The 8th International e-VLBI Workshop

Science and Technology of Long Baseline Real-Time Interferometry

June 22nd - 26th 2009 - Madrid, Spain

Book of Abstracts

This workshop is sponsored by the Centro Nacional de Información Geográfica - Instituto Geográfico Nacional (CNIG-IGN) of Spain and EXPReS. EXPReS is an Integrated Infrastructure Initiative (i3), funded under the European Commission's Sixth Framework Programme (FP6), contract number 026642.

Scientific program

Monday June 22nd 2009

0900 - 0905 Welcome - Jesús Gómez–González (IGN Deputy Director)
0905 - 0910 Welcome by the EXPReS Project Coordinator - Huib J. van Langevelde

SESSION 1 - INTRODUCTORY TALKS - Jesús Gómez–González (IGN)

0910 - 0950 John Conway: Setting the scene; the scientific applications of e-VLBI (invited)
0945 - 1025 Michael Garrett: LOFAR project status (invited)

SESSION 2 - TRANSIENTS I - James Miller-Jones (NRAO)

1030 - 1110 Tim O'Brien: Novae and CV's (invited)

1110 - 1130 *Coffee break*

1130 - 1210 Alexander van der Horst: Probing gamma-ray burst and supernova explosions with radio observations (invited)
1210 - 1250 Miguel Pérez–Torres: Type II supernovae and starbursts (invited)
1250 - 1320 Andreas Brunthaler: A new radio supernova in M82

1320 - 1500 *Lunch*

1500 - 1540 Julie McEnery: Multi-wavelength observations of high energy transients (invited)

SESSION 3 - NON-TRANSIENT e-VLBI OBSERVATIONS - Chris Phillips (CSIRO/ATNF)

1540 - 1610 Zsolt Paragi: A suspected dark lens revealed with the e-EVN
1610 - 1640 Hayden Rampadarath: Is an AGN at the center of the disk galaxy IC 2497 responsible for Hanny's Voorwerp?

1640 - 1710 *Coffee break*

1710 - 1740 Alfonso Trejo: e-VLBI observations of the ULX at M33
1740 - 1830 Andreas Brunthaler: Spectral line applications using e-VLBI (invited)
1830 - 2030 eVSAG meeting (closed *for members only*)

Tuesday June 23rd 2009

SESSION 4 - GEODESY AND ASTROMETRY - Huib van Langevelde (JIVE)

0900 - 0940 Rüdiger Haas: e-VLBI for geosciences (invited)
0940 - 1010 Erhu Wei: Numerical simulations on the optimal geodetic observing conditions with RADIOASTRON
1010 - 1040 Maria Rioja: Multi-view e-VLBI

SESSION 5 - TRANSIENTS II - Zsolt Paragi (JIVE)

1040 - 1110 Greg Hallinan: Active stars and brown dwarfs (invited)

1110 - 1140 *Coffee break*

1140 - 1220 Vivek Dhawan: Microquasars & e-VLBI: made for each other? (invited)
1220 - 1300 James Miller–Jones: The proper motion and changing jet morphology of Cygnus X-3
1300 - 1320 Valeriu Tudose: Correlated radio/X-ray behaviour of Cyg X-3

1320 - 1450 *Lunch*

1450 - 1520 Anthony Rushton: Variations within the compact jet from the black hole candidate GRS 1915+105
1520 - 1600 Michael Kramer: Pulsars, e-VLBI and LEAP (invited)

1600 - 1630 *Coffee break*

1630 - 1710 Rob Fender: Monitoring the variable radio sky with LOFAR (invited)
1710 - 1750 John Swinbank: Standards and systems for transient response (invited)
1750 - 1900 Panel discussion: Future organisation/multiwavelngth coordination to maximise science impact of e-VLBI

21:00 Conference dinner at Restaurant "El Cenador del Prado"

Wednesday June 24th 2009

All sessions at Yebes Observatory

0830 Bus leave from hotel Agumar

0830 - 0945 Drive to Yebes

SESSION 6 - REGIONAL AND INSTRUMENT REPORTS - John Conway (Onsala Space Observatory)

1000 - 1030 Arpad Szomoru: eEVN progress (invited)
1030 - 1100 Mamoru Sekido: e-VLBI activities in Japan (invited)

1100 - 1130 *Coffee break*

1130 - 1200 Tasso Tzioumis: e-VLBI progress in Australia (invited)
1200 - 1230 Zhong Chen: Chinese VLBI network and its application to e-VLBI (invited)
1230 - 1300 Vivek Dhawan: NRAO VLBA upgrade plans and prospects (invited)
1300 - 1330 Bong Won Sohn: Current status of Korean VLBI network and future plan for e-VLBI (invited)

1330 - 1430 *Lunch*

SESSION 6 (cont) - Tasso Tzioumis (ATNF)

1430 - 1630 Visit to Yebes observatory

SESSION 6 (cont) - Tasso Tzioumis (ATNF)

1630 - 1700 Ralph Spencer: Progress and status of eMERLIN (invited)
1700 - 1730 Huib van Langevelde: Future of e-VLBI (invited)

1730 - 1800 *Coffee break*

1800 - Return to Madrid

Thursday, June 25th 2009

SESSION 7 - NREN MEETING - John Chevers (DANTE)

0900 - 0935 John Chevers: Future prospects for GEANT (invited)
0935 - 1000 Shaun Amy: Connecting telescopes down under - the Australian research and education network
1000 - 1025 Mauro Nanni: The network infrastructure for radio astronomy in Italy
1025 - 1050 Gerhard Kronschnabl: Regular e-transfer experiences for geodetic INTENSIVE experiments at Wettzell

1050 - 1120 *Coffee break*

1120 - 1145 Richard Hughes-Jones: Experience gained in using 4 Gigabit trans-european link from Onsala to Jodrell Bank
1145 - 1210 Discussion of network issues

SESSION 8 - e-VLBI TECHNIQUES - Arpad Szomoru (JIVE)

1210 - 1235 Paul Boven: e-VLBI networking tricks
1235 - 1300 Richard Dodson: GPU - channelised e-VLBI, a more efficient approach
1300 - 1325 Christian Plötz: e-control - a new concept for remote control of VLBI telescopes and first experience at Wetzell

1325 - 1450 *Lunch*

1450 - 1515 Chris Phillips: e-VLBI developments on the LBA
1515 - 1540 Jonathan Hargreaves: Connecting iBOBs to the eMERLIN correlator
1540 - 1605 Jouko Ritakari: European 4 Gbps VLBI and e-VLBI

1605 - 1640 *Coffee break*

SESSION 9 - VDIF SESSION - Alan Whitney (MIT-Haystack RAO)

1640 - 1710 Alan Whitney: Introduction VDIF and VTP (invited)
1710 - 1730 Richard Hughes-Jones: A proposal for defining the VLBI application transport header
1730 - 1830 Open discussion

Friday June 26th 2009

SESSION 10 - SOFTWARE AND DISTRIBUTED CORRELATION - Richard Hughes-Jones (DANTE)

0900 - 0925 Chris Phillips: Performance testing of the DiFX correlator
0925 - 0950 Mark Kettenis: e-VLBI with the SFXC correlator
0950 - 1015 Yuri Pidopryhora: The latest tests of the SFXC correlator
1015 - 1040 Dominik Stocklosa: User interaction and workflow management in Grid enabled e-VLBI experiments

1040 - 1110 *Coffee break*

SESSION 11 - THE FUTURE OF NETWORKS AND VLBI SCIENCE - Ralph Spencer (JB-CA/Manchester U)

1110 - 1145 David Salmon: Ja-Net prospects (invited)
1130 - 1205 Ivan Andonovich: Application Driven Petabit Optical Networking (invited)
1205 - 1240 Roshene McCool: Long baselines in the Square Kilometre Array (invited)
1240 - 1315 John-Paul Hemingway: Advances in Optical Networking Technologies Transmission and Switching Techniques for Tb/s of Optical Data (invited)
1315 - 1330 Discussion and wrap up

