HALF-YEARLY REPORT

Report for the period January – June 2005
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1. Institute and Summary of Activities

e-VLBI EXPReS Proposal Funded!

On 17 March 2005 (just one hour before the deadline) a large funding proposal was submitted to the EC Research Infrastructure programme – Communications and Network Developments. The proposal known as “EXPReS” (Express Production Real-Time e-VLBI Service), ran to 136 pages and involves 19 different partners, including several of the major National Research Networks (NRENs) in Europe (e.g. SURFnet) and the pan-European research network GÉANT, operated by DANTE. In May we received word from the EC that the project would be funded, having come top out of 43 proposals submitted to the call. The EXPReS project will help to upgrade the EVN correlator at JIVE, so that it can reliably connect together (via optical fibre) 16 VLBI telescopes located across the globe simultaneously, generating an aggregate data flow of 16 Gbps into JIVE. A crucial aspect of the proposal is to transparently combine this e-VLBI network with the eMERLIN telescope, now being developed in the UK. This unique combination will generate high fidelity images that are sensitive to a large range of angular scales, achieving micro-Jansky noise levels in a typical 12 hour observing run. Another goal of the project is to support future research in the area of e-VLBI and Grid-based (software) correlation. In addition, the project will also study how an extended LOFAR (distributed across Europe), might adopt some of the networking solutions now being pioneered by JIVE and the European e-VLBI & NREN communities. Another important aim of the project is to provide partial support for the provision of high-speed network connections to those telescopes that are still not connected to GÉANT at Gbps speeds. Although this latter part of the project was reduced by 300 kEuro, the broad international nature of the programme was retained. This means that the EXPReS project will support “last mile” connections and network enhancements not only in Europe but also in China, South Africa, Puerto Rico, Australia & Chile. Contract negotiations with the EC will begin after the summer with completion expected by the autumn of 2005. The project is likely to start sometime in the first quarter of 2006.

Further e-VLBI Progress

In addition to the success of the EXPReS proposal, the current e-VLBI Proof-of-Concept project continues to make good progress. Construction began of the last-mile connection to Medicina (IRA) in Italy during the period of this report (see Figure 1) and the first continuum e-VLBI science demonstration was successfully conducted in March (see Figure 2). During the last e-VLBI network test, sustained data transfer rates of 128 Mbps were obtained between JIVE and the European telescopes (Jodrell Bank, Cambridge, Onsala, Torun and Westerbork). With EXPReS given the green light, the first open Call for e-VLBI proposals is expected to be issued in February 2006.

Figure 1: the last-mile is now under construction to the 32-m telescope in Medicina, Italy.
Figure 2: Recent e-VLBI observations made at 64 Mbps and including the 300-m telescope at Arecibo, Puerto Rico, were able to detect a faint (sub-mJy) Supernova in UGC11794 (Garrett et al).

ESA Huygens Success Story!

On Friday, 14 January 2005, a new chapter opened on the history of mankind’s exploration of the Solar System, as the ESA Huygens probe successfully landed on the surface of Saturn’s largest moon, Titan. In a project led by JIVE, radio astronomers provided crucial support to the mission, organising and conducting global VLBI tracking of the Huygens spacecraft during its entry into and descent through the atmosphere of Titan. The leading radio telescope of the Huygens radio astronomy network, the 110-m Green Bank Telescope (GBT) of the NRAO provided the first confirmation of the healthy state of the Huygens spacecraft after its arrival in the upper atmosphere of Titan (see Figure 3). JIVE staff were placed strategically around the globe: Sergei Pogrebenko and Max Avruch were stationed at Green Bank, USA, looking after the radio observations, while Leonid Gurvits provided a direct link between the entire global radio telescope network and ESA officials, scientists and engineering staff at ESA’s Operational Centre in Darmstadt, Germany.
By mid-afternoon, it seemed that the initial detection of the Huygens signal would surely be the high-point of our involvement in the project, but events began to unfold in a quite unexpected way. As the first panoramic images of Titan were generated on Friday evening, it became clear that one of the two communication channels between Huygens and Cassini had failed (channel B). This was the data channel that included the Huygens-Cassini Doppler wind experiment — the experiment for which our VLBI observations were a “backup” — in case of possible transmission & reception problems between Huygens and Cassini. With this failure, the VLBI radio astronomy data is now the only way to reconstruction the 3-D trajectory of the probe, and in particular to salvage the main aims of the Doppler wind experiment, specifically the determination of the wind-speed encountered by the Huygens probe during its descent. ESA currently refers to the VLBI data as “channel C” and there is now significant pressure on us to re-focus our efforts in recovering this crucial mission data!

An interesting highlight of the day was the successful transmission of VLBI data from the Parkes and Mopra telescopes in Australia to JIVE via an eVLBI dedicated light-path (arranged and coordinated by about a dozen research networks spanning the globe from AARNET in Australia, to SURFnet in the Netherlands). As JIVE staff worked through the wee hours of Saturday morning, calibrator fringes were detected to the Australian telescopes - only a few hours after the probe observations had been made. This was the first indication that the VLBI observations had been made successfully, and on Saturday afternoon Leonid Gurvits was invited to participate in the ESA Press Conference presenting the first results from “channel C.”

Figure 3: The dynamic spectrum of the Huygens carrier signal at 2040 MHz measured with a resolution of 0.9 Hz over a period of 3 minutes from data obtained via Mark 5 VLBI data recorded at the NRAO’s R.C.Byrd Green Bank Telescope.
The Software Correlator developed by Sergei Pogrebenko of JIVE is now producing superb results from the Huygens VLBI data with a level of detail that is beyond our original expectations and those of ESA. Figure 4 presents the radial velocity measurements of the probe during its descent – the wind velocity is clearly observed to be largest during the initial descent.

![Figure 4: radial velocity measurements of the Huygen's probe as processed at JIVE from radio telescope VLBI data. The discontinuity in measurements around 12.75 hr UT, clearly marks the time of landing.](image)

Figure 5: JIVE received significant press coverage during the first few weeks after the Huygens landing on Titan, featuring in national and international TV, radio and newspaper coverage.

![Figure 5: JIVE received significant press coverage during the first few weeks after the Huygens landing on Titan, featuring in national and international TV, radio and newspaper coverage.](image)
Visit of Huygens Project Scientist to JIVE

In February we welcomed several distinguished visitors to JIVE, including Jean-Pierre Lebreton, the Project Scientist of the ESA Huygens mission. It was Jean-Pierre’s first visit to JIVE - he was anxious to meet the people and see the hardware that have played such an important role in the success of the Huygens mission (see Figure 6), in particular the recovery of the science associated with the data lost from the Doppler-wind experiment and the first detection of the probe as it descended through the stratosphere of Titan (see previous section). Jean-Pierre was able to inspect the most recent results produced by JIVE, including data from the Parke’s telescope. These now show that the probe survived for at least 3 hours after it reached the surface of Titan.

Figure 6: The Huygens project scientist, J-P Lebreton, visited JIVE in February to meet JIVE staff and to see the progress being made with the Huygens VLBI data set.

Preparations for the EC Press Event

By the end of this reporting period, preparations for the large EC Press Event to be held on 6-7 July were well advanced. The event will highlight the EC’s role in supporting Large-scale Astronomical Research Infrastructures with an eye towards future facilities. The event will be attended by the Janez Potocnik (EC commissioner for Research and Science) and Maria van der Hoeven (Dutch minister for Education and Science). In addition, around 70 top international journalists are also expected to descend on Dwingeloo to hear about e-VLBI and the other astronomical projects.

JIVE Board meets in South Africa

The JIVE Board and EVN Consortium Board of Directors met in South Africa last month. Both
meetings were hosted by Prof. Justin Jonas of the Hartebeesthoek Radio Astronomical Observatory (HRAO). For the JIVE board the most important issue was the form of the evaluation of JIVE – this should take place well before the current MoU expires at the end of 2007. It was agreed that the evaluation should be conducted under the auspices of the European Science Foundation (ESF) in the first quarter of 2006. The panel terms of reference were discussed extensively by the board. The evaluation panel will comprise four members in total with at least half of the panel being astronomers.

**Inauguration of Yebes 40-m VLBI telescope**

In April, the Director JIVE and the chairman of the EVN Consortium attended the formal opening of the new 40-m radio telescope of the IGN/OAN in Yebes, Spain. Their Royal Highnesses the Princes of Asturias inaugurated the telescope, toured the new facilities, (including a new visitor’s centre) and spoke at length to various distinguished guests. The new telescope is expected to play a major role in the EVN over the next few years - the first VLBI fringes are expected in 2006.

![In April 2005, their Royal Highnesses the Princes of Asturias inaugurated the new Yebes 40-m VLBI telescope. The event was attended by the Director JIVE and the chairman of the EVN Consortium.](image)

**New appointments & Departures**

Two new JIVE Support Scientists have recently been appointed – Rebeca Soria Ruiz (OAN, Spain) and Lisa Harvey Smith (JBO, UK). Both Rebeca and Lisa are expected to arrive at JIVE in early October and will replace Andy Biggs and Andreas Brunthaler.

Huib Jan van Langevelde has recently been assigned a joint appointment between JIVE and the Sterrewacht Leiden (associate Professor at Leiden - “nul-aanstelling UHD”) effective 1 July. Huib will spend up to 1 day per week in Leiden. The appointment further underpins JIVE’s commitment to involve more Dutch astronomers in radio astronomy in general, and VLBI in particular.

Andy Biggs finished his term as a Support Scientist in the Science Operations and Support Group at the end of May, and left to take up his new position at the UK Astronomy Technology Center at the Royal Observatory, Edinburgh.

At the end of June, Steve Parsley, head of Correlator maintenance and R&D, left JIVE to take up a position at the University of Cardiff, working on the CMB “Clover” Telescope. Steve had worked for JIVE for almost 8 years and had played a key role in the development of the MkIV correlator, with particular regard to the Station Unit (SU) and Playback Unit (PBU) systems. Steve is looking
forward to returning to his family, still based in Bristol, UK. The Clover telescope is an exciting project that is expected to make polarisation measurements of the CMB from Dome Concordia in Antarctica. We wish Steve every success in the future.

