



# European VLBI Network Newsletter Number 4 January 2003

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## [1. Report from the Chairman of the Consortium Board of Directors \(CBD\) of the EVN](#)

A lot has happened in the period since the last Newsletter. We have had significant personnel changes within the EVN and have taken significant decisions concerning the future of VLBI. We have also had the first successful European tests of e-vlbi; this has had a major impact, especially in the European Commission.

As many of you will know, Richard Schilizzi stepped down as the Director of JIVE at the end of December to take up the post of Director of the International SKA Project. Richard was the driving force behind the creation of JIVE in the early 1990s and the funding and construction of the EVN data processor at JIVE. He has been a major influence in much of EVN policy for even longer. His new job will bring him new and probably more difficult challenges and we wish him well.

You will all have seen the advertisement for Richard's replacement as Director of JIVE. The deadline for applications is 15 February 2003. Until the appointment of a new Director, Mike Garrett is acting as the Interim Director. This in turn has meant that Mike stepped down as Chairman of the Technical Operations Group (TOG), a job which he performed with great professionalism. Walter Alef of the Max Planck Institut fur Radioastronomie in Bonn has replaced Mike with immediate effect; Gino Tuccari of IRA, Noto has agreed to continue as the vice-chairman.

In November the EVN CBD met at the Harnack-Haus in Berlin. The agenda was

extensive but a major discussion point was the future recording system for VLBI. In the near-term, before e-vlbi is widely available, we have to move to disc-based systems (so-called d-vlbi). Two systems were under consideration, the Metsahovi-JIVE PC-EVN and the Haystack Mk5. The "*provisional*" decision was to adopt Mk5. However, this has yet to be ratified and will not be until certain technical issues have been resolved. Whatever happens will be a joint decision of the EVN and NRAO. This will ensure that the astronomy community moves together.

Finally, we should all take note of the excellent developments concerning e-vlbi in Europe. Two very public demonstrations have been performed, at iGrid2002 in Amsterdam and at the EU's FP6 opening in Brussels. These demonstrations (see [www.dante.net/geant/press/PUB-02-006.pdf](http://www.dante.net/geant/press/PUB-02-006.pdf)) transmitted data from Jodrell Bank Observatory, recorded on a PC-EVN disc, over UKERNA, Geant (the EC-funded international fibre network) and SURFNet to JIVE where it was correlated with data from WSRT. I have been informed by senior people within the EU that they are extremely impressed by the success of this demo and they encourage us to make e-vlbi a reality.

Phil Diamond ([pdiamond@jb.man.ac.uk](mailto:pdiamond@jb.man.ac.uk))  
Chairman, CBD of the EVN

## **2. Call for Proposals - Deadline 1 February 2003**

Observing proposals are invited for the EVN, a VLBI network of radio telescopes in Europe, Asia and South Africa operated by an international Consortium of institutes ([www.evlbi.org](http://www.evlbi.org)). The EVN is open to all astronomers, and encourages use of the Network by astronomers not specialised in the VLBI technique. The Joint Institute for VLBI in Europe, JIVE ([www.jive.nl](http://www.jive.nl)), can provide support and advice on project preparation, scheduling, correlation and analysis. See [www.evlbi.org/support/evn\\_support.html](http://www.evlbi.org/support/evn_support.html).

PIs can apply for time by completing a coversheet ([www.evlbi.org/proposals/prop.html](http://www.evlbi.org/proposals/prop.html)) and attaching a scientific justification (maximum 2 pages). Up to 2 additional pages with diagrams may be included; the total, including cover sheet, should not exceed 6 pages. The detailed call for proposals ([www.observ.u-bordeaux.fr/vlbi/EVN/call-long.html](http://www.observ.u-bordeaux.fr/vlbi/EVN/call-long.html)) has further information on Global VLBI, EVN+MERLIN and guidelines for proposal submission. The EVN User Guide is available at [www.evlbi.org/user\\_guide/user\\_guide.html](http://www.evlbi.org/user_guide/user_guide.html), the EVN Status Table ([www.oso.chalmers.se/~vlbi/EVN/EVNstatus](http://www.oso.chalmers.se/~vlbi/EVN/EVNstatus)) gives current antenna capabilities and the on-line VLBI catalogue ([www.ira.cnr.it/~tventuri/cata.html](http://www.ira.cnr.it/~tventuri/cata.html)) lists sources observed by the EVN and Global VLBI.

