Press Release

The sharpest view in the Universe – live at long last!

Faster, deeper, sharper: thanks to GÉANT, Europe's radio-astronomers can now observe transient objects at the edge of the Universe.

Cambridge, 27 January 2004 – For the first time, astronomers led by JIVE, the European Joint Institute for Very Long Baseline Interferometry, used GÉANT, the world's most advanced international research network, to combine data from radio telescopes in the UK, Sweden and the Netherlands, generating images of a jet of gas moving at nearly the speed of light close to the edge of the visible Universe.

Thanks to GÉANT's bandwidth, Europe's astronomers got the image they were looking for in hours, rather than months. Without GÉANT, they would have had to wait for up to six months to see the result of their labours. And would have missed most of the show anyway.

Europe's radio-astronomers have dreamed for some time of transmitting their data electronically using a network such as GÉANT. GÉANT matters to them because the ability to electronically combine several radio telescopes' data together has the effect of bringing an enormous boost to the telescopes' sensitivity and operational reliability. Concretely, this means they can look deeper into the early Universe - and do so in exquisite detail.

In the experiment, the astronomers created Europe's - and the world's - first internationally distributed electronic Very Long Baseline Interferometer (eVLBI). VLBI allows radio astronomers to distinguish objects separated by about 1 milliarcsecond – that's the equivalent of seeing individual astronauts on the moon from earth (by comparison, the resolution of the Hubble space telescope is about fifty times poorer).

Radio interferometry is based upon the principle that the resolution of an image depends on the size of the "eye" looking at it – and that a very large eye can be simulated by combining images obtained from several remote telescopes. In this experiment, the data from the telescopes was combined to yield an image offering the resolution of a single, 957 km -wide radio telescope.

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It is a potent technique, allowing astronomers to gaze back to the very edge of the Universe. But until now, its practitioners faced two serious challenges, both born of the fact that the data had to be recorded onto tape and physically shipped to a central location for processing and analysis.

First, the image may be sharp – but it's very dark. That's because each telescope generates enormous amounts of data, most of which is lost (until last week, there was no way to collect, match and process the tens of gigabits per second generated directly - and the data tapes used typically yield an effective bandwidth of only 128 Mbits per second). This seriously degrades the image's sensitivity. "It's like trying to look up at the stars at night wearing sunglasses", said Mike Garrett, JIVE's director. At the edge of the Universe, only the very brightest objects can be seen at all, and most of the sky seems dark to VLBI astronomers.

Second, the physical handling of data storage media from various locations led to months of frustrating delay between an observation and the resulting image. This can waste precious observing time, since it's impossible to know during the observation if all the telescopes are operating as they should (if one of them didn't, the time all of them spent on that observation is irrevocably lost). And it forces VLBI astronomers to treat the cosmos as a static display. They simply can't react to the Universe's sudden events like gamma-ray bursts or supernova explosions.

The solution is obviously to link the telescopes together through an electronic network – to do eVLBI, with its potential to realise much higher data rates, and make analysis in near real time a possibility. But, before GÉANT, doing this was simply impossible: the required bandwidth simply wasn't available (indeed, VLBI in the United States is also still carried out with data tapes)

In last week's experiment, three telescopes at the Onsala Space Observatory in Sweden, the Jodrell Bank Observatory in England and the Westerbork Radio Observatory in the Netherlands, were connected by GÉANT to the European VLBI Network's central processing facility (operated and developed by JIVE) in Dwingeloo, also in the Netherlands, to be correlated and processed into a ten-milliarcsecond resolution image of Blazar 2007+777. Astronomically, the test resulted in a routine image. But "for someone who spent a lot of time watching telescope data stream locally on to tape, this was quite an event," said Dr Garrett.

Each telescope was connected to its country's National Research and Education Network, and the data routed onwards through GÉANT to SURFnet, the Dutch research network, for delivery to JIVE.

Telescopes, for obvious reasons, tend to be located in remote areas – but networks aren't. The difficulty and expense of building a high bandwidth network all the way to each telescope is what makes international eVLBI a challenge. "We are as delighted as our friends at JIVE at the success of this first experiment. We look forward to connecting more telescopes through GÉANT to the eVLBI network as the year progresses," said Mr Dai Davies, General Manager of DANTE, which operates GÉANT.

Thanks to GÉANT, radio-astronomers using Europe's telescopes can look forward to much more sensitive, sharper images – and will soon be able to react quickly to the Universe's many surprises.

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The achievement shows how GÉANT can support distributed European "big science". GÉANT provides the network infrastructure essential to support the growing number of research projects that use facilities located in several different countries.

"As radio-astronomers are discovering, Europe's delivery trucks have a rather low bandwidth compared to GÉANT," said Dai Davies. "I'm very pleased indeed to see GÉANT supporting distributed European research so successfully. This achievement is a real Big Bang for international research networking."

The data rates used for this first test were still quite low (256Mb/sec)."But we are aiming for 1Gb/sec on six telescopes by the end of this year", Dr Garrett said. "We'll finally be able to take those sunglasses off". With GÉANT and its successors, DANTE hopes to offer astronomers data transfer rates of 10 Gb/sec within four years. "We'll see objects almost ten times fainter than we can today in incredible detail," Dr Garrett added.

Astronomers will then be able to explore the Universe when it was still a baby. Dr Garrett explained that the hope was to catch the light of the very first galaxies: "with eVLBI, we may finally see the most famous event in all of Genesis: the transition from 'And darkness was upon the face of the deep' to 'Let there be light: and there was light'."

It is at that remote time that the Universe is suspected of having taken on the basic shape it has today. Many of the heavier chemical elements that make up our bodies were forged in those first, young stars. With electronic VLBI, we may in a very real sense be able to witness our own creation.

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About GÉANT

Reaching over 3,500 research and education institutions in 32 countries through its direct connection to 28 National and Regional Research and Education Networks, GÉANT provides the highest capacity and offers the greatest geographic coverage of any network of its kind in the world. Enabling scientists to compete on an international stage by providing them with a world-class backbone that offers the bandwidth and the Quality of Service required for research and development activities at this level, GÉANT has dual roles of providing an infrastructure to support researchers, as well as providing an infrastructure for research itself. GÉANT is co-funded by the European Commission as part of its Fifth R&D Framework Programme. GÉANT is delivered by DANTE for Europe's research and education networks.

- MORE 'ABOUT' -

About DANTE

DANTE's name derives from the acronym 'Delivery of Advanced Network Technology to Europe'. Owned by European NRENs (National Research and Education Networks), it is an organisation whose purpose is to plan, build and operate pan-European networks for research and education. Working in partnership with Europe's NRENs and in cooperation with the European Commission, DANTE has been fundamental to the success of European research networking over the last decade, delivering the data communications infrastructure essential to the success of many research projects in Europe today.

Further information about DANTE and GÉANT can be found at www.dante.net

About JIVE & EVN

JIVE is the Joint Institute for Very Long Baseline Interferometry in Europe. It was created by the European Consortium for VLBI and is a member of the European VLBI Network (EVN). Its primary task is to operate the EVN MkIV VLBI Data Processor (correlator). JIVE also provides a high-level of support to astronomers and the Telescope Network. JIVE is hosted by ASTRON (the Netherlands Foundation for Research in Astronomy) in Dwingeloo, The Netherlands.

Detailed information about JIVE and EVN can be found at www.jive.nl and www.evlbi.org

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