JOINT INSTITUTE FOR VLBI IN EUROPE

Report for the third quarter, 1999

Summary

The highlight of the quarter was the formal conclusion of the commissioning phase of the data processor and the start of production operations. On 21 July, two years to the day after the detection of first fringes, the first production version of the control software was released and operations could begin. During the subsequent three weeks, the efficiency of operation reached 27% including test time and clock searches. A much improved version of the first image (of 3C380) was generated using global baselines, and the first science project was processed yielding the first VLBI detection of HI absorption in NGC4261. Thereafter, priority was given to enhancing the control software and in chasing down bugs, in order to make optimum use of Paul Maguire's time before he left the project at the end of the quarter. Considerable effort was also expended in comparing the output of the JIVE correlator with that of its VLBA counterpart for the same data tapes in order to build up confidence in the correlator model and its application.

Other highlights of the quarter included the publication in an EVN Memo of the theoretical model for the tape path of a Metrum (ex-Penny & Giles) tape drive, the release of new post-correlation software producing an AIPS++ Measurement Set from the data output from the correlator.

On the management side, positive news was received from the European Commission in Brussels concerning successful bids for funds from the Fifth Framework Programme in the Access to Major Research Infrastructure and Infrastructure Coordination Network lines.

The post-correlation integrator project continued to make progress this quarter, and the first milestone of writing data to tape was within days of being achieved at the end of the quarter.

The main focus of activity in the MkIV upgrade project during the quarter was preparing the upgrade of the Chinese stations.

A Network Monitoring Experiment was correlated for the first time at JIVE in September and the results prepared by the EVN Support Group for presentation at the TOG meeting on 1 October. The EVN Support Group was also responsible for generating ANTAB calibration data for the September session, as well as supporting the correlation of 5 EVN experiments at Bonn. Nineteen PI's were assisted in preparing schedules for the September session, and 6 PI's spent time at JIVE reducing their data during the quarter.

The institute remained active in research during the quarter with 6 papers published and a further four submitted, 17 talks given at conferences and in other institutes, and supervision given to 11 students.

- Institute

Management

The Management Team met on 12 July and 6 August.

European Commission

The FP5 IHP Access and Infrastructure Cooperation Network proposals submitted to the EC in Brussels were successful. Garrett prepared and submitted contract preparation forms for the new Access Contract; Schilizzi did likewise for the ICN contract. These appear to be in order and the contracts are expected to begin on 1-1-2000. A list of TMR users was sent to Brussels. The final PECO-2 report was accepted by the EC, and the contract is now completed.

The RTD propsal to FP5 was not successful.

Review of the operations of the EVN data processor at JIVE

A review committee copmposed of Walter Alef (MPIfR), Phillip Diamond (Jodrell Bank), Kerry Kingham (USNO), and Jon Romney (NRAO, chair) spent the last two days of the quarter in Dwingeloo reviewing the status of the data processor. Their conclusions were that an impressive amount had been achieved, but that a substantial amount still needed to be completed. They recommended freezing the control software and pushing forward as fast as possible on production correlation in order to get data to the PI's and fully validate the modes now available. Their conclusions will be submitted in written form.

Review of the EVN and JIVE

A self-evaluation report on the EVN was prepared by Schilizzi, Booth, Diamond and Zensus and submitted to the European Science Foundation.

Publications/publicity

Gurvits finalised the publication and distribution of the "EVN and JIVE Annual Report 1998".

Final modifications and several updates were made to the EVN/JIVE Symposium papers submitted to New Astronomy Reviews. The special NewAR issue is expected to appear in December 1999.

Garrett organised and contributed to JIVE's presentations at the ASTRON 50 years open-day. Garrett tested the new mail system via server4.

Personnel changes

Derek McKay resigned from his position as support scientist at Jodrell Bank in July. Paul Maguire moved to Dwingeloo for the 3 month period July to September and left the project at the end of the quarter.

VLBI School

The LOC (Gurvits (chair), Garrett, Gabuzda, Sjouwerman, De Haas, N. Vermeulen) continued preparation for the EVN School (to be held in Dwingeloo, 3-5 November 1999).

Visitors

B. van Dam (Univ. of Leiden), J. Conway (OSO), W. Vlemmings (Univ. of Leiden), M. Tordi (Univ. of Bologna), A. Marecki (Torun), R. Booth (OSO), P. Diamond (NRAL), A. Zensus, A. Roy, Tian Wenwu, Jin Chengjin, Y. Hagiwara, E. Ros, J. Klare, I. Owsianik, T. Krichbaum, M. Reid, R. Porcas, W. Alef (MPIfR), V. Tornatore (Milano), R. Noble (NRAL), F. Mantovani (IRA, Bologna), P. Maguire, J. Romney (NRAO), K. Kingham (USNO).

The large contingent from the MPIfR came to Dwingeloo on 27 August for the second annual JIVE-MPIfR science meeting.

Infrastructure

Garrett assigned computing resources to visiting scientists, monitored e-mail from the generic JIVE account and tested the function of "pine" using the PC mail server. Schonewille updated the JIVE web pages and made new pages for the announcement and registration of the TOG meeting, and for an IAU Symposium on "Galaxies and their constituents at the highest angular resolutions" to be held as part of the General Assembly in August 2000 (Schilizzi is Chair of the SOC). Campbell, Gabuzda, Philips and Sjouwerman alternated in writing the minutes of the monthly JIVE institute meetings.

- Commissioning the EVN/MkIV Data Processor (Bos, Buiter, Campbell, Casse, Hazell, Kamphuis, Kramer, Van Langevelde, Leeuwinga, Maguire, Millenaar, Noble, Olnon, Parsley, Phillips, Pogrebenko, Schonewille, Verkouter, Zwier)

Summary

By the end of the quarter, the commissioning phase of the correlator was declared complete. A large fraction of the software and hardware development is finished and only very few of the originally planned tasks were still open. Work remains to be done on the experiments and tape databases, as well as the correlator configuration software.

The first production version of the control software was released on July 21, exactly two years after first fringes. The first result was a much improved version of the first image, this time using Global baselines. We also processed the first science project, making the first VLBI detection of HI absorption in NGC 4261.

