100 GHz photomixer upwards to 600 GHz. Also, the Nobeyama Radio Observatory is actively collaborating with NTT Photonics. Many of the considerations for an ALMA direct photonic LO have been presented in ALMA memo #200 and #319.

Two other promising applications of photonics have arisen that were previously done with millimeter wave sources. First, phase calibration by injection of a reference tone into the receivers can be done by using the same type of central station lasers, fiber distribution, and a photomixer, mounted perhaps at the subreflector. Second, the transmitter for the holography measurements on the TI can be done by using the same lasers at the central station and distributing the fiber to the holography tower to a photomixer bolted to a feed horn. Both of these projects are recently underway.

Recently there have been some developments in the photonic LO area in other organizations. The AMiBA project in Taiwan has decided to adopt the NRAO reference distribution system. This will involve personnel from Taiwan spending time in Tucson and the resulting collaboration is likely to benefit both the NRAO and the AmiBA project. Also the Australia telescope has decided to adopt the same system with, hopefully similar benefits.

4.3.2 Local Oscillator Multipliers

A draft of the LO Multiplier section of the new ALMA Project Book was written, reviewed, and submitted. A draft memo on the results of the phase noise was written and reviewed and will be issued soon. Planning continues for an integrated test of the LO driver chain using a photonic reference.

Work was continued on the design of an integrated varistor doubler / power amplifier module to convert 25-30 GHz to 50-60 GHz power. This will be done using custom UVA diodes in the doubler section. Amplifier blocks for a 26-40 GHz power module were completed, and two such power amplifiers for use by the SIS mixer group were completed. Blocks for W-band power amplifiers were manufactured and will be sent to JPL for installation of MMIC chips.

A test system employing Labview for acquiring and analyzing LO chain characteristics was configured and the engineers have used it to program the frequency of a YIG-tuned oscillator as part of the development program.

A collaborative project with JPL was started to utilize the quick-turnaround capability of the multiplier wafer fabrication group at the University of Michigan, led by Jack East. The plan is to transfer some current JPL technology to U. Michigan, and use their foundry to test new multiplier designs.

4.3.3 Local Oscillator Reference

Work continues on the Reference Generator digital section. The FPGA chips (XCV50) have arrived and Xilinx Foundation software is being used to design and test the FPGA. As soon the schematic entry is completed, simulation of the design with the internal simulator in the Foundation software will begin. Testing of this design in hardware will use the same Xilinx Virtex evaluation board that was bought for the high speed Data Transmission fiber optic link development. This also provides the opportunity to get experience with the Xilinx software on a simpler and lower speed design before working on the 10 Gb/s Data Transmission link.

Fabrication is underway of the microstrip breadboard for the divide by 512 prescaler in the 2nd LO Synthesizer. This counter / prescaler provides coarse tuning for the YIG.

4.4 Backend Subsystem

4.4.1 Data Transmission Fiber Optic Link

Most of the board routing on the Clock Generator PCB has been completed using Protel. This board will be ready for fabrication in early August.

4.4.2 Downconverter

The Wiltron scalar network analyzer was used to measured return losses and insertion losses of coax cable to be used as interconnects in the downconverter bench prototype and test interferometer modules. Also a pair of evaluation isolators from each of two vendors were tested for return loss, insertion loss and isolation from 2-18 GHz. Oddly, the performance of the lower cost isolators is vastly superior. Evaluation continues of a sigma delta digitizer for the total power detectors, but successive approximation digitizers will also be investigated for comparison.

4.5 Correlator

The FIR filter printed circuit boards are being manufactured by a contractor.

PCB layout of the Long Term Accumulator card was nearly completed, with careful attention given to the traces carrying the rack-to-rack LVDS signals.

PCB layout of the Station Card was continued and is complete. Work on the firmware continues.

Work on the design of the Correlator Card is continuing. The contractor is continuing design work on the custom correlator chip. A review of progress on chip design was held at the contractors' facility. The design of the fundamental element of the correlator, namely the lag cell, has been completed and approved, using low-power standard cells. Simulations show that the chip should work up to about 170 MHz (considerably above the required 125 MHz, giving a good design margin) and dissipate about 1.5W, which is well below the target 2.0W. It was determined that the cost and power consumption of a version of the chip which would incorporate 8K rather than 4K lags would both be too high in the chosen 0.25 micron process, so the chip will have 4K lags, which is the original specification. The remainder of the chip is now being designed, with a target of completion by the end of September 2000. We expect prototype chips in April 2001.

The design of a test fixture card which will be used in testing both the FIR filter and station cards was completed and PCB layout was continued.

An initial design of the station logic control card was further refined. PCB layout will be delayed until later in the year, allowing for changes in the design which may arise.

4.6 Computing

In July, a Use Case working group met for a week in Grenoble and worked on top-level use cases for the ALMA array under the direction of the chair of the Science Software Requirements (SSR) committee. These initial use cases were circulated to the SSR for comment by its members. These use cases then formed the input to the Analysis and Design (A&D) group, which met the following week in Garching and continued work on its Architecture document. At present the A&D group is concentrating on package identification and sequence diagrams.