![Steve Parsley at his farewell party in June](image)

**Figure 8:** Steve Parsley at his farewell party in June

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**PhD students at JIVE**

For some time JIVE has been active in the supervision of PhD students at Dutch universities. In the last few months this has stepped up a gear, we are currently involved in the supervision of 2 PhD students at the Kapteyn Institute in Groningen (Alicia Berciano Alba working on gravitational lensing, and Julianne Sansa working on e-VLBI). In addition, we are also involved in the supervision of Valeriu Tudose in Amsterdam – Valeriu has been busy working on VLBI observations of the recent Magnetar outburst that erupted between Christmas and New Year. In May Seungyoup Chi arrived in the Netherlands to working on high resolution observations of the faint radio source population. Seungyoup’s position is funded by both JIVE and the Kapteyn Institute. In June Dr. Olaf Wucknitz joined JIVE as the ANGLES post-doc of the JIVE/ASTRON/Kapteyn node. During the period of this report the EC reported that the ESTRELLA Marie Curie action (coordinated by Neal Jackson at Jodrell Bank) is to be funded, providing 2 or 3 additional PhD students at JIVE for the next 3 years. This will bring the total number of students being supervised and funded (or co-funded) by JIVE to seven.

**JIVE staff research**

During the period of this report, 15 papers were published in scientific journals or conference proceedings, and a further 9 were submitted for publication. 61 oral and 4 poster presentations were made at scientific meetings/colloquia, as well as a number of other presentations at management meetings and during tours of the correlator. The institute was happy to host 21 visitors during this period, many of whom made extensive use of the support facilities.

JIVE featured in a great deal of media coverage, including national TV around the Huygens Descent.
2. Science Operations and Support

2.1 Production Correlation

2.1.1 Sessions and Their Experiments

Before the session 1/2005, the VLBI observations of the Huygens probe as it descended through the atmosphere of Titan took place. From the correlator's perspective, this included our first ever correlations from Australian and Japanese telescopes (where most Australian telescopes recorded with PC-EVN and Kashima with K5, both subsequently translated to Mark 5), and continued our experience with VLBA observations recorded with Mark 5. The inhomogeneity of the array resulted in more than the usual amount of difficulty in preparing the control files and clock-searching, but eventually everything worked well, and this experiment saw a record that still stands for the most disk-stations being correlated simultaneously (15).

Session 1/2005 had a total of 10 user experiments. Among these was the first 1Gbps user experiment to be correlated and distributed (the 1Gbps experiment from session 3/2004 had recording problems at Jodrell Bank that required extra effort including off-line manipulation of the recorded data -- this was finally correlated towards the end of this half-year period). Three of the experiments were globals. However, only three VLBA stations provided their recordings on tape; those that participated in the Huygens observations sent disks. There was a great deal of problems with winter weather in Europe, with several stations having to take themselves out of experiments because of snow or high winds.

The Jun'05 session had 12 user experiments, including 3 more 1Gbps recordings. In one of these, Green Bank also participated at 512 Mbps (by recording with 1-bit sampling instead of the 2-bit sampling used elsewhere -- testing showed that this posed no real problem to the data processor; the correlator "saw" Green Bank's data as being 2-bit sampled, but the magnitude bit always set to "high"). There was an unusually high number of equipment problems at the stations in this session. Noto suffered an azimuth-drive casualty in the third user experiment, which sidelined it for the remainder of the session. Torun was without its H-maser, which was out for servicing, and substituted a Rubidium frequency standard with a consequent reduction in coherence time. Effelsberg suffered a Mk4-formatter casualty, which required them to shift to the VLBA formatter and tape recording for 1.5 experiments (these were the only tapes received from this otherwise all-disk session).

The table below summarizes projects correlated, distributed, and released this half-year. The table lists the number of experiments as well as the network hours and correlator hours for both user and test/NME experiments. Here, correlator hours are the network hours multiplied by any multiple correlation passes required.

<table>
<thead>
<tr>
<th></th>
<th>User Experiments</th>
<th>Test &amp; Network Monitoring</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Ntwk_hr</td>
</tr>
<tr>
<td>Observed</td>
<td>24</td>
<td>343</td>
</tr>
<tr>
<td>Correlated</td>
<td>24</td>
<td>339</td>
</tr>
<tr>
<td>Distributed</td>
<td>23</td>
<td>326</td>
</tr>
<tr>
<td>Released</td>
<td>20</td>
<td>284</td>
</tr>
</tbody>
</table>
The following table summarizes by session the user experiments still in the queue as of 30 June (entries = remaining to do / total). Ad-hocs are listed chronologically between sessions as they were observed. The actual correlator time is typically between 1.5-2.5 times these estimates, depending on the number of redos or other problems.

<table>
<thead>
<tr>
<th>Date</th>
<th>N to corr</th>
<th>Corr hrs</th>
<th>N to dist</th>
</tr>
</thead>
<tbody>
<tr>
<td>2/2003</td>
<td>1/25</td>
<td>11/447</td>
<td>1/25</td>
</tr>
<tr>
<td>Ad-hocs</td>
<td>0/2</td>
<td>0/28</td>
<td>0/2</td>
</tr>
<tr>
<td>3/2003</td>
<td>0/9</td>
<td>0/127</td>
<td>0/9</td>
</tr>
<tr>
<td>2/2004</td>
<td>0/14</td>
<td>0/237</td>
<td>0/14</td>
</tr>
<tr>
<td>Ad-hocs</td>
<td>0/6</td>
<td>0/40</td>
<td>0/6</td>
</tr>
<tr>
<td>3/2004</td>
<td>0/14</td>
<td>0/280</td>
<td>2/14</td>
</tr>
</tbody>
</table>

Experiments remaining to correlate from previous sessions are described below:

2/2003: EM048 - awaiting PIs to provide revised coordinates for their targets based on a preliminary correlation pass we did for them using only short baselines and a short integration time.

1/2004: GG053a/b/c - require 4 passes each, since each subband/polarization must be done separately to allow 1/8s integrations. With full-correlator output in 1/8s, or by dropping back to 1/4s integrations, only 2 passes per experiment would be needed, changing the “Corr.hrs” entry to 66/228hr.

The following plots show (a) the work division among various correlator tasks as a number of hours per week; (b) correlator efficiencies (completed correlator hours per production time, completed correlator hours per total time, completed network hours per total time) as percentages; and (c) backlogs of the various experiment statuses, expressed as the sum of correlator hours. All plots cover the past three years, with Jan-Jun’05 highlighted. Plots (a) and (b) show 6-week moving averages; plot (c) shows a snapshot every week. In plot (a), bursts of time spent on network tests (cyan) in and immediately following sessions are apparent, and the difficulty of obtaining fringes to all the non-standard stations in the Huygens-descent observation is shown by the large green peak starting from mid-January. Since 25 April, we have been running with two operators while keeping the 1:3 night-shift rotation, reducing the net hours-per-week to 66.67 with the 6-week smoothing used in the plot. The recent flurry of test activity stems primarily from work on recirculation, PCInt, and fine-tuning the disk-servo’ing algorithms.
a) Work division correlator

b) Correlation Efficiency
2.1.2 Logistics/Infrastructure

We currently have 13 working tape playback units (DPUs) and 15 Mark 5A units attached to the station units (SUs) for operations -- 3 fully connected to their SUs and 12 sharing an SU with a DPU. The Mark 5A units that was loaned to Metsähovi was returned after session 1/2005.

The following table charts how we have kept up with the fundamental rule for recycling Mark 5 disk-packs within two sessions. Each row corresponds to a two-session cycle in which disks we receive should be redistributed to the stations. Ad-hoc experiments and out-of-session tests are not included in these numbers. All entries have the form "N_packs for N_TB":

<table>
<thead>
<tr>
<th>IN</th>
<th>OUT</th>
<th>NET OVERDISTRIBUTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Session 3/2003 20 for 22.000</td>
<td>Session 2/2004 28 for 30.520</td>
<td>8 for 8.520</td>
</tr>
<tr>
<td>Session 1/2004 53 for 63.689</td>
<td>Session 3/2004 68 for 86.312</td>
<td>15 for 22.623</td>
</tr>
<tr>
<td>Session 2/2004 78 for 111.516</td>
<td>Session 1/2005 47 for 69.890</td>
<td>-31 for -41.626</td>
</tr>
<tr>
<td>Session 1/2005 88 for 140.583</td>
<td>to recycle by Session 3/2005</td>
<td></td>
</tr>
<tr>
<td>Session 2/2005 100 for 176.992</td>
<td>to recycle by Session 1/2006</td>
<td></td>
</tr>
</tbody>
</table>

We began by distributing more disks than conventionally required, which permitted stations that did not have enough disk packs on-hand to participate as Mark 5 stations. The size of session 1/2005 was cut back to match disk availability. Recycling prior to session 2/2005 fulfilled all the distribution requirements for the scheduled experiments (i.e., the "under-distribution" did not affect the experiments observed). After distributing disks to the stations for session 2/2005, we had another ~ 52 TB worth of releasable disk packs in-house.

Since the EVN has achieved essentially all-disk operation, distributing tapes serves only to balance the trans-Atlantic tape flux for global experiments (as long as the VLBA remains tape-based). However, in session 1/2005, only three VLBA stations sent us tape; in session 2/2005, there was only one global that came to us for correlation, and it used only one NRAO station recording onto disk. Therefore, there wasn't a need to send tapes to Socorro in this period.
However, discussions with NRAO led to the identification of a different broker for shipments to the US, which should reduce delays/expenses clearing customs upon entry into the U.S. and subsequent ground transportation to Socorro.

2.2 EVN Support

2.2.1 Network Monitoring, Reliability, and Performance

We continue to process Network Monitoring Experiments (NMEs) via the pipeline, with the results being posted to the EVN web pages and EVN Reliability Indicators (ERI) calculated. In addition to routine network monitoring, NMEs are used for ftp fringe tests and to test new network and correlator capabilities.

The ftp fringe tests have been very successful in identifying telescope problems early in the session (initial results are reported on the same day as the experiment is observed) and have helped "save" user experiments in a few instances:
- in session 1/2005 K-band fringe-test, there were no fringes to Effelsberg, and the problem at the station was fixed prior to the actual beginning of the session.
- in session 1/2005 C-band NME, a problem with BBC2 at Urumqi was noticed, and it was replaced before user experiments began prior to session 2/2005.
- BBC3 at Torun was seen to be dead, and a higher BBC was substituted via non-standard patching for experiments within the session, where possible (i.e., ones not using all BBCs).

The pipeline provides telescope staff with feedback on gain corrections for all experiments correlated, both NMEs/fringe-tests and user experiments. These data are being used to identify stations/frequency bands with particular problems. We now can routinely make plots of sampler-statistics per channel, which should help the stations set their attenuators properly for 2-bit data. Furthermore, the increasing frequency of and participation in 1Gbps user experiments exercises 16 channels at more and more stations, which provides a fuller snapshot of their equipment performance. We anticipate modifying NME observing tactics to match this.

