JOINT INSTITUTE FOR VLBI IN EUROPE

Report for the fourth quarter, 1999

Summary

Correlator development and production operation competed for time throughout the quarter with the result that a substantial number of bugs were eliminated at the cost of production efficiency. First fringes were detected using the data distributor. Data was written to tape by the prototype post-correlation integrator for the first time. Procedures for handling the various logistical issues associated with production correlation are under development. Shift work was introduced in December for production correlation; the correlator is now manned 80 hours per week.

The first meeting of the panel set up by the European Science Foundation to review the performance of the EVN and JIVE in the past 5 years and plans for the coming 5 years, took place in London in November. Their work is expected to be completed in May 2000.

The main focus of the MkIV upgrade project continued to be the preparations for upgrading the two Chinese stations scheduled to take place in April 2000.

The EVN Support Group continued its involvement in the analysis of the NME experiment from September, as well as generating ANTAB files for the November session. The correlation of 11 EVN experiments on the VLBA correlator in Socorro was also supported. Four PI's received assistance with scheduling, and 13 investigators came to JIVE to carry out their data calibration and analysis with support from local support scientists.

The institute remained active in research during the quarter with 19 papers published and a further 11 submitted, 9 talks given at conferences and in other institutes, and supervision given to 11 students.

New contracts with the European Commission for Access to Research Infrastructure and an Infrastructure Cooperation Network in Radio Astronomy were signed and sent to Brussels; these contracts are expected to commence early in 2000.

Three international events were hosted by JIVE during the quarter - the EVN Technical and Operations Group held in October, the third EVN VLBI School in November, and the meetings of the EVN and JIVE Boards also in November.

Jean Casse retired on 15 October after 3 decades of working for the NFRA, including many years as Head of the Laboratory, and 5 years in JIVE as Project Manager for the construction of the EVN data processor.

- **Institute**
-

Management

The Management Team met on 11 October, 22 November, and 17 December. The JIVE Board met in Hoogeveen on 27 November.

European Commission

Garrett arranged for the draft FP5 IHP Access Contracts to be signed and returned to Brussels before the Christmas vacation. The hope is that the new FP5 IHP contract will formally begin before EVN session 1/2000 is underway. The annual report for the Concerted Actions EC project (including the associated cost statement) was submitted to the project coordinator. Two separate lists of external users granted access to the EVN via the TMR contract were submitted to the EC.

Gurvits assisted in coordination of the FP4/RTD Programme "Enhancing the European VLBI Network".

International collaboration

Gurvits and R. G. Strom (NFRA) prepared materials for a proposal to the Royal Dutch Academy of Sciences on Dutch-Chinese collaboration in radio astronomy for the period 2000-2002.

Review of the EVN and JIVE

The ESF Review Panel (Fenstad, Vanden Bout, Culhane, Karow) met for the first time in London on 15 November and with the "Reference Panel" (Booth, Diamond, Grewing, Schilizzi, and Zensus) on 16 November. The main issue discussed with the reference panel concerned the scientific performance of the EVN. The next meeting will be held at JIVE in February 2000, at which time other issues will be discussed.

Publications

The EVN/JIVE Symposium special issue of New Astronomy Reviews (vol 43, pp503-779) appeared in press before the end of the quarter. It included 54 papers related to recent scientific and technical progress in VLBI and in particilar, the EVN and JIVE.

At the end of the year, Gurvits issued a call for contributions to the "EVN and JIVE Annual Reports 1999".

Events

1) EVN Technical and Operations Group, 1-3 October

About 40 people participated in the TOG meeting. During the first morning, time was spent on the correlator floor, showing the representatives from the stations how their tapes played back. In the afternoon 15 people participated in the EMU meeting. The TOG meeting took the entire next day. A short executive meeting and a tour of Westerbork was held on October 3.

2) EVN VLBI School

More than 40 participants attended the EVN School from 3-5 November. The LOC (Gurvits (chair),

Garrett, Gabuzda, Sjouwerman, De Haas, and N. Vermeulen) and the SOC ensured that the lectures, demonstrations, and scientific talks were well prepared, which contributed to the lively atmosphere that prevailed throughout the School.

3) EVN Directors meeting, 26 November; JIVE Board meeting, 27 November

Some 20 people attended the EVN Directors meeting held at the Observatory in Dwingeloo. The 7 JIVE Board members and JIVE Director attended the Board meeting in Hoogeveen.

Personnel matters

Jean Casse retired on 15 October after 5 years as Project Manager for the construction of the data processor. Jean Francois Desmurs finished his appointment as JIVE Support Scientist at the OAN, Alcala in Spain at the end of the year. On November 29 the correlator operators started working in shifts. This means that every working day the correlator is manned for 16 hours, from 0800 to 2400, amounting to 80 hours a week.