1330 *Lunch*

List of posters

Ilya Bezrukov: e-VLBI technique in radio network "Quasar"
Kenneth Johnston: Near Real-time UT1 estimation using e-VLBI
Aard Keimpema: SFXC : A distributed software correlator for VLBI
Kensuke Kokado: e-VLBI activites at Tsukuba 32m Station and correlation center
Michael Lindqvist: e-VLBI related activities at the Onsala Space Observatory
Walid Majid: VLBI calibrator density at the milli-Jansky level
Hiroshi Takaba: Development of real-time Giga-bit Geodesy e-VLBI using Super-SINET
Kazuhiro Takashima: Fundamental research about the space-time information certification using VLBI correlation technique
Ivars Smelds: Looking for fringes from the Irbene 32 m radio telescope
Erhu Wei: Analysis of the Length of Day with 2008-2009 VLBI Observations

Abstracts of oral contributions

Session 1: Introductory talks

Setting the scene; the scientific applications of e-VLBI *(invited)*

J. Conway (Onsala Space Observatory, Sweden)

Moving data transport from recordable media to fibre links has important advantages for long baseline interferometry which enhances its range of scientific applications. Real time operation improves reliability and can marginally improve the 'speed of response' to transient events. However the most dramatic improvement is in the 'speed of results', which may be important in cases where the results are 'perishable' (geodesy or spacecraft navigation) or for planning future observations of transients. Furthermore by combining e-VLBI with software correlation it is possible to automate VLBI, allowing very long or continuous observations with a small network of telescopes. Looking to the future e-VLBI should allow for an easier expansion path to large bandwidths and provide a testbed for the SKA.

LOFAR project status *(invited)*

M.A. Garrett (ASTRON)

The Low Frequency Array (LOFAR) is a next generation radio telescope currently under construction in the Netherlands. I will report on the current status of the project, potentially including results from early astronomical commissioning data. I will place particular emphasis on the international expansion of the project (E-LOFAR) in which LOFAR stations will be located in Germany, France, Sweden, the UK and potentially Poland, Italy and the Ukraine. The complementarity between E-LOFAR and the e-VLBI technique will also be discussed.

Session 2: Transients I

Multiwavelength observations of Novae and CV's *(invited)*

T. O'Brien (Jodrell Bank Centre for Astrophysics, University of Manchester)

I will review recent work on novae and CV's paying particular attention to the multiwavelength campaign on the 2006 outburst of RS Ophiuchi, which included observations with EVN/VLBA, MERLIN, Spitzer, UKIRT, VLTI, HST, Swift, XMM-Newton and Chandra. I will aim to address how future e-VLBI observations could contribute to understanding these types of systems and how they can be combined with observations at other wavelengths in coordinated campaigns.

Probing gamma-ray burst and supernova explosions with radio observations *(invited)*

A. J. van der Horst (NASA/MSFC/ORAU, U.S.A.)

In recent years an association between gamma-ray bursts (GRBs) and Type Ib/c supernovae (SNe) has been established: a large fraction of GRBs is caused by a relativistic jet emerging from the collapse of a massive star. Not all Type Ib/c SNe, however, are accompanied by a GRB. Radio observations probe the fastest ejecta in stellar explosions, enabling detailed studies of these ejecta, their direct environment, and the nature of the relation between GRBs and SNe. I will review the advances that have been made by adding radio observations to the broadband picture of stellar explosions, monitoring the light curves and spectra, and measuring their size evolution with (e)VLBI. Also I will discuss the new possibilities for studying these events that are offered, now and in the near future, at both extreme ends of the electromagnetic spectrum: high-energy gamma-rays with the Fermi Gamma-ray Space Telescope, and low-frequency radio waves with several new-generation telescopes and existing radio telescopes with enhanced capabilities.

Type II SNe and starbursts *(invited)*

M. A. Pérez-Torres (Instituto de Astrofísica de Andalucía, Spain)

I will review the current status of radio studies of Type II SNe and starbursts at the highest angular resolution, presenting a few of the most remarkable RSNe cases (SN 1993J, SN 1986J,...) and starbursts (M82, Arp 220, Arp 299) imaged with VLBI. I will also discuss the possibilities for future studies, using the eEVN.

A new radio supernova in M82

A. Brunthaler (MPIfR), K.M. Menten (MPIfR), M.J. Reid (CfA), C. Henkel (MPIfR), G.C. Bower (Berkeley) and H. Falcke (Nijmegen, ASTRON)

We report the discovery of a new radio supernova in M82, 1.3″ south and 2.0″ west of the radio kinematic center. It was first discovered as a bright radio transient of unknown origin with the VLA. An e-VLBI observation at 18cm in April 2009 shows an unresolved source. VLBI images taken with the High Sensitivity Array in May 2008 and April 2009 at 22 GHz show at sub-milliarcsecond resolution a ring like structure with an expansion speed of roughly 11000 km/s. This confirms the supernova nature of this source. The measured expansion rate indicates an explosion date in late January 2008. Very Large Array observations in April 2009 indicate an optically thin syncrotron spectrum with a spectral index of -0.8.

Multi-wavelength observations of high energy transients *(invited)*

J. McEnery (NASA/GSFC, U.S.A.)

Session 3: Non-transient e-VLBI observations

A suspected dark lens revealed with the e-EVN

Z. Paragi (JIVE), S. Frey (FÓMI, SGO), B. Campbell (JIVE) and A. Moor (Konkoly Observatory)

Ryan et al. (2008) reported the discovery of an optical arc with the HST, about 4 arcseconds away from the radio source FIRST J121839.7+295325. They investigated the possibility that the arc is gravitationally lensed by the FIRST source, and found this model viable. The lensing galaxy itself is optically unidentified, making this system a candidate dark lens. We carried out short e-EVN observations of FIRST J121839.7+295325 in January 2009, to see whether the radio emission is coming from AGN activity. The target was detected and showed a double structure, bringing in the new possibility that the radio source itself is lensed. Further e-EVN observations were carried out in March and April 2009 at 5 and 1.6 GHz, respectively. These results will be presented here.

Is an AGN at the center of the disk galaxy IC 2497 responsible for Hanny's Voorwerp?

H. Rampadarath (JIVE & Leiden University), M.A. Garrett (ASTRON), T. Muxlow (Jodrell Bank), Z. Paragi (JIVE), T. Osterloo (ASTRON), H. van Arkel, K. Schawinski (Yale University) and C. Lintott (University of Oxford)

In early 2008 Dutch school teacher, Hanny van Arkel, discovered one of the most bizarre objects discovered via the GalaxyZoo.org morphological census, SDSS J094103.80+344334.2. This object, now known as "Hanny's Voorwerp" appears as an irregular cloud located 15-25 kpc from the massive disk galaxy IC 2497. In the optical it is dominated by [O III] emission lines, and a WHT spectrum shows strong line emission, with high-ionization lines (He II, [Ne V]). With the aim of determining how the Voorwerp was formed, IC 2497 was observed by the e-VLBI along with WSRT and MERLIN. The e-VLBI, with a short 2hr observation at 18cm detected a compact radio source at the centre of IC 2497 which strongly suggests the existence of an AGN. With the additional observations from WSRT (1.4GHz, 4.9 GHz & 21 cm) and MERLIN (18cm), the data suggests that Hanny's Voorwerp is being photo-ionized by an AGN at the centre of IC 2497, a plasma jet clearing the path through the ISM/IGM towards the nebulosity.

e-VLBI observations of the ULX at M33

A. Trejo (UNAM), K. Ghosh (NASA), Z. Paragi (JIVE) and S. Fabrika (JIVE)

Some of the Ultraluminous X-Ray (ULX) sources have associated very weak radio counterparts. It has been a challenge to detect such emission, so far none of the ULXs have been detected on milliarcsecond scales. Observations with the very long baseline interferometry technique would be crucial to unveil the real nature of ULXs. One of the nearest ULXs is located very close to the center of M33. Here we give a progress report of our e-EVN monitoring programme of this ULX.

Spectral line applications using e-VLBI *(invited)*

A. Brunthaler (Max-Planck-Institut für Radioastronomie)

I will review possible spectral line applications using the capabilities of e-VLBI. I will also present a wish list of future developments which are required for selected projects from an observers point of view.