Timely delivery of amplitude calibration results can still sometimes be a problem, but the overall situation continues to improve. ANTAB file generation at the stations seems to be going well. At C-band, the overall calibration quality is generally quite good (comparing reasonably with the VLBA), although Torun and Noto continue to have noticeable errors. K-band is more problematic for all stations -- gain errors don't seem to be stable (limiting the transferrability of NME results to user experiments). Further investigation into opacity effects, pointing errors, poor sensitivity, and other possible causes is an ongoing topic. Automatic flagging also works well, with progress in Noto coming during this period.

Various enhancements to the field system and “sched” were included to facilitate scheduling native disk-based experiments up to 1Gbps recording rates. The tactics for treating adaptive tape motion in disk experiments evolved over the half-year; noticeable reductions in the servoing time, especially for high recording rates, made this less advantageous at the correlator.

2.3 PI Support

The EVN archive at JIVE continues to be populated with telescope feedback, standard plots, pipeline results, and FITS files. The first bulk public release of all experiments distributed prior to 1 June 2004 took place on 1 June 2005, in accordance with the EVN Data Archive Policy. Since then, incremental public-release of individual experiments has occurred after the expiration of their one-year proprietary period. The explanation of how to lodge waiver requests to extend the proprietary period was revised in liaison with the EVN PC Chair.

Pre-observation scheduling help and review of submitting observing schedules continued this year. We contacted all Principal Investigators (PIs) prior to their scheduling to ensure they knew how to obtain help, and then checked over schedules posted to VLBEER prior to stations
downloading them. More attention was paid to including PIs of experiments using EVN telescopes but being correlated elsewhere. We also used this pre-observation communication to inform them about the benefits of the RadioNet trans-national access programme (if applicable), as well as the extra reporting input they would eventually need to provide.

<table>
<thead>
<tr>
<th>Number of visitors analyzing VLBI data at JIVE per month</th>
</tr>
</thead>
<tbody>
<tr>
<td>Month</td>
</tr>
<tr>
<td>January</td>
</tr>
<tr>
<td>February</td>
</tr>
<tr>
<td>March</td>
</tr>
<tr>
<td>April</td>
</tr>
<tr>
<td>May</td>
</tr>
<tr>
<td>June</td>
</tr>
</tbody>
</table>

A new linux PC was bought, and one of the older unix workstations was replaced by a new linux PC in the visitors' room, which now has 4 linux PCs, a unix workstation, and a windows PC.

3. Software Development

3.1. Correlator Software

As usual, a substantial amount of work is associated with the daily operations of the data processor. This includes the systemic inspection of data processor logs, as well as reacting to specific problems raised by the operations staff.

The intermittent failure of phase-cal detection was traced back to an SU timing problem. This was remedied by making changes to the SU internal software. These were implemented during a visit by Phillip Hazell in May. Further work concentrated on verifying that the output of the phase-cal is significant for improving the data product.

Several patches were introduced in the correlator control code. These include improvements to the message queue code, tape head peaking, midnight crossing and correlator modes for 2 stations. Many changes that were introduced into the code maintenance system are dealing with the enhancements made for e-VLBI correlation.

A major improvement this semester concerns the servoing of disk units. This has been an annoying problem for quite some time. Even when carefully specifying the offset bytes for Mark 5 playback times, no perfectly instantaneous playback could be achieved. After a visit to the Bonn correlator it was realised that the broadcasting of ROT clocks is organised differently in the JIVE environment. Frequent ROT broadcasts caused some confusion to the internal Mark 5 logic when it is in the process of servoing the disks. These multiple broadcasts do not occur in the other MkIV correlators. In the end this could be fixed by requesting an upgrade to the internal workings of the Mark 5 units.

Several areas needed updates to deal with the new VEX files which now allow disk only schedules. This affects the job preparation and the process control but also the creation of the output product. A special feature was introduced to allow testing with a correlator model that includes pole nutation terms.

3.2. Logistic Software

Among the changes to enable e-VLBI are some tools that prepare the correlator environment for e-VLBI. Some changes in the code were made to deal with disk only schedules, this included code in the project administration software.
Upgrades were made to the archive software, in particular to the interaction of the pipeline script and the archive, making the uploading safer and more robust. A new tool was created to write export DAT tapes automatically. This ensures a uniform product and at the same time it produces professional labels. The local backup procedure was enhanced with software to make use of a newly acquired high capacity LTO tape archive system. The tapes are kept at the Westerbork site. An upgrade was made to the paternoster access software.

3.3. ALBUS

The year started with producing extensive reports that cover the first year of activity and an implementation plan for the next year. The ALBUS management at JIVE made some changes to the overall project structure at this point, most notably the introduction of the ParselTongue project. The ALBUS crew participated in the RadioNet software forum at Jodrell Bank. This was an excellent opportunity to discuss work plans and ideas, as well as present preliminary results. It also served as a deadline for producing the requirement documents. At JIVE requirements documents were finished for all local work packages, including post-processing and wide-field imaging, for which there is no activity yet. In conjunction with the Software Forum meeting an ALBUS project meeting took place.

Calibration transfer

The project to incorporate phase cal detection data in the final correlator product was delayed when it was found that the phase cal units were not working robustly. After this was finally fixed, work concentrated on verifying that the data will properly calibrate the relative phase differences between observing bands.

Ionospheric calibration

The requirements document sketches the possible approaches and calls for initial test observations. Time for doing these tests has been requested via the EVN scheduler and observations were made for this in June. Ionospheric calibration measurements were collected from the same dates from co-located GPS receivers, as well as global ionospheric models based on GPS networks. There was some close interaction with FusionNumerics in Boulder to accommodate their ionospheric weather products for our applications. A start has been made to write software that transforms this range of different measurements into estimates of the path delay at individual telescopes. A plan was made to convert these into TEC estimates suitable for AIPS data files.

Infrastructure Software

Initial work has started on the ParselTongue implementation during a one month visit to NRAO by Kettenis. The first ParselTongue work package concentrates on making AIPS scripting in Python feasible. The tool allows straightforward scripting of AIPS tasks with additional functionality to make smart decisions on the flow of the script. In addition, these scripts have a superior interface to the normal operating system environment. The implementation has a built-in capability for remote processing. This functionality was successfully demonstrated locally and was perceived very favourably (see figure 25 in the science section). Ongoing development focuses on accessing the calibration table structure. A structure for sharing and distributing the software is being discussed.
4. Technical Operations and R&D

4.1 Data Processor Maintenance

Data Playback Units

JIVE continued to return failed capstan motors to the manufacturer for repair. Eventually a total of five motors accumulated at Metrum UK. After extended testing, two of these were eventually returned “no fault found”. Two of the remaining three were repaired. The last had already been repaired six times and was retired.

Metrum have been working on an improved design for the capstan motors which introduces a modified tacho assembly. The benefits of the new design are largely due to increased clearances and more accurate control of the manufacturing and assembly tolerances. Metrum claim that these changes greatly improve the performance and reliability of the motor. JIVE motors can be upgraded to the new design at a cost of £1695.00 per motor. However, in view of the ongoing migration to Mark 5 this cost is difficult to justify. JIVE will continue to work with the existing design and ad-hoc repairs for the time being.

Overview of problems with the Data Playback Units (DPUs) in this half year period:

- DPU 11 Capstan motor replaced.
- DPU 13 Tape path readjusted completely
- DPU 13 Broken upper reel brake replaced.

Overview of problems with the Correlator in this half year period:

- Correlator board 5 in crate 3 was replaced.

Overview of problems with Production Mark5s in this half year period:

- Mark 5 unit 8176 had a problem with the network card. This was solved in house.
- A disk in module JIVE 036 was replaced.

Station Units

A total of twenty-two TRMs were cleaned to remove the corrosion mentioned in the last report, and then coated with a protective material (see figure 9). The treatment seems to have halted the degradation but no firm conclusion has been reached about whether this produces a real improvement in reliability. Nonetheless, it was decided to send another ten for salvage. The DMM in SU8 was replaced.

Figure 9: TRM before and after corrosion salvage
Infrastructure

On March 16 serial port 2 of the paternoster PC ceased to function. Switching over to port 1 solved the problem.

Hardware Failures & downtime

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<table>
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<tr>
<td>DPU</td>
<td>4 failures; 7h downtime</td>
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<tr>
<td>SU</td>
<td>1 failure; 30m downtime*</td>
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<tr>
<td>Correlator</td>
<td>0 failure</td>
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<tr>
<td>Totals</td>
<td>5 failures; 7h 30m downtime</td>
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<tr>
<td>Number of infrastructure breakdowns</td>
<td>1 failure</td>
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<tr>
<td>Mean operational time between re-starts of online control software</td>
<td>No statistics for this period</td>
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<td>Projected life-time of heads</td>
<td>2123 hours</td>
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*Excludes individual board failures

Reflecting the shift to disk-based operations, tape damage statistics will no longer be collected.

4.2 Data Processor Developments and Upgrades

Infrastructure
The last two of the eight 19" racks needed to accommodate 16 Mark 5 units and Station Units were delivered and assembled.

4.3 Technical R&D Projects

PCInt software

The aim of the project is to handle PCInt by data output rate of the correlator, permitting high spectral resolution and wide-field imaging projects to be made. Having shown that the hardware data-path works, the bulk of time in this half year went into data validation. In order to demonstrate the use of the system a final test needs to be successfully completed showing correlated data.

An enhancement of the Correlator Board (CB) DSP firmware has been made to accommodate a change in data readout semantics. In the old system data are copied from a fixed region in memory where the start/end of a data block is implicit. In the new system data emerges from a serial link and a marker is needed to locate each data block. The CB DSP now inserts a special bit-pattern (that can never originate in the correlator chips) in the serial stream before starting to send the data. The modification has been tested and incorporated into the forthcoming production version of the CB DSP firmware.

Next, the reconstructed data-blocks must be interpreted. Existing code has been migrated to the PCInt to perform this function. First tests have produced erroneous data and this area is the subject of ongoing investigation.

Tools for plotting fringes are required to complete the tests. Two programmes have been written: an offline compiled code ‘decoder’ which allows decoding of raw correlator data (enabling different/updated decoding methods to be tested) and a Python-based plotting tool for flexible inspection of the decoded data. The decoder outputs the data-points in a plain-text file that can be plotted using the plotting tool.

