JOINT INSTITUTE FOR VLBI IN EUROPE

Report for the fourth quarter, 1998

Summary

The highlight of the quarter and of the year was the official inauguration of the EVN MkIV data processor at JIVE which took place on 22 October with 300 guests in attendance. The successful "live" demonstration of fringes was a fitting end to 5 years and 10 months of design, construction and testing, and the earlier years of fundraising. The ceremony formed the highlight of the first day of the 4th EVN/JIVE Symposium held in Dwingeloo from 22 to 24 October. Almost 100 participants took part in what was generally acclaimed as a scientifically interesting and well organised Symposium. The unwelcome influx of floodwaters the week following the festivities caused a one month's delay in the start of the commissioning of the data processor. Current planning shows operations beginning in July 1999.

Progress in the MkIV upgrade project for EVN stations equipped with VLBA recording terminals is slow but steady. Delays have been experienced in the delivery of the new formatters for the recorders.

The usual support was given to EVN operations via the Network Monitoring Experiments and to individual astronomers preparing their observations, as well as correlating, calibrating and analysing their data. The EVN real-time fringe verification project underwent a partially successful test during the quarter. Problems at various stations have been identified. Discussions on the use of a software correlator developed by JPL are ongoing.

Twenty two scientific or technical presentations were made during the quarter, eight papers were published and sixteen submitted.

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Inauguration of the data processor

The demonstration of fringes at the opening ceremony was a fitting climax to the years of preparation under the leadership of Jean Casse in Europe and Alan Whitney at Haystack. At least 28 people worked actively on this project for all or part of the almost 6 years from the start of the design phase to the opening; a total of nearly 75 person years from the participating institutes and 5.2M Euros in hardware.

The ceremony itself was the result of many months of careful planning by the Local Organising Committee composed of Nelleke Vermeulen, Michael Garrett, Leonid Gurvits, Gijs Brandsma, Rene Genee, Sandra Mellema, Heleen de Haas and Richard Schilizzi. Speeches were given by Relus ter Beek (Queen's Commissioner in the Province of Drenthe), Reinder van Duinen (Chairman of the General Council of Netherlands Organisation for Scientific Research NWO), Pim Fenger (Coordinator of the International Research and Science Policy, Netherlands Ministry of Education, Culture and Science), Roy Booth (Chairman of the JIVE Board), Harvey Butcher (Director of NFRA) and Richard Schilizzi (Director of JIVE). Following the speeches, Mr ter Beek performed the official opening ceremony.

4th EVN/JIVE Symposium

The Symposium was the first scientific gathering of this size organised in the new building in Dwingeloo. The organisation was in the hands of the *Scientific Organising Committee* led by Michael Garrett with Bob Campbell and Leonid Gurvits as members, and *the Local Organising Committee* comprising Michael Garrett, Leonid Gurvits, Bob Campbell, Lorant Sjouwerman, Nelleke Vermeulen, Sandra Mellema and Heleen de Haas. The scientific programme included 44 presentations and 18 posters from the 110 participants. Contributed papers are in the process of being refereed for publication in New Astronomy Review; editors are Garrett, Campbell and Gurvits. An extended demonstration of the data processor for the Symposium participants was led by Huib Jan van Langevelde and Chris Phillips.

JIVE Board

The Board met in Bonn on 14 November. The main items on the agenda were the Director's Report, the budget for 1999 and the forward look for 2000 to 2003, the Visiting Committee, and publications (Annual Report, EVN poster and JIVE Newsletter)

Consortium Board

The Consortium Board met in Bonn on 13 November and in executive session on 14 November. The main issues were reports from the EVNPC, EVN Users Meeting, TOG, EVN Scheduling and NME , progress on the EVN upgrade, and discussions on a number of technical issues, preparation for the Fifth Framework Programme, "global" relations, space VLBI, RFI, and a proposal for a symposium at the Manchester IAU General Assembly. The executive session was devoted to a new Memorandum of Agreement for the Consortium which reflects the many changes in the organisation since the first agreement was drawn up in the 1980s

European Commission

Garrett and Schilizzi attended mid-term reviews on 23 October for two of the contracts with the EC administered by JIVE: access to large scale facilities, and research and technical development. Favourable reports on both contracts were subsequently issued by the reviewing panel.

Preparations have begun for a number of proposals for the Fifth Framework programme. Garrett, Schilizzi , Booth and Butcher attended an informal discussion of possibilities in Brussels in November.

Personnel changes

Paul Kamphuis began his 2 year appointment with JIVE on 1 October. He is working on the post- correlation integrator for the data processor in the Technical Operations Group.

Infrastructure

Van Langevelde and Schonewille reorganised the JIVE and EVN web pages. Gurvits continued to participate in the work of the Dwingeloo Library committee. Sjouwerman and Philips alternated in writing the minutes of the monthly JIVE institute meetings.

Visitors:

Phil Hazell (Avonsoll Ltd), Roel Gloudemans (ex-RUL), Jin Chengjin (MPIfR, Bonn), R. Noble, P. Maguire, P. Shepherd (Jodrell Bank), W. Tschager (RUL), Yongjun Chen (Shanghai), participants in the 4th EVN/JIVE Symposium, and guests at the official opening of the EVN/JIVE Data Processor.

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

Summary

The major event of this quarter, of course, has been the opening of the Data Processor. In the weeks leading up to October 22, preparations for this event dominated development team activity. In the process the correlator passed its last construction milestone. It was then possible to spin 16 tapes simultaneously and produce fringes. These efforts were rewarded by some very successful demonstrations, both during and after the opening ceremony.

The impressively on-target planning prepared by Casse many months before the opening came to a close on October 22. A new plan, aimed at achieving operational status by the middle of 1999 was therefore needed. With inputs from team members a new plan was prepared by van Langevelde and Parsley.

