



Express Production Real-time e-VLBI Service

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Author: T. Charles Yun, Project Manager, JIVE
Co-Authors EXPReS Management Team

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Section 1.0- Introduction

The past month has seen a great deal of activity and progress. The project has been able to coalesce after the Board Meeting and specific activities are in a position to begin submitting their activities for presentation. Inside of JIVE, the departure of our office manager caused a bit of concern (loss of institutional memory), but the team has been able to take up slack and adjust extremely well. Activities are now moving forward and showing much more obvious progress. The deliverables are beginning to accumulate and there are now results showing that e-VLBI is establishing itself as a useful service to astronomers around the world.

Section 2.1- NA1- Management

The Board Meeting and kickoff were energetic catalysts to help push a variety of activities to completion. The project controls are starting to take hold and members now understand the reasoning behind the various activities. The first manifestations are metrics on deliverable status and delays. The project still faces some large schedule issues due to delayed start of personnel, but as of this report, all individuals should be on staff. As part of the annual review process, a new project plan that reflects the current state of staffing and resources will be created. The modified plan will begin to be reviewed internally at the beginning of the New Year.

EXPRoS continues to have good external visibility. Various activity groups note presentations at conferences and participation in workshops. The Project Manager was provided the opportunity to present at the IST 2006 Event in Helsinki, Finland as well as participate in the Concertation meeting on e-Infrastructure that was held immediately prior. A great deal of interest was shown in EXPRoS and e-VLBI during these meetings.

In coordination with SURFnet, a consortium partner, EXPRoS participated in the SURFnet GigaPort seminar for astronomers. This event brought together astronomers and networking experts to help disseminate and inform astronomers about the capabilities of advanced networks, such as SURFnet6. The collaboration is seen as one of the ways in which expertise and activities are being extended beyond the consortium and into the community (astronomy, networking, academic, etc) at large.

The project's wiki-space continues to expand responsively to reflect activity. Currently, project deliverables and links to their products are available. Individuals are also taking advantage of the

ability to upload content and provide substance to what was initially just a skeleton for the project activities.

Section 2.2- NA2- EVN-NREN

The EVN-NREN forum has been active in linking the e-VLBI and networking community. Their meeting resulted in a list of actionable items. The items focus on a variety of topics, but highlight the facilitation role that the forum provides.

John Chevers participated in the IST 2006 Event in Helsinki, Finland, representing DANTE. DANTE had a sizeable display booth on the show floor that received a steady stream of visitors. At the booth, a DANTE produced video highlighted e-VLBI and the way in which application users are taking advantage of regional and international networks. Several members of EXPreS were highlighted in the video.

Status of NA2 deliverables

D#	AD#	title	month due	status
D4	NA2	EVN-NREN meeting No. 1 (under auspices of EXPreS)	3	4

The primary deliverable for NA2 was delivered and registered via the wiki.

Section 2.3- NA3- e-VLBI Science

The preprints of the first two refereed publications (additional information in the appendices) to come from EVN e-VLBI operations appeared on the 'astro-ph' preprint server on Nov 2. These publications Tudose et al. 2006 (<http://arxiv.org/abs/astro-ph/0611054>) and Rushton, et al., 2006 (<http://arxiv.org/abs/astro-ph/0611049>) have been accepted for publication in Monthly Notices of the Royal Astronomical Society (UK). This Journal is one of the four front line astronomy journals (all of approximately equal prestige). The astro-ph exploder is the primary means of keeping track of new literature for the global astronomical community and hence EXPreS e-VLBI efforts have therefore obtained a larger exposure.

The call for e-VLBI proposals for the upcoming run on 14/15 December was distributed to the astronomical community on the 17th November (a copy of the call is available in the appendices). This call indicated that all 6 European stations with good connectivity would be involved at a probable data rate of 256MBit/s. A copy of the call and summary information about proposals for the year are available in the appendices.

After much iteration with the stations the schedule for e-VLBI operations in the first half of 2007 has been finalized, with a total of 6 times 24hr runs allocated (the announcement is included in the appendices). The first run will be a 'double header' with initial observations on Monday/Tuesday 29th/30th January and the second run on Thursday/Friday 1st/2nd February. This will be a first test of 'adaptive observing' in which in the first run an observer can look at a group of sources, have e-VLBI data immediately to analyze and then adapt the schedule for the second run depending on what had been found (perhaps concentrating on the brightest source or the source with the most interesting structure). This type of experiment has never been done before with VLBI and is a unique opportunity allowed by the transition to media to Internet transmission.

To support the above adaptive observing the SA1 part of the project has been working on tools for the quick analysis of data and techniques for fast/robust calibration. Additionally this foray into adaptive observing requires a culture change at the radio-telescope (because the second experiment must be prepared at very short notice compared to conventional VLBI operations). Based on the results of this first try we hope in the future to reduce the time between the two runs of an adaptive experiment; with a possible end goal of real-time adaptation of observing schedules in response to the e-VLBI output.

The first eVSAG face-to-face meeting was held on 28th November in Westerbork in the Netherlands, In total, 14 members were present (an additional 3 joined by teleconference). There was a lively discussion on a number of aspects of present and planned future operations. Minutes are in draft form and should be finalised early in December.

The eVSAG chair (John Conway) gave a report on e-VLBI science and the eVSAG meeting to the EVN directors meeting on 29th November in Dwingeloo (Netherlands).

Status of NA3 deliverables

D#	AD#	title	month due	status
D6	NA3	First meeting of eVSAG under auspices of EXPReS	4	4

The eVSAG meeting has been completed fulfilling deliverable 6. An action item on the minutes exists to determine the date of the next meeting.

Section 2.4- NA4- Public Outreach, Dissemination and Communications

Most NA4 work in November consisted of publicity-related activities: issuing a press release for the upcoming publication of the first e-VLBI science papers in the monthly notices of the Royal Astronomical Society (UK); creating a PowerPoint template to present a uniform EXPReS identity for future presentations at astronomy and networking events; assisting with the highlight of EXPReS in a brochure for the Global Lambda Integrated Facility (GLIF); and, creating a new EXPReS poster for the NWO Director's visit to JIVE on 30 November 2006.

Outreach activities for November included updating the EXPReS Web site with the following: a new Papers & Presentations Page (<http://www.expres-eu.org/papers.html>) making EXPReS and e-VLBI publications and presentations available to the general public; posters for general use in the Document Archive (<http://www.expres-eu.org/docs.html>); and, a new Open Day page (http://www.expres-eu.org/openday_2006.html).