One of the most basic elements of the PCInt system has been made available from the Python scripting language. It is now possible to interface with the ServiceLocator, which is a system-specific database. Here processes can look up how and where to contact other processes in order to get something done. The fact that this database is now reachable from Python means
access from the scripting language to various components in the PCInt system is now feasible. It has already enabled an inherently simple application (delivering the same ASCII string to a number of specific components in the PCInt system) to be implemented without the use of compiled code.

e-VLBI

In January, the third EVN-NREN project meeting was held, once again at Schiphol airport. Twenty technical representatives of VLBI institutes and the networking community met to review progress and plan future developments. The meeting was very positive and all agreed that e-VLBI in Europe had moved on considerably in the previous 12 months. A series of scheduled e-VLBI tests and demos, at about six weekly intervals was proposed and agreed. A full account of the meeting is available in the minutes (http://www.evlbi.org/evlbi/evlbi.html), which includes links to some of the presentations given.

Several of the tests that followed in the next few months either failed or were only partly successful. It was found later that most of these problems were due to incompatibility of a new version Mark5 code with older Linux kernels.

The first e-VLBI continuum demonstration was staged on 11 March 2005: leading to tentative detection of SN2001em (see section 6, Research). This test showed greatly improved reliability and ease of operation. Most of the experiment was done at 64 Mbps, but fringes were detected between Onsala and Westerbork at 256 Mbps.

Transatlantic e-VLBI tests, bringing data from US and European telescopes to JIVE/Haystack, were not particularly successful to date, partly because of code version-kernel problem; partly because of large, poorly understood, fluctuations in connectivity.

Good progress was made with the deployment of network monitoring tools around Europe (also within GÉANT). Further nodes are needed to pinpoint bottlenecks. The networking community has shown increased interest in the connectivity problems and several of the tests were monitored by them and discussed in detail. In an effort to better understand and locate problems Dante have prepared a network map showing details of the paths from telescopes to JIVE (see figure 10).

The remaining target of the current project is to move as rapidly as possible to provide a reliable e-VLBI network that can be used for serious science. An important issue to be addressed is the choice of a suitably aggressive network protocol. To this end a PhD student (based at the Kapteyn Institute in Groningen), with expertise in networking, is working with JIVE to research this subject.
5. EC and International Projects

5.1. EC projects

JIVE continued its broad involvement in the implementation of the **EC FP6 I3 Project RadioNet**. The contract commenced in January 2004. The Institute is involved in the following RadioNet tasks:

- Gurvits is the RadioNet Project Scientist and member of the RadioNet Management and Executive teams and administers the RadioNet TNA and NA travel budget;
- Van Langevelde is the leader of the RadioNet Joint Research Activity ALBUS (development of user data reduction software for radio astronomy – see section 3.3 of the present report) and a member of the RadioNet Executive team;
- Tibbe participates in secretarial tasks for the RadioNet Management and Executive teams and administers RadioNet documentation at JIVE;
- Campbell coordinates the RadioNet Trans-National Activity “Access to the EVN”.

The Institute also acts as the banker for the RadioNet travel budget.

During the first 6 weeks of 2005, the JIVE contingent of RadioNet officers was actively involved in the preparation and submission of the First Annual RadioNet report which was accepted by the European Commission in April 2005. The semi-annual RadioNet Board meeting was held at the Paris Observatory on 29 March 2005 and was augmented by a scientific mini-symposium co-organised by Gurvits and N. Dubouloz (Paris Observatory).

JIVE was chosen by the EC to host the EC Press event on astronomy developments in Europe, scheduled for 7 July 2005. In preparation for the event, JIVE together with its RadioNet and EVN
partners, prepared of new PR materials (including a new JIVE booklet, produced in collaboration with A. Gunn, JBO) and renewed JIVE exhibition booth.

The **EC FP6 Coordination Action EuroPlaNet** commenced its activities in January 2005. JIVE is a member of EuroPlanet. The project reflects JIVE’s involvement in the ESA/NASA mission Cassini/Huygens and other Space Science projects. In particular, JIVE participated in the coordination of the ground-based observations in support of the Cassini/Huygens mission and preparatory activities for the ESA BepiColombo mission to Mercury.

JIVE is involved in the **EC FP6 proposal on the SKA Design Study project**. The Institute’s specific task deals with the SKA science and technology simulations. Representatives of the Institute (Garrett, Reynolds, Gurvits) participated in a number of preparatory meetings on this project. The project is expected to commence in the second half of 2005. JIVE is also involved in the SKA Science Conferences Marie Curie proposal (submitted by ASTRON in May 2005).

### 5.2 Space Science Projects

Beginning of the reporting period was marked by the culmination of the ESA/NASA/ASI Cassini/Huygens mission: on 14 January 2005, the European planetary probe Huygens entered the atmosphere of Titan after a seven-year interplanetary trip. JIVE coordinated the radio astronomy segment of the mission, which included VLBI tracking and two independent direct Doppler measurements (the latter conducted by JPL). The effort provided crucial support to the mission and saved one of the mission experiments, the Doppler Wind Experiment. The quality and quantity of the data make it possible to achieve much more than the original scope of the project (e.g. Titan astrometry, parachute motion dynamics).

![Figure 11: Artist’s impression on the Huygens descent on Titan, 14 January 2005.](image_url)

VLBI Tracking of the Probe was conceived originally to support the Huygens Doppler Wind Experiment. Seventeen radio telescopes (see figure 12) took part in the observations on 14
January 2005. The telescopes were capable of receiving the Huygens Channel A carrier signal at the frequency of 2040 MHz. Data processing was conducted at JIVE. It involved both the “standard” MkIV EVN Data Processor and a special narrow-band software correlator, specially developed for these observations.

Figure 12: Configuration of radio telescopes involved in VLBI tracking of the Huygens Probe as seen from Titan in the beginning of tracking at 09:30 UTC and at the end of the experiment at 16:00 UTC on 14 January 2005.

Preliminary results of VLBI data processing indicate that the goal of the experiment – ultra-precise measurements of the Huygens Probe position in the atmosphere and on the surface of Titan – will be achieved. The radio interferometric response from the Huygens carrier signal (so called “VLBI fringes”) was detected on most of baselines. Radial velocity measurements (see figure 13), a by-product of VLBI data processing, will serve as an additional, “bonus” set of data for fine-time analysis of the Huygens Probe motion.

The Huygens VLBI tracking experiment is an example of the synergy between experimental techniques developed in fundamental astrophysics based on advanced technologies in radio physics, quantum electronics, digital signal processing, and planetary science. This synergy is the first step in future novel applications of VLBI in planetary missions of the coming decades.

Spin-off of the Huygens VLBI tracking project includes development of the prototype of a general-purpose high spectral resolution Software Correlator.

JIVE featured in more than 200 major national and international mass media (e.g. Nature, CNN, BBC, AWST, Discovery, etc.)

JIVE Personnel involved in the Huygens VLBI Tracking project included Gurvits (Project Manager), Pogrebenko (Project Scientist), Avruch, Bignall, Brunthaler, Campbell, Garrett, Oerlemans, Tibbe.

JIVE participated in the initiative “Towards a European Infrastructure for Lunar Observatories” in collaboration with ASTRON, EADS Space Transportation and other industrial and scientific organisations. The development resulted in establishing the EADS project LIFE (Lunar Infrastructure For Exploration). The second working meeting of the initiative group was conducted at the EADS Space HQ in Bremen on 22-24 March 2005. A white paper resulted from this activity is expected to create a basis for a much wider international initiative.
Figure 13: Radial velocity of the Huygens Probe obtained from VLBI Mark 5 data recorded at the GBT and Parkes radio telescopes (upper panel). Two lower panel plots show high-time resolution “zooms” in the radial velocity data.

JIVE participated in the preparation of a series of experiments on board the ESA BepiColombo mission. The mission is expected to be launched in 2012 for studies of Mercury and near-solar environment.

5.3. Other international projects

JIVE continued active participation in the collaboration with the radio astronomy groups in China under the KNAW-CAS contract. Gurvits coordinates this contract together with Strom (ASTRON). The new phase of the project began in January 2005 with the focus on VLBI support of the Chinese Lunar programme. JIVE is involved in preparation of the experiment, in particular exploiting know-how obtained in the Huygens VLBI tracking project.

Following the decision by the EVN Consortium Board of Directors, JIVE continued to coordinate EVN efforts to assist the Ventspils International Radio Astronomy Centre (Latvia) and the Institute for Radio Astronomy of Ukraine to upgrade the telescopes in Irbene (32 m) and Evpatoria (70 m) to the EVN-compatible level. In March 2005, Gurvits (together with W. Baan and representatives of the European Space Agency) visited the Institute of Radio Astronomy National Academy of Sciences of Ukraine (IRA, NASU) and the National Ukrainian Space Agency for in-situ assessment of the readiness of the 70-m radio telescope in Evpatoria for VLBI test observations with EVN. In the second half of 2005 JIVE will begin to assist IRAU to upgrade RT-70 to the Mark 5 level. Discussions also took place regarding a role for VIRAC within the RadioNet collaboration.
6. Research

Anderson

The exploration of ADAF accretion flow models for low-luminosity AGNs continued. The low-luminosity Seyfert galaxies in Anderson’s thesis sample are more than four orders of magnitude more luminous than the prototypical source used to test ADAF models (Sgr A*), and the numerical models suggest significant differences occur at the higher luminosities. Experiments were performed to change the models to bring the model radio emission into better agreement with observations.

Figure 14: ADAF modifications to match the radio spectrum. The standard ADAF model generates a radio spectrum which is typically too steep at centimeter wavelengths for low-luminosity AGNs (LLAGNs). This can be corrected by allowing the ratio of the magnetic field pressure to gas pressure vary as a function of radius. In this case the relative magnetic field strength is decreased toward the inner regions of the accretion disk, and the spectral shape matches the observations well, as shown in the plot on the right hand side. However, this reduces the strength of the radio emission. The plot on the left hand side shows the actual model emission, while the model spectra on the right hand side have been arbitrarily increase by a constant scaling. For very luminous LLAGNs, magnetic field adjustments to the standard model are not capable of properly matching the radio emission.

Avruch

Avruch has worked primarily on the observation and analysis of the Huygens Probe VLBI Tracking Experiment. In the weeks leading up to impact on January 14th, Avruch coordinated the observational setup of the 17 telescopes which took part. Frequency settings, calibrator sources, and a detailed schedule were selected by the JIVE team in consultation with collaborators at the individual telescopes, and then distributed in the form of telescope control files. These required several iterations to achieve the proper setups for each station, due to the unusual conditions of the experiment.

