

JOINT INSTITUTE FOR VLBI IN EUROPE

Report for the second quarter, 1999

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1. Institute

First image from the EVN data processor

The highlight of the quarter was the production of the first image from the data processor, of the quasar 3C380.

European Commission

Three submissions were made to the EC in response to the Call for Proposals for the Fifth Framework Programme:

1. Access to Research Infrastructures, Garrett on behalf of the EVN
2. An infrastructure cooperation network in radio astronomy, coordinated by Schilizzi
3. An RTD proposal "Signal processing and transport in radio astronomy" coordinated by Diamond.

Review of the EVN and JIVE

The European Science Foundation has agreed to the request by NWO to carry out a review of the activities of the EVN and JIVE. This will start in November 1999.

Publications/Reports

Garrett finished editing and refereeing papers for the EVN/JIVE symposium *New Astronomy Reviews* (special issue). A total of 54 papers were submitted electronically to NewAR. A table of contents, LOP and preface were also submitted. A symposium web page presenting PS and PDF versions of all the papers submitted to NewAR was also created.

Gurvits edited, and prepared for publication, the "EVN and JIVE Annual Reports for 1998".

Schilizzi and Gurvits prepared a report on the activities carried out under the KNAW grant for Dutch-Sino collaboration in radio astronomy (1996-1998).

Personnel changes

Dr Robert Campbell began his appointment in the Science Operations section of the Data Processor group in April.

Infrastructure

Sjouwerman, Philips, Gabuzda and Campbell altered in writing the minutes of the monthly JIVE institute meetings. Schonewille is responsible for the JIVE web pages. Garrett assigned computing resources to visiting scientists and monitored e-mail from the generic JIVE account.

Conference/meeting organisation

1. "Perspectives on Radio Astronomy", Amsterdam and Dwingeloo, April 1999, LOC, Gurvits.
2. EVN VLBI School to be held in Dwingeloo, 03-05 November 1999, SOC/LOC, Gurvits (chair), Garrett.

Visitors

R. Booth (OSO, Sweden), I. Snellen (IoA, UK), I. Fejes (FOMI, SGO, Hungary), A. Lobanov (MPIfR, Germany), M. Norbury, B. Anderson (Jodrell Bank, UK), P. Hazell (UK), A. Pushkarev (ASC, Russia), B. van Dam (Univ. Of Leiden, NL), P. Maguire (JIVE/NRAL, UK), K. Mujakawa, A. Richards (Jodrell Bank, UK), J. Yates (Univ. of Hertfordshire), P. Cassaro (Univ. of Catania, Italy), W. Aldrich (Haystack, USA), M. Filho (Univ. of Groningen), J. Conway (OSO, Sweden)

- Data Processor Group: Commissioning the EVN/MkIV Data Processor (Anderson, Bos, Buitter, Casse, Kamphuis, Kramer, Van Langevelde, Leeuwinga, Maguire, Millenaar, Noble, Olton, Parsley, Phillips, Pogrebenko, Schonewille, Shepherd, Tuccari, Verkouter, Zwier)

Summary

Highlight this quarter was the first image produced on the EVN MkIV data processor at JIVE. By reaching this milestone the entire datapath is basically verified. Subsequently, many parts of the software and hardware needed to be polished up to come to a cleaner data product and move towards streamlined operations. A lot of progress was made in this area, although the end of this activity was not reached before the end of the quarter.

Behind the scenes, behind the row of DPUs in the JIVE basement, work continued on several problems in the SUs. These have mostly been solved, improving the overall reliability.

In this quarter the data distributor was installed and tested in the basement.

2.1 Correlator Section

The data distributor hardware is installed and connected to two correlator units for the first tests. The tests by Bos, Millenaar and Zwier showed a problem that occurred only at 32 MHz clock rate. It took considerable time to find out that it was a bad production batch of a bus driver. The hardware will be integrated in the next quarter when the software required is ready.

The correlator status interface and the setup interface software has been integrated with the correlator control software. This makes it possible to configure the correlator from the correlator control computer (C3). A set of fixed hardware configurations for 8 stations has been implemented for the first correlation run. A large

fraction of the configuration software has been written by Bos and is due to be tested in the next quarter. This package will integrate the data distributor and provide the tools for correlator resource management.

The DSP software provided by Haystack has been adapted to our needs. The access to the low level DSP routines has been integrated in the existing test program of the correlator hardware and tested. The routines and tasks to be added by us have been defined and the implementation has started.

Phillips identified a problem with the validity counts of data from the correlator. Even when no valid data was on tape, the correlator still gave approximately 25% validity.

2.2. Station Units

Flat line and data shift problems identified during the previous quarter were investigated further by Pogrebenko and Parsley. Initial work concentrated on the TRM Xilinx which was found to have an xblox counter that could lock up. When this was replaced the flat line problem was cured but data shifts remained. Further investigation of clock distribution and termination resulted in a fix for this problem too.