Infrastructure

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

Visitors

Young Chol Minh (TRAO, Korea), A. Khokhlova (Moscow State Univ. Russia), M. Masheder (Univ. of Bristol, UK), A. Sergeev (ASC, Moscow, Russia), C. Reynolds, T. Cawthorne (Univ. of Central Lancashire, UK), N. Gizani (Univ. of Madeira, Portugal), Jiangfeng Zou, Hong Xiaoyu (SAO, China), A. Freihold, M. Wunderlich (MPIfR, Germany), Dharam Vir Lal (Indian Ins. Of Astrophysics, Bangalore), D. Dallacasa (IRA, Bologna), W. Vlemmings, B. van Dam, W. Tschager (Univ. Leiden, NL), T. Gillibrand (NRAL, UK), I Agudo (IAA, Spain), T. Galama (CalTech, US), I. Snellen (IoA, UK), V. Tornatore (Politecnico Milano, Italy)

- **Post-commissioning development on the EVN/MkIV Data Processor (Bos, Buiter, Campbell, Casse, Hazell, Kamphuis, Kramer, Van Langevelde, Leeuwinga, Millenaar, Noble, Olnon, Parsley, Phillips, Pogrebenko, Schonewille, Tenkink, Verkouter, Zwier)**

Summary

In this quarter, time on the correlator was divided between testing and production, usually giving priority to testing in the mornings. This was useful, but quite a difficult way of making progress. When shift work started in December a better balance was found. A reasonable number of projects were processed and investigated by the end users. Quite a number of problems surfaced, which implied that the development mostly concentrated on bug fixing.

2.1 Correlator Section

Hardware

Two input boards in correlator units two and three have been repaired. The testing of the recirculation mode of the data distributor has started in the lab after the transfer of the board designs from the UNIX environment to the NT environment.

Software

Phillips worked with Bos to debug correlator modes which use two correlator crates. The extra correlator capacity is needed for spectral line experiments and continuum experiments which require cross polarisations correlated. This development continues.

The integration of the data distributor in the configuration software is ready for tests. Debugging has been delayed due to the two unit configuration tests. The good news is the we have seen fringes

using the data distributor. This means that the data path is functioning as it should.

Pogrebenko developed SU configuration test scripts for DDU testing.

2.2 Station Units

Pogrebenko and Leeuwinga worked on the modification of a number of TRM's and CRM's, in order to solve the clock distribution problem between CRM and TRM modules of the Station Units. At the same time the PROMS on the boards in the Station Units were checked and reprogrammed if nescesarry, to make sure that they all contain the correct software version.

Phillips worked with Hazell to allow for "formatter offsets" at the observatories. The original design of the SU did not allow for the fact that sometimes the clock of the formatter at the observatories has an integral second offset. Hazell had implemented a work around for this when he was at Haystack, but this had never been tested. With a few iterations of the SUCC and su_control, this was verified to work with real data.

2.3 Play Back Units

Wear on critical parts in the tapepath was discovered during the process of re-adjusting the tape path of all DPU's. These are mechanical parts which are in contact with the tape. Buiter will investigate this and come which a proposal to improve these parts.

The process of re-adjusting the tape path of all the DPU's and replace the non-selfpacking take up reel with a self-packing one continued again this quarter.

2.4 SUIM/TSPU

Pogrebenko worked on the Pulsar Gating RD project, drafting a project plan.

2.5 High level control software

This quarter Olnon was primarily working on the stabilization of the JIVE Correlator Control Software (JCCS). Early in October he created the first real production release of the JCCS, which was still in use

at the end of the quarter. Together with Bos, Olnon started the integration tests of the next version of the correlator software and its JCCS support. Olnon also brought the new HP development

workstation (jaw1) up to steam and moved the JCCS code repository from Jodrell Bank to that machine. The rest of his time Olnon spent on the JCCS documentation suite: with the help of Noble he moved it to JIVE, added some documents from developer's areas, and kept on reading the

various documents.

Development

Most of the work by Olnon was just bug fixing for the current release. But he worked on some enhancements for the flexible correlator configuration to come, and on generalizations in the VEX-CJD-VEX transformations to support a wider range of experiment schedules.

Maintenance

On October 8, shortly after Maguire left the software development team, Olnon made the second JCCS Release. It has been used for standard production throughout the last quarter and across the

millennium boundary, without fundamental changes. In parallel, several dedicated Test JCCS Systems have been built, exercised and removed for ongoing development and bug-fixing activities. Switching between various JCCS Systems is very easy except when it also involves switching between really different real-time system versions. That is a temporary problem, both because the need for such switches will soon disappear and because the RT startup procedure will be streamlined.

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. Olnon, continued this work. New is, that now a local JCCS code database residing on jaw1 is used, and the Baseline System is maintained on that same

machine.

Data Handler

Phillips worked with Verkouter to figure out how to make the data_handler more robust with respect to bad data. Other problems in the system (which affected a single integration) were causing the data handler to insert a spurious 10 minute jump in the decoded time.

Verkouter implemented some small changes in the data handler. The statistical analysis of the BOCF framenumbers seems to be more robust now. The detection of a BOCF framenumber wrap automatically becomes more robust as well. Since the change no erroneously detected BOCF

framenumber wraps have been detected. Also, a discussion was started to see if and how we could make the BOCF framenumber to time translation could be made even more robust.

Model Software

Campbell added a patch to CALC8.1 to allow operation after 31dec1999, and tested to ensure resulting model delays/rates show expected sidereal drift across the new year.

Processor control

Along with Olnon and Verkouter, Phillips tried to identify the reason why often (though not always) the software only allows a single subjob to run. This significantly slows down production. Unfortunately the cause of this problem could not be found and is still outstanding.