For the observations, Avruch was part of the JIVE/ESA/JPL contingent at the Green Bank Telescope. The observations went very well. The Huygens signal was detected by the JPL Radio Science Receiver at about 10:20 UTC (see figure 15), the first proof that the probe had survived entry. The probe was observed, by the Parkes telescope, to land at approximately 12:45 UTC. The probe’s batteries far outlasted expectations, so that at 15:00 UTC, when the VLBA was scheduled to end observing, the Mauna Kea telescope was reallocated and kept in the array. As Huygens set below the Parkes horizon at 16:00 UTC, and all telescopes performed a final calibration, Avruch quickly prepared an extended schedule for several telescopes in Europe that
might possibly continue the observation. Some attempted it but there were problems due to the non-standard frequency employed.

Figure 15: First Detection of the Huygens Probe at the Green Bank Telescope, by the JPL Radio Science Receiver.

Figure 16: (u,v)-coverage by the Huygens VLBI Tracking array on the phase reference source J0744+2120.
Avruch oversaw the processing of Huygens experiment GG057C at the EVN MKIV correlator at JIVE. Special handling was required due to some unusual features of the observation, and a few bugs in correlator control software were uncovered. The data were processed in February and March, and post-processing with AIPS began in April. Data quality was good. Reduction of the data set to derive phase-referenced corrections for the Huygens scans is ongoing.

Avruch has also been involved in developing the software correlator for the Huygens tracking Experiment.

![Figure 17: Preliminary image of the phase reference source J0744+2120 in the Huygens Tracking experiment.](image)

**Biggs**

Time was awarded to observe the six-image gravitational lens system B1359+154 with the High Sensitivity Array (HSA), a telescope consisting of the VLBA, GBT, and phased-VLA as well as the Arecibo and Effelsberg antennas. The goal of the observations is to try and detect the jet, currently only visible in the three brightest images. B1359+154 is of particular interest due to its six-image configuration; this results from the chance alignment of three galaxies (that form part of a larger group) along the line of sight to the background quasar. If the jet can be detected in all six images then it may be possible to constrain the mass distribution in the core of a group of galaxies.

**Bignall**

Bignall is PI on an EVN+MERLIN proposal which was submitted for the February 1 deadline, to observe the BL Lac objects identified in the "Deep X-ray Radio Blazar Survey" which had not previously been observed at high resolution. The newly identified BL Lacs tend to have properties intermediate between those of the "classical" X-ray- and radio-selected BL Lac samples. The EVN+MERLIN proposal was successful and a 48-hour observation was scheduled in the June session, in which 16 target sources were observed. The WSRT local interferometry data obtained simultaneously will also be analysed and will assist with polarization calibration. Bignall is co-I on a VLA proposal (PI Landt) submitted for the February 1 deadline, to image the 15 sources of the
sample remaining to be observed in C array, which was also allocated the requested time. The combined radio data will be used to constrain jet and beaming parameters which are important to resolve the origin of the different spectral energy distributions observed in BL Lacs.

Bignall is a co-author on a paper by P. Edwards (ISAS/JAXA) et al. entitled “ZS 0506+056: Intra-Day Variability and VLBI Imaging” which is in preparation. The BL Lac object ZS 0506+056 is an intra-day variable (IDV) radio source that is possibly associated with a high-energy EGRET detection. Bignall contributed ATCA results obtained for her PhD project and was also involved in the MASIV VLA Survey from which data on ZS 0506+056 are presented in this paper. Bignall is also co-author on a paper by K. Wajima (Korea Astronomy and Space Science Institute) et al. entitled “Milliarcsecond-Scale Structure in the Gamma-Ray Loud Quasar PKS 1622-297”, which is in preparation to be submitted to PASJ. Results of ATCA monitoring obtained for Bignall's PhD thesis are included in this paper (see Figure 18).

Figure 18: Results of ATCA flux density monitoring of the gamma-ray loud quasar PKS 1622-297 at 4.8 and 8.6 GHz. (Top) Total flux density at 4.8 GHz (left) and 8.6 GHz (right) on 2001 June 2-3, when the largest amplitude intra-day variability (IDV) was observed. Horizontal axis shows hours UT since 2001 June 2 (day 153), 00:00 (Bottom). Long-term flux variation at 4.8 GHz (left) and 8.6 GHz (right). Horizontal axis shows days since 2001 January 1. The observed IDV was shown to be consistent with what is expected from refractive interstellar scintillation of the VLBI core.

Bignall is PI on a project using the Nancay Radio Telescope to undertake daily monitoring of three IDV sources over a two-month period during March and April 2005. The aim is to characterize scintillation timescales in the strong scattering regime. The timescale of refractive scintillation, combined with angular size measurements (or upper limits) from VLBI, in principle allows determination of the distance to the scattering screen, a parameter which is not easily measurable by any other technique.
Bignall continued work on the paper presenting analysis of two-station time delays for PKS 1257-326. A more rigorous analysis of uncertainties in flux density measurements and time delay fitting was undertaken following discussion with co-authors D. Jauncey (ATNF) and J-P. Macquart (NRAO). An ATCA proposal for observations of PKS 1257-326 (PI Kedziora-Chudczer) was revised and resubmitted for the June 15 deadline after missing out on time during 2005 - the ATCA was heavily oversubscribed for the previous term during the Southern Winter millimetre observing season.

Bignall reduced the ATCA data obtained during the "Live" Huygens Tracking Experiment, but the faint background sources could not be detected in these ATCA data due to the presence of Saturn in the field!

Brunthaler

Brunthaler was first author on a paper about the geometric distance and proper motion of M33. The paper was published in March 2004 in Science. Brunthaler is also co-author on a paper submitted to the ApJ by A. Loeb that sets constraints on the proper motion of M31 based on the survival of M33's disk in tidal interactions with M31 in the past.

Brunthaler is first author on a paper about the Seyfert galaxy III Zw 2. The paper describes the structural and spectral evolution of the nuclear radio jet and appeared in A&A in May 2005.

Brunthaler was involved in a project (PI Hachisuka) to measure the distance of W3OH by VLBI observations of water masers in this source. A publication was prepared which is ready for submission.

Brunthaler reduced archival VLA data of the nucleus of the nearby galaxy M81 to search for circular polarisation. The source shows strong variability in the circular polarization at all frequencies but the sign stays constant over almost one decade. This makes the nucleus of M81 very similar to the center of the Milky Way, where the same polarization properties were found earlier. A publication was prepared and will be submitted soon.

Campbell

Campbell continued to provide ionospheric simulations to D. Lebach (CfA) in support of VLBI astrometry related to the Gravity Probe-B guide-star program. He collaborated with S. Britzen (MPIfR) on statistical studies of the jet-component kinematics of CJF sources. Work focussed on estimating proper motions for each jet component from the elliptical Gaussian component parameters, uncertainties, and correlation matrices derived by our dfmap variant, including means of taking individual-epoch behavior of specific components into account in the ensemble statistics.

Garrett

On 27 December 2004, a giant flare was detected from the magnetar SGR 1806 - 20, only the third such event recorded. This burst of energy was detected by a variety of instruments and even caused an ionospheric disturbance in the Earth's upper atmosphere that was recorded around the globe. Garrett was part of a team of astronomers (led by Chryssa Kouveliotou, NASA/GSFC) that detected and followed up the fading radio afterglow produced by this outburst, using a variety of radio telescopes, including the VLA, ATCA, MERLIN and the VLBA+GBT. Garrett led the VLBA campaign, proposing 3 epochs of rapid response science observations of the source and
Figure 19: The main panel shows the visibility amplitude of SGR 1806-20 as a function of projected baseline length (in units of thousands of wavelengths; 100 kλ ~3.5 km) at epoch 2005 Jan 06.8 (9.9 days after the giant flare), as seen by the VLA (Gaensler. The decrease in amplitude as a function of increasing baseline length clearly indicates that the source is resolved. The inset shows images of the source at three epochs (before the giant flare - left, and after the outburst – middle and right), smoothed to a uniform resolution of 0.5" (indicated by the green circle at lower right).

Figure 20: VLBA+GBT+VLA 1.4 GHz observations of SGR1806-20 after the giant flare. Structural changes in the radio source are clearly seen between the two epochs (Fender, Muxlow, Garrett et al. 2005).
scheduling them on the 3, 5 and 10 January. The VLA observations (Gaensler et al. 2005, Taylor et al. 2005 – see figure 19) and the MERLIN/VLBI+GBT (Fender, Muxlow, Garrett et al. 2005 – see figure 20) show a resolved, linearly polarised radio nebuila, expanding at approximately a quarter of the speed of light. To create this nebuila, at least $4 \times 10^{43}$ ergs of energy must have been emitted by the giant flare in the form of magnetic fields and relativistic particles. The radio observations were published in various publications including Nature, the latter receiving significant public attention via various press releases.

![Figure 21: The tentative e-VLBI detection of SN2001em in NGC7112.](image)

In March, Garrett was PI of the first e-VLBI continuum science demonstration observations (see Paragi et al. 2005). The target source of these observations was SN2001em – a supernova event that unexpectedly brightened in 2004, leading some (e.g. Packcynski et al.) to suggest that this source might be an example of a misaligned GRB and that the brightening was due to enhanced radio emission associated with the (now) non-relativistic jets. The eVLBI observations of the source were dogged by various problems – in particular this observation employed phase-referencing techniques and the rapid source switching gave problems for the real-time on-line correlator software which had been optimised to long scans without switching. By the time the software had been changed the source was setting for most of the eVLBI antennas involved (Onsala, Westerbork, Arecibo and Torun; Jodrell Bank and Cambridge were wided-off earlier in the day). With all these problems only about 30 minutes of good data were obtained but it was still possible to detect the source on all baselines involving Arecibo. A tentative image of the SN2001em is presented in Figure 21.

Garrett supported Sunita Nair (Raman Research Institute) in her development of a model of a helical jet in the gravitationally lensed radio source, PKS1830-211 (Nair, Jin & Garrett MNRAS 2005) in which ballistically ejected plasmons from a precessing nozzle are able to fit previous structural changes in the source as seen in 43 GHz VLBA observations. An observed jet precession period of 1.08 yr is inferred from the model, translating to an intrinsic period of 30.8 yr for a source at redshift $z_s = 2.51$ and an assumed jet bulk velocity beta of 0.99c. This fits well with
the picture of the active galactic nucleus hosting a binary black hole system at its centre, with the jet emitted by one member of the system and the precession as being a result of its orbital motion around its companion.

Gurvits

Gurvits continued to work on various aspects of massive VLBI surveys of extragalactic radio sources. During the first half of 2005, he was involved in finalising a major publication of a massive 2 cm VLBA survey of hundreds of AGN of various types (Kovalev et al. 2005, AJ, accepted). This work represents the largest data set to date fine structure monitoring of extragalactic radio sources at 15 GHz (Figure 22).