Session 4: Geodesy and astrometry

e-VLBI for geosciences *(invited)*

R. Haas (Chalmers University of Technology)

The application of VLBI in a geodetic mode is a very powerful tool for geosciences. Geodetic VLBI is the only geodetic space technique that is sensitive to both the terrestrial reference frame (TRF) and the celestial reference frame (CRF). It thus gives the complete transformation information between these two frames. This transformation is described by earth orientation and rotation parameters. These parameters are influenced by a variety of geodynamical phenomena that include periodic ones, e.g. tidal effects, but also episodic ones, e.g. sudden mass redistributions in connection with earthquakes. Accurate and precise observations of earth orientation and rotation variations are therefore an important basis to improve the understanding of the geodynamical phenomena behind these variations. Many of the episodic phenomena are not fully understood today, for example earthquakes, volcanic eruptions, or the reaction of the ocean to sudden and large atmospheric changes. The use of e-VLBI techniques in geodetic VLBI has the potential to address in particular such episodic geodynamic events. The e-VLBI techniques will allow short latency of the results, flexible and adaptive observing strategies, and accuracy improvements due to increased observed bandwidth. One example of e-VLBI applications for geodetic VLBI is the Fennoscandian-Japanese project for ultra-rapid UT1-observations. Within this project the earth rotation angle UT1 was successfully determined within 3.5 minutes after a one-hour long observing session. Some examples of targets for e-VLBI application for geosciences will be presented.

Numerical simulations on the optimal geodetic observing conditions with RADIOASTRON

E. Wei (School of Geodesy and Geomatics, Wuhan University), P. Zhou (School of Geodesy and Geomatics, Wuhan University) and J. Liu (GNSS Center, Wuhan University)

For all the three pillars of space geodesy(the geometry of the Earth surface and its displacements, the orientation of the Earth axis and its rotation speed, and the Earth's gravity field and its time variations), well-defined, highly accurate and stable global Earth-fixed and celestial reference frames are of primary importance. Over the last decade considerable changes took place in space geodesy: the accuracy of the space geodetic techniques has improved dramatically reaching now 10^{-9} for geometry, Earth rotation and the gravity field. Many new missions are being prepared, planned, or operational already. All these developments pose new and demanding challenges concerning the consistency and accuracy of the three pillars and thus better-defined, more accurate and stable global Earth-fixed and celestial reference frames are crucial to meet these challenges. As a new and rapidly developing technology, Space VLBI (SVLBI) has tremendous potentials in geodetic research. SVLBI can not only directly interconnect the above two reference frames, but also it can be used to avoid or examine the systematic errors made by the other juxtaposed multi-techniques. In this paper, SVLBI mathematical model with nutation parameters is discussed. Then, with the availability of the data from RADIOASTRON, simulations have been done. With the simulation results, the feasibility for estimation of EOPs has been researched, and the optimal number of stations and epochs to estimate the geodetic parameters have been analysed. Conclusions are drawn. And the implications for possible dedicated geodetic SVLBI missions in the future are discussed.

Multi-view e-VLBI

M.J. Rioja (UWA, ICRAR), R. Dodson (UWA, ICRAR), R.W. Porcas (MPIfR), J. Reynolds (CSIRO) and D. Ferris (CSIRO)

Multi-view VLBI presents important advantages for phase referencing and astrometric projects, and provides a very large field of view. We present its superior performance when applied to observations at low frequencies, to calibrate the ionospheric perturbances. Of particular interest is the synergy with the multi-field/multi-beam unique features of the innovative design for future instruments, and its application for joint e-VLBI observations with next generation radio telescopes.

Session 5: Transients II

Active stars and brown dwarfs *(invited)*

G. Hallinan (Galway University)

VLBI observations of active dwarf stars and tight binary systems have, in some cases, successfully resolved large scale coronal structures. For the former, coronal sizes up to several times the stellar size have been confirmed, while for the latter extended halo radio structures of similar size to the entire binary system are observed. Such observations have been key to constraining brightness temperatures for the associated radio emission and hence understanding the mechanism responsible. Future multi-frequency studies (Radio/X-ray/H-alpha/Zeeman Doppler Imaging) of both flare and quiescent stellar radio emission will be greatly assisted by the increased sensitivity and frequency coverage of e-VLBI. In particular the evolution in source size and spectral characteristics during and after flares will be studied. The advent of e-VLBI is also of great importance to the study of brown dwarfs, some of which have been found to produce periodic pulses of coherent radio emission in a similar fashion to pulsars. e-VLBI studies of previously detected tight binaries may clarify which components are producing radio emission, thereby providing clues to the physical characteristic associated with radio activity. The possibility also exists whereby both components in a tight binary system are detected, opening an exciting new observational window in VLBI. In this case, the superior astrometry and resolution offered by global e-VLBI can be used in ongoing dynamical mass measurement campaigns used to constrain current evolutionary models of brown dwarfs.

Microquasars & e-VLBI: made for each other? *(invited)*

V. Dhawan (NRAO)

Microquasars are laboratories for physics on many scales. I attempt to summarize where we stand, with a VLB bias. In the inner disk, relativistic effects are traced by Fe lines and KHz X-ray variability. This is also the jet launching region, tied to the larger corona, which exhibits $\sim$Hz variability and hard X-rays from Compton up-scattering of disk photons by relativistic electrons in the outflow. Compared to distant AGN, galactic binaries offer better prospects to view the matter content of jets, $\dot{M}$, B, distances, comparison with NS and CV (surface vs event horizon) etc. VLB resolution is essential to resolve jets from other synchrotron morphologies such as shells and pulsar wind nebulae. Moving outward, the jet impacts the interstellar medium which acts as calorimeter and densitometer - radio and X-ray emitting lobes have been imaged in a few cases, igniting months after the initial ejection. Low frequencies and low resolution are needed here. Playing to another VLB strength, astrometry on the radio cores gives proper motions, galactic orbits, and parallaxes of microquasars and pulsars, as well as their parent populations of massive star-forming regions. On the technical side, realtime VLBI is the right way to do transients. The first response should include a survey of reference sources. Widefield SKA pathfinders, software correlators, and transient surveys are on the horizon. These new arrays are key to removing the bottlenecks to rapid response on over-subscribed instruments. e-VLBI can go widefield with a hybrid approach, where the initial correlation keeps a disk archive with large FOV to be imaged to locate the transient.

The proper motion and changing jet morphology of Cygnus X-3 *(invited)*

J. Miller-Jones (NRAO), C. Sakari (Whitman College), V. Dhawan (NRAO), V. Tudose (ASTRON), R. Fender (University of Southampton) and Z. Paragi (JIVE)

Cygnus X-3 is a high-mass X-ray binary system which is continuously active in the radio band. With a typical flux density of 60-100 mJy at GHz frequencies, it occasionally undergoes giant outbursts when it brightens by up to two orders of magnitude and launches relativistic jets which are seen to evolve on timescales of days. The location of the core of the binary system has hitherto been uncertain, hindering the interpretation of the complex morphologies observed in VLBI observations of these jets. Using e-EVN and archival VLBA observations, we have measured the proper motion of this system, allowing us to place a lower limit on its peculiar velocity, and hence to derive constraints on the formation mechanism of the compact object. Furthermore, with an accurate position for the X-ray binary core, we are able to properly interpret the varying jet morphology seen in previous outbursts. We show that the observed position angle of the jets varies significantly between different outbursts, arguing for either jet precession or a jet aligned very close to the line of sight. This would make Cygnus X-3 the best example of a microblazar in our Galaxy.