The objective set is to be ready to process a restricted range of astronomical modes defined as follows:

- 2-bit sampling.
- Cross-polarization modes.
- Spectral line modes with 1024 or 512 spectral points per baseline, but not yet ones that use oversampling.
- The correlator model and tape handling will be sufficient to support phase referencing.
- MkIV and VLBA modes, including fan-out, but not barrel-rolling.
- More than 8 stations simultaneously processed.
- Telescopes with VLBA-type control files.

These modes, combined with the requirement that it will be possible for operators to run the data processor, constitute the targets for the commissioning phase. The priorities were chosen in order to make the EVN MkIV correlator operational for a basic set of MkIV modes to be used in the EVN. This strategy was discussed briefly with the EVN PC. A subset of these capabilities will be advertised in the EVN call for proposals for the February 1999 deadline.

The important milestones for the commissioning phase are:

Milestone	**Date**
All hardware available (except DDU)	20 May 1999
Comparison with VLBA data	10 Feb 1999
First image	01 Mar 1999
Clean correlator data available	07 Apr 1999
First user data released	10 May 1999
DDU ready	01 Jun 1999

Full operator control	10 Jun 1999
Data processor operational	30 Jun 1999

The whole team is committed to maintaining this challenging timeline and so far there has been no serious slippage.

2.1 Correlator section

During this quarter we received the last correlator boards from Haystack. With the modules that worked, four correlator units were integrated, tested and installed in the basement in Dwingeloo. The system successfully survived the inauguration. The system test program has been extended to accommodate the four correlator units. Software that passes the status information on to the correlator control computer is ready to be integrated.

The next step is the addition of the data distributor. This unit is waiting for the completion of the preselector boards. The prototype of which has been debugged. All necessary boards have been manufactured and will be assembled and tested during the next quarter. Parallel to this the software necessary for testing has been developed.

De Haan worked on the DZB correlator for Astron. He finished the testing and repairing (where necessary) of almost fifty A/D boards, including the (6) racks the boards are placed in. He also assembled several Post-selector boards, and did some testing on the TAAM-boards together with Schoonderbeek.

2.2 Station Units

In a revision to the contract with ATSC it was agreed that the remaining Station Units would be delivered to JIVE following a limited "Bench Test". This became necessary because ATSC no longer have access to a DPU for the full FAT. The remaining units will be fully tested and accepted when they arrive at JIVE.

During commissioning of the system Pogrebenko and Philips have identified a number of hardware and software bugs in the Station Unit which are gradually being fixed. On his return from a period at Haystack, Phil Hazell (Avonsoll Ltd) was hired to re-work the SU software and assist JIVE in becoming self sufficient in this respect. Some problems with the "position to footage" command in the SU were identified. It turned out that embedded software was not correctly dealing with timeouts, particularly near low tape points. This caused the DPU's to sometimes "freeze" for 5-10 minutes while in operation.

Metrum Information Storage have continued to tackle migration of the Phase Cal Module design to E-Series Xilinx. This has proved to be difficult. In December Pogrebenko, Parsley and Hazell visited Metrum to discuss the problem with the local engineers. This was a very useful session in which a major cause of the problem was identified. Following this all, prototype PCMs were recalled to Metrum to enable a more exhaustive test to be carried out before commitment to the production design. If this goes well, a replication contract will be possible in early 1999.

Olnon and Heald installed pRISM+, a package for developing the pSOS+ modules for the SUCCS (Station Unit Control Computer Software). Olnon then assisted Hazell in finding out how to work with that package, remotely as much as possible.

2.3 Play Back Units

The adjustment made to the tape paths of all DPU's proved to be correct so that the opening ceremony could take place without problems. After the opening of the Data Processor a review of the situation and in particular of the available spares was conducted which led to an additional list of items to be purchased in order to secure our independence and fast reactions to calamities.

It was also decided to secure new guiding caps of better quality. An order has been placed for some 60 caps made of aluminum nitrate to enhance the hardness and reduce the risk of tape edge damage as the cap wears.

At the end of the quarter, all but two triple cap headstacks from Spin Physics had been delivered and tested. More headblocks have been ordered so that one can easily swap between real and dummy headstacks.

Martin Leeuwinga started with work to copy a Tape Position Test Box device at the beginning of December.

2.4 SUIM/TSPU (Station Unit Interface Module/ Test Synchronisation Pulsar gating Unit)

The last adjustments of the TSPU for the WSRT modes were done by Andrea Maccaferri and Sandro Cattani in Medicina. Hardware was tested intensively and a document on the test procedure was compiled in Medicina. It looks like the basic part of the project was complete at the end of the year, but some advanced features like Test Injection and Pulsar Gating still require full integration into the correlator environment.

2.5 High level control software

The first month of this quarter was effectively taken up by preparations for the inauguration of the Data Processor on the 22nd October. Once all the excitement was over, further progress was made on coding new software, although testing this was deferred.

Maguire and Shepherd incorporated the location broker into the existing code. This is an essential prerequisite of running multiple jobs simultaneously, and it enables services to be assigned and located dynamically at run-time.

Maguire added various enhancements to SU_Control, including a facility to peak the heads whilst the tape was being processed. This cannot be tested, however, until some bug-fixes in the the SUCC software are completed. He also finished a preliminary version of a GUI for Processing_Job, which

still needs testing.

Shepherd added some enhancements to the Persistence Classes.

Noble added support for tape motion commands to the Status_Monitor GUI and carried out related modifications to its code. Support for these commands in Processor_Control and SU_Control is scheduled for early in the next quarter. He also completed the "final" version of the Data Formats specification (with the exception of some auxiliary files still to be specified), together with doing other documentation work.

