IVS Newsletter

Issue 24, August 2009

VLBI2010 Project Executive Group Created

– Hayo Hase, BKG and Dirk Behrend, NVI Inc./GSFC

Many ongoing VLBI2010 developments are executed at different places inside and outside of the IVS world. The developments include new radio telescopes, new feeds and receivers, new observation modes, new observation spectra, new processing software for correlation and post-processing, and a new data archiving format. Currently, these activities are carried out by the different stakeholders of the IVS in a loosely organized manner.

Recognizing that these processes need to be better coordinated, the IVS Directing Board established a VLBI2010 Project Executive Group (V2PEG) at its meeting in Bordeaux on March 23, 2009. In addition to its organizational function, the V2PEG will also be the focal point for gathering and disseminating information about VLBI2010 and for promoting the new system.

As its first action the V2PEG is collecting information about the various VLBI2010 activities. The resulting matrix will make it possible to track developments for completeness and timeliness hence ensuring that VLBI2010 efforts proceed in a convergent manner. The first major milestone will be the coordination of a VLBI2010 demonstration session tentatively scheduled for spring 2012. Ultimately, when the development phase is complete, the group will guide the deployment of next generation systems and the transition to full VLBI2010 operations. This, of course, will be a major challenge for the entire IVS.

One important goal of VLBI2010 is to expand the network of next generation VLBI stations in order to obtain global, homogeneous coverage. The VLBI2010 radio telescopes should be erected at current sites but also at new sites possibly requiring new host organizations. The accompanying promotional task is very important for the success of the new system and is thus considered a vital part of the V2PEG work. For this task the V2PEG will draw upon the Progress Report of the VLBI2010 Committee (see Figure) as an excellent tool.

The V2PEG consists of Hayo Hase (chair), Dirk Behrend, Chopo Ma, Bill Petrachenko, Harald Schuh, and Alan Whitney. Any of the members can be contacted with questions regarding the VLBI2010 project. An e-mail exploder list has been set up under the address ivs-v2peg@ivscc.gsfc.nasa.gov.

The Progress Report of the IVS VLBI2010 Committee was published under the title "Design Aspects of the VLBI2010 System" as NASA Technical Memorandum NASA/TM-2009-214180. The report can be downloaded from the IVS Web site at ftp://ivscc.gsfc.nasa.gov/pub/misc/V2C/TM-2009-214180.pdf. There is a limited number of printed copies available. Please send a note to the Coordinating Center if you would like to request a copy.

Travel Grants for GM2010 in Hobart

The 6th IVS General Meeting (GM2010) will be held in the second week of February 2010 in Hobart, TAS, Australia. The event will be co-sponsored by the International Association of Geodesy (IAG). For this, young scientists (35 years old or younger at the time of application) can apply for the IAG International Travel Award, which has a maximum financial support of US$800. The IAG limits the total number of travel awards per given year to a maximum of 10. For the IVS GM2010 we thus expect not more than 3–4 awards being granted. In addition to the IAG, also the Federation of Astronomical and Geophysical Data Analysis Services (FAGS) provided funds for a travel grant for one young scientist. The FAGS grant amounts to about US$800.

The IAG awards will be allocated by the IAG Office, where the selection process is based upon letters of support (from one IAG Fellow or two Associates) that need to be submitted separately and the applicants' ability to actually attend the meeting. The selection of the FAGS awardee will be done by the IVS. The IAG applications need to be received by the IAG Office three months before the meeting; i.e., not later than the second week of October 2009. Applications from developing countries will get precedence and are thus especially encouraged.

The IVS would like to coordinate the application process for both travel grants. We thus ask all candidate applicants to contact

Dirk Behrend (Dirk.Behrend@nasa.gov)

not later than

September 15, 2009

to discuss further details. Please keep in mind that the final decision on the IAG travel grants lies with the IAG and not the IVS. The FAGS grant, however, will be allotted by the IVS.

Permanent Component

Pulkovo Observatory, St. Petersburg, Russia

The Central Astronomical Observatory at Pulkovo of the Russian Academy of Sciences in St. Petersburg, Russia operates an IVS Associate Analysis Center. Since September 2006 the VLBI group of the observatory, which is commonly known as "Pulkovo Observatory", contributes to studies of the Celestial Reference Frame (CRF), the Earth Orientation Parameters (EOP), and the Terrestrial Reference Frame (TRF). Newsletter editor Hayo Hase e-interviewed Dr. Zinovy Malkin, who is the technical lead of Pulkovo's VLBI group, to learn more about the observatory and its VLBI activities.

Zinovy, Pulkovo Observatory is an important location in the history of astronomy. Can you briefly explain the reason why and where it is located?

VLBI group lead Zinovy Malkin in his office; (below) The Large Pulkovo Radio Telescope (LPR) which is mainly used for observations of the Sun. The dish in the foreground is not a part of the LPR. The LPR was a prototype of the famous radio telescope RATAN-600 near Zelenchukskaya in North Caucasus.