Correlated radio/X-ray behaviour of Cyg X-3

V. Tudose (ASTRON), J. Miller-Jones (NRAO), R. Fender (SOTON), Z. Paragi (JIVE), A. Szostek (LAOG), C. Sakari (Whitman College), A. Rushton (JBO), M.A. Garrett (ASTRON), V. Dhawan (NRAO) and R. Spencer (JBO)

In order to test the recently proposed classification of the radio/X-ray states of the X-ray binary Cyg X-3, we present an analysis of the radio data available for the system at much higher spatial resolutions than used for defining the states. The radio data set consists of archival Very Large Baseline Array data at 5 or 15 GHz as well as new electronic European Very Long Baseline Interferometry Network data at 5 GHz. In the X-ray regime we use quasi-simultaneous with radio, monitoring and pointed Rossi X-ray Timing Explorer observations. We find that when the radio emission from both jet and core is globally considered, the behaviour of Cyg X-3 at milliarcsecond scales is consistent with that described at arcsecond scales. However, when the radio emission is disentangled in a core component and a jet component, it is hard to draw a confident conclusion. But it is clear that in active states the radio emission from the jet is dominating that from the core. This strongly suggests that any causal relation between the accretion state (as traced by the soft X-rays) and the radio emission in these states is spurious.

Variations within the compact jet from the black hole candidate GRS 1915+105

A. Rushton (Jodrell Bank Centre for Astrophysics), R. Spencer (Jodrell Bank Centre for Astrophysics) and R. Fender (University of Southampton)

High-resolution observations of the black hole candidate GRS 1915+105 have shown the radio emission to be dominated by a compact steady jet (< 20 mas), whilst in the low/hard state (e.g. Dhawan et al. 2000). We have found a close relationship between the X-ray and radio emission from the steady jet using the Ryle Telescope and RXTE-ASM. The relationship was fitted empirically using $S_{\mathrm{X-ray}} \propto S^{\xi}_{\mathrm{radio}}$, with a power-law index of $\xi \sim 1{,}7$. This suggests either a turn-over of the Gallo et al. (2003) universal XRB relationship; from a radiatively efficient to inefficient accretion disk or direct evidence of a variation in another fundamental parameter, e.g. accretion radius. This talk will discuss the X-ray/radio properties associated with the compact steady jet in GRS 1915+105.

Pulsars, e-VLBI and LEAP *(invited)*

M. Kramer (MPIfR)

LEAP, Large European Array for Pulsars is an ambitious project which aims to use large radio telescopes in Europe to directly detect gravitational waves. Recognising the need for a larger amount of collecting area to achieve the sensitivity required to do sufficiently high precision pulsar timing the project will coherently combine the signals of the telescopes to form a tied-array beam which can be used for high precision timing. This project can benefit greatly for the technologies being developed in the e-VLBI era. I will present the current project, the possibilities for improvement and how e-VLBI can also benifit pulsar astronomy in general.

Monitoring the variable radio sky with LOFAR *(invited)*

R. Fender (Southampton and Amsterdam University), B. Stappers (University of Manchester) and R. Wijers (University of Amsterdam on behalf of the LOFAR Transients Key Science Project)

In this presentation I will discuss the exciting prospects for semi-continuous monitoring of the entire northern hemisphere sky at radio wavelengths with LOFAR. I will outline the technical capabilities and proposed modes of LOFAR, as well as the software pipeline currently under development to automatically identify, report and classify transients, as well as trigger observations on other multi-messenger facilities.

Standards and systems for transient response *(invited)*

J. Swinbank (University of Amsterdam)

Across a variety of different wavelength regimes, new facilities are being planned or are under development which will discover transients at an unprecedented, and potentially overwhelming, rate. The next challenge will be to address this deluge of data. How can we classify the data, decide what is important, trigger appropriate follow-up observations – and do so quickly, and, where possible, with minimal human intervention? I will discuss some of the approaches the LOFAR Transients Key Science Project has been investigating to these issues, with an emphasis on the importance of adopting common standards.

Session 6: Regional and instrument reports

eEVN progress *(invited)*

A. Szomoru (JIVE)

e-VLBI activities in Japan: status and future plan of NICT part *(invited)*

M. Sekido (NICT, Kashima), Y. Koyama (NICT), K. Moritaka Kimura (NICT, Kashima), T. Kondo (NICT/Ajou University Korea), H. Takiguchi (NICT, Kashima), T. Hobiger (NICT), K. Kazuhiro Takefuji (NICT, Kashima), H. Harai (NICT), K. Takatoshi Ikeda (NICT/JGN2plus), S. Shimojo (NICT/JGN2plus) and H. Takeuchi (JAXA/ISAS)

VLBI group of NICT is playing a part of leading role of e-VLBI technology development in Japanese VLBI community. VLBI group and network research group inside NICT are closely collaborating for mutual benefits in both research areas. NICT Kashima 34m radio telescope is connected by 10Gbps network domestically and 1Gbit internationally. Some of the recent progresses with e-VLBI technology are as follows: NICT's K5/VSSP software correlator has been utilized for ultra-rapid UT1 experiment under the collaboration with Onsala, Metsähovi, and Tsukuba. UT1 measurement within 5 min. after the observation has been successfully realized as the fastest record ever achieved. Implementation of that quick data processing scheme to regular UT1 VLBI observation is being prepared. A software correlation system for VERA project of NAOJ has been developed with NICT's high speed software correlator GICO-3. A Mark5B emulator system has been developed with K5/VSI DAS and participation to the first realtime e-VLBI observations have been realized with Australia and JIVE in 2008-2009. Development status of digital BBC backend system ADS3000+ will be presented as well. As a short term target of our e-VLBI project, adoption of newly proposed international standard VLBI data Interchange format (VDIF) is being prepared. This report will present a half of Japanese e-VLBI activities related with NICT. Other half will be given in presentation by Prof. Kawaguchi of NAOJ, who is connecting domestic radio telescopes with research network SINET3.

e-VLBI progress in Australia *(invited)*

T. Tzioumis (ATNF, CSIRO)

The Australian VLBI community has played a critical role in e-VLBI developments not only locally on the Long Baseline Array (LBA) but also regionally in the Asia-Pacific and internationally via the EXPReS project. e-VLBI developments are also a strategic activity in the development of technologies for the SKA. And e-VLBI capabilities are now open to user proposals on the LBA. The current status and progress of e-VLBI in Australia will be given, as well as an outline of future plans.

Chinese VLBI network and its application to e-VLBI *(invited)*

Z. Chen (Shanghai astronomical observatory)

NRAO VLBA upgrade plans & prospects *(invited)*

V. Dhawan (NRAO, Socorro)

The VLBA is heavily invested in disk recording and will continue to operate in that mode in the near future. The scientific needs of the majority of users are well met by this mode of operation, and changeover to fiber would be dictated by overall cost reduction rather than a perceived need for real-time correlation. However, the enhancements under way are real-time compatible. I will provide an update on NRAO activities in areas such as: * New receivers, digital backends, and expansion of recording bandwidth to 1 Gbps, 4 & beyond. * The transition to software correlation and new capabilities. * Experiments with spacecraft astrometry which might provide the incentive for real-time connectivity, and, if there is time/interest, * EVLA update (roughly, <= 1mJy, 5-sigma, in 1 s, over 10 GHz).

Current status of Korean VLBI Network and future plan for e-VLBI *(invited)*

B. W. Sohn (Korea Astronomy and Space Science Institute)

Progress and status of eMERLIN *(invited)*

R. Spencer (University of Manchester)

The upgraded MERLIN array of telescopes (eMERLIN) run by The University of Manchester at Jodrell Bank Observatory is nearing completion with operation expected in early 2010. The correlator, being built by NRC is crucial to the performance of the instruments. Station boards and a baseline (correlator) have been delivered. Signal paths have been tested - with an autocorrelation spectrum being obtained in April, and fringes expected soon. I will report on the current progress, and comment on some of the design features, in particular on the interface to VLBI.

The future of e-VLBI *(invited)*

H. J. van Langevelde (JIVE)

In this paper I will discuss the future of VLBI and the role of e-VLBI in this vision. The scientific ambitions of the EVN are described in the EVN2015 science vision. I will review the scientific case for long baselines interferometry in the next decade, and the synergy with the SKA and its pathfinders. Building on the experiences with e-VLBI, there are options to enhance the sensitivity and operational efficiency of the EVN and global VLBI arrays. JIVE is developing options for a correlator that is capable of dealing with these much larger data streams. Even beyond that the science case calls for high frequency capabilities and much more telescope elements in order to revolutionize the imaging capabilities beyond those of the existing VLBI arrays. The roadmap for implementing this will be discussed, including the options to follow-up the successful EXPReS project.