Heald continued with work on the Tapes Database and its GUI.

This quarter Olnon spent almost all his time on consolidation work. Prior to the opening the highest priority for the whole software team was to ensure a stable performance of the current version of the correlator control programs. That meant exhaustive testing, debugging and repairing. Shortly after the successful opening demonstrations, Olnon went to Jodrell Bank for two weeks of face-to-face discussions with the other members of the software development group. The whole package was reviewed, especially the sections developed by Shepherd, and even more specifically the list of todo's.

Olnon started on the urgent maintenance issue of bringing all system components under proper configuration control: the real-time software components must also come under revision control (CVS), and all the software must be split into operational, test and development streams. Progress has been slow on this, because of the down-time due to the flooding, subsequent absences from Dwingeloo, the end-of-year holiday season, and the ever increasing divergence between testing/operational and development versions.

Phillips continued to test new software from Jodrell after a period of no changes (due to a software freeze before the opening ceremony). This included changes to some of the messages sent to the SU to fix a problem correctly identifying upper and lower sidebands. This required parallel changes to the embedded SU software made by Phil Hazell.

2.6. Post correlation software

Verkouter started to design and implement a new JIVE MeasurementSet filler. The new filler is capable of reading the existing format (as written by Bos) as well as the upcoming new dataformat, the Correlator Output Format, which will be written by the DataHandler software running on DDD. Part of Verkouter's time was spent on trying to get header information out of the data, in order to be able to compare the information to what the existing diagnostic software yields.

2.7 Infrastructure

The flooding in the basement in the last week of October caused considerable extra work. Fortunately all equipment survived without damage. Cracks discovered in the concrete walls where water came through, were repaired by a specialised company. This and the flooding itself caused considerable delay in the ongoing tests of the processor. Jan Buiter wrote a note with a proposal for an Equipment Rescue Plan (ERP) in case of serious flooding of the basement and no electrical power available to pump the water away.

A local 24 V transformer was installed in the mains distribution cabinet to make JIVE operations independent from a 24 V line that came from upstairs and that failed just before the official opening. This failure created problems in a power supply in the TSPU module a couple of hours before the opening. Fortunately there was a spare power supply available. Overvoltage protectors were installed in the mains cabinet in the DPU and Correlator circuits.

To avoid EMC problems in processor equipment (for example the TSPU) the paternoster was equipped with new 3-phase motors with proper filters and a new frequency converter.

In the area of infrastructure work was done to create proper connections for network and telephone lines to the control console and the operators desks. Whiteboards were mounted on the walls and a row of cupboards was installed in the JIVE store.

2.8 Testing and preparing for operations

Phillips with Bos and later Progrebenko, started testing fractional bit-shift corrections in the correlator software. Initial results are encouraging and a significant improvement in signal to noise was achieved, though it is possible that phase corrections may not be implemented correctly. Further tests are continuing.

Phillips has consolidated a set of Glish programs into a suite of analysis routines in AIPS++. These routines allow for visual and analytical inspection of the raw correlator output. These routines proved to be very useful while testing the fractional bit-shift corrections.

Phillips scheduled another EVN test observation. This observation, of the OH maser source W3(OH), will be the first correlation of spectral line data. One hour of the observation was scheduled to be observed in an "oversampled" mode to test correlating of oversampled data.

Kramer experimented with QT (the graphical user interface that is used for the online software). He wrote an application to view the IERS earth orientation parameters, logs and GPS files in local directories.

Because of future script development, Kramer attended a Perl course. This course offered, besides the fundamental knowledge of Perl, some new insights for software development in Perl, especially in the areas of Object Orientation and available class libraries. As a first application, the procedure for entering new tape entries in the Tape Catalogue web page was enhanced by using Perl.

Schonewille assisted with the operational tests of the EVN MkIV data processor and studied operational aspects of the EVN MkIV data processor. From 9-19 Nov. he visited NRAO in Socorro in order to obtain an oveview of the information flow and logistics around the correlator. For part of the quarter, he tested and repaired the sampler modules for the DZB correlator system (NFRA).

2.9. Thin Film Head array project

Hans Hinteregger at Haystack has mounted three of the new rowbars in a stack and is ready to begin electrical testing. The main test is to verify that the wider flats and somewhat smaller corner wrap angles of the new 3-bar assembly result in robust head-tape contact, independent of speed from 1 to 8 m/s, independent of direction, tolerant to moderately large > 50% variations in tension, corner wrap, and humidity in the tape path. This main test follows more extensive than anticipated mechanical work to design, build, and learn to use precision assembly and alignment tools and mounting modifications.

Eight phase 2 part 1 partial **prototype** subassemblies were delivered to Haystack by Seagate in October 1998. These are 'partial' prototypes because:

1] They still have a long 1 um write gap like the feasibility heads, which results in a 6 dB recorded signal loss relative to a VLBI recording made with a good 330 nm write gap, as specified for the true phase 2 part 2 prototype.

2] The part 1 bars are from the initial developmental wafer run of the commercial LTO target format. While most channels in each bar are electrically good, each bar has a few bad read and/or write elements with an open circuit, abnormal resistance, or short circuit between MR element and a shield. The wafer design has since been slightly revised; array pitch will be slightly larger in the commercial product than in the partial prototype, for example. Resistances have also been added to the shield circuits to ameliorate the effects of MR-to-shield shorts and still permit static charge to bleed off to prevent ESD death of MR elements.

3] The flat lapping process used was not 'maturely' implemented and resulted in excessive 80-100 nm pole-tip recession. Disk rowbars are lapped to limit recession to about 15 nm and 30 nm max is specified for production tape heads. 90 nm excess recession results in 6 dB excess spacing loss at the 900 nm bandedge wavelength even when there is good contact on the otherwise flat surface.