Phillips started to look at how su_control configures the SU, with the aim of documenting (and improving) how su_control interacts with the SU.

2.6 Post correlation software

The bulk of Verkouter's time was spent on implementing (yet) another format for user data export as well offering the possibility of splitting one MeasurementSet into multiple pieces. The export utility tConvert can now produce FITS files with UV-data according to the FITS-IDI format as described by Chris Flatters in AIPS Memo #102.

First, this had to be implemented before splitting a MeasurementSet up could be dealt with. The previous format (FITS random-groups structure) would not allow splitting a MeasurementSet into multiple

pieces and have them recombined back into one UV-database in classic AIPS. This seems finished, although fully automatic recombination of UV-database fragments back into one whole database is not yet supported by classic AIPS. Verkouter has had contact with members of the classic AIPS team and, if asked, they might be willing to build in support for automatic concatenation of FITS-IDI files.

Phillips improved the suite of Glish scripts to produce VLBA "sniffer" type plots which allow rapid verification of production data and analysis of problems with the output data from the data processor.

2.7 Infrastructure

The problem of high humidity in the air for the cooling of the equipment looks to be solved. The swopping of the in- and output water pipes of the cooling block gave the expected improvement. But final conclusions have to wait for the summer climate with higher humidity then we have now

during this period of the year.

A new cable was installed from the automatic fire extinguisher system to the main ASTRON fire detector system. Due to lack of an interface unit the systems could not be connected yet.

Campbell made a summary/operating guide for experiment correlation preparation and data flow analysis

2.8 Testing and preparing for operations

Kramer released version 1.3 of program log2vex with some cosmetic changes.

Phillips wrote some perl scripts to help keep track of the status of experiments while they are being correlated.

Phillips helped Tenkink prepare an operators manual for the data processor.

Phillips started maintaining a buglist for the data_processor. This currently has many entries, mostly affecting the operators though some affect the output data. Trying to reduce the size of this list has a

high priority, though the cause of many of these problems is unclear.

2.9 Post Correlator Integrator

In the second week of October the first milestone of writing data to tape was reached. This was followed by improving the architecture of the code and improving the data path for writing data to the SCSI controller and tape. In November a setup was made for the actual recording board application. This application integrates receiving correlator board data and writing it subsequently to tape. It required rewriting the routine for writing to tape and it also showed a few errors in the processor module used on the recording board. These errors were reported to Pentek the board manufacturer. A work-around was created for this problem and by the end

of December the second milestone was reached. By that time it was possible to write (test) data coming from a correlator board to a tape.

Also in October a comparison was made between 3 DSP boards to select the most suitable board to be used as the processing board in the project. It turned out that the original processing board selected was best replaced by a board from Spectrum Signal Processing. This board fits into the original design of the PCInt unit but also makes it possible to simplify the design by placing the SCSI controller directly on the processing board. This simplification would mean that the recording board is no longer

required. Development on this board is however continued in order to be able to use the board for testing purposes. The selected processing board was ordered at the beginning of December and expected to be delivered in February 2000.

3. Dataprocessor Operations (Campbell, Kramer, Van Langevelde, Leeuwinga, Phillips, Schonewille, Tenkink)

3.1 Production

In the last quarter of 1999 8 projects were processed. At the start of the quarter the production rate was largely limited because 40% of the 40 hours available in the week were spent on testing software fixes and the data distributor. This situation improved considerably when in December shift work started. Then the number of hours spent on production increased from on average 24 hours per week to approximately 60. As a result the support group became overloaded with experiments to check

out. Moreover, new experiments needed to be setup with a greater urgency. This is still a very time consuming phase in the correlation process. Over the whole quarter about 30% of the time available for production went into experiment check out (investigating clocks, tape playback, curing telescope related problems). Most of this work is done by Campbell. Schonewille coordinates the hour-to-hour activities on the correlator.

There was a small crisis in playing back thick tapes at double speed. This doesn't seem to give acceptable data quality. Another problem was the fact that it remained unclear for a long time, whether any data from the Torun recordings in the September session could be salvaged.

The overall efficiency (yield over working hours) of the correlator remains at a low 10% as a result of all these things. This has been recognized as a problem by the EVN-PC, which was forced to allow only a limited number of experiments to be send to JIVE. In addition these should not exercise any new modes.

Several tours (6) of the correlator were organized (TOG meeting, EVN school, ITU, geodesy students, national science day).

We received feed-back from a few PI's on pilot experiments (Dallacasa, Garrett). In both cases the PI's were able to calibrate and map their data, which was encouraging. However, both users expressed some worries about the data quality and especially the large number of visibilities discarded by the correlator. A clear correlator based problem was not identified. Campbell and Phillips assisted the PI's investigating the data quality.

Phillips over saw the correlation of EP030. The PI for this experiment found some strange errors in the data, with a baseline (but not station) base. Investigation continues.

3.2 Correlator testing

Campbell and Van Langevelde processed FR004, a phase referencing test. The data quality was satisfactory overall . However, the phase referencing was never successful. Several off-line tests were carried out with the data, but no conclusion on the cause of failure was reached. It was realized that a more optimal experiment could be designed. A request for a new test was sent to the EVN-PC chair.