Session 7: NREN meeting

Future prospects for GEANT *(invited)*

J. Chevers (DANTE)

Connecting telescopes "Down-Under": The Australian research and education network

S. Amy (CSIRO, Australia Telescope National Facility)

The Australian Academic and Research Network (AARNet) provides research and education network infrastructure and services for Australia. This presentation will give an overview of the current network and outline development plans to grow the network in the coming years. The current and projected use of this network for radio astronomy applications will also be discussed with an emphasis on e-VLBI and the role this plays in developing technologies for the next generation of radio telescopes.

The network infrastructure for radioastronomy in Italy

M. Nanni (INAF-Istituto di Radioastronomia), G. Maccaferri (INAF-Istituto di Radioastronomia) and F. Mantovani (INAF-Istituto di Radioastronomia)

The participation to the EC funded EXPReS project, the agreement with Garr, the Italian NREN, and the agreement with Lepida (the Emilia-Romagna Region e-government network), made it possible to set up an efficient optical fiber network for the italian radioastronomy. The Medicina 32-m dish is now an active member of e-EVN community. We will analyze the progresses made since the radio telescope was connected to the regional and GARR backbones in terms of speed in data transmission. We will also present the future plan of the Garr-X network and the opportunities foreseen to connect the Noto 32-m dish and the Sardinia 64-m Radio Telescope to the JIVE hardware correlator and to the Instituto di Radioastronomia DiFX software correlator.

Regular e-transfer experiences for geodetic INTENSIVE experiments at Wettzell

G. Kronschnabl (Geodetic Obs. Wettzell), A. Neidhardt (Techn. Univ. Munich) and C. Plötz (Geodetic Obs. Wettzell)

Since several years the Geodetic Observatory Wettzell participates to the daily one-hour INTENSIVE-sessions (INT) in order to determine UT1-UTC in addition to the 24h-sessions. The INT1 sessions are observed together with Kokee Park Observatory every weekday and are correlated at Washington Correlator (WASH). On Saturday and Sunday RTW is engaged for the INT2/K sessions together with Tsukuba/Japan which are correlated at Japan and on Monday morning INT3/K completes the intensive observations in the network of Wettzell, Tsukuba and Ny Alesund, which are correlated at Bonn. For all of the experiments e-transfer is used to ship the data over standard internet connections to the correlators or dedicated data centers in near real time. Wettzell itself routinely uses the increased internet-connection of 622 Mbit/sec for that e-transfers. Wettzell made good experiences with it and all of these efforts reduces the delay times from the observation over the correlation to the final geodetic data product.

Experience gained from provisioning and using a 4 Gigabit trans-European link from Onsala to Jodrell Bank

R. Hughes-Jones (DANTE), A. Rushton (JBO), J. Hargreaves (JBO) and S. Casey (Onsala Space Observatory)

This talk will describe design and implementation of the 4 Gigabit lightpath that has been established between Jodrell Bank in the UK and Onsala in Sweden. This network path was provisioned as part of the FABRIC research activity of the EU EXPReS project and involved the help and close collaboration of DANTE, JANET, NORDUnet and SUNET. The talk will describe the measured performance of multi-gigabit UDP and TCP flows over this trans-European link and the steps required to overcome some of the current limitations in the network hardware. The talk will also describe the design, implementation and operation of the iNetTest unit, a network test device constructed from the iBoB. The iNetTest units have been used to test the 4 Gigabit link, throughput, packet loss, packet jitter, and long term stability measurements will be reported together with a comparison of PC based measurements.

Session 8: e-VLBI techniques

e-VLBI networking tricks

P. Boven (JIVE)

e-VLBI is only possible because we have access to long distance, high performance networks - straight from the radio telescopes into JIVE. This presentation will discuss what we've learned in the EXPReS project about how to make the best use of these networks. Topics include the importance of packet spacing, use of multicast, surprises with trunked paths, and lightpath debugging.

GPU-channelised e-VLBI. A more efficient approach

R. Dodson (UWA, ICRAR), D. Ferris (CSIRO) and C. Phillips (CSIRO, ATNF)

We will present an approach to e-VLBI in which the channelisation and fringe rotation is done at the antennae, on a GPU. This allows a number of the processing steps to be done with a high number of bits per sample, before encoding for transport over the bandwidth limited e-VLBI data pipe. Thereby reducing the digitisation losses.

e-control: new concepts for remote control of VLBI-telescopes and first experiences at Wettzell

C. Plötz (Bundesamt für Kartographie und Geodäsie, Geodätisches Observatorium Wettzell), A. Neidhardt (Forschungseinrichtung Satellitengeodäsie, Technische Universität München, Geodätisches Observatorium Wettzell), M. Ettl (Forschungseinrichtung Satellitengeodäsie, Technische Universität München, Geodätisches Observatorium Wettzell) and H. Hase (TIGO/BKG)

The requirements for VLBI systems increase. A higher observation density, real-time access for more variable schedules, highly automated observations and remote control of complete sites for example require new add-ons for the controlling software. To improve this situation (semi-) autonomous, remote accessible control systems will become more and more reality and offer reliable, safe and modular structures from upper controlling layers down to the basic single components. An extension to the current fieldsystem with remotely accessible, autonomous process cells is the first approach at the Geodetic Observatory Wettzell. It set up on the specially designed and at Wettzell developed middleware generator "idl2rpc.pl" to generate the remote C++- interfaces. Modern graphical user interfaces in combination with a first adapter to the fieldsystem as extension show the possibilities to control radio telescopes remotely. Within first successful remote control and attendance tests with regular observations of the telescopes at O'Higgins, Concepción and Wettzell the already implemented extensions were already tested in the global communication network.

e-VLBI developments on the LBA

C. Phillips (CSIRO, ATNF)

e-VLBI has continued to progress with the LBA. The Hobart antenna is now included regularly as part of the array, in a mixed rate mode. e-VLBI correlation at 1 Gbps using a cluster at the Curtin University of Technology has been demonstrated and Curtin has also supplied second cluster for ATCA (additional to the existing cluster at Parkes) to allow distributed correlation at 1 Gbps. An initial VDIF sample implementation for the LBADR recorder has been developed.

Connecting iBOBs to the eMerlin correlator

J. Hargreaves (Jodrell Bank Observatory)

This talk will describe the hardware - cables and connectors - used to import and export data from the eMerlin correlator via iBOBs. Correlator FPGA configurations used to process data from local antennas will compared to the configurations for the import and export cases.

European 4-Gbps VLBI and e-VLBI

J. Ritakari (Metsähovi Radio Observatory), J. Wagner (Metsähovi Radio Observatory), G. Molera Calvés (Metsähovi Radio Observatory) and A. Mujunen (Metsähovi Radio Observatory)

I will describe the European possibilities for four-Gbps VLBI and e-VLBI, emphasis on equipment and methods that are available now. There will also be some discussion about the capabilities and limitations of the networks and DBEs or DBBCs.

Session 9: VDIF session

Introduction to VDIF and VTP *(invited)*

A. Whitney (MIT Haystack Observatory)

A proposal for defining the VLBI application transport header

R. Hughes-Jones (DANTE)

This talk will propose ideas for defining the application transport header that will be required for moving VLBI data as defined in the "VLBI Data Interchange Format (VDIF) Specification", as proposed by the VDIF Task Force. The talk will consider moving VDIF data with 3 different network transport protocols: UDP/IP, TCP/IP, and raw frames e.g. Raw Ethernet or proprietary framing. It is hoped that this talk would briefly outline the requirements and thus form a basis for discussion.