### **EVN Observing Sessions in 2003**

2003 Session 1 Feb 06 - Feb 27 18/21cm (+ MERLIN), S/X, 1.3cm

2003 Session 2 May 22 - Jun 12 18/21cm (+ MERLIN), 6cm, 5cm, +...

2003 Session 3 Oct 23 - Nov 13 90cm, 18/21cm, 6cm (with Jb-1), +...

Proposals received by 1 February 2003 will be considered for scheduling in Session 2, 2003 or later. Finalisation of the planned observing wavelengths will depend on proposal pressure. Most proposals request 12-48 hours observing time. The EVN PC also encourages larger projects (>48 hrs) but these may be subject to more detailed scrutiny, and the EVN PC may, in some cases, attach conditions on the release of the data. Special features for Sessions in 2003;

- Hartebeesthoek normally available for all observations south of declination +30.
- 512 Mb/s capability at 6cm and 18cm
- Shorter integrations times now available with the EVN Correlatorat JIVE: 1 second minimum dump time for the entire correlator.
- Phase referencing performance now greatly improved with new telescope positions (see [www.evlbi.org/user\\_guide/stapos.html](http://www.evlbi.org/user_guide/stapos.html))
- EVN Data Analysis pipeline is now in operation (see [www.evlbi.org/pipeline/user\\_expts.html](http://www.evlbi.org/pipeline/user_expts.html))
- Lovell Telescope resurfacing is now complete; surface adjustment should be completed this year ready for 6cm observing in session 3/2003 ([www.jb.man.ac.uk/tech/lovellupgrade/topping.html](http://www.jb.man.ac.uk/tech/lovellupgrade/topping.html))

### **3. Report from the Technical Operations Group**

The TOG met at the end of September 2002 at the Institute of Radio Astronomy, Bologna. It was a good meeting, a full summary of which can be found at [www.evlbi.org/tog/togmins/tog\\_rep\\_bol2002.txt](http://www.evlbi.org/tog/togmins/tog_rep_bol2002.txt).

In the last half of 2002, amplitude calibration was the main focus of TOG activities. By monitoring the Total Power values recorded by the Base Band Convertors (BBCs), continuous TSYS measurements were introduced in session 1/2002 for MkIV Data Acquisition Systems (DAS) and in session 2/2002 for VLBA DAS (in the latter case it is changes in AGC attenuation that are monitored). So far the results look good and there are plans to further improve measurements made with the VLBA DAS. People involved in these developments include: John Conway (OSO), Ed Himwich (NVI/GSFC), Cormac Reynolds (JIVE), Paul Burgess (JBO) and Dave Graham (MPIfR).

A Calibration workshop was held at Medicina, along side the main TOG meeting. John Conway and Alessandro Orfei organised the workshop, and presentations were made by A. Kraus, C. Reynolds and E. Himwich. Ed Himwich and Carl Holmstrom were able to demonstrate directly to the EVN VLBI friends, the significant enhancements that have recently been made to the Field System (FS), particularly the area of antenna calibration. In the new system all calibration information resides within the FS, and it is possible to track variations in the antenna's measured calibration as a function of frequency (within the observing band). A standard and common flux scale is also embedded within the FS. TSYS data are thus (for the first time) generated

using consistent data sources. This work has involved significant s/w effort from Himwich, Holmstrom and Reynolds. The workshop, sponsored by RadioNet was considered to be a great success and many actions arose from it.

In addition to calibration, significant progress has recently been made in logging the antenna position, in particular during periods when data are being recorded but the antenna is off-source (e.g. slewing between target-calibrator cycles in phase-reference observations). For the first time UVFLG data can be generated from the FS logs (Reynolds). See [www.evlbi.org/tog/uvflg/uvflg.html](http://www.evlbi.org/tog/uvflg/uvflg.html). At last (!) UVFLG files (for most of the EVN telescopes), together with continuous TSYS measurements for all, will now be standard products associated with all EVN observations.

At the TOG meeting Huib van Langevelde (JIVE) announced that he will no longer be able to support the EVN (MkIV) contribution to Craig Walker's Sched. Huib's contribution in this area has been immense - the wealth and complexity of MkIV modes that can now be scheduled are a testament to those efforts. Cormac Reynolds (JIVE) takes over from Huib in this area.

Paul Burgess (JBO) has started to procure obsolete components from the funds made available by the CBD. The first practical benefits of this programme are now being seen - in particular, Torun has been able to fix most of their failing BBC systems. For the user this means fringes in all IFs!

Thin tape supply continues to limit the ability of the EVN to observe at the highest possible data rates (512 Mbps). The replacement of the current magnetic tape recorders with PC disk-based systems was a major point of discussion for the TOG. The merits of both PC-EVN and Mk5 systems were discussed with a preference for the latter - mainly because it appeared to be a maturer solution and one that is already being used by the geodetic community (with which there is significant overlap within the EVN). Continued development of PC-EVN was also widely encouraged until the full potential of this system has been clearly demonstrated.