The first production Station Units for Haystack Observatory were built by AlliedSignal. A number of problems were encountered which JIVE, as design authority, agreed to investigate. These were:

- Flat lines and data shifts
- Correllator frame header errors
- ROT stops
- General data quality problems

A sample unit was delivered to JIVE and Will Aldrich visited to assist. Hazell (Avonsoll Ltd) assisted the investigation by providing many diagnostic variants of the DCM micro code and Leeuwinga implemented numerous delicate trial modifications. After two weeks of intensive work much useful information had been gathered but none of the problems had been solved. Finally, working alone, Pogrebenko solved the problem of ROT stops by changing the distribution of one clock line. This change also seems to have eliminated the frame header errors. TRM data shifts remain to be fixed; the changes that fixed these problems in the JIVE units are not successful in the Haystack units.

Schonewille and Leeuwinga assisted with the test of the station units.

JIVE still awaits the return of Station Units and boards rejected back to the manufacturer for repair. AlliedSignal had hoped to use test facilities in place for the Haystack units but data quality problems have prevented this.

Hazell continued to wrestle with ISI pSOS but we remain unable to build Station Unit software at JIVE, using the tools purchased from BESTools (at a cost of f25k). Olon spent some time mediating between Phil Hazell

(working on SU control software) and the pSOS support people.

Metrum Information Storage manufactured 18 Phase Cal Modules and Parsley visited to witness the factory acceptance tests. Two minor problems were encountered

- The PCM micro would sometimes crash due to a stack error. This problem was cured by a small change to the software.
- The PCMs did not report their serial number and, in any case, Metrum had not wired the serial number coding header. This will be corrected before delivery.

Phillips and Parsley verified that Maguire was using the correct configuration for the CRMs in 1 and 2 bit fanout modes.

2.3. Play Back Units

In order to better understand the properties of the tape path of the DPUs, a theoretical model for finite element analysis has been constructed and a number of simulations have successfully been run. The software package used for the structural analysis is ANSYS.

The investigation of the problems in a number of DPUs with the capstan motor were completed this quarter. Jan Buiter traced the problem back to a poorly matched connector pair inside the motor.

The new Tape Guide Caps made from the material Shapal-M have been returned to Metrum because of problems with the mechanical mounting on their shafts. The M3 thread in the cap collapsed after moving the screw in and out a couple of times. Metrum has produced a solution to the problem that needs careful checking at JIVE.

The process of re-adjusting the tape path of all the DPUs which involves also the replacement of the non-selfpacking take up reels by a self-packing ones continued this quarter. Four DPUs have by now been completed.

All but one headstacks for position 2 (away from capstan) have been adjusted and are ready for mounting on the DPUs.

2.4 SUIM/TSPU

Andrea Maccaferri and Sandro Cattani spent about two months moving SUIM/TSPU projects from UNIX-based ViewLogic to a PC-based one. In May they visited JIVE and brought with them a package containing the full technological documentation for two major boards (SUIM and TSPM/CLKM), one small (PLL32/18) and 12 large scale XILINX chips. They successfully mounted the package on a JIVE PC.

Re-routing of several XILINX chips showed full compatibility between old UNIX-based design and the new one.

A preliminary revision of the documentaion was supplied to Haystack, but since they received the CD-ROM, the functionality of SUIM was changed to enable a better way of validity bit handling.

A long standing problem of TSPM serial link crashes was cleaned by Sandro Cattani as well: he made a couple of broad-band transformers to de-couple cable connections between the TSPU digital boards and the splitter boxes. The solution was tried for quite a long time and it appeared that crashes no longer affect the TSPU.

2.5 High level control software

This quarter Olon completed the first version of the "persistent CJD" code. This software converts the Correlation Job Descriptor, which at run time contains all the information the Correlation Job needs, into a VEX-formatted file which is stored together with the data produced by the Job. This ASCII file effectively is the job log and could be used to rerun the job instead of the original VEX-format scheduling file plus the additions from other information sources. The current version cannot yet accommodate all the flexibility in the CJD, but should be enough for the early operational situation.

Olon also made some minor alterations and additions to the code associated with VEX/CJD. This usually concerns additional data to be stored and accessed, or different ways of doing so. These changes were prompted by the testers' activities as well as by the requirements of the latest software developments themselves.

Verkouter finished implementing the first version of the Correlator Output Format (COF) in the data_handler. The output of the correlator is now written in this hierarchical format. This format was designed to be the standard output format for the EVN MkIV correlator. It will also be the format which will be archived.

At Jodrell Bank, this quarter has been spent largely consolidating existing code prior to the end of Paul Maguire's contract. A major new addition, though, was the combining of the delay model into Preparation_Job. Maguire completed new code in the following areas:

1. Processing_Job now has a new GUI giving more information about the state of the tapes.
2. The code necessary to call the delay model (currently CALC) directly from Preparation_Job.

He also modified Correlator_Control to enable it to handle a new format status message from the Correlators, and Processor_Control to pass that information on to Status_Monitor.

Noble added code to SU_Monitor to enable it to send information to the controller for the activity display world map. This required some changes to be made to SU_Control (done by Maguire), Status_Monitor and associated messages.