Session 10: Software and distributed correlation

Performance testing of the DiFX correlator

C. Phillips (CSIRO, ATNF)

The DiFX software correlator is used for all LBA operational disk and e-VLBI correlation and is being actively developed for use at NRAO and Bonn and other institutes. A benchmarking approach using fake e-VLBI data has been developed to test how well DiFX performance and scales across a multinode cluster. This approach eliminates disk i/o as a bottle neck in the performance testing.

e-VLBI with the SFXC software correlator

M. Kettenis (JIVE), A. Keimpema (JIVE), D. Small (JIVE), D. Marchal (University of Amsterdam) and M. Sipior (JIVE)

The SFXC software correlator developed at JIVE has reached a state of maturity where we're concentrating on optimization and testing on "real-world" data sets. In this context, distribution of sampled data is an important issue. I'll discuss an approach that makes use of existing Grid middleware suitable for near-realtime correlation that can potentially be distributed over multiple clusters. I'll also discuss an entirely different approach, more suitable for real-time correlation where data is streamed directly into a cluster using the GEANT2 AutoBAHN and Internet2 DCN infrastructure.

The latest tests of the SFXC software correlator

Y. Pidopryhora (JIVE), A. Keimpema (JIVE) and M. Kettenis (JIVE)

Recently a number of improvements were made to the SFXC software correlator developed within the EXPReS FABRIC research activity. It has been tested by processing data from an actual VLBI experiment. We are presenting an analysis of these tests, including a comparison of accuracy with the EVN MkIV hardware correlator at JIVE.

User interaction and workflow management in Grid enabled e-VLBI experiments

D. Stoklosa (PSNCT), Rajtar (PSNCD), Kaliszan (PSNCM), Lawenda (PSNCN), Meyer (PSNCM) and Stroinski (PSNC)

The purpose of this presentation is to show the way workflows are managed in the radio-astronomical VLBI experiments with the support of Grid environment. The current status of VLBI process is described briefly, and the main part of this document presents the architecture of e-VLBI system, which integrates astronomical VLBI experiments with the Grid environment. The e-VLBI system has been created within EXPReS project (http://www.expres-eu.org/).

Session 11: The future of networks and VLBI science

Ja-Net prospects *(invited)*

D. Salmon (JANET)

Application driven petabit optical networking *(invited)*

I. Andonovic (Strathclyde University), I. Glesk (Strathclyde University), C. Michie (Strathclyde University), D. Simeonidou (Essex University), I. Henning (Essex University), D. Hunter (Essex University), R. Nejabati (Essex University), R. Spencer (JBO) and S. Garrington (JBO)

Optical networking based on Dense Wavelength Division Multiplexing (DWDM) has been the platform which has satisfied most applications but a new bread of sophisticated users e.g. within the scientific community are driving solutions beyond evolution strategies provided by the traditional telecommunications sector. Current commercial DWDM systems are based on a 10Gbit/s rates, with manufacturers beginning to install 40Gbit/s transmission technologies. These systems are upgraded through energising additional wavelengths but are difficult to scale due to limitations in the total number of wavelengths that can be managed easily. Ethernet-based technologies are presently the subject of development by industry pushing transmission rates beyond 100Gbit/s but a range of technology constraints will have to be overcome to reach the 1TbE milestone. Optical Time Division Multiplexing (OTDM) is a proven route to providing ultra high per channel data rates which can inherently scale beyond 100Gbit/s, making more efficient use of the available optical fibre capacity and with suitable management protocols, can allocate capacity dynamically to applications. Although various coherent and multilevel data coding schemes have demonstrated high bit rates, they fail to offer the bandwidth granularity required by applications. The presentation will summarise the state-of-the-art in optical networking and introduce an OTDM platform that meets the requirements of future user intensive applications. The approach enables user driven, highly scalable, flexible, granular platforms which can operate well beyond 100Gbit/s whilst supporting a heterogeneous mix of bandwidth intensive applications.

Long baselines in the Square Kilometre Array *(invited)*

R. McCool (SKA Programme Development Office)

The Square Kilometre Array (SKA) is an international programme dedicated to the construction of a radio interferometer with unprecedented sensitivity. It will be an extremely powerful survey telescope with the capability to follow up individual objects with high angular and time resolution. The telescope will be made up of thousands of elements and will be distributed across an area extending to thousands of kilometres. This paper will look at the science cases that drive the requirements for long baselines in the SKA. It will discuss in detail the data networking requirements and challenges for these long baselines and describe possible implementation strategies.

Advances in Optical Networking Technologies Transmission and Switching Techniques for Tb/s of Optical Data *(invited)*

J.-P. Hemingway (Ciena Ltd)

Optical Networking has evolved rapidly in recent years to keep apace with the every increasing thirst for bandwidth consumption. Nowhere is this more evident than in the field for e-Science, Distributed Computing and Research. As the need for Service Lightpaths of GbE to 10GbE have become commonplace then the natural evolution for the optical carrier wavelength has been towards 40Gb/s and 100Gb/s. This presentation will review the techniques that have evolved to develop optical transmission systems capable of 8Tb/s and beyond, including the modulation approaches to enable wavelengths at both 40Gb/s and 100Gb/s. In addition, optical networks require high-speed elements that can provision, (re)direct and groom lightpaths and the approaches for both all-optical (OO) and electrical-optical (OEO) switching will be discussed.

Abstracts of poster contributions

e-VLBI technique in radio network "Quasar"

I. Bezrukov (IAA RAS), M. Kaydanovsky (IAA RAS), A. Mikhailov (IAA RAS) and A. Salnikov (IAA RAS)

The development of technical facilities in Russia makes it possible to apply the e-VLBI technique in radio network "Quasar". Some experiments have been made on the translation of intensive sessions of UT1 data from Badary and Zelentchuk observatories to the center of correlational data processing in the Saint-Petersburg Institute of Applied Astronomy, Russian Academy of Science. Intensive session of 40GB in volume has been transmitted at 50 Mbps via shared networks using Tsunami-udp protocol. The regime of real-time e-VLBI has been used, in which the observation data UT1 recorded by Mark5B are transmitted to the buffer server, within the time of antenna pointing from one source to another. The data obtained allow one to draw a conclusion on the possible organization of e-VLBI technique via shares networks.

Near real-time UT1 estimation using e-VLBI

K.J. Johnston (U.S. Naval Observatory), D.A. Boboltz (U.S. Naval Observatory), A.L. Fey (U.S. Naval Observatory), K.A. Kingham (U.S. Naval Observatory), R. Ojha (U.S. Naval Observatory) and R. Gaume (U.S. Naval Observatory)

The U.S. Naval Observatory routinely schedules, correlates and analyzes dedicated VLBI observations to estimate the UT1 component of Earth Orientation Parameters. The possibility of near real-time transfer of VLBI data over optical fiber networks to the Washington Correlator will drastically reduce the latency of UT1 estimation (which is now about 2-3 days due to conventional shipping) and increase the usefulness of these measurements. We discuss general plans for implementation of e-VLBI at the Naval Observatory with emphasis on use of the DiFX software correlator.

SFXC: A distributed software correlator for VLBI

A. Keimpema, Y. Pidopryhora and M. Kettenis (JIVE)

SFXC is a distributed software correlator currently under development at JIVE within the FABRIC and SCARIe projects. Currently SFXC is capable to produce accurate results similar to the EVN hardware correlator at JIVE. Furthermore a first image has successfully been produced. Current efforts are focused on the optimization of the correlation algorithm.

e-VLBI activities at Tsukuba 32m station and correlation center

K. Kokado, S. Kurihara and K. Takashima (Geographical Survey Institute-GSI)

Tsukuba 32m VLBI station of Geographical Survey Institute(GSI) has been operational for more than ten years. For the decade, we have improved the observation system for advancement of VLBI observation, such as introduction of remote control system for local stations (Aira, Chichijima, Shintotsukawa) and data transfer system via high-speed network. These improvement enabled us to significantly increase the number of sessions to which Tsukuba 32m station participates. We has also participated in ultra-rapid dUT1 experiment, and we succeeded to obtain UT1 result within 4 minutes after end of the observing session with Onsala on February 21st, 2008. GSI is also operating the Tsukuba VLBI correlation center to process the data of domestic and international VLBI sessions. We installed the K5/VSSP correlation system and developed an application software "PARNASSUS"which enable us comprehensively handling distributed correlation. Now we make effort to introduce auto data transfer and correlation system for INT2 session.

e-VLBI related activities at the Onsala Space Observatory

M. Lindqvist (Onsala Space Observatory), S. Casey (Onsala Space Observatory), J. Conway (Onsala Space Observatory), R. Haas (Onsala Space Observatory), R. Hammargren (Onsala Space Observatory) and J. Johansson (Onsala Space Observatory)

During the last years Onsala has played a major role in the testing of real-time e-VLBI in both the astronomical and space geodesy communities. Current progress and future directions will be presented.

