

NA3 -eVLBI Science Forum

EXPReS May 29th 2007

John Conway, Onsala, Chalmers Univ, Sweden

- eVLBI Science Conference (Month 31, Oct 2008)
- eVLBI Science Advisory Group (eVSAG)
- Give science advice to rest of project-advertise observing opportunities
- Online eVLBI science forum, news to users EVN newsletter etc

eVSAG-Members-1

EVN/Express members

- John Conway – Chairman
- Patrick Charlot – EVN PC Chairman
- Richard Porcas – EVN Scheduler
- Huib vanLangevelde - EXPReS coordinator
- Arpad Szomuru – SA1 leader
- Paco Colomer – SA2 leader
- Charles Yun– JRA1 leader
- Rudiger Haas - Geo VLBI rep
- Vacant – Space Navigation rep
- Bob Campbell – JIVE correlator rep

eVSAG-Members-2

Station members

- Z. Paragi – JIVE, Netherlands
- R.Vermuelen – ASTRON, Netherlands
- A Alcola – CNIG-IGNA, Spain
- C.Phillips – CSIRO, Australia
- J.Quick – Hart, SA
- T.Venturi – INAF, Italy
- A.Lobanov– MPI, Germany
- A.Lahteenmaki-MRO, Finland
- C.Salter – NAIC, Arecibo
- E.Pazderski- NCU, Poland
- M.Lindquist. OSO, Sweden
- H.Hase, TIGO, Chile/Germany
- D.Jiang, Shanghai, China
- T.Muxlow(?) Uni Manchester, UK
- I.Smeds, Latvia

Total of 25 members, 15 from observatory EXPReS participants

Face-to-Face Meetings

First F2F meeting Nov 29th 2006 at Radionet/CBD
– delayed 4months wrt project plan

Discussion of science use of eVLBI document

Second meeting in project plan Month 16,
Now scheduled for June 29th in Gothenburg,
Day before PC. On time.

eVLBI End Use

- Adaptive Observing- adapt runs based on results
- 'Persishable' observing- space nav, geo
- Automated observing – month long expts?
- Targets of Opportunity – no disk stockpile
- Connect to real time arrays (LOFAR, eMERLIN)

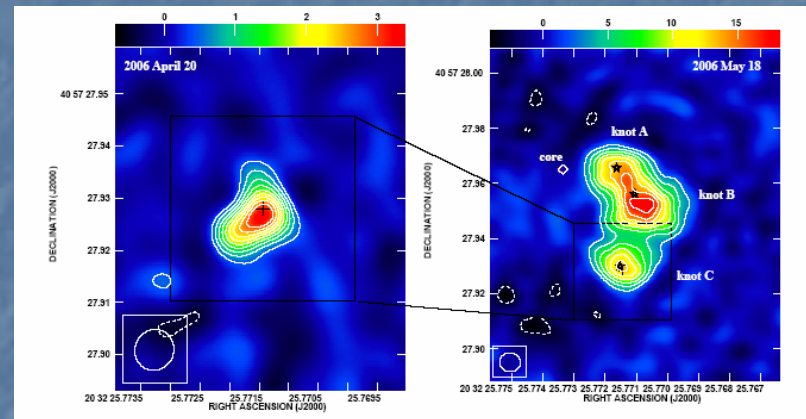
eVLBI astro runs in Year1

Date	Submissions / scheduled	Mbps/antennas	Comments
2006 Mar 16	3/1	128/5	Technical failures, no useful data
2006 Apr 20	3/2	256/6	Gave published observations (Tudose et al 2007 and Rushton et al 2007)
2006 May 20	0/1	256/6	Planned Technical only run, not advertised, but was used to observe a previously submitted proposal. Part of published observations of Tudose et al (2007)
2006 Jun 26	0/0	256/6	
2006 Oct 26	4/2	256/6	
2006 Dec 14	3/3	256/6	
2007 Jan 29/Feb 1	1/1	256/6	First adaptive, 'double header' observation. Technical success but no active sources.
2007 Feb 20	1/1	256/6	

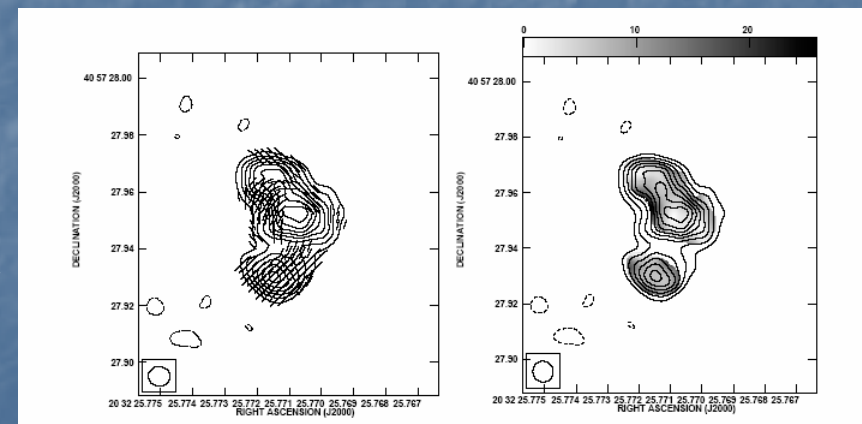
In every case proposal deadline 2 weeks before session as agreed in Nov 2005, CBD.