Noble added a graphical component to Status_Monitor for the Data Distributor (DDU), and displays for the detailed Correlators, TSPU and DDU status information.

In May Maguire visited JIVE and tested and debugging a large number of new modules started. The improved way to deal with the correlator model, a new processing job interface and correlator control all needed to be tested out. Initial testing was done by Van Langevelde, later Phillips took over. During and following Maguire's stay, a multiple-scan job was attempted and finally run on the Processor for the first time. This required some minor changes to SU_Control to handle the requirements of the Station Unit in this case.

Finally, Noble completed the design for the controller for the activity display world map. This was the last piece of detailed design left to do.

Paul Maguire leaves Jodrell at the end of this quarter. He will be working for JIVE for a while longer, though on a contract basis. Work done at Jodrell for JIVE has contributed something like 16 person-years of software effort to the project.

Olson furthered the evolution of the JIVE Correlator Control Software (JCCS) from development to

operational phase. This quarter he routinely kept the Baseline System up to date with respect to the code development stream. He also standardly extracted and tested several completely self-contained JCCS Test Systems from the code database, each one uniquely identified by its extraction date. All these systems were exercised by the astronomical testers and switching between them turns out to be as easy as expected. Any moment now we could release JCCS Operational Systems. These only differ from Test Systems in that they will be more strictly maintained and documented.

Olson also updated those parts of the real-time software that share code (typically messages) with the high-level control software. He rebuilt and tested the relevant program sections in both the real-time and the high-level areas.

In addition, Olson keeps spending quite some time assisting other users of the JCCS and its working environment, e.g. software developers, testers and operators.

2.6 Post correlation software

Verkouter started work on linking the on-line system to aips++ in order to be able to read the COF and transform it to an aips++ measurement set. The skeleton is ready, however, some more time is needed to gather all the information from VEX-files, Correlation Job Descriptor in order to construct a measurement set which allows close inspection and creation of user data.

Phillips worked with Verkouter, testing the software for creating aips++ measurement sets from the new Correlator Output Format. Phillips also updated the suite of aips++ Glish programs used for analysing the correlated data. The original version of this software was not flexible enough to handle the large amounts of data from an 8 station correlator.

2.7 Infrastructure

The false alarm problem with the gas extinguisher system from Thorn Security was solved by replacing the complete unit. This after long investigations. The real problem was never understood by Thorn.

The problem of high humidity in the air for the cooling of the equipment was traced back to leaking couplings in the cold water cooling pipes which come from the central cooling machine outside the building. Repair is underway.

The World Wide Processing Activity Display (WWPAD) was mounted on the wall and the final cabling to the control computer was installed. All cables could be mounted in such a way that they are completely invisible. The ground wire to the mains distribution cabinet was connected. This means that we have a proper ground available now, instead of a combined neutral and ground.

The DDD computer, a SUN ultra 60, arrived at JIVE. Its installation is delayed because of intensive testing using the correlator network.

Leeuwinga assembled a 19" rack, including power supply and cabling, for the Post Correlator Integrator.

2.8 Testing and preparing for operations

After the project GL034 was processed completely for the first time, the data was loaded into aips++ and subsequently classic AIPS. This data path needed relatively little smoothing out, only a few patches were made by Verkouter. Within 4 days, on April 7, Van Langevelde produced the first image produced by the EVN MkIV data processor at JIVE. For calibrating and imaging we rely on classic AIPS and these tasks were performed using the standard techniques. Most of the time was spent doing extensive editing as automatic flagging is only partially implemented. This, and the amount of time available for processing, limited the dynamic range of the first image to 200:1.

The image shows 3C380 at 6 cm using EVN antennas, a subset of stations in the global experiment GL034, which was also used during the demonstration of fringes at the opening ceremony. A complete 8 hour track from 8 European stations was processed: Cambridge, Effelsberg, Jodrell (Mk2), Medicina, Noto, Onsala, Torun and Westerbork. All the stations had reasonable data quality. Four 4 MHz bands in a single polarization (LCP) centred on 4987 MHz were processed in a 2 bit, 1:1 mode.

The source shows the same features as previous VLBI maps. In particular, we were happy to see the jet pointing in the same direction!

A problem that was revealed in making the first image involved the weighting of the data and the behaviour of the correlator in case that the data was marked invalid.

A more careful series of comparisons were made between the subset of GL034 that was correlated both on the JIVE and VLBA correlators. Phillips and Campbell discussed with Bryan Anderson what differences may be present in the JIVE correlator model compared to the VLBA. The correlated data were fed into aips++, and a GLISH program was written to fit arbitrary-order polynomials to the baseline-based residual phases on each baseband/time-range in common.