Correlator demos were given in conjunction with the NFRA 50th Anniversary Open Day, the WSRT Geodesy Station Opening, and the Correlator Review Committee visit.

2.1 Correlator Section

Board repairs

All boards with not directly solvable problems have been collected by Bos, Millenaar and Zwier during the last two years. These boards (except one correlator board) have now all been repaired. This has taken a considerable amount of time. A report is being prepared that summarizes the errors found and the debugging effort. We still have to replace the VME bus communication module as the modified version sent by Haystack does not work properly.

Software

Bos has not yet finished the software for the generation of configuration from C3 parameters. The specification and configuration load part has already been integrated with the C3 software during Paul Maguire's visit. This means that the generation, loading and startup of a correlator configuration from C3 works. The next step is the integration of the data distributor.

Pogrebenko developed special scripts to run the station units for Data Distributer tests for Bos and Millenaar.

2.2. Station Units

Pogrebenko, Hazell and Phillips solved the problem of intermittent data corruption in VLBA-mode playback. After an extensive search for a hardware cause, involving the preparation an several diagnostic variants of the TRM software, the fault was traced to an error in the software itself.

Pogrebenko and Parsley solved the clock distribution problem between CRM and TRM modules of the Station Unit. The breakthrough was to use a redundant trace in the backplane and some unused buffers to split clock distribution and halve the number of loads on each CRM driver. This extensive modification will be applied to all units during the next quarter.

Leeuwinga assisted Pogrebenko with the modification of DCMs and DMMs in the JIVE Station Units by redistributing a clock line on the DCMs and placing several termination resistors on the DCMs and DMMs. The SUIMs in the first eight Station Units were fitted with a second serial link transmitter. This second output of the Station Unit was then connected to the correlator. Leeuwinga made a small pcb that will be used for testing the output signals on the SUIM.

JIVE continues to await the return of Station Units and boards rejected back to the manufacturer for repair. AlliedSignal reported substantial progress but a few boards have faults which stubbornly resist diagnosis. They have agreed to implement all known modifications on the rejected boards before return to JIVE.

Phillips correlated data from the FR002 experiment to be used for verifying (astronomically) fanout modes. However it is proving difficult to develop a robust test. Measuring the noise in the closure phase will probably give the best results.

Schonewille assisted with the test of the station units.

Maguire with advice from Pogrebenko, upgraded the SU control software to its current state.

2.3. Play Back Units

The theoretical model for the tape path has been completed and is described in EVNDOC #103. The tape paths of a number of DPU's have been measured using thin tapes from the experiment GL34 at speeds of 80, 160 and 320 ips. The test results show that the tape guiding of the newly adjusted DPU's is excellent and within the predicted values. The guiding tests have also been used for assessing the quality of the tape path of the acquisition units participating in GL34. The end result appeared in EVNDOC #104.

Two stepped headstacks from Metrum have been delivered to us and extensively tested. One of the headstacks showed cracks. It nevertheless meets the specification on the SNR and the geometry.

The process to develop new tape guide caps continued this quarter. The NFRA workshop produced two new stainless steel tape guide caps. These caps will be hardened in a special surface treatment procedure called kolsterising and put on a DPU to test them.

The process of re-adjusting the tape paths of all the DPU's and replacing the non-self-packing take up reels with self-packing versions continued this quarter.

2.4 SUIM/TSPU

One of the spare CLKM boards was assembled for Ari Doorduin to run his tests for Westerbork ADC unit.

2.5 High level control software

Van Langevelde worked on a draft to upgrade VEX to version 1.6. This is important for various aspects in the operations of the data processor. The new definition allows the PI to specify completely at schedule time the way he wants his experiment processed. It also has an improved model for timing scans in which tape motion and telescope motions are cleanly decoupled.

Roger Noble wound down his involvement with the control software this quarter. He completed one new document on the Correlation Job Descriptor, and did a few adjustments to the Status Monitor display during a visit to JIVE in early September. In late September he visited JIVE again to give a presentation on the control software to the visiting review panel.

Olnon worked with Maguire to help him finish as much software as possible before his departure and to learn from him about the various Controller modules. Time was also spent on meetings and discussions with other group members about design and implementation. The rest of Olnon's time was divided almost equally between development and maintenance.

Development

Most work concerned the Correlation_Job_Descriptor (CJD), the central object that describes and directs all processing. Both its creation and its persistence (saving and recreation) are handled in Preparation_Job and were debugged and extended a bit further.

The CJD is first created from the input VEX file, i.e. the scheduling VEX file merged with external information (by Kramer), and then rewritten in its persistent form as an output VEX file.

The user/operator can set more parameters than before via the processing command line or via the Experiments_Database GUI and these settings are now echoed in the output VEX file and can so be read by the re-processing (if not done via the Experiments_Database) and by the off-line processing procedures.

The creation of the CJD's Action_Table and Logical_Arrays (especially the time windowing) and their use in directing the multiple-scan operations were revisited. More information is now read from the VEX file and written into the (persistent) CJD, and less assumptions are being made about regularity, ordering and completeness in the VEX file. Work on that last part is still unfinished, but we can handle most practical situations or make it so by slightly editing the input VEX file.

Maintenance

Olnon's maintenance work falls into two parts: providing testers and operators with appropriately stable and stand-alone JIVE Correlator Control Software (JCCS) Systems, and continuous monitoring of the health and contents of the code database.

On July 20 Olnon made the first JCCS Release, and this was used almost unaltered for the first production operations during the rest of this quarter. End of September preparations started for the second release, that should serve the operators through the end of the year. In the mean time some five Test JCCS Systems were built for developer/testers to work relatively undisturbed by other developments and operations.

Routine monitoring of the changes in the code and testing them in conjunction with the rest of the system (by keeping up the Baseline JCCS System) is necessary to get early warnings of inconsistencies and to be able to compose a working Test System or Release when needed. This includes inspection and backup of the Real-Time components on which the JCCS Systems depends. Olnon also successfully tested moving the code repository from Jodrell Bank to the new HPUX development machine in Dwingeloo. That move can be effectuated any time we decide disturbance to be minimal.