Communications support for the EXPReS team included updating the wiki with secure areas for financial information and sensitive documents.

Status of NA4 deliverables

D#	AD#	title	month due	status
D1	NA4	Creation of Public EXPReS web-site	2	4
D7	NA4	Creation of EXPReS web-based management tools	4	4
D10	NA4	Generation of PR material (phase 1)	6	x

The NA4 deliverables are all proceeding according to plan. Most of the PR materials (D10) have been created, but are currently being treated as an ongoing activity that will respond to events. Completed materials are available on the website and linked from the wiki.

Section 3.1- SA1- Production e-VLBI Correlation

Work on various software tools continued. A data status monitoring tool, providing an instantaneous and detailed overview of the overall data quality was delivered. The information generated by this tool is also fed back to the participating stations via a web interface. Work on a pipeline aimed at near real-time display of intermediate results is progressing well. Some transport protocol evaluation was done during a JRA1 demo.

A white paper was produced with staff members of SURFNet regarding the use of lightpaths across Europe and is available on the wiki:

<http://www.jive.nl/dokuwiki/doku.php/expres:sa1>

A successful e-VLBI science session took place on the 26th of October, in which data was transferred at 256 Mbps from 5 telescopes for about 14 hours continuously. This also gave us an opportunity to test our new correlator control computers during a real-time experiment. It became clear that (re)start-up times have decreased dramatically with a corresponding increase in responsiveness and robustness of the system.

Status of SA1 deliverables

D#	AD#	title	month due	status
D5	SA1.1	central data link control	3	3
D11	SA1.2	job preparation utilities	6	0
D12	SA1.3	fast/adaptive sched. tools	6	1
D27	SA1.4	eMERLIN VSI interface design	9	0
D28	SA1.5	network protocol decision	9	1

Deliverable D5 is in draft form and is awaiting review to be accepted as complete. Deliverables D11 and D12: these are strongly linked, and work will start on this within the next two months. Deliverable D27: work on this will start on 1 December 2006 when the newly hired digital engineer at Jodrell Bank joins their staff. Deliverable D28: we expect more progress after a network engineer will start working at JIVE on 1 December 2006.

Although it may seem the activity is lagging behind, we are in fact ahead when looking at the total amount of work done. Because of a number of reasons, it was impossible to follow the timeline as set out in the project plan; we intend to submit a revised plan at the end of year one. At this time the following deliverables are partially or completely finished:

D#	AD#	title	month due	status
D40	SA1.8	monitoring processes	12	2
D44	SA1.10	real-time control software	15	3
D47	SA1.11	real-time pipeline	16	2
D50	SA1.12	visibility monitor	18	3
D96	SA1.21	monitoring user interfaces	30	2

Deliverables D44 and D40 are in draft form and are awaiting review to be accepted as complete. The other deliverables will be more fully updated as they near completion.

Additionally, Dr. Zsolt Paragi, e-VLBI support scientist at JIVE, provided a summary of production e-VLBI correlation activities in 2006. His summary is included as an appendix to this report.

Section 3.2- SA2- Telescope Network Connections

Activity for SA2 proceeds, if at a slightly slower pace than desired. The activity has provided an explicit date for the collection of “feasibility study” deliverables of 15 December. The project manager and the activity participants have been in ongoing discussions regarding this item. While late, there is now an understanding of how and when this item will be completed. It was pointed out that many of the activities for SA2 occur at a frequency that is less than monthly, so the current month’s update is a bit short.

Status of SA2 deliverables

D#	AD#	title	month due	status
D13	SA2	Feasibility study of the last-mile connection to the nearest NREN node for participant CNIG-IGN	6	1
D14	SA2	Feasibility study of the last-mile connection to the nearest NREN node for	6	1

		participant MPIfR		
D15	SA2	Equipment of the last-mile infrastructure for participant INAF (telescope in Medicina)	6	1
D16	SA2	Feasibility study of the last-mile connections to the nearest GEANT NREN node for participant CAS (Shanghai, Urumqi, Miyun, Yunnan)	6	1
D17	SA2	Feasibility study of the last-mile connection to the nearest NREN node for participant VIRAC	6	1
D18	SA2	Feasibility study of the last-mile connection to the nearest NREN node for participant HRAO	6	1
D19	SA2	Feasibility study of the last-mile connection to the nearest NREN node for participant NAIC (Arecibo)	6	1
D20	SA2	Feasibility study of the last-mile connection to the nearest NREN node for participant TIGO	6	1
D21	SA2	Feasibility study of the last-mile connection to AARNET for participant CSIRO	6	1

Section 4.1- JRA1- FABRIC

JRA1 has made significant strides and progress recently, with notable improvements against the recent month 7 demo. This test included successful use of Tsunami protocol for e-VLBI. The data from the demo was evaluated and a draft document is being circulated. Following the demo, efforts were made to improve connections. Hardware upgrades at Metsahovi and Jodrell Bank have been successfully established 896 Mbps connections. There is optimism that these successes can be generalized.

Additionally, staffing is now complete and many of the items delayed due to manpower issues will be started. John Hargreaves started at Jodrell Bank to work on coding FPGA's. Yuri Pidopryhora started at JIVE and has begun work on software. It is worth noting that existing staff have been able to realign their activities to continue progress by addressing future items not constrained by delayed items.

Status of deliverables of JRA1 as of 1/11/2006

D#	AD#	title	month due	status
D2	J1.1	Data acquisition requirements document	2	4
D3	J1.2	Protocols strategic document	2	4
D8	J1.3	Visualization software	4	0
D9	J1.4	Correlator design specification 3)	5	3
D22	J1.5	Overall design document	6	0
D23	J1.6	e-VLBI-Grid design document	6	4
D24	J1.7	e-VLBI fringes PC-EVN 4)	7	3
D25	J1.8	LOFAR connection strategic document	7	2
D26	J1.9	Data acquisition design document	8	1

Completed deliverables are available on the wiki. Those deliverables with status "3" that are listed above have been submitted as drafts and are simply awaiting minor modifications dealing with presentation/publication; the core work has been completed. For D3, Jodrell Bank has updated

VLBI_UDP, including the measurement of one way delay. The use of DCCP for VLBI has progressed.

The JIVE team finished a first cluster version of the correlator software which was made available to the group at PSNC. PSNC has embedded the software correlator in cluster environment and are currently testing in various processor configurations.