Campbell then carried out empirical comparisons of the model-polynomials from each correlator. These revealed some CALC features that had not been included at JIVE (axis offset, Niell dry- and wet- troposphere contributions). Implementation required some modifications to CALC code to handle the center-of-earth based individual-station delays. There were also some round-off errors entering via the intermediate files written during the computation of model polynomials via dcalc/gspine that should become moot now that this is process is integrated into prepjob. Currently, a typical maximum difference in residual phase-rate for an individual (11-min) scan is only 0.025mHz for EVN baselines and 0.5mHz for intercontinental baselines. Anywhere from one-third to all of a specific phase-rate difference can be

attributed to the model. Liaison with John Benson at the VLBA and others continues to find the remaining sources of model differences at the level of 10's-100's of ps at each station.

After it became clear that ways to dynamically configure the correlator would not be ready for processing the pilot projects and early user projects, Van Langevelde drafted a document with canned modes which would allow a certain number of projects to be processed. These were subsequently implemented by Bos and tested by Phillips. The planning for the commissioning was changed accordingly by Van Langevelde and Parsley.

Van Langevelde worked out a plan for the number of experiments that could be accepted in various sessions. This plan was reflected in the EVN call for proposals and discussed at the EVN PC meeting.

Kramer developed an application, called "log2vex", that prepares sections for vexfiles, using information from the station logfiles, gpsfiles and eopfile. The program has a graphical user interface, which can easily show the quality of the observed scans of all stations for an experiment. Furthermore it has the possibility to delete scans interactively. In addition the program can show the found Clock information, derived from the GPS files, in a graphical way. Finally a VEX-file can be created, merging the information found into an experiment Sched file, which can be used as input for the online software

Tenkink worked on improving the usability of the paternoster. A layer of user interface software was written. The paternoster was taken into operation.

Campbell and Van Langevelde scheduled a phase referencing test observation, which will test both the correlator model as well as continuous tape motion.

Phillips assisted Campbell and Leeuwinga with learning how to run the correlator control software. Phillips assisted Campbell in running and analysing scans from the GL34 experiment which were also correlated in Socorro to make a detailed comparison of the correlator models. Schonewille assisted with the operational test of the EVN MkIV data processor and studied operational aspects of the EVN MkIV data processor. Schonewille also keeps the tape-library up to date.

2.9 Thin Film Head array project

Seagate has not yet answered the request from Haystack for a quote for wafers manufactured to the requirements of the VLBI community. While waiting, Haystack is investigating the procedures and costs of the mechanical processing of the wafers.

Seagate is obviously no longer interested in this development and Haystack is currently investigating alternative sources of wafers. The problem with this option is that the VLBI market is very small so that it is very difficult to produce wafers for acceptable prices.

2.10 Post Correlator Integrator

The aim of this project is to design and prototype a new hardware item called the Post Correlator Integrator (PCI). The unit is being developed at JIVE, primarily by a newly recruited specialist but the work also involves other, permanent staff. The PCI project has not been mentioned in previous quarterly reports and a summary to date follows.

The PCI enhances the capability of the Data Processor by providing an output path for data rates that exceed the maximum transfer rate of the LAN. To achieve this, the PCI receives outputs from the correlator and performs various re-ordering and DSP functions. In general these processes will result in a reduction in the volume of data to be passed to an output port and/or data storage device.

Following the official launch of the project in May '98, Pogrebenko and Parsley produced an outline specification, a preliminary budget and a time-line. From this the profile of a suitable DSP engineer was derived resulting in the recruitment of Paul Kamphuis at the beginning of October 1998.

In the month of October '98 Kamphuis was familiarised with the architecture of the Data Processor and studied the requirements for the PCI. Possible applications for the PCI unit as well as its interaction with the surrounding environment were analyzed leading to the generation of a fully detailed design specification.

In this process three demanding applications were identified, each imposing important requirements on the PCI. The three applications identified are Pulsar Search Mode, Multiple Field Center Processing and Re-circulation. The Pulsar Search Mode requires high throughput rate while the other two applications require additional processing power and internal storage memory. Based on these applications a general application was defined handling all requirements.

The analysis of the environmental interaction revealed also that it is required for the PCI to be housed inside the Correlator crate. This requires the PCI to reside in a VME rack. Because of this, it should also be possible for the Control Computer to access the PCI in the same way as the Correlator. Therefore the RT system in the PCI rack must run the same software as the RT system in the Correlator rack. Hence the RT system must be identical. For proper operation the RT software requires additional synchronization signals. The signals are available in the correlator rack and have to be distributed to the PCI rack. This requires an additional Control board in the PCI rack. It turned out that for this Control board an existing Clock Module could be used.

Another environmental issue is the data connection to the Correlator. Each Correlator board is equipped with a special output port for high throughput rates. Because the Correlator is logically subdivided into Correlator segments consisting of 4 correlator boards, it is preferred for the PCI to be divided into the same kind of segments.

At the beginning of November the design specification was formally reviewed and approved. From this, and an initial survey of available DSP boards, it was determined that the requirement could be achieved using commercially available board products.