4] The flex interconnects supplied by Seagate are too awkward and bulky to be used in a true VLBI prototype assembly. Full parallel operation of new write driver and preamp circuits cannot be properly tested with these interconnects. The development of the parallel R/W interface including flex is stalled pending an agreement to produce VLBI bars with a preproduction [qualification] phase to replace part 2 of prototype phase 2.

The main concern at the moment is still Seagate's willingness to accept Haystack's business proposal to produce rowbars. The future of the thin-film project depends critically upon their response. Will Aldrich at Haystack has also been investigating the "head-intimate" electronics.

- Recording terminal upgrade to MkIV (Spencer et al)

Software

Van Langevelde worked on support of MkIV telescopes in Walker's (NRAO) Sched. A new version was issued, which contains many enhancements. The most work was involved in upgrading the internal sorting for the VEX modes. This allows users to set up more complex schedules for MkIV

telescopes, for instance switching modes during the observations. Other upgrades included support for the JIVE correlator.

Formatters

MkIV upgrade

Test observations for the remaining modes that still needed to be verified, were scheduled by Van Langevelde and McKay and took place on 27 November. The data is to be analysed by Jon Romney after correlation at Socorro.

VLBA upgrade

Delays in delivery of the new formatters have occurred due largely to the export licence requirements for Torun and China. Further documentation is required and is being pursued by I. Diegel at Allied Signal.

Manual

We are still waiting for the final version for this from GMR Associates.

Read/Write Electronics

A quotation has been received from Metsahovi for the read/write electronics, excluding the head assemblies.

The head assemblies are to be made at MPI Bonn, terms are being negotiated. Bonn is also making the new head blocks.

China Upgrades

A set of 4 MHz filters for Urumqi has been ordered. A set of narrow band filters is also required. Terms of agreement with the Chinese are being arranged by L. Gurvits.

- Network Support Group Activities (Garrett, Aaron, Campbell, Desmurs, Fridman, Gurvits, van Langevelde, Massi, McKay, Mioduszewski, Polatidis, Sjouwerman)

4.1 Network Monitoring, Reliability and Performance

Sjouwerman scheduled and partly correlated in Bonn, the 6 and 18 cm Network Monitoring Experiments (NME) from the November 1999 EVN session. The NME report was written-up and distributed in December. The NME's were scheduled and observed in such a way that they could

also be used to determine the instrumental polarisation terms of the EVN antennas. Two of the NME experiments were later processed in mode C by Campbell and Massi. Massi exported the data into AIPS for further analysis. The aim is to determine the D-terms of the array in order to remove the instrumental polarization on parallel hand and cross-hand data.

McKay has continued work on the EVN real-time fringe verification project. Integration into the the Field System of the MkIII data buffer control has now been completed. During the November 1998 EVN session, this system was tested among the five EVN stations that have MkIII data buffers. Unfortunately, only one station managed to operate as planned, but the problems with the others have now been identified. Nevertheless, the working station managed to acquire data and automatically FTP it to the software correlator repository without human intervention. As previously reported, this data can be processed automatically, and an auto-correlation spectrum was available in less than 15 seconds after the completion of the November observations (again, without any human intervention). The spectra obtained readily showed the phase-cal signal. McKay et al. are still in consultation with JPL concerning an existing software correlator for the proposed EVN real-time fringe checking project.

Mioduszewski is keeping track of the performance of the EVN as seen from the VLBA correlator during the November session. Once all experiments are completed, a report will be sent to the EVN. The system that Mioduszewski set up to provide fast feedback to stations was used successfully during the November network session.

4.2 Calibration

During this period, Desmurs produced the ANTAB calibration files associated with session 4 1998. The software, LOG2ANT, produced the files automatically with very little intervention.

Mioduszewski tested a new capability of AIPS and the VLBA in which calibration tables are automatically transfered with the data files.

4.3 Data Correlation

Campbell supported the correlation of several EVN experiments at Bonn. Mioduszewski was contact for spectral line experiments EE002, ED010. This involves checking schedules, facilitating correlation and checking correlator output.

4.4 Observing and Telescope Support

McKay supported observations at Cambridge and Jodrell Bank for the November 1998 EVN session. Polatidis supported the CMVA observations at 3mm in November 1998 and the EVN observations in November-December 1998. Fridman installed the APEX injection

phase-cal system on RT7 at

Westerbork.

4.5 General Network Support

McKay and van Langevelde scheduled experiment FT003 for the verification of the remaining MkIV modes on the NRAO correlator. This experiment was observed on 27 November and correlation was completed on 21 December by Romney (NRAO). A total of seven modes were tested, of which five were successfully observed and are now considered "validated" by NRAO. The problems with the remaining two modes have been identified and will be investigated further in 1999. It is expected that the updated document, "Validated VLBA and VLBA-compatible MkIV Recording Modes", will be ready

for the user community by February 1999.

Gurvits obtained import licenses of the Chinese Ministry of Foreign Trade and Economics for the MkIV formatters for Shanghai and Urumqi Observatories in accordance with the requirements of the US Department of Commerce. Preparation of the contractual documents required for the MkIV upgrade at Shanghai and Urumqi Observatories continued. Gurvits also continued to assist to Shanghai and Urumqi observatories in the maintenance of their VLBI instrumentation.

Sjouwerman generated the Experiment Feedback Facility web pages for the November EVN session. Other web pages were also updated and the EVNtech VLBI exploder and PC-SCHED scheduling software maintained.

Garrett wrote up a short report on the performance of the EVN to be included in the minutes of the TOG.