The Software Engineering (SE) was reactivated in July, and a lengthy SE “practices” document was issued for public comment. Work on jointly defining the project’s coding standards and documentation templates was started, the former based on an initial definition document from the NRAO. ESO negotiated an 80% reduction in the licensing fees for Rational Rose (a CASE tool) for the entire project.

In the ALMA Common Software (ACS) area prototyping with the ANKA system, which forms the basis of the first ACS release was undertaken to gain real-world familiarity with the underlying technology. Porting of parts of this system to VxWorks continued. Internal comments on the ACS Architecture document were sent to the document authors.

In the control software (CS) area, a revised AMBSI interface board (for device interfacing) was sent out for external manufacturing. Options for interfacing to the IF subsystem’s total power detectors were investigated, and the CAN interface has been recommended. Although the interrupt rate is rather large (~2k/s) the CPU loading is only ~10% and saves the effort of creating a new interface. This recommendation is being studied by members of the IF, Systems, and software groups. An early draft document containing a standardized approach for “device controllers” was distributed for internal software group comments. Preliminary mount-control IDL was presented to the ACS group for consideration.

In the correlator control software (CCS) area, effort was extended to make the test correlator (for the test interferometer) subscribe to the ALMA system-wide 48ms timing pulse (the test correlator is adapted from an existing design). This requires hardware and software changes. Programming for the narrow bandwidth 100MHz mode was undertaken. Test correlator fine delays were implemented, although final testing requires a geometric delay model server.

In the telescope calibration (TC) area, a discussion on data formats for the test interferometer was started. The format will be FITS based and largely follow the internal structures used by the IRAM CLIC package that will perform the actual telescope calibrations. A reuse document was started to describe the capabilities of the CLIC package.

European and U.S. members attended the EIE antenna control software PDR. Work is done jointly to keep the software interfaces aligned for both antennas and somehow independent of their design. They also jointly attended a teleconference on holography for the test interferometer (the European side is providing the analysis software, and the U.S. side is producing the control and data production software).

Work on ALMA array requirements – including a feature list – will continue. Planning for a test period on the (former) NRAO 12m telescope for late this year should be finalized. Replies to comments on the ACS architecture document will be distributed, and several draft documents related to control software and telescope calibration data formats will be circulated. A simplified Control Software implementation based on ACS is going to be demonstrated as a way to use Control software and ACS together and will be the basis for the preparation of the KP 12m tests. Interviews for a vacant staff position in Tucson will be held. A new revision of the AMBSI will be manufactured and tested. Preliminary versions of TI ICDs for compressor, CRG and total power computer interfaces will be issued.

4.7 Systems Engineering

During the months of June and July 2000, we continued to refine the interface specifications for electronic devices, with concentration on those needed for the test interferometer. A meeting was held in Socorro among engineers based there and in Tucson, covering the design of the front end, data transmission, local oscillator, and monitor/control systems for the test interferometer and resolving various outstanding interface issues, including timing. Gie Han Tan of ESO visited Tucson and Socorro to coordinate systems engineering work between the NRAO and ESO. It was agreed that ESO will provide first drafts of the detailed construction standards for such things as electronics packaging and wiring.

We also worked with the correlator group on synchronization of the Test Correlator with the other electronics. This correlator is a clone of the GBT spectrometer, so some adaptation is needed for the ALMA application.

An informal review of the plans for the holography system for antenna evaluation was held by international teleconference [1]. The PDR for this system occurred very early (April 1999, see [2]), so the recent meeting was an update. Portions of the detailed design and construction may now be done in Europe. It was agreed to hold a CDR on 2000-Oct-10.

Some work was done on the design of common d.c. power devices.

Over the next month, it is intended to complete the systems engineering section of the Project Book; to revise the system block diagram to reflect current plans; to review various draft documents from ESO; to collect a complete set of interface specifications for all Test Interferometer devices; to begin prototyping of common d.c. power conversion devices; and to finalize the holography system design and begin ordering components for it.

[1] See minutes of teleconference at http://www.tuc.nrao.edu/~demerson/holmins7.htm .

[2] See summary of holography PDR at

http://www.tuc.nrao.edu/~demerson/holopdr/holo_pdr.recm.html.

4.8 Imaging and Calibration

4.8.1 Configuration Studies

To spur on the imaging simulation work as a test of the competiting strawperson configurations, Yun started some imaging simulation using UVCON in AIPS. Various procedures were corrected and problems solved after some discussion among Yun, Butler, Conway and other people in the configuration working group. Multi-configuration imaging is identified as a potentially important additional issue for the array design and imaging. Steven Heddle (ALMA/Eu) has made significant progress in getting the AIPS-based "black box simulator". A worldwide teleconference on configuration progress will occur in late August, before the ASAC meeting.

Yun discussed various options for the configuration PDR with Al Wootten. Although a detailed report will be given to the ASAC at their Berkeley meeting, it appears that the PDR should not occur before later this year.

The result which is emerging from the simulations is that pointing errors dominate differences due to choice of configuration style. This suggests that operational considerations may be of more weight in the final choice of configuration than was originally thought.