Phillips worked with Olnon, Maguire and Verkouter testing and debugging all aspects of the high level control

software. He also tested and debugged the interface to the CALC program for calculating the correlator model. The initial version of this code did not work in many situations. Further debugging with Maguire identified most of the robustness problems. Phillips tested and verified code by Verkouter and Maguire to automatically include tape playback statistics in the data stream and identified a problem with more than 3 scans per tape pass. Working with Maguire a workaround was developed, though a more robust solution is still required.

Paul Maguire spent most of this quarter working at JIVE in Dwingeloo. Only for a short period of two weeks he went home to work on documentation. Since it was his last leg as JIVE software developer, he tried to get finished as much as possible and got all the support possible from the other people in the data processor group. This included maximum access time to the correlator hardware for testing.

Although most of the projected work on the various software components got done in time, not all of it is ready to be integrated in the operational system. The testing and subsequent bug hunting stages

were cut short in favour of completeness. That was decided to be the most effective way of using Maguire's time and knowledge.

During his last three months Maguire modified almost all modules of the Correlator Control Software. In many places he only made small changes to enhance robustness and to clean up the code. The more significant improvements were in the following areas:

Delay model

The polynomials used to be part of the Correlation_Job_Descriptor (CJD) that is sent around to all Controllers. That massive "broadcast" caused serious performance problems. Maguire designed and implemented the persistent polynomials: The polynomials themselves are stored as Persistent Objects in a database and only their Persistent_IDs are kept in the CJD. Of course Preparation_Job, which CALCulates the polynomials, and the Controllers that need them had to be changed accordingly.

Processing procedure

Maguire enhanced the actual processing procedure in several places. The peaking procedure (positioning all tapes and heads) was further optimized, checkpointing was added to facilitate multiple scans per job and job recovery, the associated scan/pass/subjob logic was revisited, tape statistics now are assembled and passed along with the output data, as well as the channel mappings needed to interpret the data streams in the off-line software.

Processing Control

Maguire modified module Correlator_Control as far as he could to meet the new version of correlator setup, including dynamical (re-)configuration. This area is still under development by Bos. Maguire also made a working version of the Experiments_Database and, most visibly, its GUI. That database communicates with the Tapes_Database and the log-file assembly (maintained by Kramer) and remembers what processing has been done on every experiment. That makes the job for the operators and testers a lot easier. Unfortunately, the current implementation still is not robust enough to be called operational.

Documentation

Maguire wrote documents describing the implementation of the modules Processor_Control, Station_Unit_Control and Tape_Handler.

Verkouter spent time on refining the handling of data coming from the correlators. The software needed (and still needs) to become more robust with respect to errors in the reported BOCF counts in the data. Furthermore, time was spent in trying to do multiple scans in one subjob. Quite a serious bug was discovered and fixed in the Correlator Output Format library. The bug was discovered and fixed within a week, during which luckily no data was produced as data produced during this week would have to be considered lost.

2.6 Post correlation software

Phillips worked with Verkout testing the software for creating AIPS++ measurement sets from the raw data from the correlator. Problems with cross-polarisation correlations were identified and corrected. He also wrote a number of Glish functions to produce tables and make plots based on the tape playback statistics.

Verkouter spent most of his time creating a new release of the software that produces an AIPS++ Measurement Set from the data coming from the correlator. The new version now reads the configuration (and other external information, like source and antennas) from the VEX-files that are written by the on-line system. This is a great step forward to automated translation of the data. Some minor bugs were uncovered and fixed after the production of the first four-polarization-combination experiment was correlated.

2.7 Infrastructure

The DDD computer was installed in the JIVE basement network. It is not switched into operation as that would impose a considerable impact on early operations.

The problem of high humidity in the air for the cooling of the equipment was not solved this quarter. The leaking couplings were not the problem. The next step is a swap of the in- and output water pipes of the cooling block. This swap was already proposed by us for a long time and finally adopted by the external company that has to do the job.

Jan Buiter wrote a memo called: "ESD Control in the Processor, Correlator- and Service room"

Due to a poor design, the automatic fire extinguisher system could not be connected to the main NFRA fire detector system. New cables and an interface unit are needed.

An electricity meter was placed in the JIVE electrical mains cable in order to get a proper view of the JIVE electricity use.

A UPS system for CCC and DDD-workstation was ordered and delivered but not yet installed.

A mobile power generator for emergency use in connexion with the equipment rescue plan was ordered and delivered.

The computer control of the paternoster was modified in such a way that one of the two computers was removed. The control is now switchable between upper floor and JIVE basement by means of a switch installed on the paternoster frontpanel (down)The upper and lower monitors still work in parallel.

Jan Buiter wrote a memo called: "Fire-alarm and other calamities outside working hours"

2.8 Testing and preparing for operations

The comparison between the ~1.5-hr subset of GL034 that was correlated both on the JIVE and VLBA correlators continued. There remained ~450-650ps modelled-delay differences for stations observing at low elevations (i.e., the VLBAs during the subset of data available) and ~0-200ps differences for the EVN stations. In the process of building up a "sensitivity table" for all CALC8.1 parameters, several model components were ruled out as a source of this difference. Actually, the above delay differences are all reduced to less than ~25ps if UT1 is changed by 0.67ms (in the sense of increasing the Earth-Orientation parameter UT1-UTC for JIVE, or conversely decreasing it for VLBA). Although this value is suggestively close to the level of single-precision round-off error for seconds-of-day around the time of these observations, this hypothesis doesn't really fit well with how CALC obtains its times. In the course of following CALC8.1 code in an effort to trace its handling of times, we found that the computation of GAST was not being done according to the recommended IERS procedure (GASTs via both the "old" and "new" ways were being calculated, but the "old" way was being used without having an external switch to control the selection, as exists for the other CALC options). This resulted in <80ps offsets -- not enough to explain the ~450-650 ps differences that the UTC correction apparently improves, nor with the proper UT behavior to reduce the ~<25ps differences after the UTC adjustment.

Comparison of the JIVE model polynomials using the old DCALC-GSPLINE and the new persistent-polynomial methods showed differences of only a couple ps at most.