Cyg X-3

- Maps made from data at two epochs, first in very weak state second just after a major flare.
- Tudose et al (2006), MNRAS accepted, Polarisation map made for second expt



Epoch 2 →



Polarisation

Total Int

First Referred Publications

Mon. Not. R. Astron. Soc. 000, 1–4 (2006) Printed 2 November 2006 (MNRAS style file v2.2)

First e-VLBI observations of GRS 1915+105

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ABSTRACT

We present results from the first successful (post) 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 coordinated in real time at the Joint Institute for VLBI in Europe (JIVE). Compact data rates of 128 Mbits 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 2.5 hours, producing 2.6 GB of visibility data of correlated data. A weak flare occurred during our observations, and we detected a slightly resolved component of 2.7×1.2 millifarcs 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 increased 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 potentially weeks due to problems in alignment of tapes/discs to the correlator. The first open call with a suitable GFT range for observations of GRS 1915+105 using the e-EVN (Electronic European VLBI Network)¹ gave us the opportunity to test e-VLBI under operational conditions. A number of recent test runs have shown that 128 Mbit data rates can be obtained reliably in the 6 European telescopes, Chesham, Bodø, M2, Medicina, Utsunomiya, Tokyo 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 Mbit connections, and also develop 1 Gbit connections as part of the EXPLoRE² project.

Microarrays are ideally suited for study by e-VLBI since they often have structures associated with the injection of radio emitting clouds in the form of jets. Time-scales of this emission are in the range of hours to days at our wavelengths, and decisions about subsequent observations need to be taken quickly.

The X-ray binary GRS 1915+105 was first discovered in 1962 (Carter-Tinney et al. 1962) by the OSO-3 instrument on the OSO-3 satellite. The system comprises a low mass, K-M III star (Srinivasan et al. 2001), companion and a 14–14 M_⊙ black hole (Casares 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 provides the opportunity of a first in relative radio-observations, with low radio-band X-ray brightness, and with a characteristic low-band radio X-ray spectrum. In such a state

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¹ see - <http://www.evn.org>

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First e-VLBI observations of Cygnus X-3

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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 observations were held, on 2006 April 26, when the system was in a quasi-quiet state several weeks after a major flare, and on 2006 May 16, 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 large, curved, relativistic jet more than 60 millifarcs in extent. In the first, and probably also second episode, 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 acquisition 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 (see Becklin et al. 1972) and X-ray flares (see Danneberg et al. 1973) show a periodicity of 4.5 hours which is interpreted as the orbital period of the system. The nature of the compact object is not known (Schwartz, Geballe & Scholtz 1986; Miller 2001). In the companion star there is compelling evidence pointing towards a WN 16-IIe super star (van Herkules et al. 2004; Fender, Hansen & Pooley 1999; Koochikannan et al. 2002).

Giant outbursts and large flares have been observed at radio wavelengths in Cygnus X-3 since 1972 (Gentley 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 (Wadaoka et al. 1994; McComb et al. 1999; Chandra et al. 2002).

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Radio observations made during such large flares at different wavelengths with the Very Large Array (VLA), Multi-element Radio Linked Interferometric Network (MERLIN), Very Long Baseline Array (VLBA), and European VLBI Network (EVN) (Geddes et al. 1992; Spencer et al. 1998; Miller, Bell & Crawford 1996; Schodel et al. 1997, 2000; Modjazowski et al. 2001; Miller et al. 2001; Miller-Jones et al. 2001) directly show or are consistent with two-sided relativistic jets (with the notable exception of the VLBA observations of a flare in February 2002, when the jet was apparently one-sided Modjazowski et al. (2001)).

2 OBSERVATIONS

One of the aims of e-VLBI is to enable mapping with long baselines 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 observation, array configura-

arXiv:astro-ph/0611049 v1 2 Nov 2006

arXiv:astro-ph/0611054 v1 2 Nov 2006

Figure NA3-1: First referred journal publications from e-VLBI

Future runs

- May 20th technical test only. June 25th next, special deadline for June 12th.
- New proposal system for 1st June deadline for observations in Aug, Sept, Oct
- Three classes of proposal A) Standard B) Triggered C) Short observations
- Double header/adaptive run 2x24hrs end of Nov, Dec, Jan and Feb runs- Deadline Oct 1st From Jan 2008 some to include Bonn, Yebes, China and Metsahovi?

Technical aspects

- 256Mbps expected, 512Mbps target.
- Allow 18/21cm, 6cm, 5cm – consider 1.3cm after Bonn/Yebes joins
- Spectral line now allowed (not triggered), spread sessions allow monitoring.

Future Proposal Policy

- Discuss at June 29th, eVSAG
- For Oct 1st - limited 'generic' proposals – source classes with no positions at time of proposal. (but still fixed slots).
- Discuss feasibility (for March 2008 onward) of extensive ToOs in non fixed slots – report of Paragi working group- discuss needs of particular science goals

Session Distribution 2008/2009

- What to do after March 2008 for last year of EXPReS????
- Present 24hrs fixed slots or 48hrs maybe?
- AND/OR- significant time for 'generic ToO on unsheduled dates' ?
- AND/OR – Replace standard expts in sessions by eVLBI?
- AND/OR – Limited offer few stations long obs in conjunction with Software correlator in 2008?

Contract Goal

- Want EU to evaluate final project as success for future funding (!)
- What will satisfy them, vs SA1/NA3 goals?
- Proposal to 'move VLBI from disk to internet' – implies must do 'significant part' of Nov 2008 or Feb 2009 sessions with eVLBI?
- OR a few nice applications plus publications – plus demonstrating capability to replace disk enough??