Van Langevelde and Phillips tried to find fringes from a test experiment that involved 3 telescopes, specially recorded for the Shanghai correlator. No detection was made, the same result the Chinese got. It was discussed with the Chinese why the experiment was non-optimal for the purpose, and they were sent the tapes from FR004.

Organizing of a high dynamic range test for the EVN and JIVE correlator has been taken on by Garrett and Gabuzda**.**

3.3 Logistics

Schonewille and van Langevelde contacted all PIs for experiments in the queue. The main purpose was to confirm correlator modes for their experiments. They were also given a likely date for the release of their experiment. Known problems with the data in their project were communicated to them.

Van Langevelde made a planning of future capabilities and adjusted the correlator status on the web. A start was made on monitoring correlator efficiencies. Daily the use of the correlator is written in a log book. Use is split out on a weekly basis in the categories production, clock search (preparation) and testing. These values can be compared with the correlator yield. Some of this was automated by van Langevelde.

Van Langevelde and Schonewille prepared and implemented the start of shift work. Several schemes were discussed and worked out in detail. Calculations were made considering the changes in salary and policies for holidays were stated. Arrangements for dinner time and emergencies had to be made.

In the final scheme in the evening the correlator run by a single operator. This was the preferred option for the operators. For safety we are looking at alarm systems that the operators can carry on their person. In the

meanwhile they continue to be monitored by Schonewille.

Van Langevelde drafted a policy on Global projects for the EVN directors meeting.

4. Recording terminal upgrade to MkIV (Spencer et al)

This quarter most of the effort has been spent on getting equipment and paperwork ready for shipment of the upgrade equipment for Sheshan and Urumqi stations to China. This and other progress is outlined below:

MkIII-MkIV upgrade

The full formatter manual has now been delivered from GMR and has been accepted. P. Burgess is assisting in the production of copies and files to be used at observatories in a restricted circulation list.

The 16 and 8 MHz passbands have been improved by the replacement of switching diodes and resistors. Some stations still need to complete this upgrade for all 16 and 8 MHz filters.

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. A specialist team has been set up to look at this, some progress has been made at Haystack on this but further work needs to be done.

VLBA upgrade

Van Langevelde worked on **Sched** to implement the use of so called VLBA4 systems. This is now finished and ready for testing.

Formatters (and crates) have been delivered from MPI to the observatories.

NFRA has produced two head assembly units (for China) from kits provided by Metsähovi. MPI Bonn has agreed to produce the further units required for EVN VLBA terminals.

The formatters etc. for the European stations (Cambridge, Yebes, Metsähovi) will be installed in the first quarter of 2000. A VLBA-MKIV switch-over fringe test (involving all stations with VLBA terminals, i.e. including

Torun and Noto as well as the above) will now be made in session 2 (May/June).

High data Rates (>256 Mbit/sec)

It is planned to test 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**.**

China upgrades

Gurvits concluded contracts for MkIV upgrade at Shanghai and Urumqi with the Oriental Scientific Instruments Import and Export Ltd. and received respective Letters of Credit. He accepted upgrade kits from MPIfR and prepared them for shipment in China. The shipment is to leave Dwingeloo in January 2000.

The revised timetable for the visit of Team China is in April 2000, after allowing sufficient time for the delivery to take place. Arrangements are being made with our Chinese colleagues.

e-VLBI/RealTime Correlator

Some of Verkouter's time was spent on incorporating JPL's software correlator into the existing RealTimeCorrelator software. So far it seems that the software itself is functioning. Using the data from the fc006 (DA193/3C84 @4.9GHz, 2MHz bandwidth, 0.25s of data) experiment of last year shows a cross-correlation on 2 out of 9 baselines. Participating stations: Mc, Ef, Wb, Jb (MkII). Fringes were found on Jb-Wb, Wb-Ef but not on Jb-Ef. This holds for all integrations that were taken. Obviously more data is required to find out what is happening. It is difficult drawing conclusions from a grand total of 3 seconds worth of data (12 times 0.25 seconds) spread over a timerange of 2h50m.

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

5.1 Network Monitoring, Reliability and Performance

Sjouwerman scheduled the 6 and 18cm Network Monitoring Experiments (NME) for EVN session 4/1999. The 18cm NME was correlated at MPIfR Bonn before the end of the session. An unfortunate cable error at Torun was discovered and corrected in time for the later 5cm session. The NME report was produced, together with a report from the Socorro correlator (see section 5.3). These reports were distributed via the EVNtech email exploder maintained by JIVE.

On the request of the TOG, Buiter paid a visit to Torun in order to help them with the adjustment of their P&G recorder. Several problems were uncovered but some remain and require further upgrades to be made to the drive. Buiter's trip report was forwarded to the TOG chair (Spencer).

Campbell discussed results from the 6cm NME from September 1999 (session 3), which was correlated at JIVE, with representatives from the various EVN stations druing the TOG meeting.

Massi continued monitoring the instrumental polarization of the EVN telescopes. The NME at 18 cm correlated at the MPIfR (Bonn) is currently being processed to completion. An analysis of the corruption of geodetic quantities by instrumental polarization is being investigated (Sorgente and Massi, 2000).