After completing the requirement analysis at the end of November, the hardware selection process was started. This process included reviewing possible solutions for a PCI unit. At the end of December a final selection was finished. The selected boards consist of a recently introduced Pentek DSP board with four state of the art Texas Instruments floating point Digital signal processors with sufficient processing power and memory to handle data coming from 4 correlator boards. This board should do all the data processing of the correlator data. Second to this processing board, a board was selected to interface to a storage device. For this board a VMETRO VME carrier board was selected. This board provides the VME rack with a PMC mezzanine bus. The PMC bus is an industrial version of the PCI bus and is going to be an industry standard. By using a PMC module for supplying a SCSI controller it is possible to replace the SCSI interface with a fibre channel interface in the future. The intention of the Fibre Channel(FC) is to develop practical, inexpensive, yet expendable means of quickly transferring data between workstations and storage devices. Fibre Channel is the general name of an integrated set of standards being developed by the American National Standards Institute (ANSI).

All components, except for the Pentek DSP board (processing board), were ordered early January 1999. The Pentek DSP board is going to be ordered in the third quarter of 1999. The processing capabilities are not directly required, because the recording part can be developed independently. By the end of March the prototype unit was assembled and ready for use. In parallel with purchasing and assembly of the prototype, work on the DSP software have proceeded according to plan.

- Recording terminal upgrade to MkIV (Spencer et al)

The main developments concern the production of upgrade equipment for the VLBA- MkIV upgrade and also electronics for the Chinese stations.

Van Langevelde and Walker (NRAO) finished a major upgrade of Sched, which allows more robust frequency and bandwidth switching during an experiment. Also the concept of observing bands was introduced to phase out the large numbers of frequency setups that are currently necessary in Sched.

Formatters

MkIV upgrade

The MkIV formatters continue to be used in network observing runs without serious problems. Extra functionalities like modulation and barrel-roll remain to be implemented. In addition there are some communication and timing problems which are currently worked around by the field system, but more seriously there are timing jumps with respect to the VLBA formatters. A small team to work on these problems will be set up.

VLBA upgrade

All MkIV systems to replace the VLBA formatters have been tested and wait to be installed.

Manual

The final version of the formatter manual from GMR Associates is expected in late 1999.

Read/Write Electronics

Delivery of the VLBA-MkIV read/write electronics from Metsähovi is expected in mid August. Installation at EVN stations could take place in the autumn.

Metsähovi are supplying head assembly kits, but soldering needs to take place. A means of achieving this difficult operation has not yet been found.

Extra tape drive components, required for the MkIV upgrade are being purchased by MPI Bonn, with reimbursement expected from individual stations.

BBCs

Investigations by Dan Smythe at Haystack clearly show that the roll off at high frequency on the 8 and 16 MHz filters is caused by switch diodes having too high junction capacity. Replacement diodes improve the situation and all stations have been recommended to change their diodes.

Narrow band filters to give 8 complete filter sets at each station (upper sideband only) have been ordered for EVN MKIII-MkIV systems.

China Upgrades

Narrow band filters have been ordered and are expected mid August.

Gurvits negotiated with the Chinese counterparts terms and conditions of the taxation and shipment insurance for the delivery in China the MkIV Data Acquisition upgrade kits for the Shanghai and Urumqi observatories. Both items have been agreed upon with the appropriate Dutch authorities. As of 30.06.99, the contract between JIVE and the Oriental Scientific Instruments Ltd. on the MkIV upgrade kits is fully prepared for signing.

Current plans indicate delivery should take place at the end of October, after checkout at Bonn and packaging at JIVE. The date for the visit of 'TeamChina' for installation and testing in situ of the

equipment is now March 2000.

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

4.1 Network Monitoring, Reliability and Performance

The 6 and 18cm NME observed in February 1999 (session 1) have been fully processed within AIPS by Massi. The D terms have been inserted in the EVN Instrumental Polarization tables available on the EVN

Operations web page. These Tables are now continuously updated after each EVN session by Massi.

Generally the values of the session 1999-1 are consistent with the values of the session 1998-4. For the first time the D terms at 6cm for Hartrao (D_L=10%, D_R=8%) and at 18cm for Urumqi (D_L=12%) could be estimated.

Sjouwerman scheduled the 6 and 18 cm Network Monitoring Experiments in the May/June session. McKay continued work on the EVN real-time fringe verification project.

Garrett prepared, circulated and presented a report on the EVN's performance to the EVN directors at EVN CBD meeting in Bordeaux. Garrett also attended the JIVE board meeting and took the minutes.

4.2 Calibration

Desmurs generated and edited the ANTAB files associated with session 2, 1999.

4.3 Data Correlation

Bob Campbell continued to support the correlation of EVN projects at the MPIfR correlator in Bonn. Experiments EP025, EH004, and EH005 from session 99/1 were correlated to completion and DATs distributed to the PIs (or taken back to JIVE in anticipation of a PI's visit).

Correlation finished for Experiment EK009A, but a problem was noticed for one of the baselines and a recorrelation job was prepared. Experiments EL020B, EF006, and EC010 from session 99/2 were prepared for production-mode correlation. The infrastructure (up to checking the GPS-derived station clock offsets/rates) was prepared for experiment EA025, which has an MPIfR co-investigator. A few DATs from earlier experiments in 1998 were discovered not to have been sent out (experiments EF003A/B, EG017A, ES016B, ER004A, and EH003 [tape 2 of 2]). PIs were notified, delivery details arranged, and all such DATs have now been forwarded.