Additional progress was made on the design of the workflow manager. A prototype version is available and the graphical user interface of WFM will be ready in the middle of December. The functional prototypes will be presented to JIVE around this time for evaluation.

Work on deliverable D8 was waiting for the arrival of the engineer Pidopryhora. Pidopryhora is now working on the software tools.

Deliverable D22 has been identified as a point of concern by the team. Additional work over the next month is scheduled to make additional progress.

A first version of the E-LOFAR interfacing document is in draft, addressing deliverable D25. The work on establishing a link between Bonn and Groningen has started with an evaluation of hardware and arrangements for the fibre connection to Effelsberg.

Progress on Deliverable D26 has been actively paused to provide additional time to investigate details of an alternative hardware device, the iBOB. A total of 10 iBOB's have been ordered from Berkeley to be used for e-VLBI acquisition systems and interface to the MERLIN correlator.

As mentioned, a significant amount of progress continues to be made by identifying and opportunistically addressing work items. The following table highlights activities with future deadlines that have made enough progress to note.

D#	AD#	title	month due	status
D30	J1.10	e-VLBI-Grid interface document	10	1
D41	J1.11	Protocols performance report	13	
D42	J1.12	Software correlator core	14	3
D43	J1.13	Software data product	15	
D66	J1.14	Data acquisition interface document	18	
D67	J1.15	LOFAR station interface report	18	
D68	J1.16	Software for workflow management	18	2
D75	J1.17	Software for correlation on cluster	23	2

In addition to the deliverables, activities in JRA1 are being presented at meetings. PSNC will present at the BELIEF conference in New Delhi. Additional details will be provided after the presentation.

Section 5.0- Appendices

The following sections contain the text of emails or links to documents referenced in the report. Shorter documents and emails are quoted in their entirety below. Longer documents are provided as linked documents. If you would like documents in a different format, please contact us and we will attempt to assist you.

Appendix - EXPReS Contact Points

For convenience, a list of the activities and the associated contact points are listed here for reference.

ID	Description	Contact	email
PC	Project Coordinator	Michael Garrett	garrett // jive nl
NA1	Management of I3	T. Charles Yun	tcyun // jive nl

NA2	EVN-NREN Forum	John Chevers	john.chevers // dante.org.uk
NA3	e-VLBI Science Forum	John Conway	jconway // oso.chalmers.se
NA4	Public outreach	Kristine Yun	kyun // jive.nl
SA1	Production Services	Arpad Szomoru	szomoru // jive.nl
SA2	Network provisioning	Francisco Colomer	f.colomer // oan.es
JRA1	FABRIC	Huib Jan van Langevelde	langevelde // jive.nl

Appendix - Deliverables

The deliverables are being tracked on the wiki at:

<<http://www.jive.nl/dokuwiki/doku.php/expres:management:deliverables2>>

The wiki contains additional information to that listed below, including some comments on drafts that are nearing full completion and some additional meta-data used to track deliverables. The snapshot below is here for reference.

The status of the deliverable on an “x” to 4 scale:

x = Ongoing effort

0 = No work started

1 = Some work started

2 = Most work completed

3 = Deliverable in draft form

4 = Deliverable completed and presented to Project Manager

D #	Activity	Activity Specific Deliverable Number	Deliverable description	Planned Delivery Month	Actual Delivery Month	Current Status (x of 4)
D1	NA4	NA4.01	Creation of Public EXPReS web-site	2	2	4
D2	JRA1	J1.1	Data acquisition requirements document	2		
D3	JRA1	J1.2	Protocols strategic document	2		
D4	NA2	NA2.01	EVN-NREN meeting No. 1 (under auspices of EXPReS)	3	6	4
D5	SA1	SA1.1	Central data link control	3		
D6	NA3	NA3.1	First meeting of eVSAG under auspices of EXPReS	4	9	4
D7	NA4	NA4.02	Creation of EXPReS web-based management tools	4	4	4
D8	JRA1	J1.3	Visualization software	4		
D9	JRA1	J1.4	Correlator design specification	5		
D10	NA4	NA4.03	Generation of PR material (phase 1)	6	1	x
D11	SA1	SA1.2	Job preparation utilities	6		
D12	SA1	SA1.3	Fast/adaptive scheduling tools	6		
D13	SA2	SA2.01	Feasibility study of the last-mile connection to the nearest NREN node for participant CNIG-IGN	6		
D14	SA2	SA2.02	Feasibility study of the last-mile connection to the nearest NREN node for participant MPIfR	6		
D15	SA2	SA2.03	Equipment of the last-mile infrastructure for participant INAF (telescope in Medicina)	6		
D16	SA2	SA2.04	Feasibility study of the last-mile connections to the nearest GEANT NREN node for participant CAS (Shanghai, Urumqi, Miyun, Yunnan)	6		

D17	SA2	SA2.05	Feasibility study of the last-mile connection to the nearest NREN node for participant VIRAC	6		
D18	SA2	SA2.06	Feasibility study of the last-mile connection to the nearest NREN node for participant HRAO	6		
D19	SA2	SA2.07	Feasibility study of the last-mile connection to the nearest NREN node for participant NAIC (Arecibo)	6		
D20	SA2	SA2.08	Feasibility study of the last-mile connection to the nearest NREN node for participant TIGO	6		
D21	SA2	SA2.09	Feasibility study of the last-mile connection to AARNET for participant CSIRO	6		
D22	JRA1	J1.5	Overall design document	6		
D23	JRA1	J1.6	e-VLBI-Grid design document	6	9	4
D24	JRA1	J1.7	e-VLBI fringes PC-EVN	7		
D25	JRA1	J1.8	LOFAR connection strategic document	7		
D26	JRA1	J1.9	Data acquisition design document	8		
D27	SA1	SA1.4	eMERLIN VSI interfaces design	9		
D28	SA1	SA1.5	Selective data processor controls	9		1

Appendix - Publications based on e-VLBI Service

The first papers resulting from e-VLBI science observations have been accepted for publication in the Monthly Notices of the Royal Astronomical Society (MNRAS). Other papers have been published as conference proceedings, but this first publication of back-to-back letters in a refereed journal is a milestone of maturity for e-VLBI. We are pleased to announce:

- First e-VLBI observations of Cygnus X-3, Tudose et al. and
- First e-VLBI observations of GRS 1915+105, Rushton et al.