A pilot project of the Deep Extragalactic VLBI-Optical Survey (DEVOS) ultimately aiming at getting VLBI images of 10,000 of optically identified extragalactic radio sources has been conducted over the last three years by an international group including Gurvits and Garrett. The project enabled the researchers to estimate the yield of 30% of VLBI detections in a FIRST-based sample of extragalactic sources. This value will be verified by further DEVOS pilot observations and might become an important input for the SKA design study. The paper by Mosoni et al. (AA, 2005, accepted) summarises the results of the pilot phase of the project. It enables a good estimate to be made of the observing resources needed for a full-scale survey. It also allows the investigators to identify previously unknown sources for future in-depth studies (Figure 23).
Figure 23: An example of a previously unknown compact structure in the radio galaxy J125954.0+335653 (Mosoni et al. 2005, AA, in press).
Van Langevelde

Van Langevelde worked with Bartkiewicz and Szymczak on 5 cm data from the November session. In this project a number of sources from the Torun blind survey were followed up with VLBI, after accurate positions had been obtained with MERLIN. The data proved to be of excellent quality and phase referencing worked flawlessly. One of the sources, called G23.657-0.127, shows a beautiful ring structure, reminiscent of the circumstellar SiO masers around evolved stars (see figure 24). Such a ring has not been observed in methanol masers before and it offers a unique perspective for the interpretation. Most importantly, in this case there can be no doubt where the central source is located. The distance to this source is unknown but can be estimated from the Galactic rotation, yielding a physical size of the ring of 1000 to 2000 AU. There is no clear velocity structure around the ring, which one would expect if this was resulting from a circumstellar disk seen face-on. Instead we prefer an interpretation were the ring delineates some sort of shock front running into the molecular material around the forming star.

Figure 24: Zero moment map of the methanol maser G23.657-0.127.

In a similar project van Langevelde and Philips (ATNF) concentrated on a sample of nearby known methanol masers. These observations were done in wide field imaging and phase referencing mode simultaneously. We obtained preliminary results on the famous Cep A young stellar object. The HW2 source (Figure 25) is supposed to originate from the ionized outflow from a massive young star. Around this object numerous water masers are known, related to shocks between the outflow from the source and the ambient molecular cloud. Intriguingly, detailed analysis of the kinematics of the water maser sources has revealed that there exists more than a single origin for these shocks; on very small scales around Cep A a number of high mass stars are forming. The 6.7 GHz masers seem to lie in the equatorial region of HW2, at an offset of 300 - 700 AU. An interpretation could be that the methanol masers lie in a circumstellar disk around the central source of HW2, but at different chemical or physical conditions than those giving rise to the water masers. Another intriguing possibility is that the methanol masers are the signposts of more young stars, still embedded in this region, like the unidentified methanol masers often seen.
in extended star forming regions. To deal with the massive data volumes, we performed calibration in batch mode, exploiting the new capabilities of ‘ParselTongue’.

![Figure 25: The source HW2 in the star forming region Cep A. The grey scales represent the 22 GHz continuum and the blue triangles the locations of H2O masers. The red dots indicate the 6.7 GHz methanol maser positions, the orange circles the 12 GHz methanol masers and the green dots the methanol maser emission at 107 GHz.](image)

In several projects with Vlemmings, van Langevelde worked on circumstellar maser papers. This worked concentrated on the interpretation of high resolution H2O masers at first. Later a start was made with the processing of new OH maser astrometry. The new measurements include an in-beam calibrator to allow more precise measurements. After it was established that this worked reliably, van Langevelde worked with Biancu (summer student from Bologna) to implement the complex data-flow in ParselTongue scripts.

Van Langevelde contributed to the Dutch discussions on a local node in the European ALMA regional centre. Additionally a section was written for the ESPRIT strawman design, which is an SRON initiative for a space born far-infrared interferometer.

Van Langevelde is part of a project to establish the JCMT as an element of the eSMA. This was funded by NWO and a plan for getting to first fringes and first imaging tests was established. After some negotiations an implementation was found that could guarantee a successful start over the summer.

**Paragi**

Paragi presented preliminary results from the small RXTE, GMRT, and EVN monitoring campaign of the Galactic radio-jet source SS433 at the “Triggering Relativistic Jets” conference in Cozumel, Mexico. This work has been carried out in collaboration with Chakrabarti et al. (SNBNCBS, Kolkata, India).
Paragi took part in VLBA observations of SGR1806-20 (in collaboration with Garrett et al.), that produced a huge radio outburst on 27 December 2004. This source is a magnetar candidate, a neutron star with extreme magnetic fields ($B \sim 10^{15}$ gauss). He processed the data together with Valeriu Tudose, a PhD student. Observations were carried out at three epochs at 1.6 GHz, on 5, 6 and 10 January 2005. The source had expanded by that time heavily, and thus the first two epochs resulted in a detection. Imaging was difficult due to the lack of good phase-reference calibrators, but the data were in agreement with a rapidly fading, ~100 milliarcsecond object that expanded in an asymmetric way.

Paragi took part in the first continuum e-VLBI science project (in collaboration with Garrett, Reynolds, Szomoru, Parsley et al.). The target source was SN2001em, a supernova that was possibly related to an off-axis gamma-ray burst. The observations were carried out with an e-VLBI array of Arecibo, Cambridge, Jodrell Bank, Onsala, Torun and Westerbork at 1.6 GHz, on 11 March 2005. The maximum data rate was 128 Mbps. All the telescopes performed well in this experiment, but Cambridge and Jodrell Bank had to stop early due to bad weather, and there were other data losses. The data were quickly pipelined, but there was no sign of the faint target. After a more thorough analysis, SN2001em was detected at sub-mJy levels. The results were presented at the "Stellar End Products" workshop in Granada, Spain, a couple of weeks later.

Reynolds

Reynolds was involved with Liu Xiang (UAO) in analysis of EVN observations of a sample of Compact Symmetric Objects. A paper titled 'EVN observations of eleven GHz-Peaked-Spectrum radio sources at 2.3/8.4 GHz' was published in A&A.

Reynolds in collaboration with Bignall (JIVE), Landt (CIA), Padovani (ESO) and Perlman (Univ. of Maryland) submitted an EVN/MERLIN proposal to observe a faint sample of BL Lac objects which was observed in June 2005.

Reynolds in collaboration with Bignall and Algaba (JIVE summer student) carried out work on imaging the intra-day variable source PKS-1257.

Wucknitz

Wucknitz started working as a postdoc (ER) in the ANGLES project on May 2nd. He will be working on the subject of gravitational lenses, especially on optimizing the use of radio data to constrain lens models. As part of this project he submitted a proposal, together with Garrett, to observe B0218+357 at 50 and 90cm with the VLBA plus Westerbork and Jodrell Bank. Wucknitz continued a theoretical investigation of the amplifications of gravitational lenses far from the optical axis which he started before joining JIVE.

7. Publications

7.1 Refereed publications

Published


Submitted


7.2 Publications in Conference Proceedings

Published


Submitted


7.3 Other publications


Brunthaler A. and Falcke H., ”Und sie bewegt sich doch...” (popular science in German) Sterne und Weltraum, 2005, Vol. 5 (May), 20
## Appendices

### 1. Table of staff activities and responsibilities

<table>
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<tr>
<th>Staff member</th>
<th>Activity</th>
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| Garrett                    | Director  
Chairman of JIVE Management Team  
Member of RadioNet Board  
Member of EVN Consortium  
Member of SKA Science Working Group  
ASTRON Management Team (by invitation)  
RadioNet FP5 Coordinator  
JIVE/RuG/ASTRON Node PI – ANGLES RTN  
Astronomical Research |
| Campbell                   | Member of JIVE Management Team  
Head of Science Operations and Support  
Astronomical Research |
| Gurvits                    | Member of JIVE Management Team  
Programme Manager  
FP6 RadioNet Project Scientist  
Manager EC ICN contract (RadioNet)  
Manager EC ARI contract (EVN Access)  
Huygens VLBI Tracking, Project Manager  
Co-coordinator KNAW-CAS (China) grant  
Coordinator space VLBI activities  
Secretary for JIVE Board meetings  
Astronomical Research |
| Van Langevelde             | Member of JIVE Management Team  
Head of Software Developments  
Member EVN-PC  
RadioNet ALBUS PI  
RadioNet executive committee  
Member NOVA Education committee  
Member NOVA Instrument Steering committee  
Member ASTRON contactraad  
Prospective PI FABRIC  
Local node manager ESTRELA  
Astronomical Research |
| Parsley                    | Member of JIVE Management Team  
Head of Correlator Maintenance, R&D  
Coordinator of EVN-NREN e-VLBI Proof of Concept prog.  
GVWG member |
| Avruch, Biggs, Bignall, Brunthaler, Paragi | JIVE Support Scientists  
Correlator, Network and Astronomer Support  
Astronomical Research |
| Paragi                     | Network Monitoring Experiments  
EVN Session Overview |
| Buiter                     | Data Processor Engineering & Maintenance  
ASTRON/JIVE ARBO Committee  
Head BHV (ASTRON/JIVE)  
JIVE infrastructure |
| Leeuwinga, Nijk, Tenkink   | Correlator Operator Team  
Data Processor Engineering Development |
| Reynolds                   | Senior Support Scientist  
Sched – EVN related Developments and Maintenance |
2. Visitors to JIVE

G. Aben  SURFnet
A. Bartkiewicz  Torun Centre for Astronomy, Poland
A. Berciano Alba  Kapteyn Institute, Groningen, NL
D. Biancu  Istituto di Radioastronomia, Bologna, Italy
S. Casey  Jodrell Bank
S. Chi  Kapteyn Institute, Groningen, NL
B. Cotton  NRAO Charlottesville, USA
R. Dodson  OAN, Spain
P. Edwards  ISAS/JAXA, Japan
E. Fomalont  NRAO, USA
P. Hazel  Avonsoll Ltd. UK
A. Howard  AARNet
R. Hughes-Jones  Manchester University
M. Makiguchi  Image Science Inc., Japan
Y. Sakata  Image Science Inc., Japan
J. Sansa Otim  Kapteyn Institute, Groningen, NL
V. Tudose  University of Amsterdam, NL
K. Wiik  Turku university, Finland
W. Vlemmings  Jodrell Bank, UK
N. Watanabe  Image Science Inc., Japan
L. Xiang  NAOC Urumqi, China