Independently, we encountered a very narrow range of source positions for which CALC8.1 would crash. This was traced to trying to calculate antenna axis-offsets for the fictitious station at the center of the Earth: the height-based meteorological parameters used in calculating tropospheric refraction returned "nonsense" values for h=-6378km; this occasionally resulted in dividing by the cross-product of two vectors that underflows left as parallel (actually, the "crash" was a little more insidious - it returned all delays/rates as 0 with no warning that an error had occurred). A simple patch was inserted to avoid this (unnecessary) calculation for the CoE station altogether.

Kramer developed a set of programs to be used for a backup procedure on jaw0:

- BackupData : for archiving the raw JIVE correlator data.

- RestoreData: to restore the data to disk again.

- ToBackup : to see which data still needs to be archived.

He also wrote an improved version (1.1) of program log2vex with:

- Calculation of GPS models at middle of observation.

- Cosmetical changes in created vexblocks.

- Handling new time format in logfiles.

- Handling continuous tape movement

Further he created the possibility for the Experiments database software of Jodrell to call log2vex on jaw0, for which a number of changes were made:

- The log, gps and eop files (from Bologna and iers site) are also automatically written to a

directory on jaw0.

- In log2vex a commandline interface was added to tell the Jodrell software which logfiles and

which tapes are arrived.

Schonewille assisted with the operational test of the EVN MkIV data processor and studied operational aspects of the EVN MkIV data processor. He also kept the tape-library up to date.

Phillips verified the full data path into AIPS for the first production release of the online software and assisted Schonewille and Leeuwinga to run the data processor to recorrelate the experiment GL34 including longer baselines from using with the first image. When this was complete Phillips calibrated and imaged the data using AIPS and Difmap to obtain an image consistent with earlier, more sensitive, observations.

Phillips performed initial clock searches for the experiment ES030a, however it was decided not to correlate the experiment since fanout modes have not yet been fully verified.

2.9 Thin Film Head array project

On September 16, 1999 a meeting was held at Haystack Observatory to discuss the situation with the thin film head-array project. Pogrebenko and Casse from JIVE participated in the meeting. The other Institutes participating in the project, NASA and the VLBA, were also represented. The discussion concentrated first on the credibility of the Seagate "route". The confidence of the audience in Seagate successfully completing the thin film head-array project has shrunk to a very low level. It was concluded that a deadline (the end of 1999) was to be set for this venture.

Alternative schemes to achieve the goals set at the beginning of the project were then discussed. A small improvement of the sensitivity of the current inductive headstack systems can be secured by applying some of the results obtained in the course of the TFH project. It seems for instance that with a different contour on the inductive headstack a longer life can be secured. A small improvement of the sensitivity can also be achieved by using partial-response maximum-likelihood methods in the decoding of the data. Another route was presented which is based on new tape recorder technology (using thin film head arrays) and in use, but still with limited bandwidth, in current commercial systems. This development, however, calls for fundamental changes in our systems and can only be realised in the long term.

2.10 Post Correlator Integrator

Kamphuis started working on the recording board DSP software. The implementation was started at the hardware access layer. This layer is required to access and configure the recording boards internal PCI bus and the connected devices. When this was finished work continued on accessing the SCSI controller and implementing the SCSI protocol. By the end of the September the implementation was only a few days away from reaching the first milestone of writing data to tape.

It was planned to order the Pentek DSP board (processing board) at the end of the third quarter, however during the year two similar board where introduced by two other companies. At least one of these board could possibly be an alternative for the Pentek board in providing an easier and more cost effective solution. At the start of the third quarter all three boards will be compared to see which of the three boards is the most useful.

- Dataprocessor operations (Campbell, Kramer, Van Langevelde, Leeuwinga, Phillips, Schonewille, Tenkink)

July 21 1999 a production release was made of the correlator software. From that date we monitor the throughput of the correlator as user experiments are processed. In the first three weeks the focus was on processing data. A re-run of GL34 and two passes of EL023 took two and half weeks. A total of 75 hours of production time was required to yield 28 hours of output data, yielding a peak production efficiency of 37%. This value is set by the time required to start up a scan in combination with the time required to start up the system after various failures. When taking test time and clock searches into account, the production efficiency was 27% during this period.

But the total production efficiency dropped over the summer as remaining software issues were the focus of the group. At the end of the quarter the September Network Monitoring Experiment was processed clock searches on the pilot projects were started. For the next quarter the main priority is to produce data on user

projects, although development cannot be frozen completely.

The data on EL023 yielded the first scientific result obtained with the JIVE data processor. Philström (Onsala) calibrated and mapped the data at JIVE. Later Philström found the first VLBI detection of HI on NGC4261 in the data.

The fact that the production rate was lower than expected, has consequences for the load in future sessions. Especially with a large number of experiments from session 3 coming to JIVE, it will be quite difficult to turn around tapes before the next session. The EVN scheduler was sent adjustments to previous capacity estimates.

- Recording terminal upgrade to MkIV (Spencer et al)

Van Langevelde worked with Himwich and Vandenberg (GSFC) on the requirements for the VEX 1.6 definition. This transfer file format revision is necessary for a number of reasons. Planned enhancements deal with improved communication from the PI to the station and a better scan schedule which includes e-VLBI capabilities.

Van Langevelde discussed with Himwich the ways to schedule the new VLBA4 formatters and VLBA4 recorders.

A meeting of the EMU group was held on 1st October at Dwingeloo. Minutes were taken by A. Foley and are being distributed. The main points to emerge from this meeting together with further developments since are as follows:

Formatters

MkIV upgrade

The full draft formatter manual has now been delivered from GMR and is being evaluated before final payment.

The 16 and 8 MHz passbands have been improved by the replacement of switching diodes and resistors. Checks will continue to be made on performance of these filters as data become available.

Narrow band filters to give 8 complete filter sets at each station (upper sideband only) have been installed.

Provision of the extra formatter capability (barrel roll etc.) and fixing existing formatter bugs is largely a software job. The timing glitches problem require thorough investigation. It is proposed to set

up a specialist team to look into this.

VLBA upgrade

All stations using VLBA DAQs were asked to check if they have old or new style monitor boards and inform MPI Bonn, where new design boards are available.

Formatters (and crates) are about to be delivered from MPI to the observatories.