5.2 Calibration

Desmurs generated and edited the ANTAB files for EVN session 4/1999. Garrett continued to provide feedback on formating and data quality problems to both Desmurs and the stations. Desmurs created a web page which summarises the gain curve information for EVN antennas (www.ira.bo.cnr.it/~evn/evn_gains).

Desmurs installed the LOG2ANT programs at Jodrell Bank and demonstrated their operation to Alastair Gunn (Jodrell Bank). Gunn is now in charge of generating the ANTAB files for session 1/2000 onwards. Neverthelss, Desmurs has continued to develop a new PERL program that will replace the shell script, LOG2ANT. The graphical interface is almost complete and the program is expected to be ready early next year. Hopefully this will also improve the on the quality and format of the current ANTAB calibration files and may also be incorporated within the PC FS.

5.3 Data Correlation

Sjouwerman visited Socorro during this period in order to support the correlation of EVN observations at the VLBA correlator in Socorro. Support was provided for EG021, EM033A, EM033B, EM035A, EM035B, EP028, EP032, EY004C, EY004D, GB035A, and GM035E.

Campbell continued to support correlation in Bonn with the remote inspection of correlated data from EC010 and EL020B, and the despatch of EF006 to the PI. EL020B was exported in 2-line totals format (FRNGX mode 402) as required by the PI. The correlation of the NME (C99L4) was also prepared by Campbell. Campbell's support of EVN data correlation at MPIfR, Bonn came to a close in this quarter. During a period just short of 12 months, he was responsible for supervising the correlation of 24 projects in total.

5.4 Observing and Telescope Support

Desmurs took part in the geodetic observations EURO 51, EURO 52 and CORE B505 with Yebes.

5.5 General Network Support

Sjouwerman generated the Experiment Feedback Facility web pages for the November EVN session and updated some EVN web pages. Garrett continued to maintain the bulk of the EVN web pages. Garrett approached the EVN PC chair proposing long track observations of DA193, in order to test the performance of the JIVE correlator at the very highest dynamic range limits.

5.6 EVN PI Support

5.6.1 Scheduling

The following PIs/Projects were supported during session 4/1999: Snellen (ES034B), Yates (EY004D) Jiang (GJ002), Gizani (EG021).

5.6.2 Support of Visitors to JIVE

Gabuzda provided data calibration and analysis support for EVN experiments EP025 (T. Gillibrand and A. Thean), ES023 (D. Dallacasa), EC010 (T. Cawthorne), Snellen (VSOP) and ET003 (V. Tornatore). Gabuzda, Garrett and Gurvits assisted Hong Xiaoyu (EH004, EH005) visiting from Shanghai. Garrett supported N. Gizani in preparing the observing schedule for EG021 (during her visit to JIVE) and Dougherty (GS011). Other visitors conducting data analysis during this period included: I. Agudo (IAA, Granada), C. Reynolds (Univ. Central Lancashire), A. Sergeev (ASC, Moscow) D. Vir Lal (IIA, Bangalore),Galama (CIT). These visitors were supported by Gabuzda with the exception of Galama who is collaborating with Campbell.

5.6.3 Local and Visitor Computing Environment

Sjouwerman maintained the JIVE visitor computing environment with its standard settings and setups. He maintained the new test version of AIPS (15OCT99) and the associated "midnight job". Sjouwerman also maintained the EVNtech VLBI exploder and PC**-SCHED** software**.**

- Space VLBI

As a member of VISC and an EVN representative in the VSOP Science Operation Group (VSOG), Gurvits continued to participate in scheduling and planning of the HALCA operations and observing programme for the period through 2000.

Gurvits participated in the ESA ISS-SVLBI study in his capacity of the project scientist. During the fourth quarter of 1999, the study concentrated on the determination of common features of the SVLBI module with other ISS-related projects, such as XEUS.

Gurvits initiated a proposal for a European segment of the VSOP-2 mission. The proposal is to be submitted in response to the ESA Announcement of the flexi-mission opportunity in January 2000.

Gurvits continued to fulfill duties of the RISC (RadioAstron International Science Committee) secretary and participated in preparation of and attended a RISC meeting in Moscow on 8 October.

- **Research**
-

Campbell

Campbell wrote up a paper from IAU Colloquium 177 on VLBI pulsar astrometry and applications to ISM and stellar evolution/dynamics studies.

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

Provided ionospheric simulations to D.Lebach in support of VLBI astrometry related to the GP-B guide-star program.

Desmurs

Desmurs spent most of his time trying to finalize the reduction of the data of project ED011A. (H2O maser in the outflow of Young Stellar Object.)

He returned to project BB057, to include in the article the modifications asked by the referee.

Desmurs spent 4 days in Bordeaux Observatory to reduce the data taken with Effelsberg last May. This project concerns a survey of OH masers at 13 GHz in HII compact regions. Desmurs spent 6 days at Effelsberg to survey OH masers in the first excited state at 6GHz in galaxies and late type stars.

