National Radio Astronomy Observatory
VLBA TEST MEMO NO. 12
MEMORANDUM

To: VLBA Project *Date:* December 21, 1987

From: Craig Walker

Subject: Test Coordination Meeting, Dec. 15, 1987

Those present: Romney, Cotton, King, Stetten, Walker, Napier, Bagri, Crane, Goss, Clark

Romney had been to Caltech to process data on the large Mark II correlator. This is the first VLB correlator with a number of stations comparable to what the VLBA will have, so it provided some interesting lessons. He is convinced of the value of subarray capability. This was especially apparent when fringe searching was needed. It would have been very nice not to have to stop the processing of many stations to find the clock to one. He was also impressed by how quickly all the tapes would lock up. He found this encouraging in that it shows that we should be able to do the same for the VLBA.

I reviewed some lessons from the NUG run:

The DQA seems to be very important, at least when first setting up a station for Mark II. Without it, we would not have been able to correct some serious problems with the formatter that might have made the data difficult to read. Once a station is working properly, it is probably not so important to have the DQA, but it would still be nice. It is not sufficient to set up the equipment somewhere such as the VLA, see that it is producing good data, and then ship it to the site. We did that several times to Pie Town. It turned out that our problem was one of temperature sensitivity and the packaging at Pie Town was such that the unit got hotter there than on the bench at the VLA. It also had to be on for a considerable time before becoming a problem. It is unlikely that the formatters that we are going to get from Italy will include a DQA and there was a feeling that trying to acquire one for each site would be difficult. However it is probably worth trying to acquire at least one extra. Does someone have an unused one?

We still don't have a very acceptable way of setting the one second tick at Pie Town. This was brought home when we were trying to start up and the station timer had lost time. It did not agree with the traveling clock, the difference being about 0.1 second. It was not easy to tell from WWV which was correct and the offset was sufficiently large that LORAN could not be set. The GPS receivers are supposed to provide a proper UT tick, but until one becomes available, we depend on the traveling clock.

I feel a bit uncomfortable about the security of the station time. While the maser is protected by both the battery systems in the UPS and its own batteries, the station timer depends on the UPS alone. Recent problems with the UPS batteries were the cause of two time losses, one just before the NUG run and one between the proper NUG observations and the ad-hoc experiment we did later. Also, there is considerable distance between the station timer and the UPS, including various plugs that can get undone if any work is being done in the area. While occasional time losses should not be a large problem, it would be good to be able to maintain long term track of the maser performance and to be able to assume that the delay is slowly changing at the processor. Also, if the VLBA's collection of masers were ever to be used as a fundamental time standard (this might be an interesting possibility), it would be very important to maintain the integrity of the one second ticks.

During the NUG run, it was noted that the system temperature, as determined from the switched power values delivered by the computer, was considerably higher than expected. Clark later traced this to a problem with the duty cycle of the cal,

which turned out to be 70/30 rather than the expected 50/50. The problem seems confined to the 610/327 receiver and is in the receiver — the driving signal has the proper 50/50 duty cycle. This will be fixed when the receiver is removed to install the subreflector. Until then, we will live with it. System temperatures need to be divided by 1.75.

Some problem with the azimuth drive control was causing fuses to blow. This cost us about the last half day of the NUG run and is delaying further tests while an effort is made to find the cause.

After the NUG run, Duquet generated listings of the monitor data. I felt that the listings were both too voluminous and too cryptic to send to observers. Clark does not agree and a bit of an argument ensued. To my mind, not much is needed to make the output useful, but at least more interpretable column headings are needed and, since the volume is large, the output should be in machine readable form. What the observer needs is to know when the data is good and what the system temperature is as a function of time.

Looking ahead, we will probably miss the next NUG run because the subreflector will have just arrived and we will be installing it. For the following run (about June), we may be able to use both Kitt Peak and Pie Town and we hope to control them from Socorro.