3. Supervision

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4. Presentations

Anderson
"Ionospheric calibration for the EVN", The First RadioNet Software Forum Meeting on Advanced Interferometry Software, Jodrell Bank, UK, 1-3 March
"Radio Emission in Low-Luminosity Active Galactic Nuclei", ASTRON/JIVE Colloquia, 27 May
"Ionospheric calibration for the EVN", The Square Kilometre Array hosted workshop “wide-field imaging techniques for radio synthesis arrays”, Dwingeloo, NL, 22-24 June

Brunthaler
"Und sie bewegt sich doch... die Entfernung und Bewegung von M33", public Talk in Trebur, 15 April
"The Geometric Distance and Proper motion of M33" Colloquium in Potsdam, 19 April
"The Geometric Distance and Proper motion of M33" Colloquium in Amsterdam, 29 April
"The Geometric Distance and Proper motion of M33" Talk at NAC in Blankenberge, 18 April

Campbell
"Climatological Ionospheric Prediction & GPS/ionosonde Constraint", Ionospheric Effects on Radio Imaging/Polarimetry, Dwingeloo, NL, 24 February
"Recent Results from the EVN Mk4 Data Processor at JIVE", 17th Working Meeting on European VLBI for Geodesy and Astrometry, Noto, Italy, 22 April

Garrett
"21st Century VLBI" Colloquium, Utrecht, NL, 12 January
"21st Century VLBI", Colloquium, Sterrenwacht Leiden, NL, 13 January
"21st Century VLBI", Colloquium, Kapteyn Institute, Groningen, NL, 31 January
"The EVN + SKA", EADS, Bremen, Germany, 23 March
"Multiple Imaging of intrinsically faint radio sources by the massive cluster A2218", ANGLES workshop, Crete, 7 April
"EXPReS", EC evaluation hearing, Brussels, 17 May
"Deep Field Studies", ASTRON evaluation, Dwingeloo, NL, 7 June
"Wide-field VLBI Imaging", SKA wide-field workshop, Dwingeloo, NL, 23 June
"EXPReS eVLBI project", Various presentations at EVN and JIVE Board mtg, Hartebeesthoek, South Africa, 23-24 May

Gurvits
"Huygens Probe as seen by radio astronomers", ESOC, Germany 12 January
"Huygens VLBI tracking – press briefing", ESOC, Germany, 14 January
"Express results of Huygens radio astronomy segment", ESOC, Germany, 15 January
"Mid-term status report on Huygens VLBI tracking", Dwingeloo, 11 February
"First results of Huygens VLBI tracking", HSWT mtg, Florence, 28 February
"Radio astronomy segment of the Huygens mission", EuroPlanet NA3 kick-off meeting, Graz, 9 March
"VLBI in Space: exploration context", EADS, Bremen, 23 March
"Radio astronomy at the edge of the Universe and in the Solar System", Space Research Institute, Moscow, 14 April
"Progress report on the Huygens VLBI tracking project", ESTEC, DTWG, 22 April
"VLBI tracking of the Huygens Probe", Europlanet kick-off meeting, Vienna, 24 April
"Christiaan Huygens, Huygens the Probe and radio astronomy", Paris Observatory, 28 April
“Aspiring new telescopes”, EVN Board, Hartebeesthoek, 23 May
“Precise VLBI tracking of the Huygens Probe”, Titan Conference, Heraklion, Greece, 1 June
“Measurement of zonal winds on Titan – the Huygens Doppler Wind Experiment”, (poster), Titan Conference, Heraklion, Greece, 1 June
“Radio Astronomy: adventure in the invisible Universe”, Amsterdam, NEMO, WYP-2005, 14 June
“Navigation in Space: from Christiaan Huygens to Huygens the Planetary Probe”, Scheepvaartmuseum Amsterdam, public lectures 18 and 19 June

Van Langevelde
“Interview on Huygens descent”, TV Drenthe, Dwingeloo, 14 January
“Interview on Huygens descent”, Radio 1, Dwingeloo, 14 January
“Interview on Huygens descent”, RTL TV, EditieNL, Dwingeloo, 18 January
“Interview on Huygens descent”, Business News Radio, Dwingeloo, 18 January
“Interview on Huygens descent”, NOS Journal, Dwingeloo, 21 January
“Wide field and high dynamic range imaging” Dutch ALMA-RC meeting, Dwingeloo, 13 January
“VLBI in beweging”, NVWS Twente, Enschede, 8 February
“A new era of Methanol maser observations”, lunch talk, Dwingeloo, 16 February
“VLBI in beweging”, rondleiding gemeente Westerveld, Dwingeloo, 21 February
“ALBUS objectives”, Software forum, Jodrell Bank, March 1
“Wide Field imaging”, Software Forum Jodrell Bank, March 2
“e-VLBI: a real-time radio telescope as big as Europe (at least)”, national URSI day, Eindhoven, 27 April
“ALBUS report”, RadioNet board, Paris, 29 April
“What is brewing at the sites of methanol masers”, poster at IAU227, Catania, 16-20 May
“Discovery of a ring structure in methanol maser emission from a protostar”, poster at IAU227, Catania, 16-20 May
“A biased view on IAU 227”, lunch talk Dwingeloo, 31 May
“Distributed Computing at JIVE”, astro-informatics meeting, Utrecht, 21 June
“New data reduction tools for the EVN”, SKA wide field imaging workshop, Dwingeloo 23 June
“JIVE correlator report”, EVN PC, Bonn, 27 June

Paragi

Parsley

Reynolds
“Amplitude Calibration”, TOG meeting, Onsala, Sweden, 30 June
“Developments in SCHED”, TOG Meeting, Onsala, Sweden, 30 June
“Calibration Transfer at the EVN Correlator”, Software Forum meeting, Jodrell Bank, UK, 1-3 March

Szomoru
“Recent e-VLBI developments at JIVE”, EVN-NREN meeting, Schiphol, 28 January
“Recent e-VLBI developments at JIVE”, RadioNet Software Forum meeting, Jodrell Bank, UK, 1-3 March

Wucknitz
“Can gravity lens gravity?”, ANGLES workshop, Crete, Greece, 5 April
5. Membership of committees

Garrett
- SKA Science Working Group
- EVN CBD
- IAU Division X Organizing Committee
- RadioNet Board

Gurvits
- RadioNet Management Team
- Global VLBI Working Group (GVWG)
- IAU Division XI Organizing Committee
- VIRAC (Latvia) Advisory Board
- BepiColombo Science Working Group
- Huygens Science Working Group

Van Langevelde
- EVN Program Committee
- NWO Beoordelings Commissie Astronomie
- NOVA Education Committee
- RadioNet executive board
- ESTRELA project management board

Parsley
- Global VLBI Working Group (GVWG)

6. Membership of professional associations and societies

Bignall
Australian Institute of Physics (1997-)
Astronomical Society of Australia (1998-)

Brunthaler
Deutsche Physikalische Gesellschaft (1995-)

Campbell
Sigma Xi (1983-)
American Geophysical Union (1996-)
International Astronomical Union (2000-)
URSI (2002-)

Garrett
International Astronomical Union (1997-)

Gurvits
Nederlandse Astronomen Club (1994-)
International Astronomical Union (1997-)
COSPAR associate (1998-)
URSI (1999-)

Van Langevelde
Nederlandse Astronomen Club (1985-)
International Astronomical Union (1997-)
URSI (1999-)

Olnon
Nederlanse Astronomen Club (1972-)

Paragi
Roland Eotvos Physical Society (2001-)
Hungarian Astronautical Society (2001-)

Parsley
Institution of Electrical Engineers, Corporate member (1983-)
Fédération Européenne d’Associations Nationales d’Ingénieurs (Eur Ing 1995-)

7. Membership of scientific organizing committees

Gurvits
- EuroPlaNet Earth-based planetary coordinated observations SOC (Graz, March 2005)
- Scientific Organising Committee of the Symposium “50 years of NRAO” (October 2006)

8. Meetings attended

8.1 Scientific conferences attended by JIVE staff members

Avruch
3rd International Planetary Probe Workshop, Athens, Greece, 26 June – 1 July

Brunthaler
Nederlandse Astronomen Conferentie, Blankenberge, Belgium, 18 - 20 May

Campbell
6th IVS Analysis Workshop, Noto, Italy, 21-22 April
17th Working Meeting on European VLBI for Geodesy and Astrometry, Noto, Italy, 22-23 April

Garrett
FP6 ANGLES workshop, Chersonissos, Crete, Greece, 3-8 April

Gurvits
“36 Lunar and Planetary Society Conference”, Houston, TX, USA, 14-19 March
Titan Conference, Heraklion, Crete, Greece, 30 May – 5 June

Van Langevelde
National URSI Meeting, Eindhoven, 27 Apr
IAU 227 “Massive Star Birth: A Crossroads of Astrophysics”, Acireale, Catania, 16-20 May

Olnon
Workshop on VO Standards and Systems for Data Centers and Large Projects, Garching, Germany, 26 June – 1 July

Kramer
Workshop on VO Standards and Systems for Data Centers and Large Projects, Garching, Germany, 26 June – 1 July
8.2 International meetings attended by JIVE staff members

**Anderson**
First Software Forum meeting, RadioNet, Manchester, UK, 28 February – 3 March

**Avruch**
Huygens DTWG / JIVE VLBI Tracking Meeting, Dwingeloo, 12-13 June

**Garrett**
EC Press Conference at RAL, Oxford, UK, 2-3 March
Lunar exploration mtg, EADS, Bremen, 22-23 March
RadioNet meetings/ inauguration Yebes telescope, Madrid, Spain, 25-29 April
EXPRes proposal evaluation, Brussels, Belgium, 16-17 May
EVN and JIVE Board meetings, Hartebeesthoek, 23-25 May
GEANT2 Launch, Luxembourg, 14-15 June

**Gurvits**
BepiColombo Sci Working Group, ESTEC, Noordwijk, 24-25 January
BepiColombo MGNS meeting, Space Res Inst, Moscow, 14-17 February
Huygens Science Working Team, Florence, 28 February
EuroPlanet NA3 kick-off mtg, Graz, 9 March
Lunar exploration mtg, EADS, Bremen, 22-23 March
Huygens Data Analysis mtg, ESTEC, Noordwijk, 22 April
Huygens Attitude Determination and Reconstruction mtg, ESTEC, 23 April
EuroPlanet Board meeting, Vienna, 24 April
RadioNet Board meeting, Paris, 28-29 April
VSOP Survey Working Group mtg, Dwingeloo, 9-14 April
EVN and JIVE Board meetings, Hartebeesthoek, 23-25 May
Huygens extended mission meeting, ESTEC, Noordwijk, 7 June

**Kettenis**
First Software Forum meeting, RadioNet, Manchester, UK, 28 February – 3 March

**Van Langevelde**
ALMA RC meeting, ESO Garching, 4 Feb
RadioNet Software Forum, 1-3 Mar
ALBUS project meeting, Jodrell Bank, 3 Mar
LOFAR BlueGene dedication, Groningen, 26 Apr
RadioNet board meeting, Paris, 28-29 May
SKA software workshop, Dwingeloo, 22-24 Jun
EVN-PC, Bonn, 27-28 Jun

**Olnon**
First Software Forum meeting, RadioNet, Manchester, UK, 28 February – 3 March
Parsley
3rd EVN-NREN meeting, Schiphol, Amsterdam, 28 January.