Gabuzda

In his work with multi-frequency VLBI polarization data for sources in a complete sample of BL Lacertae objects, Gabuzda's PhD student A. Pushkarev (ASC, Moscow) discovered that the local thermal plasma in and around the VLBI jet of the source 0820+225 has a clearly non-uniform distribution. This was quite unexpected for objects of this type**.**

Garrett

Garrett (in collaboration with Garrington and Muxlow - JBO) scheduled two EVN observations of the Hubble Deep Field. Phase-reference observations of the HDF included a bright primary calibrator and a closer but much fainter secondary calibrator. Gizani and Garrett produced schedules for an EVN observation of Hercules-A. Both projects were observed in session 4/1999. Garrett was involved in a press release regarding the recent EVN and 20 station Global VLBI observations of M82 (Pedlar et al).

Garrett (in collaboration with de Bruyn, Baan and Schilizzi) produced the deepest WSRT image yet using the new MFFEs. 72 hours of data produced an image with an r.m.s. noise level of 8 microJy/beam and discovered more than 30 new radio sources in a 10 arcmin square region of sky centred on the HDF and surrounding Flanking Fields. Three of the new sources are located within the HDF itself and are associated with moderate redshift (z ~ 0.5) disk or irregular galaxies. All three sources are also ISO detections, and this, together with their steep radio spectra suggests they are starburst galaxies. The fact that these sources are not detected by comparable VLA observations at the same frequnecy suggests that at least some of the microJy source population are larger than the previous VLA/MERLIN observations suggest. A poster describing this work was presented at the IAU 199 and an article will appear in the forthcoming NFRA Newsletter.

Garrett continued to think about the prospects of conducting an EVN Deep Field by employing a combination of phase-referencing within the beam and wide-field imaging techniques. This work has some bearing on the multi-field correlation project currently under development at JIVE via the TMR RTD project.

Gurvits

Gurvits together with K. Kellermann and S. Frey continued to analyze the "angular size - redshift" relation for milliarcsecond radio structures in quasars based on the VLBA survey at 15 GHz. In other collaborations, he reduced and analysed (with A. Lobanov, MPIfR) VSOP observations of the high-redshift quasar 2215+020 and the BL lac object 0235+164 (with S. Frey, Penc). Papers are in preparation.

Gurvits continued to participate in the reduction and analysis of the VSOP Survey data.

In his role as guest editor of Advances in Space Research, the COSPAR scientific journal, Gurvits submitted a full package of materials for the Proceedings of the COSPAR Symposium "VSOP mission and its results" (Nagoya, 1998) to the Elsevier Science.

Gurvits prepared schedule files for the experiment ES034B (study of milliarcsecond structures in z>4 quasars). The observations were carried out in the November-1999 EVN session.

Gurvits gave a lecture ("Space VLBI") at the EVN VLBI School 1999 in Dwingeloo.

Van Langevelde

In a very focused visit Pihlström worked on writing up the results of the NGC4261 project in collaboration with van Langevelde. A large fraction of the analysis was complete, and after a local meeting with most collaborators (Conway and Jaffe) work on the paperstarted. Within 3 weeks the paper, which describes the first scientific result obtained with the JIVE correlator, was finished. It was approved for publication in A&A Letters in the same quarter.

Van Langevelde and Vlemmings (Leiden) finished a paper on the astrometric monitoring of U Her.

During a visit of Vlemmings he worked with van Langevelde on the data reduction of polarimetric water maser VLBI. The goal is to detect linear polarization and Zeeman shifts in H2O masers at intermediate distances from massloosing giants. Some progress was made, but on the whole the project is very complicated.

As a co-I van Langevelde worked on schedules for GD013 (Diamond) and EY004D (Yates, Richards).

Massi

In Massi et al. (Massi,Ribo',Paredes,Peracaula,Estalella 20000 in preparation) we present a new EVN hybrid map of the X-ray binary source LSI 61303 showing a south-east extended structure. This structure although present in prior published maps is in this map more pronounced and completly evident. The elongation has the same position angle as the jet-like source, 2' apart, detected in our previous VLA deep survey. This coincidence strongly support the hypothesis that the large scale VLA jet is associated to LSI 61303.

Microquasars are a selected class of radio emitting X-ray binaries (REXRBs) that behave as scaled down versions of quasars and active galactic nuclei (AGNs). The population of REXRBs with confirmed relativistic ejections is still a very reduced one, with the best representative examples being SS~433, GRS~1915+105, Cygnus~X-3 and GRO~J1655$-$40. By cross-correlating different radio and X-ray catalogues we (Paredes, Marti, Ribo, Massi 2000 in preparation) selected the source {bf LS~5039} and observed it on May 1999 by VLBA. The VLBI map clearly indicates that LS~5039 is a source of bipolar jets emanating from a central core. The radio jets account for ~20% total flux density of the source. There is some asymmetry in the jet lobes, both in flux density and separation from the core, that may involve Doppler boosting effects. We conclude that LS~5039 is a new member of the class of known galactic microquasars.

Phillips

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

Pogrebenko

Pogrebenko worked on a mathematical model for simulation of array calibration and RFI rejection for LOFAR/SKA sensor field architectures.

Sjouwerman

Sjouwerman observed the Galactic Center at 86 GH with SEST for a pilot project to detect stellar 86 GHz masers. Furthermore he scheduled ES028, a project to detect the circumstellar OH masing shell of V720 Oph with the EVN/MERLIN array. This project will be a pilot project for the JIVE correlator.