There is still a problem with the production of the head assembly units. Kits have been produced by Metsähovi but component insertion and cable connection needs to be done.

4 units are required for the European stations, and 2 for China. In view of the urgency for China the latter 2 are being assembled at NFRA, after negotiation between Schilizzi and Van Ardenne. Commercial firms have been identified who can manufacture the rest if funds are available.

It is expected that formatters will be installed in the European stations in January. Modification to the samplers also needs to be made before that time. Checks using a local tape test (using the VLBA DQA) should also be made at that time. A VLBA-MKIV switch-over test will be made at the end of the Feb/March session with a fringe test.

VLBI/RealTimeCorrelator

Verkouter has taken over the support for and the development of the e-VLBI project after Derek McKay left Jodrell Bank. On August 13th, NASA's Jet Propulsion Laboratory has released their software correlator code. Verkouter obtained a copy of this and the aim is to use this code to produce cross-correlation functions. In order for that to work some work still needs to be done.

China Upgrades

Terms of agreement with the Chinese have been arranged by Gurvits, and the contract to supply Urumqi and Shanghai with MkIV upgrade. The contract requires minor modification before being signed. The date on the contract is 31st January, Equipment has to be in China within a month of that date.

Parts are being collected at Bonn, the head assemblies for China are being produced at NFRA (see above), and then will be sent to Bonn for testing. All equipment will then be collated at JIVE before being shipped off.

The provisional timetable for the visit of Team China is in March/April 2000, after allowing sufficient time for the delivery to take place. This needs to be agreed with our Chinese colleagues, and in good time for visa procurement.

Gurvits continued preparation for shipment in China MkIV Upgrade Kits for Shanghai and Urumqi Observatories. According to the decision by EVN TOG and EVN CBD, the installation of the kits will take place in March-April 2000.

High data Rates (>256 Mbit/sec)

Initial tests have been made at Westerbork. 512 Mbit/sec recording with 2 headstacks proved successful, but unreadable at 320 ips on one headstack. The new design headblock was needed for 320 ips. Tests by Smythe showed that many headstacks had one or two heads which did not work at 320 ips, (for both METRUM and Spin-Physics headstacks), however the headstacks were still usable without too great a loss of data (particularly if barrel roll was available).

Preliminary planning indicates that we should be testing 2 headstack-512 MBit/sec in the network next autumn, 320 ips recording tests will come later following installation of new head blocks. The latter should be installed if any repairs e.g. to the inchworm necessitating removal of the old head block are required.

- EVN Support Group Activities (Campbell, Desmurs, Gabuzda, Garrett, Gurvits, van Langevelde, Massi, Sjouwerman)

5.1 Network Monitoring, Reliability and Performance

Sjouwerman acted as PI for both the 6 and 18 cm Network Monitoring Experiments (NME) in session 3/1999. The 6cm Network Monitoring Experiment was correlated at JIVE (Sjouwerman & Campbell), in preparation for the TOG meeting 1-2 October.

Massi continued to monitor the instrumental polarization at the EVN stations. The NME's at both 6cm and 18 cm of session 1999/2 were correlated to completion (in pseudo mode C) and processed in AIPS. The D-terms have been posted to the "EVN Instrumental Polarization tables" available on the EVN Operations web page.

5.2 Calibration

During this period, Desmurs generated the ANTAB calibration files EVN session 1999/3.

Desmurs started to develop a new program in PERL replacing the function of the LOG2ANT software. The long-term aim is to include it in a future version of the FS. At the moment a Beta version is ready. It works only with the new FS format files. It has been tested successfully on the log files produced by Effelsberg and

Medicina but further testing and development is required.

Garrett provided extensive feedback to Desmurs regarding errors in the format of the ANTAB calibration files. A post-correlation analysis of the performance of the EVN during the 18 cm NME experiments (session 3/1999) was made and a report distributed via EVNtech. From the same data set problems with the labeling of the FITS file produced by the JIVE DP system were uncovered.

5.3 Data Correlation

Campbell continued to support the correlation of EVN projects at the MPIfR correlator in Bonn. The recorrelation job finished for experiment EK009A. Correlation of experiments EF006, EC010, and EL020B from session 1999/2 began. By the end of the quarter EF006 has been completed and the PI notified. DATs containing the MkIII-correlated data for ET003A,B in HOPS format were generated at the PI's request.

5.4 Observing and Telescope Support

Desmurs took part to the geodetic observations "CORE B 504" with Yebes.

5.5 General Network Support

Sjouwerman generated the Experiment Feedback Facility web pages for the September EVN session and updated some EVN web pages. Garrett maintained the EVN WWW pages. Sjouwerman also maintained the EVNtech VLBI exploder and PC-SCHED software.

Sjouwerman revived the AIPS demonstration scripts originally used for the last EVN VLBI School (No. 3). These were updated in preparation for use in the next school at JIVE (November 1999).

Gurvits discussed with the directors of the Crimean Astrophysical Observatory (CrAO) terms of the continuing collaboration of the Simeiz radio telescope with the EVN. A letter from CrAO to this effect has been sent to the EVN CBD Chair.

5.6 EVN PI Support

5.6.1 Scheduling

Sjouwerman helped in the scheduling of project ES034A, and, together with Vermeulen (NFRA), he helped in scheduling some UHF VLBI projects observed in session 3/1999. Desmurs also actively helped the PIs of

UHF EVN observations during the September session. In all 12 UHF projects were supported: EO004A/B/C, EV008A/B, EM034, EP031A/B EP030, EB015A/B, and VAH1. In addition, Sjouwerman, van Langevelde, Gabuzda and Garrett supported several other experiments in session 3, viz. EK009B, EP027, W018, GM035C, EY004C, EY005C.

5.6.2 Support of Visitors to JIVE

Gabuzda provided data calibration and analysis support for EVN experiments EC007 (P. Cassaro), EF004 (M. Tordi), EM028 (A. Marecki), ET003 (V. Tornatore), EP025 (A. Thean), EM021 (F. Mantovani), and EM025 (F. Mantovani). Sjouwerman maintained the JIVE visitor friendly workstation environment with its standard settings and setups. He installed the new test version of AIPS (15OCT99) and the associated "midnight job".