The first European e-VLBI science observations were successfully conducted in April and May 2006. These have been implemented under the standard EVN "open skies" policy, ensuring that the facility is able to take advantage of and respond to the best ideas of the entire international astronomical community.

First e-VLBI observations of GRS 1915+105

A. Rushton,¹ R. E. Spencer,¹ M. Strong,¹ R. M. Campbell,² S. Casey,¹ R. P. Fender,^{3,4} M. A. Garrett,² J. C. A. Miller-Jones,⁴ G. G. Pooley,⁵ C. Reynolds,² A. Szomoru,² V. Tudose^{6,6} and Z. Paragi²

¹The University of Manchester, Jodrell Bank Observatory, Cheshire SK11 9DA
²Joint Institute for VLBI in Europe, Postbus 8, 3900 A A Dwingelo, The Netherlands
³School of Physics and Astronomy, University of Southampton, Highfield, SO17 9JF Southampton, UK
⁴Astronomical Institute of the Romanian Academy, Cotroceni 405, 1999 SJ Bucharest, Romania
⁵University of Cambridge, Madingley Road Astronomy Observatory, 2, 2, Plumton Avenue, CB3 0HJ Cambridge, UK
⁶Astronomical Institute of the Romanian Academy, Cotroceni 405, 1999 SJ Bucharest, Romania

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ABSTRACT

We present results from the first successful open cell e-VLBI science run, observing the X-ray binary GRS 1915+105. e-VLBI science allows the rapid production of VLBI radio maps, within hours of an observation rather than weeks, facilitating a decision for follow-up observations. A total of 6 telescopes observing at 5 GHz across the European VLBI Network (EVN) were correlated in real time at the Joint Institute for VLBI in Europe (JIVE). Constant data rates of 128 Mbps were transferred from each telescope, giving 4 TB of raw sampled data over the 12 hours of the whole experiment. Throughout this, GRS 1915+105 was observed for a total of 5.5 hours, producing 2.8 GB of stabilities of correlated data. A weak flare occurred during our observations, and we detected a slightly resolved component of 2.7×1.2 millisecond with a position angle of $140^\circ \pm 2^\circ$. The peak brightness was 10.2 mJy per beam, with a total integrated radio flux of 11.1 mJy.

Key words: ISM: jets and outflows - X-ray binaries: individual (GRS 1915+105).

1 INTRODUCTION

The use of the Internet for electronic very-long-baseline interferometry (e-VLBI) data transfer offers a number of advantages over conventional recorded VLBI, including improved reliability due to real-time operation and the possibility of a rapid response to new and transient phenomena. Decisions on follow-up observations can be made immediately after the observation rather than delayed by several weeks due to problems in shipment of tapes/discs to the correlator. The first open cell with a suitable COST range for observations of GRS 1915+105 using the e-EVN (recently European VLBI Network) gave us the opportunity to test e-VLBI under operational conditions. A number of recent test runs have shown that 128 Mbps data rates can be obtained reliably by the 4 European telescopes, Chandra, Jodrell Bank2, Medicina, Onsala, Tientsin and Westerbork, currently connected via national and international research networks to the EVN correlator at Joint Institute for VLBI in

Europe (JIVE). Steps are currently being taken to improve the reliability of 256 and 512 Mbps connections, and also develop 1 Gbps transmission as part of the EXPOSE² project. Microquasars are ideally suited for study by e-VLBI since they often have flares associated with the ejection of radio emitting clouds in the form of jets. Time-scales of this emission are in the range of hours to days at cm wavelengths, and decisions about subsequent observations, need to be taken quickly.

The X-ray binary GRS 1915+105 was first discovered in 1992 (Castro-Tirado et al. 1992) by the WATCH instrument on the GRANAT satellite. The system comprises a low-mass, K-M III star (Groer et al. 2001) companion and a 14.2 M_⊙ black hole (Groer et al. 2001a). It was the first Galactic source observed to display superluminal motion, and is well known for its rapid variability and strong variable radio flux. It spends the majority of its time in relative radio-quietness, with low radio and X-ray brightness, and with a characteristic low/hard state X-ray spectrum. In such a state

¹ E-mail: rushton@jive.mn-uk.ac.uk (AR)
² <http://www.ihb.org/ihb/>

³ see - <http://www.expose.org>

First e-VLBI observations of Cygnus X-3

V. Tudose,^{1,2*} R.P. Fender,^{3,1} M.A. Garrett,⁴ J.C.A. Miller-Jones,¹ Z. Paragi,⁴ R.E. Spencer,⁵ G.G. Pooley,⁶ M. van der Klis¹ and A. Szomoru¹

¹Astronomical Institute, Buzura Park, University of Bucharest, Buzura 405, 1099 SJ Bucharest, Romania
²Astronomical Institute of the Romanian Academy, Cotroceni 405, 1999 SJ Bucharest, Romania
³School of Physics and Astronomy, University of Southampton, Highfield, Southampton SO17 9JF
⁴Joint Institute for VLBI in Europe, Postbus 8, 3900 A A Dwingelo, The Netherlands
⁵University of Manchester, Jodrell Bank Observatory, Madingley Road, Cheshire SK11 9DA
⁶University of Cambridge, Madingley Road Astronomy Observatory, 2, Plumton Avenue, Cambridge CB3 0HJ

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ABSTRACT

We report the results of the first two 5 GHz e-VLBI observations of the X-ray binary Cygnus X-3 using the European VLBI Network. Two successful observing sessions were held, on 2006 April 20, when the system was in a quasi-quiet state several weeks after a major flare, and on 2006 May 18, a few days after another flare. At the first epoch we detected faint emission probably associated with a fading jet, spatially separated from the X-ray binary. The second epoch in contrast reveals a bright, curved, relativistic jet more than 40 milliseconds in extent. In the first, and probably also second epoch, the X-ray binary core is not detected, which may indicate a temporary suppression of jet production as seen in some black hole X-ray binaries in certain X-ray states. Spatially resolved polarisation maps at the second epoch provide evidence of interaction between the ejecta and the surrounding medium. These results clearly demonstrate the importance of rapid analysis of long-baseline observations of transients, such as facilitated by e-VLBI.

Key words: accretion, accretion discs - stars: individual: Cygnus X-3 - ISM: jets and outflows - radiation mechanisms: non-thermal - techniques: interferometric.