The first astronomical observatory in Russia was founded by Peter the Great in St. Petersburg in 1725. This observatory was located in the downtown area; but as the city grew the astronomical observations became more and more problematic. As a result, a new observatory was founded by Nicolai the First in 1839. The place for the new observatory was chosen at Pulkovo Hill, a small hill about 70 m high, which is located about 19 km south of St. Petersburg, featuring a good astronomical environment. It was completely destroyed during the Second World War, but was completely rebuilt in 1947-1954. Accordingly, this year we celebrate the 170th anniversary of the observatory!

How is the interrelation with other VLBI groups in Russia? Can you explain how the IVS work is distributed within Russia?

I currently count five VLBI groups working in geodesy and astrometry in Russia. Four of them are well known within the IVS and are located at the Institute of Applied Astronomy, Pulkovo Observatory, and Moscow and St. Petersburg State Universities. The fifth group is at the National Research Institute for Physical-Technical and Radio Engineering Measurements (Russian abbreviation: VNIIFTRI) and performs VLBI data processing for the Russian State EOP Service using the OCCAM software package.

Unfortunately, there is little cooperation in the analysis field. But perhaps more important is the Russian cooperation with regards to the IVS VLBI2010 activities that started in 2008. VNIIFTRI is the principal proposer of a new Russian VLBI network that shall be compliant with the VLBI2010 requirements and shall form part of the IVS VLBI2010 network. Co-proposers and contributors are Sternberg Astronomical Institute of Moscow State University, Pulkovo Observatory, Lebedev Physical Institute, as well as several engineering organizations.

Compared with others, your group is fairly new. Please describe the work you are doing and introduce the members of your staff.

Nominally, our group consists of four members: Natalia Miller, Elena Popova, Julia Sokolova, and myself. Some of us have also other obligations. As a matter-of-fact, our group is still "under construction"! Natalia is our main specialist in mathematics, and she is working now on completing her PhD thesis on Earth rotation. Elena joined us in 2008 and is investigating the source velocity field and related problems. Julia is a specialist in CRF related issues; she currently is on leave of absence at Curtin University of Technology, Perth, Australia. I'm working mainly on EOP and CRF issues.

The Pulkovo VLBI group is part of the Laboratory of Radioastrometry and Geodynamics headed by me. The lab, in turn, is a part of the Department of Radioastronomy Researches, which is headed by Dr. Alexander Stepanov, the Director of Pulkovo Observatory. In particular, our lab also supports a permanent EPN GPS station at Pulkovo, and we investigate GPS station motion and earthquake activity in the North-West region of Russia. We are trying to compensate for our small staff size by cooperating with colleagues inside and outside of Pulkovo Observatory. Our main topics of interest are EOP and CRF. Other works include troposphere, optical characteristics of geodetic radio sources, VLBI observations of approaches and occultations in the Solar System, and VLBI statistics.

What difficulties do you encounter with your work?

I think that the problems and difficulties that we have are similar to the ones of other groups. I'd put on the top of the list insufficient funding and lack of active young people willing to devote their life to our science!

The IVS maintains different VLBI software packages for the analysis. Which one are you using?

I'm working with an OCCAM clone for EOP computation. Julia has also experience with the official OCCAM v. 6, using it to compute source position catalogs and time series. In the long term—when we have staff for this work, I'm thinking of acquiring a software package that would allow us to compute

global solutions and daily SINEX files. I'm leaning towards the Munich OCCAM version, which has proven to provide high-quality results for EOP, TRF and CRF, and it seems to be simpler, support-friendly, and easier to modify than Calc/Solve.

Within the VLBI2010 program the IVS intends to modernize all elements of VLBI operation from observation to analysis. In your view, what should be improved within the analysis process?

First, let us agree what we mean by analysis. Some people, like Leonid Petrov, deem VLBI analysis to start at the fringe amplitudes and phases coming from the initial correlation process. I don't have much experience in this part of analysis. Now, for me, analysis begins with v.4 database. In brief, VLBI analysis should be improved in several evident directions: better modeling of atmosphere and geophysical processes, better parameterization, and automation. However, success in analysis improvement not least depends on support from operation centers, stations, and correlators. More refined and automated analysis requires better scheduling, maybe more informative and standardized log files and correlator reports, among other things. I don't pretend to make any new discoveries in this subject. Most of the points mentioned have been discussed within VLBI2010.

What can Pulkovo Observatory contribute to the modernization?

Now we mainly participate in activities that don't require much funding, such as analysis, system overview, optimal planning of operations, and so on. I hope we can provide several useful contributions to the common effort.

The ICRF2 is about to replace the ICRF. What are the differences between the two?

I can mention at least three major improvements of the ICRF2 with respect to the ICRF, ordered by their importance (as I see it):

- elimination of significant systematics at the level of ~0.2 mas;
- more uniform sky distribution of the defining sources;
- increase of the number of defining sources from 212 to 295.