- **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	VLBI studies of extremely distant quasars
Vermeulen and Gurvits	Z. Paragi	FOMI	PhD	Milliarcsecond structures in galactic and extra galactic radio sources
Gabuzda	I. Agudo	IAA, Granada	PhD	Parsec-scale Studies of the BL Lacertae Object 0735+178
Gabuzda	A. Pushkarev	ASC, Moscow	PhD	Polarization Properties of 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
Gabuzda	C. Reynolds	Univ. of Centrel Lancashire, UK	PhD	Theoretical and Observational Studies of the Parsec-scale Structure of BL Lac.
Van Langevelde	W. Vlemmings	Leiden Univ.	PhD	Astronomy of OH masers
Schilizzi	W. Tschager	Leiden Univ.	PhD	Peaked spectrum sources

Van Langevelde attended a Perl programming course.

- **Meetings, work visits, symposia, conferences**
-

Meetings, work visits, symposia, conferences Fourth Quarter 1999		
meetings, work visits, symposia, conferences	**date**	**name**
Technical Operations Group, Dwingeloo, NL	1-2 Oct	Buiter, Campbell, Desmurs, Gabuzda, Gurvits, Schonewille, Van Langevelde
Workvisit AOC, Socorro, USA	6-20 Oct	Sjouwerman
IACG SVLBI Panel, ASC, Moscow, Russia	7 Oct	Gurvits, Schilizzi
RISC meeting, ASC, Moscow, Russia	8 Oct	Gurvits, Schilizzi
Workvisit SEST, La Serena, Chile	21-30 Oct	Sjouwerman
XEUS Final Presentation, ESTEC, Noordwijk, NL	25 Oct	Gurvits
ESA F2/F3 Proposal briefing, ESTEC, Noordwijk, NL	28 Oct	Gurvits
JIVE Board meeting, Dwingeloo	29 Oct	Garrett, Schilizzi
EVN-CBD, Dwingeloo	30 Oct	Garrett, Schilizzi, Van Langevelde
ESTEC, Noordwijk, NL	2-5 Nov	Sjouwerman
EVN VLBI school, Dwingeloo, NL	3-5 Nov	Campbell, Gabuzda, Gurvits, Phillips, Van Langevelde
Workvisit, Torun, Poland	4-11 Nov	Buiter
Onsala Symposium, Sweden	7-10 Nov	Schilizzi
EVN-PC meeting, Florence, Italy	15 Nov	Van Langevelde
ESF Review Group, London, UK	16 Nov	Schilizzi
Embedded Systems Conference Europe, Maastricht, NL	17-18 Nov	Kamphuis
MPI Bonn, Germany	24-26 Nov	Sjouwerman
IAU Symposium 199, Bangalore, India	28 Nov-6 Dec	Schilizzi
Workvisit AOC, Socorro, USA	29 Nov-17 Dec	Sjouwerman

- **Presentations**
-

Campbell

"So You Want to Do VLBI", EVN/JIVE School, Dwingeloo, 3 Nov

Gabuzda

"Post-correlation processing: what you do when you do VLBI (review)", EVN VLBI school, Dwingeloo,

4 Nov

Garrett

Various Presentations at the EVN CBD meeting - Dwingeloo, 29 Oct

"Pushing the limits: phase referencing, snapshots observations and wide-field imaging", EVN VLBI school, Dwingeloo, 4 Nov

"Faint Radio Sources" - Sterrewacht Leiden, 16 Dec

Gurvits

Status of the MkIV upgrade preparation at the Shanghai and Urumqi observatories, TOG meeting, Dwingeloo, 1 Oct

Review of the VSOP science, P.N.Lebedev Phys. Institute, Moscow, Russia, 11 Oct

VLBI in Space (lecture), EVN VLBI School, Dwingeloo, 3 Nov

Phillips

"Spectral Line VLBI", EVN VLBI school, Dwingeloo, 5 Nov

Schilizzi

"What is VLBI about: scientific highlights", EVN VLBI school, Dwingeloo, 3 Nov

Sjouwerman

"AGB stars as signposts for ancient starburst activity in the Galactic center" (Poster) L.O. Sjouwerman, H.J. Habing, M. Lindqvist, H.J. van Langevelde, A. Winnberg at "Star formation from the small to the large scale" ESA Space Science Department at ESTEC 1999, Noordwijk, NL, 2-5 Nov

- **Publications**
-

Published:

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 43, 699-702

R.M. Campbell, "Ionospheric Corrections via PIM and Real-Time Data", New Astronomy Reviews, 43, 617.