4.6 EVN PI Support

4.6.1 Scheduling

Garrett assigned JSS to EVN projects and directly supported GB031 and GP018. Desmurs supported EVN PIs with spectral-line observations at 6GHz (session 4, 1998; projects ES026 and EE002). Desmurs also produced the SCHED setup files (in collaboration with van Langevelde) for the

EVN observations at 6.03 and 6.67 GHz. Sjouwerman aided PI's in scheduling the projects EE002A and GG038A. Polatidis supported scheduling of the spectral line experiment GB028 and the continuum experiment GM035A/B for the November 1998 EVN session. Sjouwerman supported the scheduling of projects EE002A and GG038A.

4.6.2 Support of Visitors to JIVE

Sjouwerman maintained the JIVE visitor friendly workstation environment with its standard settings and setups. He installed and maintained the new test version of AIPS (15APR99) and its 'midnight job', and reinstalled the 15OCT98 version.

Sjouwerman supported Yongjun Chen (Shanghai) during his visit to JIVE to analyse EVN observations of the BL Lac AO 0235+164. Gurvits assisted A. Volvach (Crimean Astrophysical Observatory) in his data reduction of project EV006. Garrett supported Chris de La Force (Jodrell Bank) during his 3 week visit to JIVE.

- Space VLBI

VSOP/HALCA

As an EVN representative in the VSOP In-orbit Checkout (IOC) group, Gurvits continued to extensively participate in scheduling and planning of the HALCA recovery operations and observing programme for the first quarter of 1999.

Gurvits assisted in the organisation of a meeting of the VISC and of the RISC in Woods Hole, MA, USA, on 6 and 7 Oct respectively. He also was chairman of the organizing committee of the scientific workshop "Radio Astrophysics with Extremely High Angular Resolution" held in the same location from 5 to 7 October.

Gurvits is acting as Project Scientist for the ESA study of the VLBI free flying module in the framework of the International space Station.

As members of the international ARISE (Advanced Radio Interferometer between Space and Earth) science advisory group Garrett and Gurvits participated in drafting a "white paper" document on the scientific case on the ARISE mission and its executive summary. Both documents are prepared for the publication at the meeting of the American Astronomical Society (Austin, 05-09.01.1999).

RADIOASTRON

Gurvits helped prepare the return to the ASC of the two RadioAstron antenna petals after thermal vacuum tests at ESTEC, and distribution of the petal test Report.

6. Research

Desmurs

Desmurs finished reducing the data of a VLBA project on SiO masers in the circumstellar envelopes of evolved stars. He found new and interesting results including confirmation of the ring shape distribution of SiO masers and linear polarization patterns tangential to the circumstellar envelope. But the most important result is the discovery of a systematic shift between the masers of two different vibrational states, which is in disagreement with previous observations made with a much lower resolution. He presented these results during the 4th EVN/JIVE meeting and has written two articles to report on these observations.

Desmurs prepared and observed 4 projects during the 4th EVN session (ed009, ed010, ed013, gb026). All these projects concerned OH masers in ultra compact HII regions at different frequencies. In particular he observed nearly simultaneously (within the time of the session) all the OH maser emission reachable with the EVN in the well known source W3(OH). This will enable a careful study of the magnetic field to be made, and also, as all the observations have been made with the phase referencing technique, the relative positions of maser transitions can be measured and reference maps obtained for studying the dynamics of the region and the proper motions of OH masers.

Garrett

Garrett continued to collaborate with Jin Chengjin on 7mm observations of 1830-211. Chengjin visited JIVE for one week in October. The first order result of the multi-epoch 7-mm data is now clear: the separation of the mm-VLBI cores of the two lensed images appears to change with epoch. Between observations made in the periods April-July 1996 and January-April 1997 the separation was observed to decrease by 200 microarcsecond. Between two epochs separated by only 2 weeks the separation changed by 80 microarcsecond. The simplest explanation is that rapid changes in the brightness distribution of the VLBI core (on the sub-parsec scale) are magnified by the lens and thus the separation of the VLBI core is observed to change as the core radio structure evolves. This is the first time this effect has been seen on such short time-scales, and the first clear evidence of any structural evolution in a gravitational lens.

Garrett collaborated with Chris de La Force, Ralph Spencer and Alastair Stirling (PI, Jodrell Bank) on VLBA 8.4 and 15 GHz observations of the famous x-ray binary Cygnus X-1. De La Force visited JIVE for 2 weeks in order to analyse the VLBA data made in phase-reference mode at three epochs separated by 2 days (the orbital period of the radio faint binary is 6 days). For the first time, extended jet emission was detected in the 8.4 GHz data and the peak of the core radio emission was seen to drift to the south from one epoch to the next. At 15 GHz the ~ 7 mJy core has very complicated multi-component structure, and the drift of the core southwards in the 8.4 GHz maps is clearly due to a

"contraction" of the northern extended radio emission seen in the high resolution 15 GHz maps. The 8.4 GHz jet lies perpendicular to the plane of the binary orbit while part of the multi-component 15 GHz emission lies in the orbital plane.

Garrett began to work on some Australian LBA data in collaboration with Rob Fender (U of Amsterdam). The 4-station observations are of XTE J1748-288 shortly after a flare. Without calibration data, progress has, however, been very limited.

Garrett contributed a section on gravitational lensing to the ARISE "white paper" to be presented at the January A.A.S. meeting.

Gurvits

Gurvits, K.Kellermann (NRAO) and S.Frey (SGO) implemented the referee's comments on their paper "The "angular size - redshift" relation for milliarcsecond radio structures in quasars and radio galaxies". The revised paper has been accepted for the publication in A&A. Gurvits, S.Frey, Zs.Paragi (SGO), R.T.Schilizzi et al. finalized the data reduction and interpretation of global and EVN VLBI observations of ten high-z quasars, including the most distant known radio-loud quasar 1428+4217. A paper has been submitted to A&A.