- Space VLBI

As a member of VISC and an EVN representative in the VSOP Science Operation Group (VSOG), Gurvits participated in preparation for the release of the VSOP AO3 (released in August 1999). He continued to participate in scheduling and planning of the HALCA operations and observing programme for the period through early 2000. He also took part in the activities of the VSOP Survey Working Group and attended its data reduction workshop at ISAS (Japan, July 1999).

Gurvits participated in the ESA ISS-SVLBI study in his capacity as project scientist. During the third quarter of 1999, the study concentrated on the analysis of critical technologies for the ISS-SVLBI mission. In another second generation Space VLBI activity, he participated in the VSOP-2 pre-kick-off coordination meeting (ISAS, July 1999) and gave a presentation on the Space VLBI activities in Europe.

Gurvits continued to fulfill duties of the RISC (RadioAstron International Science Committee) secretary and prepared a RISC meeting in Moscow (held 08 October 1999).

Gurvits attended VISC, IACG and GVWG meetings (Toronto, August 1999) dedicated to various aspects of Space VLBI activities and gave there several presentations.

- Research

Campbell

A new movie illustrating global seasonal/solar-cycle/local-time dependence of the peak-height of the F2 layer was made, complementing existing ones for global vertical TEC and slant TEC/Faraday rotation as seen from selected stations.

Campbell collaborated with S.Britzen on multi-epoch observations of the OVV PKS 0420-14.

Desmurs

He attended the URSI meeting held in Toronto (Canada) on 13th to 21th of August. He participated more specifically at the session J2 on "very high resolution imaging in VLBI" and presented an oral contribution and a poster.

The reduction of the project ED011A follow. Now three sources have been reduced but the quality of the data do not allow a very high dynamical range and only few maser spot are visible in the maps. (This project concern H_2O maser in the outflow of Young Stellar Object). Of the 9 antennas initially requested only 5 gave valuable data and this goes down to 3 for some sources of our project.

He submitted a new proposal to the VLBA (PI: C.Sanchez-Contreras) on SiO masers in evolved stars and prepared the schedules of the project CC011 for the CMVA (PI: F.Colomer) on SiO masers at 86GHz in AGB stars. The project will be observed on October 23th.

Gabuzda

Most of Gabuzda's research time was spent supervising research projects undertaken by the following post-graduate and undergraduate students:

A. Pushkarev (ASC, Moscow), PhD, VLBI Polarization Properties of a Complete Sample of BL Lac Objects; Mr. Pushkarev arrived for a several month stay at JIVE as a summer student at the end of May. During his stay, he constructed images at 15, 8, and 5 GHz of about ten sources in a complete sample of 34 BL Lacertae objects. These images revealed a number of interesting total intensity and polarisation structures, including evidence for a helical magnetic field in the curved jet of 0823+033.

P. Cassaro (Univ. Catania, Italy) -- JIVE summer student, arrived for a several month stay at the end of May to work on EVN+MERLIN Observations of several BL Lac Objects

P. Kochenov (ASC, Moscow), PhD, Polarization Intraday Variability in Compact AGN; D. Gabuzda, P. Kochenov (ASC), R. Kollgaard, and T. Cawthorne submitted their paper "VLBI and VLA Observations of Intraday Polarization Variability in 0917+624 and 0954+658" for publication in Monthly Notices of the Royal Astronomical Society.

A. Sergeev (ASC, Moscow), PhD, VLBI Properties of X-ray BL Lac Objects

D. Vir Lal (Indian Institute of Astrophysics, Bangalore), PhD, VLBI and VLA studies of a Matched Sample of Seyfert Galaxies. Gabuzda worked closely with Vir Lal during her stay at the IIA in August; the global VLBI observations of the Seyfert Galaxies indicated the nearly universal presence of a compact VLBI core, and a number of cases of clear one-sided milliarcsecond-scale jets, suggesting the presence of relativistic motions in these sources.

N. Garnich (Sternberg Astronomical Institute, Moscow), undergraduate research student, Study of Self-Calibration Algorithms and Second-Epoch Global VLBI Observations of a Complete Sample of BL Lac Objects

In addition, Gabuzda constructed 22-GHz total intensity and polarisation images of seven compact BL Lacertae objects from global VLBI observations involving the VLBA and Effelsberg. These confirmed the general tendencies observed previously at lower frequencies, and also provided evidence for twisted jets in several of the sources.

Garrett

Garrett continued to prepare for EVN observations of the Hubble Deep Field (scheduled for session 4/1999). NEOS VLBI observations of J1241+6020 were requested and an accurate position provided by Marshall Eubanks (USNO). This source will be the primary delay/rate/phase calibrator, lying within 1.5 degrees of the HDF. Searches for "secondary" calibrators within 0.5 degrees of the field were made by Garrington using MERLIN. Two reasonable candidates have been identified. Work continued with De Bruyn (NFRA) on WSRT observations of the Hubble Deep Field. A total of 72 hours of data have been obtained. The data quality is good on all runs and we are confident of surpassing the previous best WSRT image in terms of rms noise level.

Garrett began to consider further the incorporation of SKA within a global VLBI Network. The first realistic simulations of SKA within a VLBI network were produced and the results presented (see publications). A strong argument was made for extending SKA itself to global dimensions. The current "nominal" configuration is limited to a maximum baseline of 1000 km. With 80% of the collecting area contained within 50 km, the resolution of SKA will be too poor to resolve most of the microJy source population unless sensitivity is compromised (by uniformly weighting the data). The ideal configuration which satisfies both the high and low resolution camps is for 50% of the collecting area to be contained within 50 km and for the remaining 50% to be scattered across the globe.

A global (including Arecibo) VLBI proposal requesting observations of the gravitational lens, 2016+112, was submitted (PI - Porcas, MPIfR).

Gurvits

Gurvits together with K.Kellermann and S.Frey continued to analyse the "angular size - redshift" relation for milliarcsecond radio structures in quasars based on the VLBA survey at 15 Ghz.

Gurvits collaborated with A.Lobanov (MPIfR) on the data reduction and analysis of the VSOP observation of the high-redshift quasar 2215+020. The paper is in preparation.