Desmurs visited the correlator at Bonn and prepared files for the correlation of line experiments CAH1A, CAH1B and ED011. The two first projects have now been released and half of the third one has been completed. Only one project (which does not have an MPIfR co-I or PI) remains in the queue (van Langevelde).

4.4 Observing and Telescope Support

Polatidis supported the mm-VLBI observations of the CMVA from 17-22 April and the EVN observations at Onsala Space Observatory for the May/June 1999 EVN session. Particular effort was spent in investigating problems with and improving the recording quality of the Mark IV terminal in consultation with staff from Haystack Observatory. The installation again of vacuum switching and a subsequent recontouring of the recording heads, improved the recording quality significantly. McKay supported operations of the Cambridge 32-m telescopes during session 2, 1999. Desmurs supported four geodetic observations conducted at Yebes: CORE B502, CORE B503, EUROPE 48 and EUROPE 49.

4.5 General Network Support

Gurvits assisted in the preparation of the visit in Urumqi of Dr. C.Stanghellini (IRA-Noto) in May 1999. C.Stanghellini installed AIPS on a LINUX WS (the first installation of AIPS at the UAO) and worked with the UAO staff on several scientific projects. A report by C.Stanghellini on his trip in China is available. Gurvits helped representatives of the Shanghai and Urumqi observatories to attend the EVN CBD meeting (April 1999, Bordeaux). Gurvits also assisted in the supply to Urumqi observatory of spare electronic components for the MkIII terminal.

Polatidis scheduled the Fringe Test Tape experiment FT003, for the May/June EVN session.

Sjouwerman generated the Experiment Feedback Facility web pages for the February EVN session and updated some EVN web pages.

4.6 EVN PI Support

Gurvits assisted A.Volvach (PI) to finalise data reduction and prepare the results of the experiment EV006 for publication.

4.6.1 Scheduling

Sjouwerman helped in the scheduling of project GS013B. Polatidis supported PIs to schedule experiments GM033B, GM035B, EA025 in the May/June 1999 EVN session. Van Langevelde supported Yates, Richards, Greenhill and Dallacasa in creating observing schedules for MkIV observing with the EVN. Garrett supported ES030A/B and GF007C.

4.6.2 Support of Visitors to JIVE

Gabuzda supported the data analysis of several visitors to JIVE during the second quarter of this year, including: Snellen (IOA), Norbury (NRAL), Xanthopoulos (NRAL), Cassaro (Catania), Pushkarev (ASC, Moscow) and Filho (Groningen). van Langevelde supported Richards

(NRAL) and Murakawa (U of Herts) as a co-I on the project. Other visitors to JIVE included Kellerman and Lobanov (co-I Gurvits) and Conway (OSO) and Wenwu (MPIfR).

4.7

Sjouwerman maintained the JIVE visitor friendly workstation environment with its standard settings and setups; it can now also be used to setup a visitor environment for NFRA. He installed and maintained the new test version of AIPS (15OCT99) and its 'midnight job', and reinstalled the 15APR99 version. Sjouwerman also maintained the EVNtech VLBI exploder and PC-SCHED software.

- Space VLBI

As an EVN representative in the VSOP In-orbit Checkout (IOC) group, Gurvits continued to participate in scheduling and planning of the HALCA operations and observing programme for the VSOP AO2 period through early 2000. He also participated in the activities of the VSOP Survey Working Group. The Group will conduct a data reduction workshop at ISAS (July 1999) after which the first batch of Survey data will be released.

Gurvits participated in the ESA ISS-SVLBI study in his capacity of the project scientist. During the second quarter of 1999, the study concentrated on the analysis of critical technologies for the ISS-SVLBI mission. The study has been reviewed at a mid-term meeting in May 1999 (Media Lario, Bosisio Parini, Italy). A brief review of the study has been prepared for the EVN CBD meeting and discussed with several EVN Directors in May-June 1999.

Garrett and Gurvits continued to participate in the elaboration of the ARISE mission scientific case, particularly, in preparation for the mission evaluation by the NAS Decadal Committee. Gurvits continued to fulfill the duties of the RISC (RadioAstron International Science Committee) secretary. He spend time in preparing for the VSOP-2 pre-kick-off coordination meeting (ISAS, July 1999).

- Research

Campbell

Campbell updated the theoretical-model portion of his program to calculate ionospheric contributions to phase-/group-delay, delay-rate, and Faraday rotation to VLBI observations, and began to investigate the use of ionosonde data as real-time constraints in addition to GPS data already included. Characterization of differences between results from this program and the various GPS-only based vertical TEC maps available on the web were investigated. A spin-off program to summarize/plot temporal coincidences of GPS satellites with a specific source from a given station for RFI identification/planning was completed.

Results of the correlation of November 1998 MkIII pulsar-astrometry observations (GC021) were reviewed, and a recorelation job was prepared.