Gurvits continued to work on 5 GHz VLBA data on the source 1156+295 related to the corresponding EVN project (PI Hong Xiaoyu). He continued data reduction and interpretation of pre-launch VLBA observation of 380 VSOP survey sources at 5 GHz (BH019) and he prepared schedule files for two 24-hour VLBA survey observations of about 60 extragalactic sources at 15 GHz in support of the VSOP Survey Programme (BG077c, 05.12.1998, and BG077d, 02-03.01.1999).

Gurvits submitted on observing proposal for the 7th cycle of the X-ray satellite ASCA (Japan) for coordinated X-ray - VLBI observations of high-redshift quasars. The proposal was granted 80 ks of ASCA time on two high-redshift quasars during 1999.

Gurvits continued to act as guest editor for Advances in Space Research in relation to the proceedings of the VSOP meeting at COSPAR Nagoya. He initiated the gathering of papers for the Proceedings of the workshop "Radio Astrophysics with Extremely High Angular Resolution".

Van Langevelde

Van Langevelde and Vlemmings (Leiden) continued their project on the determination of the radio parallax and proper motion of the Mira U Her. Good progress was made on the algorithms for fitting the motions on the sky. A comparison was made between the positions of the OH masers and the optical Hipparcos position. Additional work was done on comparing the serendipitous 1665 MHz maser observations.

Massi

A filler program at the 100-m Effelsberg telescope has been proposed and accepted for the first 6 months of 1999 to monitor UX Arietis and make a survey of a selected sample of RS CVn type stars. Multi-epoch VLBA observations of the X-ray binary system LS 5039, in which a radio counterpart has been recently discovered (Paredes et al. 1998) have been proposed (Paredes, Massi).

McKay

McKay continued work on GRO1655-40, in which observations from 1994 are being re-analysed. This work is being done in collaboration with Diana Haanikan (Helsinki). The work on the 1997 outburst of GRS1915+105 is nearing completion, with the main paper having been now accepted by MNRAS.

Mioduszewski

Mioduszewski received 3 target of opportunity VLBA observations in November, to observe galactic jet source SS433 during and after a 2.5 Jy flare.

Phillips

Phillips continued processing ATCA data of northern methanol masers, and scheduled an EVN spectral line observation.

Polatidis

During his visit to NRAL, Jodrell Bank, Polatidis worked on the calibration and initial analysis of MERLIN obesrvations of the nucleus of the Seyfert Galaxy IC694. The project is a collaboration with S. Aalto (PI, OSO), S. Radford (NRAO) and J.E. Conway (OSO), aiming to

investigate, at sub-arcsec resolution, the kinematics and dynamics of the central ISM region of IC694.

Polatidis continued the analysis of the 6cm VLBA observations (BM100) of flat spectrum radio sources with M. Marcha (Obs of Lisbon, Portugal) during her visit to OSO (Nov 22-29). They also worked on the definition of a new sample of flat spectrum radio sources, with declination 0 to -20 degrees to investigate the differences between BL Lac objects and radio galaxies. As part of the study of this new sample, Polatidis observed 30 of these sources at 3 and 2 mm with the SEST radio telescope in Chile.

Polatidis made CO(2-1), 13CO and HCN observations of OH megamaser galaxies, with the 20m OSO radio telescope (Nov 18-21), in a project in collaboration with S. Aalto (OSO).

Sjouwerman

In Onsala, Sjouwerman and Lindqvist wrote up a survey for H_2O and SiO masers in Galactic center OH/IR stars. Sjouwerman continued to investigate the Galactic center starburst that took place around 1-4 Gyr ago.

- Education and training

SUPERVISION				
Staff member	**Student**	**Institute**	**Degree**	**Subject**
Gurvits	S. Frey	SAO Hungary	PhD	Cosmology
Gurvits	Z. Paragi	SAO Hungary	PhD	High redshift quasars
Gurvits	B. van Dam	RUL	Drs	High redshift galaxies
Van Langevelde	W. Vlemmings	RUL	PhD	VLBI astrometry of masers
Schilizzi	W. Tschager	RUL	PhD	Peaked spectrum radio sources

McKay gave a 6-lecture series on C programming for astronomy students at Jodrell Bank.

Olnon took a 4-day course on `Client-Server Programming with UNIX' with AT in Nijmegen.

Verkouter followed a course on Object Oriented Analysis, Design and Modelling using Universal Modelling Language (UML) from November 23-26

Kramer followed a course in the Perl language.