Gurvits finalized imaging and analysis of data from the pre-launch VLBA observation of 380 VSOP survey sources at 5 GHz (project BH019). The paper is in the final preparation stage.

Gurvits collaborated with S.Frey on VSOP study of the source 0235+164 (observation of 30-31.01.1999). The results have been presented at the URSI GA (Toronto, August 1999).

Gurvits continued to act as a guest editor of Advances in Space Research, the COSPAR scientific journal.

Gurvits has investigated simulated VLBI observations involving SKA and a next generation Space VLBI mission (SVLBI-2). The paper describing this study has been submitted to the Proceedings "Perspectives on Radio Astronomy".

Gurvits assisted in preparation of the schedule for the experiment ES034 (study of milliarcsecond structures in $z>4$ quasars). The observations have been conducted during the September-1999 EVN session.

Gurvits attended XXVIth URSI GA (Toronto, Canada) and gave there three presentations at the workshop of Comm J "Very high resolution in VLBI".

Gurvits participated in the conference "New Millennium in Galaxy Morphology" (Johannesburg, South Africa) and gave there a presentation on recent VSOP results.

Van Langevelde

Van Langevelde continued with Vlemmings (Leiden) on the interpretation of phase referencing data on circumstellar OH masers. A draft paper was written, but a problem was discovered in the accuracy of the a-priori positions of the phase reference sources. This was further investigated with the help of Beasley (NRAO). As a result a strong confirmation was obtained of a long standing prediction that the OH maser can amplify the stellar image.

Vlemmings also started on a project to study polarization of H2O masers in circumstellar shells, supervised by Diamond and van Langevelde.

Van Langevelde collaborated with Philström on JIVE data on the HI absorption in NGC4261. The detection of the line on the Jb-Wb baseline seems to associate it with the counterjet. A discussion on the interpretation of this result was started with other project members (Conway, Jaffe, Schilizzi).

Massi

In Massi et al. (1999) we discuss a set of three consecutive VLBI observations of the binary system UX~Arietis. The most interesting result of these observations is the variation with time of the source structure. The usual interpretation in terms of gyrosynchrotron emission from relativistic electrons trapped in a magnetic loop and undergoing collisional and radiative losses is not able, alone, to explain the observed variations. By using optical and radio information we have produced a model of two giant loops anchored on a rotating star. As the star rotates, the loops change their relative position and orientation with respect to the line of sight, causing the observed variation of the source structure. The qualitative agreement found is consistent with our hypothesis and makes these observations a sort of a pilot experiment for a new way of using VLBI to investigate in detail the structure of stellar coronae.

In order to quantitatively test our model of evolving electrons confined in loops anchored on a rotating star, we (Massi, Franciosini, Ros) proposed to observe the system UX Arietis with VLBA at 5 GHz during 7 consecutive days, 6 hr each, with dual polarization and carrying out phase-referencing to track the radio structure in great detail along one rotation period (6.4 days).

For the same deadline (1 October) we (Ribo, Massi, Marti,Paredes,Ros) have re-submitted a proposal to the EVN for observing a selected sample of radio X-ray binary sources (REXRB). The targets have been identified by means of a selective cross-correlation between the NRAO VLA Sky Survey (NVSS) and the ROSAT All Sky Survey (RASS).

Phillips

Phillips spent a little time processing 100 GHz single dish data obtained at Onsala Observatory in May.

Sjouwerman

Sjouwerman and Sandqvist (Stockholm) continued to work on VLA observations of all four 1.6 GHz maser lines of the OH molecule in the Galactic center. Sjouwerman reduced VLA data on 22 GHz water masers in the Giant Molecular Cloud M-0.13-0.08 in the Galactic center, two VLA data sets of 1720 MHz OH masers in the Galactic center which were taken in a time span of 12 years, and a 1190 MHz WSRT observation in order to attempt to detect the OD radical in absorption. A paper on H2O and SiO maser searches in OH/IR stars in the Galactic center was submitted to A&A.

- Education and training

SUPERVISION				
Staff member	**Student**	**Institute**	**Degree**	**Subject**
Gurvits	B. van Dam	Leiden Univ.	Masters	VLBI studies of high-redshift radio galaxies
Gurvits	S. Frey	FOMI	PhD	
Gurvits and Vermeulen	Z. Paragi	FOMI	PhD	
Gabuzda	A. Pushkarev	ASC, Moscow	PhD	Polarization Properties of BL Lac Objects
Gabuzda	P. Kochenov	ASC, Moscow	PhD	Polarization Intraday Variability in Compact AGN
Gabuzda	P. Cassaro	Univ. Catania, Italy	PhD	BL Lac Objects
Gabuzda	A. Sergeev	ASC, Moscow	PhD	Properties of X-ray BL Lac Objects
Gabuzda	D. Vir Lal	Indian Institute of Astrophysics, Bangalore	PhD	VLBI and VLA studies of a Matched Sample of Seyfert Galaxies
Gabuzda	N. Garnich	Sternberg Astronomical Institute, Moscow	Under- graduate research student	Study of Self-Calibration Algorithms and Second- Epoch Global VLBI Observations of a Complete Sample of BL Lac Objects
Van Langevelde	W. Vlemmings	Leiden Univ.	PhD	Astronomy of OH masers
Schilizzi	W. Tschager	Leiden Univ.	PhD	Peaked spectrum sources