VLBI calibrator density at the milli-Jansky level

W. Majid (JPL/Caltech) and E. Fomalont (NRAO)

With the advent of high speed and high bandwidth recorders, the VLBI community is now in a position to further improve astrometric measurements by taking advantage of fainter calibrators that are closer in angular position to the targets of interest. Over the past two years, we have carried out a high frequency VLBA survey of a complete sample of radio sources with flux densities above 10 mJy. One of the main goals of these observations is to determine the fraction of radio sources which have sufficiently compact emission for use as calibrators for VLBI observations. We will discuss our results and future VLBA observations, currently being planned.

Development of real-time Giga-bit geodesy e-VLBI using Super-SINET

H. Takaba (Gifu University) and e-VLBI team in Japan

We paper report the development of a gigabit real-time e-VLBI geodetic system. For an experiment using the Super-Sinet of the National Institute of Informatics, the 32-m telescope at the Geographical Survey Institute in Tsukuba City, the National Astronomical Observatory of Japan in Mitaka City, and the 11-m telescope at Gifu University were connected using a 2.4Gbps optical line. By two-way transmission through the optical line, S/X band data was transmitted by uplink and downlink at 2Gbps. Their distributed correlation processing by the correlators at the National Astronomical Observatory of Japan and Gifu University realized the world's fastest real-time geodesy e-VLBI at 4Gbps.

Fundamental research about the space-time information certification using VLBI correlation technique

K.Takashima (Geographical Survey Institute-GSI), R. Ichikawa (National Institute of Information and Communications Technology-NICT), F. Takahashi (Yokohama National university) and T. Otsubo (Hitotsubashi university Yasuhiro)

We have a plan to develop the techniques for validating the position and time information of users with the demanded accuracy. NICT already developed APPS and position validation test servers with mm accuracy for advanced users. The main target of this research is to generalize this system for the user who does not need high accuracy. In addition, the system will be able to validate not only position information but also time one (4-D validation). The user terminal with GPS chip and digital TV tuner should send GPS position information and sampling data of digital TV carrier to a certificate center. In the certificate center, the sampling data of digital TV carrier should be recorded simultaneously and be correlated with the user's data. We can detect a fringe using the user position information as apriori value if the position is correct. In this case, we will give the certification to this user. The focus of this research is the development of e-VLBI technique using digital TV carrier.

Looking for fringes from the Irbene 32 m radio telescope

I. Smelds (Ventspils International Radio Astronomy Center) and E. Pazderski (Torun Centre for Astronomy)

The VLBI fringe test on the baseline Irbene (Latvia, near Ventspils) is described. The history of first VLBI equipment tests and current status of the antenna as the plans for near future are also given. There were several trials, to get fringes from Irbene 32 m telescope mainly with EVN telescopes in order to add Irbene 32 m antenna to the VLBI network. Coherence test was done on 17-19 August 2006, then the first Irbene-Torun fringe test was made on 17-19 November 2006, using 12 GHz receivers. Data correlation done at JIVE did not bring fringes detection. The next attempt was made during the regular EVN VLBI February 2009 session. Unfortunately the test also failed supposedly because of DBBC problems. The test on baseline Torun â Irbene is planned for the end of May 2009. The results will be described in our contribution. This time 5 GHz receivers will be used. After checking diskpack operation we hope to check our ability to participate in the e-VLBI sessions too, using Irbene 1Gbps link.

Analysis of the length of day with 2008-2009 VLBI observations

E. Wei (School of Geodesy and Geomatics, Wuhan University, China), X. Tian (School of Geodesy and Geomatics, Wuhan University, China) and R. Zhang (School of Geodesy and Geomatics, Wuhan University, China)

The variation of the earth rotation is so complex that the observation and research on it have always been the important subjects for the geo-scientists and astronomers to work on. The characters and periods of the variation of earth rotation have been studied on by some scholars using a variety of observation data, which makes people know more about the earth rotation. With the appearance of space technology such as VLBI, SLR,etc., and also, with the improvement of accuracy, more and more long-term earth rotation information with high precision are acquired. It is of great importance to analyze the variation of earth rotation with these high-precision data. The variation of the earth rotation is usually expressed as changes in length of day (LOD). The faster the earth rotation speed, the shorter LOD, otherwise LOD will be longer. In this paper, with the VLBI data in NGS format observed during 2008.1-2009.3 and relevant software, the information about LOD is required. Compared with the information of LOD downloaded from ivs network, the difference is analysed. At the same time, the curve map is made with 2001-2009 VLBI data to analyze the periods of earth rotation, with which the seasonal changes and changes in short-cycle are present and analyzed. At last, the factors that possibly cause the changes of LOD are analyzed.

Scientific Organizing Committee

⋆ John Conway, Onsala Space Observatory (Sweden)

⋆ Ralph Spencer, Jodrell Bank Centre for Astrophysics (UK)

Rob Fender, Southampton University (UK)

Mike Garrett, ASTRON (The Netherlands)

Alexander J. van der Horst, NASA/MSFC/ORAU (USA)

Rüdiger Haas, Onsala Space Observatory (Sweden)

Richard Hughes-Jones, DANTE (UK)

Huib Jan van Langevelde, JIVE (The Netherlands)

James Miller-Jones, NRAO (USA)

Zsolt Paragi, JIVE (Netherlands)

Miguel Pérez-Tores, IAA-CSIC (Spain)

Chris Phillips, CSIRO (Australia)

Mamoru Sekido, KSRC/NICT (Japan)

Arpad Szomoru, JIVE (Netherlands)

Steven Tingay, Curtin University of Technology (Australia)

Tasso Tzioumis, CSIRO (Australia)

Pablo de Vicente, OAN-IGN (Spain)

Alan Whitney, Haystack Observatory, MIT (USA)

Local Organizing Committee

⋆ Francisco Colomer, CNIG-IGN (Spain)

Laura Barbas, OAN-IGN (Spain)

Jean-François Desmurs, OAN-IGN (Spain)

Yvonne Kool, JIVE (The Netherlands)

Rebeca Soria-Ruiz, OAN-IGN (Spain)

Charles Yun, JIVE (The Netherlands)

⋆ *Committee chairs*

Registered participants

Name	Surname	Institute	Country	email
Shaun	Amy	CSIRO ATNF	Australia	Shaun.Amy@csiro.au
Tao	An	Shanghai Astronomical Observatory	China	antao@shao.ac.cn
Ivan	Andonovic	Strathclyde University	U.K	i.andonovic@eee.strath.ac.uk.
Rafael	Bachiller	Observatorio Astronómico Nacional	Spain	r.bachiller@oan.es
Laura	Barbas Calvo	OAN	Spain	l.barbas@oan.es
Ilya	Bezrukov	Institute of Applied Astronomy Russian Academy of Science	Russia	bezrukov@ipa.rssi.ru
Paul	Boven	JIVE	Netherlands	boven@jive.nl
Andreas	Brunthaler	Max-Planck-Institut für Radioastronomie	Germany	brunthal@mpifr-bonn.mpg.de
Valentín	Bujarrabal	Observatorio Astronómico Nacional	Spain	v.bujarrabal@oan.es
Paul	Burgess	Jodrell Bank Observatory Univ. Manchester	U.K.	paul.burgess@manchester.ac.uk
Bob	Campbell	JIVE	Netherlands	campbell@jive.nl
Simon	Casey	Onsala Space Observatory	Sweden	simon.casey@chalmers.se
Patrick	Charlot	Lab. d'Astrophysique de Bordeaux	France	charlot@obs.u-bordeaux1.fr
Zhong	Chen	Shanghai Astronomical Observatory	China	chenzhong@shao.ac.cn
John	Chevers	DANTE	U.K.	john@dante.net
Francisco	Colomer	Observatorio Astronómico Nacional	Spain	f.colomer@oan.es
John	Conway	Onsala Space Observatory	Sweden	John.Conway@chalmers.se
Pablo	de Vicente	OAN	Spain	p.devicente@oan.es
Jean-François	Desmurs	OAN	Spain	desmurs@oan.es
Vivek	Dhawan	NRAO	U.S.A.	vdhawan@aoc.nrao.edu
Richard	Dodson	University of Western Australia	Australia	richard.dodson@uwa.edu.au