Lee King described the current status of the azimuth wobble problem. NRAO is not doing much at the moment. The manufacturer is trying to understand it. In an effort to reduce it, the rails for the next antenna will be aligned using targets on the antenna structure and rotating the structure. That way, the effect of the wheels should be taken out too. Will the wheels ever slip or otherwise change their orientation as a function as azimuth?

The impact of the problem was reviewed. The basic pointing specification is 8" rss. The error budget that gives this allows 5" peak for the track. The tests with the levels show variations of 10" peak, which imply pointing errors of 11" rss assuming other contributions meet spec. The level measurements include the effects of the wheels. If the wobble, measured by the levels, can be reduced to 6.1" peak, then the 8" overall pointing spec should be met.

At Pie Town, there is an overall tilt of 10" –15" (probably from sag of the foundation). RSI is wondering if the foundation is deforming, causing some or all of the problem. At Fort Davis, this will be monitored carefully.

Napier feels that there is no one thing wrong with the rail. Several things are out of spec, adding up to the overall problem. This will make it difficult to fix. He asked how difficult it would be to solve the problem with either a lookup table in the computer or by using tilt meters. Clark is not sure that he could make a lookup table that would help. Napier is wondering what we should do about the contract — should we require RSI to provide tilt meters or what? How much effect do pointing errors have on observations since the sources are compact, unlike on the VLA where pointing errors cause closure errors on large sources. Since the FWHM of the beam at 86 GHz is only about 30" , a 10" pointing error will reduce the amplitude by something like a quarter, which will certainly complicate calibration.

There was some discussion of the status of our ability to do pointing observations. Clark noted that the data collection for single dish pointing works. The program that fits beams to that data to find pointing offsets almost works and the program to reduce the results in terms of a pointing equation exists for the VLA (recently converted to VAX's) and should work for our data. We can start accumulating some data to test the system. Of course the serious efforts to understand the pointing itself must wait for the subreflector and the availability of higher frequencies.

There is an offset of 0.6 degrees in setting of the azimuth encoder. There was some discussion of whether to try to reset this or leave it alone and let the computer

take care of it. The latter option was chosen.

Glitches still occur every 5 to 10 minutes while the antenna is tracking. At a glitch, the antenna moves about 15" and settles in about 1.5 seconds. This is probably a communication problem between the ACU and the control computer. It is not considered serious, but it should be found and fixed when possible.

The possibility of borrowing an optical telescope with a CCD from the 12m telescope was discussed. That telescope is now used to track sources during 300 GHz observations with the 12m. It could be mounted on the VLBA antenna structure and used to monitor tracking and, perhaps, to help in understanding the pointing. The system does not include any software — the image of a star field is displayed on a TV and monitored by eye. To be useful for serious pointing studies, it would be good to have pointing offsets obtained automatically by computer — probably a difficult problem. Also, any problems with pointing that have to do with the subreflector, focus rotation mount, quadrupod, feed cone, or other structure above the backup structure will not affect the pointing seen by the telescope. Clark said that he does not know how well the single dish pointing will work. If it works well, we should not need the telescope. If it does not, we may want the telescope and will want to do interferometer pointing. We should know this summer.

Our knowledge of the polarization and efficiency of the 610/327 system was reviewed. For the first fringe test, there seemed to be no difference between the two polarizations. The second test showed a large difference. It is not clear what changed. Also, at the time of the first test, the efficiency seemed to be lower than expected by about a factor of two. About the time of the second test, the efficiency was near the expected value. Nothing intentional was done to the system in between so there is a question as to whether something changed of its own accord or if there was some sort of operator error. At the end of the NUG run, I made an quick efficiency check and it seemed to be low — somewhat like at the time of the earlier fringe test. We don't have results from the processors on the NUG run yet. This all needs to be checked with more observations.

There was a discussion on how much Mark III testing, as opposed to astronomical observations, would be needed over the next few years until the VLBA correlator is available. It was generally agreed that it would be small, probably not more than a few (of order 10) hours per month. Most testing will be done with the Mark II system and will use the Charlottesville correlator.