1 INTRODUCTION

The X-ray binary Cygnus X-3 was first detected in X-rays by Giacconi et al. (1967). The infrared (e.g. Beukens et al. 1972) and X-ray flares (e.g. Poutignat et al. 1972) show a periodicity of 4.8 hours which is interpreted as the orbital period of the system. The nature of the compact object is not known (Schwartz, Geballe & Schind 1996; Mitra 1998). As for the companion star, there is compelling evidence pointing toward a WN Wolf-Rayet star (van Kesterik et al. 1996; Fender, Hanson & Pooley 1999; Koch-Mannat et al. 2002).

Class outbursts and large flares have been observed at radio wavelengths in Cygnus X-3 since 1972 (Groer et al. 1972). In quiescence the soft X-ray emission is correlated with the radio emission, while the hard X-ray is anti-correlated with the radio in a flare state, the situation is reversed: the hard X-ray correlates with the radio and the soft X-ray emission is anti-correlated (Wataabe et al. 1994; McCollough et al. 1999; Choudhury et al. 2002).

Radio observations made during such flare states at different resolutions with the Very Large Array (VLA), Multi-Element Radio-Linked Interferometer Network (MERLIN), Very Long Baseline Array (VLBA), and European VLBI Network (EVN) (Glebbeek et al. 1983; Spencer et al. 1998; Molnar, Bond & Grindlay 1998; Schallmayer et al. 1995, 1998; Mioduszewski et al. 2001; Martí et al. 2001; Miller-Jones et al. 2004) directly show us are consistent with two-sided relativistic jets (with the notable exception of the VLBA observation of a flare in February 1997, when the jet was apparently one-sided; Mioduszewski et al. 2001).

2 OBSERVATIONS

One of the aims of e-VLBI is to enable mapping with long-baseline networks of radio telescopes in a manner which makes it possible to map transient phenomena, such as microquasars, in near real-time. This will provide the ability to make informed decisions about the optimum observing strategy to employ (frequency of observations, array compo-

* E-mail: tudose@astron.ro (VT)

arXiv:astro-ph/0611049 v1 2 Nov 2006

arXiv:astro-ph/0611054 v1 2 Nov 2006

First pages from each the e-VLBI papers to be published

Both of the observations were made with a 6 telescope array utilizing national and international research and education networks to bring data from the telescope locations to the correlator in real time. Further e-VLBI sessions took place through the summer with the science run in October routinely able to employ 256 Mbps data rates. When you consider that the first science demonstrations in September 2004 were limited to data rates of 32 Mbps, the rate of progress over the last 2 years is impressive.

The Tudose et al. observations managed to capture the X-ray binary system Cygnus X-3, both in quiescence (April 2006) and during a huge, active outburst (May 2006) - the total intensity and (the very first VLBI) polarisation images are shown in the image above. For more information on the detailed scientific results see the astrophysics preprint server - <http://arXiv.org/abs/astro-ph/0611054> and <http://arXiv.org/abs/astro-ph/0611049>.

Appendix - 2007 e-VLBI Schedule Announcement

Date: Wed, 11 Oct 2006 08:42:22 +0200 (CEST)
From: Zsolt Paragi <zparagi@jive.nl>
To/CC: --removed due to length--
Subject: A change in the e-VLBI dates in 2007
Hi,

In order to completely avoid the Easter period from proposing/scheduling/observing/pipelining point of view, we decided to move the April e-VLBI test to 27 March. This is a Tuesday following the week session 1/2007 finishes. Would everybody be happy with this?

Just for completeness:

29 Jan. 9:00 UT - 30 Jan. 13:00 UT (Mon/Tue)

1 Feb. 14:00 UT - 2 Feb. 16:00 UT (Thu/Fri)
(optional, science only; 2 hours "warming up" for correlator)

20 Feb. 9:00 UT - 21 Feb. 13:00 UT (Tue/Wed)

27 Mar 9:00 UT - 28 Mar 13:00 UT (Tue/Wed)

22 May 9:00 UT - 23 May 13:00 UT (Tue/Wed)

25 Jun. 9:00 UT - 26 Jun. 13:00 UT (Mon/Tue)

With regards,
Zsolt

Appendix - EVN e-VLBI Call For Proposals

Date: Fri, 17 Nov 2006 11:05:49 +0100 (CET)

From: John Conway

To: <vlbi@nrao.edu>, <evntech@jb.man.ac.uk>, <merlin-announce@jb.man.ac.uk>

Subject: [vlbi] EVN eVLBI call for proposals

CALL FOR EXPERIMENTAL EVN e-VLBI SCIENCE PROPOSALS

Proposals for experimental science use of the EVN's developing e-VLBI real-time VLBI capability are invited for the following 24 hr period

Run start: Thur, 14 Dec 13 UTC

Run end: Fri, 15 December 13 UTC

Proposal Deadline: Thur 30th Nov, 23:59:59 UTC

Using antennas Wb14 (tied array), Tr, On, Mc, Jb2, Cm

Available observing bands are either 6cm or 18cm (but not both). Only continuum proposals are presently supported. Proposals can be made for any length of time within the above slot up to 24 hours in length.

The observations will be run at the highest possible bit rate allowed by internet traffic. Based on recent experience it is expected that 128 Mbit/s will be achieved and probably 256 Mbit/s; however due to the still experimental nature of the system this performance cannot be guaranteed.

Note all proposals **must** be sent to and checked by Bob Campbell (campbell@jive.nl) **prior** to submission in order to ensure that all needed technical information for scheduling is included (see details below).

To accommodate observations requiring rapid reaction and results, e-VLBI proposals can be made before the deadline given above. Envisioned uses for e-VLBI runs are 1) Targets of Opportunity, 2) Preliminary fringe test or other observations where rapid turnaround is required to plan future proposals or observations. Any submitted e-VLBI proposals which can be better executed in regular session observations are very unlikely to be scheduled for these e-VLBI runs. In all cases proposed projects should take account of the limited numbers of telescopes and bandwidth available, carefully justifying that the science goals can be reached.

Proposals are eligible for scheduling only for the above advertised run. Proprietary rights on the data are the standard ones of one year after data distribution. PIs are strongly encouraged to visit JIVE during or immediately after the observations to help rapidly reduce their data. Proposals submitted for the above e-VLBI deadline will be reviewed by the EVN PC within one week. Scheduling of these proposals will be carried out by JIVE staff using information supplied in the proposal.