Name	Surname	Institute	Country	email
Bob	Eldering	JIVE	Netherlands	eldering@jive.nl
Rob	Fender	University of Southampton	U.K.	r.fender@soton.ac.uk
Alan	Fey	U.S. Naval Observatory	U.S.A.	afey@usno.navy.mil
Jesús	Gómez González	Instituto Geográfico Nacional	Spain	jggonzalez@fomento.es
Cristina	Garcia-Miro	Madrid Deep Space Communication Complex NASA/INSA	Spain	cgmiro@mdscc.nasa.gov
Michael	Garrett	ASTRON/Leiden	Netherlands	garrett@astron.nl
C. Guillermo	Giménez de Castro	Univ. Presbiteriana Mackenzie	Brazil	guigue@craam.mackenzie.br
Rüdiger	Haas	Chalmers University of Technology	Sweden	rudiger.hass@chalmers.se
Gregg	Hallinan	National University of Ireland Galway	Ireland	greg@it.nuigalway.ie
Jonathan	Hargreaves	Jodrell Bank Observatory	U.K.	jh@jb.man.ac.uk
John-Paul	Hemingway	Ciena Ltd	U.K.	jphemin@ciena.com
Ed	Himwich	NASA/GSFC/NVI	U.S.A.	Ed.Himwich@nasa.gov
Russ	Hobby	Internet2	U.S.A.	rdhobby@internet2.edu
Richard	Hughes-Jones	DANTE	U.K.	Richard.Hughes-Jones@dante.org.uk
Kenneth	Johnston	US Naval Observatory	U.S.A.	kjj@usno.navy.mil
Aard	Keimpema	Joint Institute for VLBI in Europe	Netherlands	keimpema@jive.nl
Mark	Kettenis	Joint Institute for VLBI in Europe	Netherlands	kettenis@jive.nl
Kensuke	Kokado	Geographical Survey Institute, Japan	Japan	kokado@gsi.go.jp
Yvonne	Kool	JIVE	Netherlands	kool@jive.nl
Gerhard	Kronschnabl	Geodaetisches Observatorium Wettzell	Germany	Kronschnabl@fs.wettzell.de
Michael	Lindqvist	Onsala Space Observatory	Sweden	Michael.Lindqvist@chalmers.se
Walid	Majid	JPL/Caltech	U.S.A.	walid.a.majid@jpl.nasa.gov
Franco	Mantovani	Istituto di Radioastronomia	Italy	fmantovani@ira.inaf.it
Andre	Marins	RNP (Rede Nac. de Ensino e Pesquisa)	Brazil	amarins@rnp.br
Roshene	McCool	SKA Program Development Office	U.K.	mccool@skatelescope.org
Julie	McEnery	NASA/GSFC	U.S.A.	julie.mcenery@nasa.gov
James	Miller-Jones	NRAO, Charlottesville	U.S.A.	jmiller@nrao.edu
Guifré	Molera Calvés	Metsähovi Radio Observatory TKK	Finland	gofrito@kurp.hut.fi
Esther	Moll	Madrid Deep Space Communication Complex NASA-INSA	Spain	emoll@mdscc.nasa.gov
Arno	Mueskens	IGG University of Bonn	Germany	mueskens@mpifr.de
Mauro	Nanni	INAF-Istituto di Radioastronomia	Italy	nanni@ira.inaf.it
Tim	O'Brien	Jodrell Bank Centre for Astrophysics University of Manchester	U.K.	tim.obrien@manchester.ac.uk

Name	Surname	Institute	Country	email
Zsolt	Paragi	JIVE	Netherlands	zparagi@jive.nl
Eugeniusz	Pazderski	Torun Centre for Astronomy	Poland	ep@astro.uni.torun.pl
Miguel	Pérez Torres	Instituto de Astrofísica de Andalucía CSIC	Spain	torres@iaa.es
Chris	Phillips	CSIRO ATNF	Australia	Chris.Phillips@csiro.au
Yurii	Pidopryhora	JIVE	Netherlands	pidopryhora@jive.nl
Christian	Plötz	Bundesamt fuer Kartographie und Geodaesie (BKG)	Germany	ploetz@fs.wettzell.de
Antonis	Polatidis	Stichting ASTRON	Netherlands	polatidis@astron.nl
Richard	Porcas	Max-Planck-Institut Radioastronomie	Germany	porcas@mpifr-bonn.mpg.de
Jonathan	Quick	Hartebeesthoek Radio Astronomy Observatory	South Africa	jon@hartrao.ac.za
Hayden	Rampadarath	Joint Institute for VLBI in Europe & Leiden Observatory	Netherlands	haydenrampadarath@gmail.com
Cormac	Reynolds	Curtin University of Technology	Australia	c.reynolds@curtin.edu.au
Maria	Rioja	University of Western Australia	Australia	maria.rioja@uwa.edu.au
Anthony	Rushton	Jodrell Bank centre for astrophysics	U.K.	anthony.p.rushton@googlemail.com
Chester	Ruszczyk	MIT Haystack Observatory	U.S.A.	chester@haystack.mit.edu
David	Salmon	JANET(UK)	U.K.	David.Salmon@ja.net
Alexander	Salnikov	Institute of Applied Astronomy Russian Academy of Sciences	Russia	ais@ipa.nw.ru
Des	Small	JIVE	Netherlands	small@jive.nl
Ivars	Smelds	Ventspils International Radio Astronomy Center (VIRAC)	Latvia	ivarss@venta.lv
Bong Won	Sohn	Korea Astronomy and Space Science Institute	South Korea	bwsohn@kasi.re.kr
Rebeca	Soria-Ruiz	Observatorio Astronómico Nacional	Spain	r.soria@oan.es
Ralph	Spencer	The University of Manchester	U.K.	res@jb.man.ac.uk
Benjamin	Stappers	JBCA, University of Manchester	U.K.	Ben.Stappers@manchester.ac.uk
Dominik	Stoklosa	PSNC	Poland	osa@man.poznan.pl
John	Swinbank	Astronomical Inst. “Anton Pannekoek” University of Amsterdam	Netherlands	swinbank@transientskp.org
Arpad	Szomoru	Joint Institute for VLBI in Europe	Netherlands	szomoru@jive.nl
Hiroshi	Takaba	Gifu University	Japan	takaba@gifu-u.ac.jp
Kazuhiro	Takashima	Geographical Survey Institute	Japan	takasima@gsi.go.jp

Name	Surname	Institute	Country	email
Xiaojing	Tian	School of Geodesy and Geomatics Wuhan University	China	tianxiaojinglove@163.com
Alfonso	Trejo-Cruz	Univ. Nac. Autónoma de México	México	a.trejo@crya.unam.mx
Valeriu	Tudose	ASTRON	Netherlands	tudose@astron.nl
Tasso	Tzioumis	ATNF CSIRO	Australia	tasso.tzioumis@csiro.au
Alexander	van der Horst	NASA/MSFC/ORAU	U.S.A.	Alexander.J.VanDerHorst@nasa.gov
Huib	van Langevelde	JIVE	Netherlands	langevelde@jive.nl
Tiziana	Venturi	INAF, Istituto di Radioastronomia	Italy	tventuri@ira.inaf.it
Harro	Verkouter	JIVE	Netherlands	verkouter@jive.nl
Erhu	Wei	School of Geodesy and Geomatics Wuhan University	China	ehwei@sgg.whu.edu.cn
Alan	Whitney	MIT Haystack Observatory	U.S.A.	awhitney@haystack.mit.edu

List of authors