J.L. Casse, "The European VLBI Network MkIV Data Processor", New Astronomy Reviews, 43, 503

Y.J. Chen, F.J. Zhang, L.O. Sjouwerman, "Is the jet of AO 0235+164 rotating ?" 1999, New Astronomy Reviews 43, 707

M.A. Garrett, R.W. Porcas, A. Pedlar, T.W.B. Muxlow, S.T. Garrington, "Wide-field VLBI imaging", New Astronomy Reviews 43, 519

A. Pedlar, T.W.B. Muxlow, M.A. Garrett, P. Diamond, K.A. Wills, P.N. Wilkinson, W. Alef, "Measurement of expansion velocity in a Supernova Remnant in Messier 82", New Astronomy Reviews 43, 535

A. Paragi, R.C. Vermeulen, I. Fejes, R.T. Schilizzi, R.E. Spencer, A.M. Stirling, "VLBA multi-frequency monitoring of SS433", New Astronomy Reviews 43, 553

J.F. Desmurs, V. Bujarrabal, F. Colomer, J. Alcolea, "Observational support for radiative pumping of SiO masers in evolved stars", New Astronomy Reviews 43, 559

M.R.W. Masheder, H.J. van Langevelde, A.M.S. Richards, L. Greenhill, M.D. Gray, "VLBI Observations of OH stars: S Persei" New Astronomy Reviews 43, 563

H.J. van Langevelde, P.J. Diamond, W. Vlemmings, A. Baudry, H.J. Habing, R.T. Schilizzi, "VLBI measurements of the parallax and proper motion of U Herculis", New Astronomy Reviews 43, 575

C.J. Phillips, H.J. van Langevelde, "Fringes on the EVN MkIV data processor at JIVE", New Astronomy Reviews 43, 609

T.W.B. Muxlow, P.N. Wilkinson, A.M.S. Richards, K.I. Kellermann, E.A. Richards, M.A. Garrett, "High resolution imaging of the Hubble Deep and Flanking Fields", New Astronomy Reviews 43, 623

S.T. Garrington, M.A. Garrett, A. Polatidis, "A VLBI and MERLIN Survey of faint, compact radio sources", New Astronomy Reviews 43 629

I.A.G. Snellen, R.T. Schilizzi, G.K. Miley, M.N. Bremer, H.J.A. Röttgering, H.J. van Langevelde, "Faint Gigahertz Peaked Spectrum sources and the evolution of young radio sources", New Astronomy Reviews 43, 675

W. Tschager, R.T. Schilizzi, I.A.G. Snellen, A.G. de Bruyn, G.K. Miley, H.J.A. Röttgering, H.J. van Langevelde, C. Fanti, R. Fanti, "VSOP/global vLBI observations of 2021+614: Detection of hotspot advance", New Astronomy Reviews 43, 681

D.C. Gabuzda, "VSOP observations of the compact BL Lacertae object 1803+784", New Astronomy Reviews 43, 691

A.B. Pushkarev, D.C. Gabuzda, "Global VLBI polarisation observations of BL Lac objects", New Astronomy Reviews 43, 695

Y.J. Chen, F.J. Zhang, L.O. Sjouwerman, "Is the jet of AO 0235+164 rotating?", New Astronomy Reviews 43, 707

C. Jin, M.A. Garrett, S. Nair, R.W. Porcas, A.R. Patnaik, "Changes in the angular separation of the lensed images PKS 1830-211 NE & SW", New Astronomy Reviews 43, 767

Submitted:

R.M. Campbell, "Pulsar Position, Proper Motion, and Parallax via VLBI", in "IAU Colloquium 177, Pulsar Astronomy - 2000 and Beyond", eds. M. Kramer, N. Wex, R. Wielebinski

S. Britzen, A. Witzel, T.P. Krichbaum, R.M. Campbell, S.J. Wagner, S.J. Qian, "Three-year VLBI Monitoring of PKS 0420-14", A&A.

D. Gabuzda, P. Kochenov, T. Cawthorne, and R. Kollgaard, "Intraday Polarization Variability Outside the VLBI Core of the Active Galactic Nucleus 0716+714", MNRAS, accepted

D. Gabuzda, P. Kochenov, R. Kollgaard, and T. Cawthorne, "VLBI and VLA Observations of Intraday Polarization Variability in 0917+624 and 0954+658", MNRAS, accepted

R. Nan, H. Zhang, D. Gabuzda, J. Ping, R. Schilizzi, W. Tian, and M. Inoue, "High Rotation Measure in the Steep Spectrum Quasar 3C147", A&A

D. Gabuzda, A. Pushkarev, T. Cawthorne, "Analysis of 6cm VLBI Polarization Observations of a Complete Sample of Northern BL Lacertae Objects", MNRAS

D. Gabuzda, P. Kochenov, and T. Cawthorne, "Serendipitious VLBI Observations of Polarization Intraday Variability in three BL Lacertae Objects", MNRAS

L.O. Sjouwerman, H.J. Habing, M. Lindqvist, H.J. van Langevelde, A. Winnberg, "AGB stars as signposts for ancient starburst activity in the Galactic center" in "Star formation from the small to the large scale" eds. F. Favata, A.A. Kaas, A. Wilson; ESA SP-445

H.J. van Langevelde, W. Vlemmings, P.J. Diamond, A. Baudry, H.J. Habing, R.T. Schilizzi, "VLBI Measurements of the Position and Motion of U Herculis", 1999, submitted to A&A

H.J. van Langevelde, Y.M. Pihlström, J.E. Conway, W. Jaffe, R.T. Schilizzi, "A thin HI circumnuclear disk in NGC4261", accepted for A&A Letters

Proceedings of the COSPAR Symposium "VSOP mission and its results", H. Hirabayashi, R.A. Preston, L.I. Gurvits (editors), 2000, Advances in Space Research, in press