Proposals must therefore contain all the necessary information needed for scheduling, including the exact target and calibrator positions etc. **** All proposers MUST contact Bob Campbell (campbell@jive.nl) ***** in good time PRIOR to submitting their proposal to ensure that all technical aspects required for observation and correlation are fully described in the proposal.

Before submitting a proposal, proposers should also consult the web pages at http://www.evlbi.org/evlbi/per_session_status.html where updated information about the status of each run can be found. Proposals should use the standard VLBI proposal cover sheet and include the normal scientific justification. The standard limits of 2 pages of text and 2 additional pages of diagrams will be strictly enforced. Proposals must be mailed to proposevn@mpifr-bonn.mpg.de. The email subject line should clearly state 'e-VLBI proposal'.

The continuing development of e-VLBI within the EVN is made possible via the EXPRES project funded by the EC FP6 IST Integrated infrastructure initiative contract #026642 - with a goal to achieve 1 Gbit/s e-VLBI real time data transfer.

Appendix - e-Production e-VLBI Correlation: e-VLBI activities in 2006

On 18 May 2006 we achieved the first six station fringes at 256 Mbps with Cambridge, Jodrell Bank, Medicina, Onsala, Torun, and Westerbork. There were first ever European 512 Mbps e-VLBI fringes on the Jodrell Bank - Westerbork baseline. The data rate was too low for Arecibo to get fringes even at 32 Mbps. We tested remote restart of Mark5As at the telescopes. After the test, there was a 13-hour science project at 128 Mbps. This went without major problems.

Cambridge, Medicina, Onsala and Westerbork participated in the 21 August 2006 test. The test objective of restarting and rebooting MarkV units was successful, although we found it is not possible to do this during a run and recover the station without restarting the run. We had the first 512 Mbp fringes between three European stations: Cambridge, Onsala and Westerbork. We also got fringes for the first time between Cambridge, Medicina and Westerbork using Medicina's new 5 GHz receiver.

The 26 October test was carried out using a new correlator control computer. Starting up correlation jobs became much faster. Initially there were network problems to Medicina and Torun, but these had been solved by the start of the observations. During the test phase we run long correlation jobs to see how long we can maintain a data rate of 256 Mbps. Since this worked fine, for the first time, we decided to run the science experiments at this data rate as well. There were two projects that targeted the X-ray binary LSI +61.303, and the eclipsing binary system Algol. Unfortunately, Onsala had to stop observing because of a storm. Due to various Mark5A related problems, we lost a significant amount of observing time during the night (30% and 20% for the two projects, respectively). Moreover, Cambridge stopped producing fringes after a couple of hours, because of a failing power supply unit in the MkIV formatter. The increase from 128 Mbps to 256 Mbps partly compensated for these losses. Both of the targets were nicely detected in the data analysis pipeline.

Appendix - e-VLBI Proposals 2006

To date, 11 proposals have been submitted for e-VLBI. 7 proposals have been accepted (4 rejected) with 3 observations contributing to 2 accepted publications and one additional paper in preparation.

The full list of proposals is included below to show the variety of proposals. As rejected proposals are included, this information should be treated as sensitive information and not distributed.

Code:	RA001
Title:	Investigation of the structure of the High Frequency Peaker 025515+0037
PI:	E. Angelakis, MPIfR, Bonn, Germany
Co-Is:	A. Kraus, MPIfR, Bonn, Germany A. Polatidis, MPIfR, Bonn, Germany T. P. Krichbaum, MPIfR, Bonn, Germany A. Witzel, MPIfR, Bonn, Germany
Requested:	Cm, Jb2, On, Mc, Tr, Wb14, 1x5 hours, 16-17 March 2006 128-4-2, dual polarization 6cm
Targets:	J025515+0037
Abstract:	We request observations of the source 025515+0037 using the e-VLBI facility at 6cm in order to image the source and attempt resolving its structure. That will clarify the nature of the source that shows a radio spectrum peaking in the range between 30-40 GHz classifying the source as a High Frequency Peaker (HFP) candidate. In case the source is a Compact Symmetric Object (CSO) then, as indicated by its spectrum turnover frequency, it must be extremely young (a few years old). That would provide us with a unique opportunity to study such a source at the very early evolutionary stages on the basis of consequent high resolution kinematic studies. The spectrum of the source between 8 and 22 GHz rises with a spectral index ($S \sim \nu^{\alpha}$) of 1.2 indicating the possibility that the source is in flaring state and further that it is characterized by quite an homogeneous structure.
Status:	rejected
Published:	-

Code:	RF001
Title:	e-VLBI observations of the relativistic jet source Cygnus X-3 in a flaring state
PI:	R. Fender, Univ. Southampton, United Kingdom
Co-Is:	M. Garrett, JIVE, Netherlands V. Tudose, Univ. Amsterdam, Netherlands R. Spencer, Univ. Manchester, United Kingdom J. Miller-Jones, Univ. Amsterdam, Netherlands G. Pooley, MRAO, United Kingdom
Requested:	Cm, Jb2, On, Mc, Tr, Wb14, 3x2 hours, first epoch on 16-17 March 2006 128-4-2, dual polarization 6cm
Targets:	Cyg X-3
Abstract:	Relativistic jets from galactic X-ray binaries are the sites of the most extreme physical environments within our galaxy, generate enormous feedback to the interstellar medium and provide us with nearby, rapidly evolving analogues of the processes at work in active galactic nuclei. Cygnus X-3 is one of the brightest objects in this class, frequently showing radio flares > 1 Jy and resolved into time-varying structures on scales from mas to arcsec. The source has very recently entered a phase of very strong activity, and is being monitored extensively at GHz frequencies. We request e-VLBI observations of the source both to probe its radio structure during these bright and active phases, and also as a test for future e-VLBI observations of such objects.
Status:	accepted; observations failed
Published:	-

Code:	RS001
Title:	eVLBI observations of GRS1915+105
PI:	R. Spencer, JBO, United Kingdom
Co-Is:	A. Rushton, JBO, United Kingdom M. Strong, JBO, United Kingdom S. Casey, JBO, United Kingdom

R. Fender, Univ. Southampton, United Kingdom
M. Garrett, JIVE, Netherlands
Z. Paragi, JIVE, Netherlands
V. Tudose, Univ. Amsterdam, Netherlands
C. Reynolds, JIVE, Netherlands
G. Pooley, UOC, United Kingdom

Requested: Cm, Jb2, On, Mc, Tr, Wb14,
1x8 hours, 16-17 March 2006
128-4-2, dual polarization
6cm

Targets: GRS1915+105

Abstract: We wish to conduct an eVLBI experiment on the transient XRB GRS1915+105. The rapid variability of radio emitting X-ray binaries (REXRB) requires real-time high sensitivity VLBI mapping and a quick response on follow up decisions, which can only be provided by real-time eVLBI. Observations taken in either the "plateau" or "flaring" state require an immediate decision for follow up observations as the source varies on the timescale of hours. The observation will be able to relate the X-ray behaviour, taken by the Rossi X-ray monitoring satellite, to that in the radio. This project will aid the development of eVLBI procedures and strategies that are required to conduct experiments needing rapid response decisions for transient sources.

