

SCIENCE IPT

Commission and Science Verification

I regret to say that we have made very little progress with Commissioning during the month of April. The period started, on April 1st, with the move of DV02 to join PM03 and DV01 on the ACA antenna stations, giving us a compact three-element array. Interferometric operation, including pointing, baseline solutions and delay settings was re-established by the night of the 2nd, but on the 3rd we had a problem with drive systems on PM03 and on the 4th came the first of a number of power outages caused by failures in the 23 kV equipment which had been brought into operation at the high site in March. These led to partial warm-ups of the receivers and the cryo-cooler on DV02 did not recover properly after this. The calibration unit on DV01 also developed a fault which has not yet been cured. (We do not yet have spares for these.) On about the 10th of April the UPS on DV02 failed, which prevented operation of that antenna and also made it difficult to work on the cryogenics problem. After a lot of work by NA Antenna IPT the UPS was brought back into operation on 23rd April but it then became clear that, even with a replacement compressor, the cryo-cooler was not able to get the receiver to its proper operating temperature and that the cold head would have to be serviced. It was therefore decided to bring DV02 down, since this servicing cannot be done with the receiver in the cabin. DV03 was moved up ahead of schedule on 29th April, but bad weather intervened before it was possible to bring it into operation. At the time of writing all the antennas are shut down and without power.

Although the major CSV activities all require at least three fully-functional antennas, we were able to continue some trouble-shooting activities with just two or, on some occasions, only one antenna. We were also able to take some more of the data needed to characterize the antenna performance, including holography on astronomical sources, Moon scans, and tracking tests. In addition we continued to improve our test procedures and to find and report software bugs. I am pleased to report that the new firmware installed by the Digital Transmission System group to cure the "8 nsec delay" problem appears to work well and that at least one of issues relating to the normalization of data from the correlator has been resolved.

Another area we worked on was the testing of the Line Length Correctors (LLC's). These are designed to compensate for changes in the effective path lengths of the optical fibres that carry the local oscillator reference signals to the antennas. At first the path lengths were found to be changing much too fast, but it was discovered that this was simply due to the fact that, although the trenches had been cut to the necessary 1 meter depth, they had not been filled in after the fibres were installed. This meant that the fibres were exposed to much larger temperature variations than had been allowed for. Once the trenches were filled in, we were able to get the LLC's operating correctly and to demonstrate that they do indeed correct the phase drifts that are seen to be present when they are not operational. We need to make more quantitative measurements of the performance of the LLC's but this is an encouraging result.

Another positive step was that we have apparently found one of the major sources of the amplitude instabilities that have been causing us a lot of difficulties with other measurements, including pointing, tracking and receiver tests. There is now strong evidence that these instabilities are due to reflections from the "membrane" which the signals pass through on their way from the subreflector to the receiver. The function of membrane is to keep the environment of the receiver cabin isolated from the outside world. Reflections lead to standing waves, which we see as "ripples" in the spectra. More critically any changes in the path, in particular those due to the wind buffeting the membrane, cause fluctuations in the power level detected. By design the membrane is tilted by 5 degrees with respect to the antenna axis. It was assumed that this would avoid reflections, but in retrospect a larger angle should have been used. We will make some temporary modifications to try to

suppress the reflections and to confirm the diagnosis, but we may need to change the design to solve this problem permanently. We are in any case keen to change to a different material to reduce the loss of sensitivity caused by the present Goretex membrane. The new material should also produce much lower reflections.

We continue to encounter problems with the Archive, which is a critical component of the software system and one that is involved in all stages of the observing process as well as the longer term storage of data. Our difficulties relate to both the handling of the Scheduling Blocks (the files that describe the observations that are to be carried out) and access to the monitoring data. At this stage it is not clear to what extent the problems are intrinsic to the archive itself and to what extent they are caused by the way that the external software components are interacting with it. This area will be scrutinized very closely in the annual software review (CDR 8) that will be taking place later in May.

On a more positive note, a new plan for the testing and deployment of the next few antennas was produced by AIV. This shows that, so long as there are no further delays in the delivery of front-ends, antennas and calibration units, or other major problems, we should have five antennas operating at the high site by the beginning of June, six in July and eight by September. Although this is substantially slower than expected when the CSV plan was drawn up, it is a good deal better than recent forecasts from the PMCS. On this basis we are still planning to hold the readiness reviews for the Early Science Call for Proposals in October.

Staffing

I am sorry to say that Lance Simms will be leaving ALMA early in May. He only joined us in January but he rapidly became a very effective member of the team and he has made a valuable contribution to the Commissioning effort. Satoki Matsushita has joined us as a Commissioning Scientist from East Asia and Koh-Ichiro Morita, who is of course the EA Project Scientist, is presently in Chile in the role of ARC liaison scientist. Bojan Nikolic, from the Cavendish Astrophysics group in Cambridge is here for an extended visit focussing on atmospheric phase-correction and related topics.