4.8.2 ALMA Complement Array

Wootten circulated a document to the ASAC summarizing thoughts of many people on the ACA.

A memo from Stephane Guilloteau was also circulated giving his views on the ALMA Complement Array, ACA. The ACA was discussed in the Imaging and Calibration Group meeting held on 18 July. Some points needing clarification surfaced.

Yun continued with the single pointing simulation to evaluate the imaging performance of the 6m versus 8m antennas for the ACA. In particular, the impact of pointing error was examined. These simulations and other discussions within the configuration group suggest that simulated mosaic observations are truly needed and important in addressing this question. To this end, investigation of the use of AIPS++ for these simulations was begun.

4.8.3 Site

Radford conducted a trip to Chajnantor. He also received the Inmarsat M4 (ISDN) terminal and initiated commissioning paperwork.

At Chajnantor Radford conducted field work with Angel Otarola (ESO) under clear weather. He restarted the multi-wavelength submm tipper after software reinstallation. At 350 um, both tippers agree. The new tipper also shows interesting results at 260 and 200 um, the 'Superterahertz windows.' Radford also repaired the lightning detector PC, and performed data backup and computer maintenance for other instruments. He launched daily radiosondes and verified correct operation of backup radiotheodolite. We now are obtaining reasonable data through the Chajnantor winter on the atmospheric structure, which has been lacking. Back in Tucson, Radford updated web pages and data files for radiosonde and tipper data and began testing the new Inmarsat M4 terminal. Radford has continued some nutator design work. Butler continues analysis of this new data from the site. Wootten and Radford discussed plans for the nutator during Wootten's visit to Tucson.

4.8.4 Interferometer/Antenna Amplitude Calibration

Mangum finished and submitted ALMA memo (No. 318) on the general amplitude calibration problem. The emphasis of this paper is to determine the uncertainty of two variants of the chopper wheel calibration technique. In this memo, Mangum recommends a chopper calibration method which has the potential for allowing ALMA to reach the 1% amplitude calibration specification recommended by the ASAC.

4.8.5 Pointing Calibration:

Mangum also worked on pointing with particular attention to the test antennas.

(1) General: Continued work on a general description of the telescope pointing problem with an emphasis on requirements for ALMA. The stringent ALMA pointing specification will force us to adopt a much more detailed model for the refractive correction term to the pointing, and will require an accurate measure of the pressure, temperature, and relative humidity at each antenna. This requirement for accurate metrological information puts some stringent requirements on these measurement devices. Mangum is writing a memo on this.

(2) Optical: Continued characterization of optical pointing system. Fabrication of mount and detector housing continues guided by ALMA antenna group. Loss of access to the 12 Meter Telescope will seriously hinder the development of this system.

4.8.6 Other

Butler brought up the concerns Napier had on beam squint in current optics designs for discussion at the 11 July ImCal meeting. The current proposal for receiver optics poses several problems in addition to this, which Butler will follow.

4.8.7 ASAC

Wootten arranged for the ASAC teleconference and he and Yun participated in the ASAC teleconference on the 10th. Wootten and Yun read and commented on the draft ASAC memoranda on receiver specs and SSR group report. Of particular concern was the issue of limited capability to switch between several different bands. Wild clarified the description of this spec to the our satisfaction. Wootten put together a tentative agenda for the September face to face meeting of the ASAC, and entered the minutes of the July meeting to the website, as well as arranging the August meeting, to be held 7 August.

4.8.8 Imaging and Calibration

Wootten held two meetings of the Imaging and Calibration group during July, at which issues dealing with configurations, the ACA, the volcanic eruption at Lascar, and other issues were discussed. He also visited Caltech, where the progress of submillimeter instrumentation at the CSO was discussed. An 850 GHz receiver providing T(DSB)sys 205K is now operational at the CSO. The progress of water vapor radiometry was also discussed, with Sargent and Carpenter. Installation of cooled 22 GHz radiometers continues at OVRO, with a goal of completing the system during the coming year. Woody will report on progress to data at the face to face ASAC meeting in Berkeley.

4.8.9 Plans for next month

Plans for the face to face ASAC meeting in Berkeley, including the agenda and reading material will be finalized by Wootten. Wootten and Butler will present a paper on ALMA capabilities for the detection of Extrasolar Planets at the IAU meeting on this subject. Wootten will also present a report on ALMA at the Observatory Reports session of Division X, as well as attend the ALMA presentation by Kawabe at a Joint Discussion on radio continuum and line observations of distant weak sources.

The most pressing issue for now is the imaging test for the ALMA Complement Array. Yun plans to concentration on this effort during August. Yun will investigate using AIPS++ in simulation efforts. The simulation efforts will reach a point where the basic simulation procedure is agreed upon, and results exist for parameters agreed upon at the March face to face meeting for presentation to the ASAC.

During August, the calibration scheme for the array will be sorted out for presentation to the JDRG meeting and the ASAC meeting in early September.

Yun will convert the web report on the double-ring/donut strawperson configurations into a more detailed write-up. Two memos are in draft form, and these should be finished and submitted to the memo series.