Status: accepted; observations failed

Published: -

Code: RF002

Title: The structure of the extremely high redshift quasar J1430+4204 after a large radio flare

PI: S. Frey, FOMI SGO, Hungary

Co-Is: Z. Paragi, JIVE, Netherlands
L.I. Gurvits, JIVE, Netherlands

Requested: Cm, Jb2, On, Mc, Tr, Wb14,
1x2 hours, 20-21 April 2006
128-4-2, dual polarization
6cm

Targets: J1430+4204

Abstract: The blazar J1430+4204 (B1428+4217) is among the highest redshift radio-loud AGNs with $z=4.72$, also a prominent X-ray source. Earlier 5-GHz EVN observations (in 1996) showed an almost unresolved mas-scale structure with a correlated flux density of ~ 180 mJy (Paragi et al. 1999). Recently, 15-GHz total flux density monitoring of the source revealed an exceptional flare that peaked in August 2005. The flux density reached 430 mJy, a factor of 3 increase within ~ 4 months in the source rest frame (Worsley et al. 2006). By means of the short target-of-opportunity e-VLBI observations proposed here, we would like to see if there is any morphologically detectable signature of the outburst in the mas-scale structure. If an emerging jet component is found, the object would be ideal for multi-frequency VLBI monitoring to study the jet kinematics and the AGN physics in this exceptional blazar.

Status: rejected

Published: -

Code: RF003

Title: e-VLBI observations of the relativistic jet source Cygnus X-3 in a flaring state

PI: R. Fender, Univ. Southampton, United Kingdom

Co-Is: M. Garrett, JIVE, Netherlands
V. Tudose, Univ. Amsterdam, Netherlands
R. Spencer, Univ. Manchester, Netherlands
J. Miller-Jones, Univ. Amsterdam, Netherlands
G. Pooley, MRAO, United Kingdom

Requested: Cm, Jb2, On, Mc, Tr, Wb14,
1x4 hours, 20-21 April 2006
128-4-2, dual polarization
6cm

Targets: Cyg X-3

Abstract: Relativistic jets from galactic X-ray binaries are the sites of the most extreme physical environments within our galaxy, generate enormous feedback to the interstellar medium and provide us with nearby, rapidly evolving analogues of the processes at work in active galactic nuclei. Cygnus X-3 is one of the brightest objects in this class, frequently showing radio flares > 1 Jy and resolved into time-varying structures on scales from mas to arcsec. The source has very recently entered a phase of very strong activity, and is being monitored extensively at GHz frequencies. We request e-VLBI observations of the source both to probe its radio structure during these bright and active phases, and also as a test for future e-VLBI observations of such objects. NB this proposal was accepted for the first e-VLBI run in March 2006 but failed due to technical problems. This is elaborated on in the science case.

Status: accepted

Published: accepted for publication in MNRAS (astro-ph/0611054)

Code: RS002

Title: eVLBI observations of GRS1915+105

PI: R. Spencer, JBO, United Kingdom

Co-Is: A. Rushton, JBO, United Kingdom
M. Strong, JBO, United Kingdom
S. Casey, JBO, United Kingdom
R. Fender, Univ. Southampton, United Kingdom
M. Garrett, JIVE, Netherlands
Z. Paragi, JIVE, Netherlands
V. Tudose, Univ. Amsterdam, Netherlands
C. Reynolds, JIVE, Netherlands
G. Pooley, UOC, United Kingdom

Requested: Cm, Jb2, On, Mc, Tr, Wb14,
1x8 hours, 20-21 April 2006
128-4-2, dual polarization
6cm

Targets: GRS1915+105

Abstract: We wish to conduct an eVLBI experiment on the transient XRB GRS1915+105. The rapid variability of radio emitting X-ray binaries (REXR) requires real-time high sensitivity VLBI mapping and a quick response on follow up decisions, which can only be provided by real-time eVLBI. Observations taken in either the "plateau" or "flaring" state require an immediate decision for follow up observations as the source varies on the timescale of hours. The observation will be able to relate the X-ray behaviour, taken by the Rossi X-ray monitoring satellite, to that in the radio. This project will aid the development of eVLBI procedures and strategies that are required to conduct experiments needing rapid response decisions for transient sources.

Status: accepted

Published: accepted for publication in MNRAS (astro-ph/0611049)

Code: RP001

Title: e-VLBI observations of the relativistic jet source Cygnus X-3 in a flaring state

PI: R. Fender, Univ. Southampton, United Kingdom

Co-Is: M. Garrett, JIVE, Netherlands
V. Tudose, Univ. Amsterdam, Netherlands
R. Spencer, Univ. Manchester, Netherlands
J. Miller-Jones, Univ. Amsterdam, Netherlands
G. Pooley, MRAO, United Kingdom
Z. Paragi, JIVE, Netherlands

Requested: Cm, Jb2, On, Mc, Tr, Wb14,
1x13 hours, 18-19 May 2006
128-4-2, dual polarization
6cm

Targets: Cyg X-3

Abstract: Relativistic jets from galactic X-ray binaries are the sites of the most extreme physical environments within our galaxy, generate enormous feedback to the interstellar medium and provide us with nearby, rapidly evolving analogues of the processes at work in active galactic nuclei. Cygnus X-3 is one of the brightest objects in this class, frequently showing radio flares > 1 Jy and resolved into time-varying structures on

scales from mas to arcsec. We have successfully observed this source during the recent first open e-VLBI sessions, and have detected the source at a very low (few mJy) "quiescent" level between flares. On May 10, Cyg X-3 flared to 14 Jy at 15 GHz, the largest flare for several years - precisely the kind of event e-VLBI was designed for. We therefore request e-VLBI observations of the source on May 18.