- Meetings, work visits, symposia, conferences

Meetings, work visits, symposia, conferences Fourth Quarter 1998		
meetings, work visits, symposia, conferences	**date**	**name**
Work visit, NRAL, Jodrell Bank, UK	1-17 Oct	Polatidis
Workshop "Radio Astrophysics with Extremely High Angular Resolution", Woods Hole, MA, USA	5-7 Oct	Gurvits
VISC meeting, Woods Hole, MA, USA	6 Oct	Gurvits
RISC meeting, Woods Hole, MA, USA	7 Oct	Gurvits
Work visit to JIVE, Dwingeloo, NL	19-21 Oct	McKay
4th EVN/JIVE Symposium, Dwingeloo, Netherlands	22-24 Oct	Garrett, Gurvits, Van Langevelde, Massi, McKay, Phillips, Polatidis, Schilizzi Sjouwerman
Mid-term review of EC contracts, Univ. of Leuven, Belgium	23 Oct	Garrett, Schilizzi
Observations at SEST, La Silla, Chile	25 Oct - 1 Nov	Polatidis
ISS-SVLBI kick-off meeting, ESA HQ, Paris, France	27 Oct	Gurvits
8th ADASS meeting, University of Illinois, Urbana/Champaign, USA	1-4 Nov	Verkouter
NRAO Array Operations Center discussions on AIPS++ developments, Socorro, New Mexico, USA	5-13 Nov	Verkouter
EVN PC meeting, Obs. de Meudon, Paris, France	5-9 Nov	Van Langevelde
EVN CBD meeting, MPIfR, Bonn, Germany	13 Nov	Garrett,Gurvits Schilizzi
JIVE Board meeting, MPIfR, Bonn, Germany	14 Nov	Garrett,Schilizzi
Work visit, NRAL, Jodrell Bank, UK	9-20 Nov	Olnon
Work visit, NRAO, Socorro, NM, USA	10-18 Nov	Schonewille
MPIfR Symposium No. 1, Bonn, Germany	17 Nov	Massi
2nd European ISS Utilisation Symposium and XEUS progress meeting, ESTEC, Noordwijk, NL	16-20 Nov	Gurvits
Spektr series RSA internal review meeting, RSA, Moscow, Russia	25 Nov	Gurvits
ISS ATV enhancement project final presentation, ESTEC, Noordwijk, NL	15-20 Nov	Gurvits
Meeting on the Fifth Framework Programme, European Commission, Brussels, Belgium	23 Nov	Garrett, Schilizzi
Station Unit Meeting, Metrum, Bristol, UK	25-27 Nov	Parsley, Pogregenko
ESF Workshop, Aachen, Germany	2-3 Dec	Schilizzi
Second workshop on Relativistic Jets in the Galaxy, Paris, France	12-13 Dec	Mioduszewski
Texas Symposium on Relativistic Astrophysics, Paris, France	14-18 Dec	Mioduszewski
Onsala Space Observatory, Onsala, Sweden	21-22 Dec	Sjouwerman

- Presentations

Casse

"Development of the EVN MkIV Data Processor at JIVE", 4th EVN/JIVE Symposium, Dwingeloo, NL, 22-24 Oct.

Desmurs

"Observational Support for Radiative Pumping of SiO masers in Evolved Stars "**,** 4th EVN/JIVE Symposium, Dwingeloo, NL, 22-24 Oct.

"Nouvelles donn'ees observationnelles en faveur d'un pompage radiatif des masers SiO dans les 'etoiles 'evolu'ees", Bordeaux Observatory, France, 22 Dec.

Garrett

"EVN Performance and Reliability", EVN Consortium Board of Directors Meeting

"Wide-field VLBI Imaging", EVN/JIVE Symposium No. 4, 22 Oct

Gurvits

"Cosmological tests with the milliarcsecond radio structures in extragalactic radio sources", Columbia Univ. New York, NY, USA, 2 Oct

"Compact radio structures in AGN across the redshift space revisited", RAEHAR workshop, Woods Hole, MA, USA, 5 Oct

"VSOP observations of quasars at 6.4-8.0 and 20-25 GHz", 4th EVN/JIVE Symposium, Dwingeloo, NL, 24 Oct

"Scientific objectives of the 2nd Generation SVLBI mission", ISS-SVLBI kick-off meeting, ESA HQ, Paris, France, 27 Oct

"Milliarcsecond radio structures in AGN as cosmological standard objects", Kapteyn Institute, Groningen, NL, 2 Nov

"Space VLBI - future missions", EVN CBD meeting, MPIfR, Bonn, Germany, 13 Nov

"The International Space Station and VLBI Radio Astronomy", 2nd ISS Utilisation Symp. ESTEC, Noordwijk, NL, 20 Nov

"Astrophysics with milliarsecond angular resolution", Moscow Physical-Technical Institute, Russia, 25 Nov

Van Langevelde

"VLBI Measurements of the Parallax & Proper motion of U Herculis", EVN/JIVE symposium, Dwingeloo, 23 Oct

Van Langevelde & Phillips:

"Demonstration of the EVN MkIV data processor at JIVE" ,EVN/JIVE symposium, Dwingeloo, 23 Oct

Massi

"Stability of the Instrumental polarization", EVN Users Meeting, JIVE, Dwingeloo, 24 Oct

"Loop structures at VLBI scale in UX Arietis", EVN/JIVE Symposium No 4, JIVE, Dwingeloo, 22-24 Oct

"VLBI observations of the stellar system UX Arietis", MPIfR Symposium No. 1, Bonn, 17 Nov

Mioduszewski

"Radio Counterparts of X-ray Binaries and X-ray Transients", New Mexico State University, Las Cruses, NM, USA 30 Oct

"VLBI Images of CI Cam", Second Workshop on Relativistic Jets in the Galaxy, Paris, France, 13 Dec

"The Radio Remnant of X-ray Nova CI Cam", Texas Symposium on Relativistic Astrophysics, Paris, France, 16 Dec

Phillips

Van Langevelde & Phillips:

"Demonstration of the EVN MkIV data processor at JIVE" ,EVN/JIVE symposium, Dwingeloo, 23 Oct

Polatidis

"Compact Symmetric Objects in a complete flux-density limited sample", 4th EVN/JIVE symposium, Dwingeloo, The Netherlands, 24 October.