Pogrebenko
EuroPlanet meeting, Vienna, 24 April
Critical Design Review of the IR-led dBBC project, Bologna, Italy, 2-4 May

Reynolds
RadioNet Synergy meeting, Granada, Spain, 19-22 January
SKADS meeting, Zaandam, 24-25 February
First Software Forum meeting, RadioNet, Manchester, UK, 28 February – 3 March
ARTI meeting, Dublin, Ireland, 11-14 April
Third IVS Technical Operations Workshop, Haystack, USA, 9-12 May
SKADS meeting, Schiphol, 15 June
EVN TOG meeting, Onsala Space Observatory, Sweden, 30 June

Szomoru
EVN-NREN meeting, Schiphol, 28 January
RadioNet Software Forum meeting, Jodrell Bank, United Kingdom, 1-3 March
Geant2 Launch, Luxembourg, 14-15 June
EXPReS proposal evaluation, Brussels, Belgium, 16-17 May

Tenkink
Third IVS Technical Operations Workshop, Haystack, USA, 9-12 May

Tibbe
RadioNet Board Meeting, Paris, France, 28-30 April

Verkouter
First Software Forum meeting, RadioNet, Manchester, UK, 28 February – 3 March

8.3 Working visits by JIVE staff members

Avruch
Huygens VLBI Tracking Observations, Green Bank, USA, 10-17 January

Biggs
MPIfR, Bonn, Germany, 18-22 April

Brunthaler
Astrophysikalisches Institut Potsdam, 18 - 20 April
Colloquium at Astronomical Institute Anton Pannekoek (speaker), Amsterdam, NL, 29 April

Buiters
Azteco, Zwijndrecht, 10 May

Gurvits
Huygens mission operations, ESOC, Darmstadt, Germany, 11-15 January
Evpatoria evaluation, Kharkov - Kiev, Ukraine, 2-5 March

Kettenis
NRAO, Charlottesville, USA, 31 January – 25 February

Van Langevelde
LOC/NOC, Utrecht, 19 Jan
Leiden, 22 Mar
Leiden, 7 Jun

Olnon
MPIfRA, Bonn, 2-3 June

**Parsley**
Avonsoll Ltd., Bristol, UK, 24th April  
Metrum Information Storage Ltd., Wells, UK, 25th April  
Metrum Information Storage Ltd., Wells, UK, 6th June

**Pogrebenko**
Huygens VLBI Tracking Observations, Green Bank, USA, 10-17 January

**Reynolds**

**Szomoru**
SURFnet study trip to Nortel and CANARIE, Ottawa, Canada, 26-29 April  
EXPReS EC Evaluation hearing, Brussels, Belgium, 17 May  
MPIfRA, Bonn, Germany, 2-3 June  
STARE meeting, Den Haag, The Netherlands, 21 June

**Wucknitz**
University of Potsdam, Germany, 22-24 May
9. Summary of work effort

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**makes use of the “SOP-regeling”

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## 10. List of acronyms and definitions

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<td>AARNet</td>
<td>Australia’s Academic and Research Network</td>
</tr>
<tr>
<td>ADAF</td>
<td>Advection Dominated Accretion Flow</td>
</tr>
<tr>
<td>AGN</td>
<td>Active Galactic Nuclei</td>
</tr>
<tr>
<td>AIPS</td>
<td>Astronomical Image Processing System</td>
</tr>
<tr>
<td>ALBUS</td>
<td>Advanced Long Baseline User Software</td>
</tr>
<tr>
<td>ALMA</td>
<td>Atacama Large Millimeter Array</td>
</tr>
<tr>
<td>ANGLES</td>
<td>Astrophysics Network for Galaxy LEnsing Studies</td>
</tr>
<tr>
<td>ASI</td>
<td>Agenzia Spaziale Italiana (Italian Space Agency)</td>
</tr>
<tr>
<td>ATCA</td>
<td>Australia Telescope Compact Array</td>
</tr>
<tr>
<td>ATNF</td>
<td>Australia Telescope National Facility</td>
</tr>
<tr>
<td>AU</td>
<td>Astronomical Unit</td>
</tr>
<tr>
<td>BBC</td>
<td>BaseBand Converter</td>
</tr>
<tr>
<td>CAS</td>
<td>Chinese Academy of Sciences</td>
</tr>
<tr>
<td>CB</td>
<td>Correlator Board</td>
</tr>
<tr>
<td>CJF</td>
<td>Caltech-Jodrell Flat spectrum Survey</td>
</tr>
<tr>
<td>CMB</td>
<td>Cosmic Microwave Background</td>
</tr>
<tr>
<td>DEVOS</td>
<td>Deep Extragalactic VLBI-Optical Survey</td>
</tr>
<tr>
<td>DMM</td>
<td>Delay Memory Module</td>
</tr>
<tr>
<td>DPU</td>
<td>Data Playback Unit</td>
</tr>
<tr>
<td>DSP</td>
<td>Digital Signal Processing</td>
</tr>
<tr>
<td>EC</td>
<td>European Commission</td>
</tr>
<tr>
<td>EGRET</td>
<td>Energetic Gamma Ray Experiment Telescope</td>
</tr>
<tr>
<td>ERI</td>
<td>EVN Reliability Indicators</td>
</tr>
<tr>
<td>ESA</td>
<td>European Space Agency</td>
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<td>ESF</td>
<td>European Science Foundation</td>
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<tr>
<td>eSMA (HJvL)</td>
<td>Extended SubMillimeter Array</td>
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<tr>
<td>e-VLBI</td>
<td>electronic VLBI</td>
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<tr>
<td>EVN</td>
<td>European VLBI Network</td>
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<tr>
<td>EVN PC</td>
<td>EVN Programme Committee</td>
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<tr>
<td>EXPReS</td>
<td>Express Production Real-Time e-VLBI Service</td>
</tr>
<tr>
<td>FITS</td>
<td>Flexible Image Transport Systems</td>
</tr>
<tr>
<td>FP6</td>
<td>Framework Programme 6</td>
</tr>
<tr>
<td>FTP</td>
<td>File Transfer Protocol</td>
</tr>
<tr>
<td>GMRT</td>
<td>Giant Metre-wave Radio Telescope</td>
</tr>
<tr>
<td>GSFC</td>
<td>Goddard Space Flight Center</td>
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<tr>
<td>HSA</td>
<td>High Sensitivity Array</td>
</tr>
<tr>
<td>IDV</td>
<td>intra-day variability</td>
</tr>
<tr>
<td>Acronym</td>
<td>Full Form</td>
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<td>---------</td>
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<tr>
<td>IRAU</td>
<td>Institute of Radio Astronomy of Ukraine</td>
</tr>
<tr>
<td>ISAS/JAXA</td>
<td>Institute of Space and Astronautical Science</td>
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<tr>
<td>JBO</td>
<td>Jodrell Bank Observatory (UK)</td>
</tr>
<tr>
<td>JCMT</td>
<td>James Clerk Maxwell Telescope (Hawaii, USA)</td>
</tr>
<tr>
<td>JPL</td>
<td>Jet Propulsion Laboratory</td>
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<tr>
<td>KNAW</td>
<td>Koninklijke Nederlandse Akademie van Wetenschappen</td>
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<tr>
<td>LLAGN</td>
<td>Low-Luminosity Active Galactic Nuclei</td>
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<tr>
<td>LOFAR</td>
<td>Low Frequency Array</td>
</tr>
<tr>
<td>Mk4</td>
<td>a VLBI data format/recording system</td>
</tr>
<tr>
<td>Mark 5</td>
<td>PC based disk recording system developed by Haystack Observatory</td>
</tr>
<tr>
<td>MERLIN</td>
<td>Multi-Element Radio Linked Interferometer Network</td>
</tr>
<tr>
<td>Mbps</td>
<td>Megabit per second</td>
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<tr>
<td>NASA</td>
<td>National Aeronautics and Space Administration</td>
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<tr>
<td>NASU</td>
<td>National Academy of Sciences of the Ukraine</td>
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<tr>
<td>NME</td>
<td>Network Monitoring Experiment</td>
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<tr>
<td>NRAO</td>
<td>National Radio Astronomy Observatory (USA)</td>
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<tr>
<td>NREN</td>
<td>National Research and Education Network</td>
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<td>NWO</td>
<td>Nederlandse Organisatie voor Wetenschappelijk Onderzoek</td>
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<td>OAN</td>
<td>Observatorio Astronomico Nacional</td>
</tr>
<tr>
<td>PBU</td>
<td>Playback Unit</td>
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<tr>
<td>PCInt</td>
<td>Post-Correlator Integrator</td>
</tr>
<tr>
<td>PI</td>
<td>Principal Investigator</td>
</tr>
<tr>
<td>ROT (clocks)</td>
<td>Reconstituted Observing Time</td>
</tr>
<tr>
<td>RXTE (ZP)</td>
<td>Rossi X-ray Timing Explorer</td>
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<tr>
<td>SGR</td>
<td>Soft Gamma Repeater</td>
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<td>SKA</td>
<td>Square Kilometer Array</td>
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<td>SRON</td>
<td>Stichting Ruimteonderzoek Nederland</td>
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<td>SU</td>
<td>Station Unit</td>
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<td>Dutch NREN</td>
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<td>TRM</td>
<td>Track Recovery Unit</td>
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<td>UAO</td>
<td>Urumqi Astronomical Observatory (China)</td>
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<tr>
<td>UTC</td>
<td>Coordinated Universal Time</td>
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<tr>
<td>VEX</td>
<td>VLBI Experiment Description format</td>
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<tr>
<td>VIRAC</td>
<td>Ventspils International Radio Astronomy Centre (Latvia)</td>
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<tr>
<td>VLA</td>
<td>Very Large Array</td>
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<tr>
<td>VLBA</td>
<td>Very Long Baseline Array</td>
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<tr>
<td>VLBI</td>
<td>Very Long Baseline Interferometry</td>
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