Desmurs

Desmurs attended the colloquium held in Granada on 27 to 29th of May on millimeter VLBI organised by IRAM.

He went to Effelsberg between the 4 and the 7 of May to observed a project concerning a survey of OH maser at high excitation level ($2\text{PI}3/2$ $J=7/2$). Four sources have been observed out of which three are new detections.

Because of a major disk failure the project on PKS1830 must be started again from the beginning. The first results obtained did not showed a clear detection of the absorption line.

He started the reduction of the project ED011A. This project concern H₂O maser in the outflow of Young Stellar Object. All the sources have been detected and the reduction of one of them (L1448mm) is in process.

He inspected in details project GB026. All the input and output log files look correct and despite the fact that one of the source was well detected in the past (during the first ad-hoc experiment with the EVN), it seems that for a still unknown reason the project failed. Even on the autocorrelation, no signal has been detected.

Gabuzda

Gabuzda, P. Kochenov (ASC), T. Cawthorne, and R. Kollgaard submitted their paper "Intraday Polarization Variability Outside the VLBI Core of the Active Galactic Nucleus 0716+714" for publication in Monthly Notices of the Royal Astronomical Society.

Garrett

Garrett submitted a proposal to observe the Hubble Deep Field (HDF) with the WSRT. In collaboration with Muxlow and Garrington (NRAL) he also re-wrote and submitted a proposal to observe the HDF with the EVN. Garrett was a co-I on a proposal submitted by Roy (MPIfR) to investigate phase-referencing with the EVN. Garrett in collobarotion with de Bryun started a preliminary analysis of WSRT observations of the HDF at 20cm. An rms noise of $\sim 20 \mu\text{Jy}/\text{beam}$ was obtained from 24 hours of data. Eventually an image from 72 hours of data will be generated with much improved rms noise levels.

Gurvits

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

He also collaborated with A.Lobanov (MPIfR) on the data reduction and analysis of the VSOP observation of the high-redshift quasar 2215+020. A 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 are in preparation for presentation 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 results have been presented at the conference "Perspectives on Radio Astronomy" (Amsterdam, April 1999) and will be used for the SKA and SVLBI-2 scientific cases.

Van Langevelde

Van Langevelde worked with Vlemmings (Leiden) on the interpretation of phase referencing data on circumstellar OH masers. The discussion focused on the emission mechanism that seems to favour blue-shifted maser spots. This resulted in an EVN proposal and a draft for a paper was produced.

Richards (Jodrell) and Murakawa (Hertfordshire) visited JIVE to collaborate with Van Langevelde on a project to monitor OH masers. Several problems were encountered in processing the data, which seem unique to EVN data correlated in Socorro.

Massi

Massi in collaboration with M. Ribo, has submitted (for the June 1 VLBI deadline) a EVN proposal for observing a selected sample of radio X-ray binary sources.

Phillips

Phillips finished a week visit to ATNF to correlate S2 VLBI data obtained with the Australian LBA network.

Phillips visited the Onsala Space Observatory to use the 20m antenna for search for thermal molecular lines which are tracers of high density gas associated with methanol maser sources.

Polatidis

Polatidis, in collaboration with S. Aalto (OSO) and J.E. Conway (OSO), continued the analysis of MERLIN observations of the nucleus of the starburst/OH megamaser galaxy IC694. Preliminary results show a disk-like continuum emission. Both the HI absorption and the OH maser emission appear to come from a similarly rotating disk-like gaseous structure with the OH maser extending up to 80 pc and the HI up to 300 pc.

Polatidis with Garrett (JIVE) and Garrington (NRAL) re-submitted a proposal to the Nordic Optical Telescope (NOT), to obtain CCD images of weak radio sources from the FIRST/MERLIN sample. The proposal asked for a replacement of the 4 nights that had been awarded to the project in Jan 1999 and were lost due to adverse weather.

Polatidis was the PI in proposals to image the HI absorbing and the OH megamaser emitting regions in starburst galaxies with MERLIN (which has been awarded observing time) and the EVN+MERLIN.

Sjouwerman

Sjouwerman and Sandqvist (Stockholm) worked on VLA observations of all four 1.6 GHz maser lines of the OH molecule in the Galactic center. New data on SiO masers in Galactic center OH/IR stars has been obtained and a paper on previous H₂O and SiO maser observations finished. Sjouwerman also investigated at which (low) frequencies very high redshift OH megamasers could be best observed using the Cosmic Microwave Background emission.

- 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		
Van Langevelde	W. Vlemmings	Leiden Univ.	PhD	Astronomy of OH masers
Schilizzi	W. Tschager	Leiden Univ.	PhD	Peaked spectrum sources

Mr. Pushkarev arrived for a several month stay at JIVE as a summer student at the end of May.