While it is clear we made good progress in 2002 (in many different areas) by the end of the year we had seen several major telescope failures within the session. There are always good reasons for such failures, the dynamic drive to continually upgrade and improve our telescopes is just one. These failures remind me of the importance of the Fringe Test Tapes that we set up some years ago, and which are still scheduled before each session. However, the time-scale for the feedback cycle to be closed is still too long. EVN proof-of-concept tests for real-time e-VLBI operations (see [www.dante.net/geant/press/PUB-02-006.pdf](http://www.dante.net/geant/press/PUB-02-006.pdf)) promise to shrink that feedback cycle from several days to a few minutes - this is one area in which there is much to be gained in the next few years.

At the beginning of this year I resign as the TOG chair, due to temporary changes in my responsibilities at JIVE. I hope to continue with some TOG activities, in particular I will be involved in pushing ahead the programme to pursue real-time eVLBI developments in the EVN. In any case, I'd like to take

this opportunity to thank all TOG members for their support of the EVN over the last few years, and wish the best of luck to Walter Alef (the new TOG chair).

Mike Garrett ([garrett@jive.nl](mailto:garrett@jive.nl))  
JIVE

#### **4. Science Highlight: Automatic EVN Imaging of the X-ray binary source Cygnus X-1**

Of the ~250 currently known X-ray binaries, approximately 50 have detectable radio emission and a dozen or so of these have been found to have radio jets. Extreme examples of the jet sources are GRS 1915+105 (Mirabel & Rodriguez 1994; Fender et al. 1999) and GRO J1655-40 (Hjellming & Rupen 1995; Tingay et al. 1995), both exhibiting apparent superluminal motion and extreme variability. However, some sources show relatively little variation, such as Cygnus X-1 and LS 5039. Cygnus X-1 has been fairly stable in the low/hard X-ray state, at around 10-15 mJy at cm wavelengths and with an extremely flat radio spectrum. The radio emission was first observed following a 'turn on' corresponding to an X-ray state change in 1972. The 'turn on' was probably the recovery from a high/soft state during which time the jet had been quenched as Zhang et al. (1997) show that the radio emission was similarly suppressed during the high/soft X-ray state in 1996. Previous radio maps on both Very Large Array (VLA) (Marti et al. 1996) and MERLIN (Newell 1997) size scales (with 5 arcsecond and 50 mas beam FWHM respectively) showed no conclusive evidence for resolved or extended emission. The source was shown to have a well collimated outflow extending around 10 mas by Stirling et al. (2001).

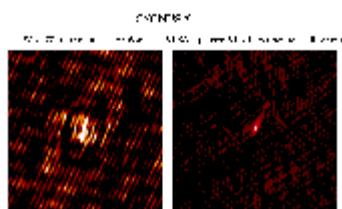


Figure 1: EVN and VLBA/VLA observations of Cygnus X-1  
(click on image for larger version)

The EVN was used to observe Cygnus X-1 at 5 GHz on 2001 May 31. In the plot we show the false colour images from the EVN automated reduction pipeline ([www.evlbi.org/pipeline/user\\_expts.html](http://www.evlbi.org/pipeline/user_expts.html)). As a comparison we also show the 8 GHz image taken with the phased up VLA and VLBA from 1998 which was reduced manually. The automated EVN reduction gives a good detection of a 4 mJy/beam (peak) extended source and yields a structure comparable to the earlier VLBA image, although with a slight change in the jet orientation. The EVN image shows some artifacts since it is the dirty map.

Usually any analysis of projected extragalactic radio jets is hampered by the unknown angle to the line of sight. However in X-ray binaries such as Cygnus

X-1 it can be inferred from observations of the accretion disk. The one-sided nature of the jet then gives a lower limit to the jet velocity ( $> 0.6c$ ). Utilising the phase referencing technique has allowed us to measure the large proper motion of 8 mas/year exhibited by Cygnus X-1. We also find that the absolute positions of the peak brightness at 5, 8 and 15 GHz are the same within errors, allowing constraints to be set on the jet opening angle and velocity.

Subsequent EVN images of Cygnus X-1 will be used to examine the non-linear structure of the jet. At present it is unclear whether the apparent bends are caused by precession, jitter or interactions with the ambient medium. Alternatively a more subtle mechanism such as variations in the pitch angle of an underlying helical field may be responsible. Polarization observations will be vital to this research. A global array including the EVN may also be able to resolve the orbital motion of the binary, assuming that the base of the radio jet is anchored to the black hole component.

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The European VLBI Network (EVN) website (<http://www.evlbi.org/>) is hosted by the Joint Institute for VLBI in Europe (<http://www.jive.nl/>).