- Publications

Published:

L.I. Gurvits, "VLBI from the Moon", Highlights of Astronomy, Kluwer Acad. Publ., 985-987

L.I. Gurvits, K.I. Kellermann, S. Frey, "Measuring cosmological parameters with Very Long Baseline

Interferometry", in Proceedings of the IAU Symposium No. 183, Kluwer Acad. Publ., 67

H. Hirabayashi et al (53 authors), "Overview and initial results of the Very Long Baseline Interferometry Space Observatory Programme", 1998, Science, 281, 1825-1829

Hogerheijde M.R., van Dishoeck E.F., Blake G.A., van Langevelde H.J., "Envelope structure on 700 AU scales and molecular outflows of low--mass young stellar objects", 1998, ApJ 502, 315

C.J. Phillips, R.P. Norris, S.P. Ellingsen and P.M. McCulloch, "Methanol masers and their environment at high resolution", 1998, MNRAS 300, 1131-1157

R.T. Schilizzi, L.I. Gurvits, G.K. Miley, M.A.R. Bremer, H.J.A. Röttgering, R. Nan, K.C. Chambers, W.J.M. van Breugel, "VLBI observations of galaxies at high redshift" in High Redshift Radio Galaxies, ed. H.J.A. Röttgering, Kluwer Acad. Publ.

Sjouwerman L.O., van Langevelde H.J., Diamond P.J., "Stellar positions from SiO masers in the Galactic center" 1998, A&A 339, 897

Stirling, A.M., Spencer, R.E. & Garrett, M.A., 1998, "High Resolution Images of Cygnus X-1", New Astronomy Reviews, 42, 657.

Submitted:

J.F.Desmurs, V. Bujarrabal, F. Colomer, J. Alcolea, "Observational Support for Radiative Pumping of SiO masers in Evolved Stars" 1998, Proc. "4th EVN/JIVE VLBI Symposium"; eds. M.A. Garrett, R.M. Campbell, L.I. Gurvits, New Astronomy Reviews, (in press).

J.F. Desmurs, V. Bujarrabal, F. Colomer, J. Alcolea, "VLBA observations of SiO masers: Arguments in favor of radiative pumping mechanisms" 1998, submitted to A&A.

R.P.Fender, S.T.Garrington, D.J.McKay et al. "MERLIN observations of relativistic ejections from GRS 1915+105", 1998, (Accepted MNRAS)

S.T. Garrington, M.A. Garrett, A.G. Polatidis, "VLBI and MERLIN Observations of Faint Radio Sources Selected from the FIRST Survey",Proc. "4th EVN/JIVE VLBI Symposium"; eds. M.A. Garrett, R.M. Campbell, L.I. Gurvits, New Astronomy Reviews, (in press).

L.I. Gurvits, "The International Space Station and VLBI Radio Astronomy", in Second European Symposium on the Utilisation of the International Space Station, ESA SP-433, submitted

Van Langevelde H.J., Diamond P.J., Vlemmings W., Baudry A., Habing H.J., Schilizzi R.T., "VLBI Measurements of the Parallax & Proper Motion of U Herculis", 1998, Proc. "4th EVN/JIVE VLBI Symposium"; eds. M.A. Garrett, R.M. Campbell, L.I. Gurvits, New Astronomy Reviews, (in press).

Masheder M.R.W., Van Langevelde H.J., Richards A.M.S.., Greenhill L., Gray M.D., "VLBI observations of OH stars: S Persei, 1998, Proc. "4th EVN/JIVE VLBI Symposium"; eds. M.A. Garrett, R.M. Campbell, L.I. Gurvits, New Astronomy Reviews, (in press).

M. Massi, S. Aaron, "Space VLBI and Spurious Symmetrization", 1998, A&A Suppl. in press.

D.W. Murphy, S.J. Tingay, R.A. Preston, D.I. Meier, D.L. Jones, J.C. Guirado, J.E. Conway, A.G. Polatidis, H. Hirabayashi, H. Kobayashi, Y. Murata "VSOP monitoring of the quasar 1928+738",Proc. "4th EVN/JIVE VLBI Symposium"; eds. M.A. Garrett, R.M. Campbell, L.I. Gurvits, New Astronomy Reviews, (in press).

I. Owsianik, J.E. Conway, A.G. Polatidis "The youngest lobe-dominated radio sources", Proc. "4th EVN/JIVE VLBI Symposium"; eds. M.A. Garrett, R.M. Campbell, L.I. Gurvits, New Astronomy Reviews, (in press).

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", A&A, submitted

Philips C.J., Van Langevelde H.J., "Fringes on the EVN MarkIV data processor at JIVE", 1998, Proc. "4th EVN/JIVE VLBI Symposium"; eds. M.A. Garrett, R.M. Campbell, L.I. Gurvits, New Astronomy Reviews, (in press).

A.G. Polatidis, P.N. Wilkinson, W. Xu, A.C.S. Readhead, T.J. Pearson "Compact Symmetric Objects in a complete flux-density limited sample", Proc. "4th EVN/JIVE VLBI Symposium"; eds. M.A. Garrett, R.M. Campbell. L.I. Gurvits**,** New Astronomy Reviews, (in press).

Schilizzi R.T., Tschager W., Snellen I.A.G., de Bruyn A.G., Miley G.K., R\"ottgering H.J.A., van Langevelde H.J., Fanti C., Fanti R., A Morphological and Spectral Study of GPS Galaxies and Quasars, 1998, submitted for the Proceedings of the Nagoya COSPAR meeting on Space

VLBI

Sjouwerman L.O., Habing H.J., Lindqvist M., van Langevelde H.J., Winnberg A., OH/IR stars as signposts for ancient starburst activity in the Galactic center, 1998, submitted for the Proceedings of, "the Central Parsecs", eds. Falcke & Cotera, PASP Conf

Snellen I.A.G., Schilizzi R.T., de Bruyn A.G., Miley G.K., Bremer M.N., Röttgering H.J.A., Van Langevelde H.J., "Faint Gigahertz Peaked Spectrum sources and the evolution of young radio sources", 1998, Proc. "4th EVN/JIVE VLBI Symposium"; eds. M.A. Garrett, R. Campbell. L.I. Gurvits**,** New Astronomy Reviews, (in press).