Mr. Cassaro arrived for a several month stay at the end of May

- Meetings, work visits, symposia, conferences

Meetings, work visits, symposia, conferences		
Second Quarter 1999		
meetings, work visits, symposia, conferences	date	name
"Perspectives on Radio Astronomy", Amsterdam, NL	7-9 Apr	Garrett, Gurvits, Sjouwerman, Van Langevelde, Schilizzi
"Perspectives on Radio Astronomy: Technologies for Large Antenna Arrays", Dwingeloo, the Netherlands	12-13 Apr	Garrett, Gurvits, Phillips, Schilizzi
EVN Board meeting + JIVE Board meeting, Observatoire de Bordeaux, France	22-25 Apr	Garrett, Schilizzi
Stockholm Observatory, Stockholm, Sweden	24-30 Apr	Sjouwerman

"Plasma physics in parsec-scale jets", Bonn, Germany	28-30 Apr	Gabuzda
ISS-SVLBI mid-term review meeting (funded by ESA), Bosisio Parini, Italy	3-6 May	Gurvits
Bureau des Longitude, Paris, France	4 May	Desmurs
Work visit, Effelsberg, Germany	5-7 May	Desmurs
54e Nederlandse Astronomen Conferentie, Elspeet, NL	5-7 May	Campbell, Gabuzda, Garrett, Van Langevelde, Schilizzi, Sjouwerman, Verkouter
Work visit, MPIfR, Bonn, Germany	7-13 May	Desmurs
Collaborative work with Jose Luis Gomez Granada, Spain	10-24 May	Gabuzda
ISS-SVLBI coordination ESTEC, Noordwijk, NL	18 May	Gurvits
Observing at Onsala, Sweden	19-26 May	Phillips
"Theory and Observations of relativistic jets", Granada, Spain	24-26 May	Gabuzda
CMVA meeting, Granada, Spain	26-30 May	Garrett
Oort Workshop, Leiden, NL	27 May	Gurvits
Metrum Information Storage Ltd., United Kingdom	29 May-6 Jun	Parsley
Work visit, Observatoire de Paris, France	1 Jun	Desmurs
Work visit MPIfR, Bonn, Germany	15-17 Jun	Gurvits
EVN-PC meeting, Heidelberg, Germany	23-28 Jun	Van Langevelde
EVN MkIII Correlation Support, MPIfR, Bonn, Germany	28 Jun - 3 Jul	Campbell

- Presentations

Campbell

"VLBI pulsar astrometry and the ionosphere", 54e Nederlandse Astronomen Conferentie, Elspeet, NL, 7 May

"Those pesky first few pico-parsecs [ionospheric effects on radio-astronomy observations]", NFRA/JIVE Colloquium, 18 June

Desmurs

"VLBI et étude des régions de formation d' étoiles", Bureau des longitude, Paris, France, 4 May

"Observations VLBI et maser SiO dans les étoiles AGBs", Observatoire de Paris, France, 1 Jun

Garrett

Garrett attended a meeting of the CMVA in Granada and presented a review of the "Current status of the JIVE Processor". Garrett attend the SKA meeting in Amsterdam and presented a paper on "VLBI's Expanding Horizons and SKA".

Garrett attended the NAC and presented a paper on "VLBI's Expanding Horizons".

"Performance of the EVN" - EVN CBD meeting Bordeaux.

Gurvits

"Toward sub-mJy radio astronomy with sub-milliarcsecond angular resolution (or SKA as seen from space)", Amsterdam, NL, 8 Apr

"Review of the SVLBI-2 in-orbit antenna assembly strategy", Bosisio Parini, Italy, 5 May

"Milli- and sub-milliarcsecond radio structures in extremely high redshift quasars as seen from Earth and Space", Oort Workshop, Leiden, NL, 27 May

Van Langevelde

"The EVN MkIV Data Processor at JIVE", NAC, Elspeet, 7 May

"A first image from the EVN MkIV data processor at JIVE", SKA meeting, Dwingeloo, NL, 9 Apr

Phillips

"Methanol Masers at High Resolution", Onsala, Sweden, 20 May

- Publications

Published:

Z. Paragi, S. Frey, L.I. Gurvits, K.I. Kellermann, R.T. Schilizzi, R.G. McMahon, I.M. Hook, I.I.K. Pauliny-Toth, "VLBI imaging of extremely high redshift quasars at 5 GHz" 1999, A&A 344, 51-60

Patnaik, Kembell, Porcas & Garrett, 1999, MNRAS, 307, L1

Muxlow, Pedlar, Wills, Garrett, Diamond, Wilkinson and Alef, 1999, AAAS, 194, 8511.

Other reports

European participation in VSOP, ISAS News (Gurvits)

Contribution on cosmological applications, ARISE Science Proposal, NASA-JPL, ed. J.S. Ulvestad (Gurvits)

Submitted:

Y.J. Chen, F.J. Zhang, L.O. Sjouwerman, "Bi-periodic variation in the BL Lac AO 0235+164", accepted by Astrophysics and Space Science

X.Y. Hong, D.R. Jiang, L.I. Gurvits, M.A. Garrett, R.T. Schilizzi, R.D. Nan, "Helical motions in the jet of blazar 1156+295", 1999, New Astronomy Review

C.J. Phillips, H.J. van Langevelde, "Fringes on the EVN MkIV data processor at JIVE", 1999, New Astronomy Reviews.