- Meetings, work visits, symposia, conferences

Meetings, work visits, symposia, conferences		
Third Quarter 1999		
meetings, work visits, symposia, conferences	**date**	**name**
MPIfR, Bonn, Germany	1-3 Jul	Campbell
VSOP-2 coordination meeting, ISAS, Sagamihara, Japan	8-9 Jul	Gurvits
VSOP Survey Working Group workshop, ISAS, Sagamihara, Japan	10-13 Jul	Gurvits
Work visit to ASC, Moscow, Russia	15 Jul	Gurvits
MPIfR, Bonn, Germany	19-23 Jul	Sjouwerman
VEX definition meeting, Jodrell Bank, UK	20-22 Jul	Van Langevelde
Metrum Information Storage ltd., Wells, UK	22-27 Jul	Parsley
Collaborative work with PhD students P. Kochenov and A. Sergeev and undergraduate research student N. Garnich, and researcher Yu. Vetukhnovskaya, Moscow	28 Jul-5 Aug	Gabuzda
Collaborative work with P. Shastri and PhD student D. Vir Lal, IIA, Bangalore, India	7-23 Aug	Gabuzda
URSI, Toronto, Canada	14-21 Aug	Desmurs, Gurvits Van Langevelde Schilizzi
VISC meeting, Toronto, Canada	19 Aug	Gurvits, Schilizzi
IACG Panel on SVLBI, Toronto, Canada	21 Aug	Gurvits, Schilizzi
Global VLBI WG, Toronto, Canada	21 Aug	Gurvits, Schilizzi
IAU Colloquium 177 "Pulsar Astronomy - 2000 and Beyond", Bonn, Germany	30 Aug - 3 Sep	Campbell
MPIfR, Bonn, Germany	1 Sep	Campbell
JENAM, Toulouse, France	6-9 Sep	Gabuzda
"Plasma Turbulence and Energetic Particles in Astrophysics", Krakow, Poland	9-11 Sep	Gabuzda
"New Millennium in Galaxy Morphology", Johannesburg, S.A.	13-19 Sep	Gurvits
Thin film heads project meeting, Haystack, USA	16-17 Sep	Casse, Pogrebenko
Work visit and colloquium at HartRAO, Hartebeesthoek, S.A.	11-20 Sep	Gurvits
"NOVA dag", Amsterdam, NL	27 Sep	Schilizzi Sjouwerman

- Presentations

Campbell

"Pulsar Astrometry and the Ionosphere", Dwingeloo-Bonn VLBI science meeting, Dwingeloo, 27 Aug

"VLBI determinations of pulsar parallax, proper motion, and position", IAU Colloquium 177, Bonn, Germany, 2 Sep

Desmurs

"New Results on 43 GHz VLBA SiO Masers Observations in AGB stars", URSI, Toronto, Canada,

18 Aug

Gabuzda

"The Parsec-Scale Magnetic Field Structures of Active Galactic Nuclei," seminar at the IIA, Bangalore, 20 Aug

"High-frequency VLBI Polarization Observations of Compact BL Lac Objects", Dwingeloo-Bonn VLBI science meeting, Dwingeloo, 27 Aug

Invited talk "VLBI Jets and BL Lac Objects," JENAM, Toulouse, 8 Sep

Invited talk "The Magnetic Field Structures of Parsec-Scale Jets: Shocks, Turbulence, and the Surrounding Medium", Krakow 10 Sep

Garrett

"New radio results on the HDF and M82", Dwingeloo-Bonn VLBI science meeting, Dwingeloo, 27 Aug

Gurvits

"Milliarcsecond radio structures in extremely high redshift quasars as seen from Space", Toronto, Canada, 18 Aug

"Dual frequency VSOP observations of AO0235+164", Toronto, Canada, 18 Aug

"Space VLBI and the International Space Station", Toronto, Canada, 18 Aug

"On the European involvement in the next generation SVLBI mission", Toronto, Canada, 21 Aug

"Space VLBI as a tool for studying the early Universe: first results and prospects", Johannesburg, S.A., 16 Sep

"Global and Space VLBI at the threshold of 21 century", Hartebeesthoek, S.A., 20 Sep

Van Langevelde

"The EVN MkIV Data Processor at JIVE", URSI, Toronto, Canada, 17 Aug

"Scientific results from the JIVE correlator", Dwingeloo-Bonn VLBI science meeting, Dwingeloo,

27 Aug

Schilizzi

"A morphological and spectral study of peaked spectrum radio sources", URSI, Toronto, Canada,

18 Aug

"Report from JIVE", URSI, Toronto, Canada, 19 Aug

- Publications

Published:

F. Colomer, J. Cernicharo, J.-F. Desmurs, A. Baudry, "VLBI observations of SiO masers at 43 and

86 GHz", 1999, Abstract URSI XXVIth General Assembly, August 13-21, commission J2.P.20, p 571.

C.Cosmovici, S.Pogrebenko, S.Montebugnoli. "Searching for the 22 GHz water line in extrasolar planets", Geofisical Research Abstracts, Volume 1, Number 3, 1999, 24th General Assembly for Space and Planetary Sciences.

C.Cosmovici, S.Pogrebenko, S.Montebugnoli, "The 22 GHz water maser line: a new diagnostic tool for extrasolar planet search", Abstract book of the conference Bioastronomy 99, Hawaii, August 2-6, 1999.

J.-F. Desmurs, F. Colomer, V. Bujarrabal, J. Alcolea, "New Results on 43GHz VLBA SiO Masers Observations in AGB stars", 1999, Abstract URSI XXVIth General Assembly, August 13-21, commission J2-20, p 560.

Garrett, M.A. "Limitations of ad hoc SKA+VLBI configurations & the need to extend SKA to trans-continental dimensions", To appear in: Scientific Imperatives at centimeter and meter Wavelengths, eds. M.P van Haarlem and J.M. van der Hulst, 1999 (Dwingeloo, NFRA).

Popular

"VSOP: the dream comes true (a European view)" Gurvits L.I., ISAS News Bulletin No. 221, 1999.8, p. 25-26 (in Japanese)

Submitted:

D. Gabuzda, P. Kochenov, R. Kollgaard, T. Cawthorne, "VLBI and VLA Observations of Intraday Polarization Variability in 0917+624 and 0954+658" Monthly Notices of the Royal Astronomical Society.

L.I. Gurvits, "Toward sub-millijansky radio astronomy with sub-milliarcsecond angular resolution (or SKA as

seen from Space)", 2000, in Perspectives on Radio Astronomy, ed. M. van Haarlem, in press

L.I. Gurvits, R.A. Preston, H. Hirabayashi, "Space VLBI as a tool for studying the Early Universe: first results and prospects" Astrophysics and Space Science, submitted

Massi, Franciosini, Paredes, Estalella "Investigation of stellar loop structures using VLBI" 1999, New Astronomy Reviews. Proc. 4th EVN/JIVE VLBI Symposium, eds. M. A. Garrett, R. Campbell, L. I. Gurvits.