Status: accepted
 Published: (joint publication with RF003)
 accepted for publication in MNRAS (astro-ph/0611054)

Code: RF004
 Title: Search for phase-referencing calibrators in the field of X-ray binaries GX13+1 and GX17+2
 PI: R. Fender, Univ. Southampton, United Kingdom
 Co-Is: M. Garrett, JIVE, Netherlands
 V. Tudose, Univ. Amsterdam, Netherlands
 Requested: Cm, Jb2, On, Mc, Tr, Wb14,
 1x3 hours, 26-27 Oct 2006
 128-4-2, dual polarization
 6cm
 Targets: (list attached to the science case - I do not have it)
 Abstract: We request e-VLBI observations of four objects (selected from the VLA archive) that may qualify as good phase-referencing calibrators in the context of the submitted EVN proposal "Observations of GX13+1 and GX17+2", under review for granting observing time in the EVN session 1, 2007. our previous experiment having as targets the fore mentioned X-ray binaries GX13+1 and GX17+2 (code EG034) partially failed likely due to the lack of good nearby phase-referencing calibrators. The present search, if successful, might also result in finding a better phase calibrator LS5039 (about 3 degrees away from GXs) which is the subject of the EVN experiment EF018 that received a rating of 1.5 at the last EVN PC meeting and has therefore good chances of being scheduled for observations in the EVN session 1, 2007.
 Status: rejected
 Published: -

Code: RP002
 Title: High resolution e-VLBI imaging of microquasar candidates
 PI: M. Pandey, CEA, Saclay, France
 Co-Is: Z. Paragi, JIVE, Netherlands
 P. Durouchoux, ESIEA, DRDI, France
 Requested: Cm, Jb2, On, Mc, Tr, Wb14,
 1x8 hours, 26-27 Oct 2006
 128-4-2, dual polarization
 6cm
 Targets: IGR J17303-0601, IGR J18406-0539 (main targets; others listed in the science case)
 Abstract: We propose to observe recently discovered INTEGRAL sources that are possible microquasar candidates with the EVN. We carried out a fully devoted radio observations of INTEGRAL sources at low frequency with the GMRT. The most interesting result obtained from our observations is, twenty four out of 40 INTEGRAL sources observed have possible radio counterparts detected within the INTEGRAL uncertainty limit for the first time (Pandey et al. 2004a) at low frequencies. With superb couple of arcsec resolution of GMRT at low frequencies we were able to provide best position constraints on the radio counterparts of the INTEGRAL sources. Precise radio coordinates have made unambiguous optical and infrared identifications possible. A few of these bright galactic INTEGRAL sources are binary systems showing variable hard XRB-like spectra with an accreting black hole or a neutron star, strongly concentrated towards the Galactic plane. These INTEGRAL sources are most probably microquasar candidates. We propose exploratory e-VLBI observations of two microquasar candidates (with high enough declinations for the EVN) to establish whether these are compact on milliarcsecond scales, as expected for an XRB system. We would like to check the compactness of nearby potential phase-reference sources as well. Our goal is to monitor these very active systems with INTEGRAL in November/December 2007 and observe them with e-VLBI if they flare.
 Status: rejected
 Published: -

Code: RP004
 Title: The Algol system on mas scale from the optical to the radio regimes I. Exploratory e-VLBI observations
 PI: Z. Paragi, JIVE, Netherlands

Co-Is: L. Mosoni, MPIfA, Heidelberg, Germany
 Sz. Csizmadia, Konkoly Observatory, Hungary
 T. Borkovits, Baja Astronomical Obs., Hungary
 M. Garrett, JIVE, Netherlands
 P. Abraham, Konkoly Observatory, Hungary

Requested: Cm, Jb2, On, Mc, Tr, Wb14,
 1x8 hours, 26-27 October 2006
 128-4-2, dual polarization
 6cm

Targets: Algol, NVSS 030650.34+411511.6 (and four other NVSS sources)

Abstract: Algol (beta Persei) is a nearby and very active eclipsing binary system in all wavelength regimes. In the radio it has highly circularly polarized radio lobes on mas scales, that emit gyrosynchrotron radiation. The likely origin of these lobes are the polar regions of the K subgiant in the system. There are frequent X-ray/radio flares, making Algol a potential future target for high sensitivity and high resolution e-VLBI experiments. The location of these flares as well as their connection to the mass transfer in the binary are not known. In this exploratory proposal we would like to establish the best calibration strategy for phase-referencing as well as the calibration of the left- and right handed telescope gains. This would also serve as a first epoch experiment to the near-simultaneous CHARA optical interferometer and VLBI observations in December 2006.

Status: accepted

Published: not yet

Code: RP003

Title: e-VLBI imaging of the gamma-ray binary LSI +61.303

PI: M. Perez-Torres, IAA-CSIC, Granada, Spain

Co-Is: J. Rico, IFAE, Barcelona, Spain
 N. Sidro, IFAE, Barcelona, Spain
 M. Sanchez-Conde, IAA-CSIC, Granada, Spain
 A. Alberdi, IAA-CSIC, Granada, Spain
 M. Guerrero, IAA-CSIC, Granada, Spain
 F. Prada, IAA-CSIC, Granada, Spain
 J. Cortina, IFAE, Barcelona, Spain

Requested: Cm, Jb2, On, Mc, Tr, Wb14,
 1x6 hours, 26-27 Oct 2006
 128-4-2, dual polarization
 6cm

Targets: LSI +61.303

Abstract: The high mass X-ray binary LSI +61.303 has been recently discovered at very high energy (TeV) gamma rays. The TeV flux has been found to be variable, hinting at a periodic structure that could follow that of the observed radio emission. Recent VLBA experimental results seem to indicate that both the radio and the TeV emission are produced by the interaction of the wind from a young pulsar with that of the companion star, contradicting the previously assumed accretion/jet (microquasar) scenario. We propose one six-hour long epoch of 5 GHz e-VLBI observations of LSI +61.303 around the maximum of the detected emission at high energies. Our proposed observations are part of a multi-wavelength campaign that includes simultaneous observations at TeV using MAGIC and also with MERLIN, near infrared and CHANDRA (1 epoch), all of them already approved. We aim at studying the correlations between the TeV flux with the wind morphological, temporal, and spectral changes both in intra-day and day-to-day timescales. The aquired data will be very useful as input for detailed, time-dependent modelling of this relevant system.

Status: accepted

Published: in prep.