I'm a little bit disappointed in the last point: I had hoped to see about 400 ICRF2 core/defining sources, one per 100 square degrees.

We know you as a very active IVS member participating in many discussions. You always contribute the famous Malkin statistics. Do you know how many VLBI observations are in the databases of the IVS so far?

Of course I do: there are more than eight million observations in total, more than seven million of them are marked as good! Everyone can find the most up-to-date VLBI data statistics on our Web site at http://www.gao.spb.ru/english/as/ac_vlbi/.

(above) Main building of Pulkovo Observatory. (below) Julia Sokolova and Newsletter editor Hayo Hase during the banquet dinner of the 5th IVS General Meeting in St. Petersburg.

Upcoming Meetings...

IAG Scientific Assembly Buenos Aires, Argentina Aug. 31- Sep. 4, 2009	6th IVS General Meeting Hobart, TAS, Australia Feb. 7-14, 2010
AGU Fall Meeting San Francisco, USA Dec. 14-18, 2009	Meeting of the Americas (AGU) Foz do Iguassu, Brazil Aug. 8-13, 2010

http://ivscc.gsfc.nasa.gov/meetings

The IVS Newsletter is published three times annually, in April, August, and December. Contributed articles, pictures, cartoons, and feedback are welcome at any time.

Please send contributions to ivs-news@ivscc.gsfc.nasa.gov.
The editors reserve the right to edit contributions. The deadline for contributions is one month before the publication date.

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The newsletter is published in color with live links on the IVS web site at http://ivscc.gsfc.nasa.gov/.

The Fifth Technical Operations Workshop as Meeting Point for VLBI Staff

– Alexander Neidhardt and Martin Ettl, FESG/TU Munich, Geodetic Observatory Wettzell

To most operators of geodetic VLBI telescopes the name Westford is a shortcut ("Wf") in the IVS Master Schedule and Haystack is a location far away in the United States where a correlator processes VLBI data, e.g. of the R&D sessions. But every two years technical VLBI staff from all over the world are invited to come to Haystack Observatory, Westford, MA to participate in one of the most useful workshops of the IVS: the Technical Operations Workshop or TOW for short. And last April the fifth TOW was held.

Authors Martin Ettl (center) and Alexander Neidhardt (right) enjoying the icebreaker.

Participants at the 5th TOW.

During almost a full week operators, technicians, and engineers taught each other in small, practice-oriented hands-on courses the usage of the current VLBI technique and instilled best practices for routine procedures of running a radio telescope and doing observations. The varied topics united under one roof old-established VLBI "gurus" and newbies to the community as well as different fields of studies. Exactly this mixture formed the basis for a productive week with "old and new" VLBI friends, establishing a fruitful information flow with each participant being able to benefit from the training and communication.

Like many others from all over the world, also a group from Germany sallied out to travel to the U.S. to that special place for VLBI at Haystack Observatory in Massachusetts. For most of them it was their first TOW. When the airplane landed, the travelers were welcomed by New England's spring weather of heavy rain and cool temperatures. But the following day a sunny morning greeted them, which they interpreted to be a positive sign for the upcoming week. After a little bit of weekend sightseeing—during which the freshmen got a first glimpse of the US lifestyle, especially of the different indications of sizes: you get almost a gallon of ice cream when you order a medium size—they picked up their rental car in Boston in order to do the drive to Haystack about 30 miles to the north west of Boston. The car, of course again medium-sized, offered enough space for the travelers and with a little help from the navigation system the hotel Westford Regency Inn and Conference Center close to Interstate 495 was easily found. At the hotel a first contact with the global VLBI family was possible when the registration and icebreaker brought all participants together. The program was well planned: everybody got their individual course timetable which organized the large number of attendees into the signed-up courses with a maximum of ten people per class. The local organizing committee consisting of Heidi Johnson, Alan Whitney, Brian Corey, and Dan Smythe plus Dirk Behrend from the program committee had everything under control.

The classes during the following days took place at the observatory in the conference rooms of the Haystack building and in the operations building of the Westford antenna. There were different types of courses. A mainstay was the operations hands-on sessions that provided active training on the actual equipment: e.g., experiment pre-checks and operations, troubleshooting, cryogenic system and receiver maintenance, or Mark 5 topics. The courses are a must for each operator. Moreover, a very impressive tour of the Westford antenna was given. Via an ear-annoying airlock, the radome-enclosed Westford antenna area could be entered. The radome has no support structure and is only perpetuated by the internal air pressure. It protects the antenna from snow loads and other external influences.

A second main pillar of the workshop was maintenance presentations and live demonstrations. From Mark 5 disk module testing, automated pointing models, and antenna gain calibration to RFI identification and hardware maintenance of hydrogen masers, all these topics offered an insight into how to troubleshoot a radio telescope site. The two main pillars were augmented by seminars and lectures to inform about special topics or subject matters that were of interest to everyone. Seminars typically gave introductions

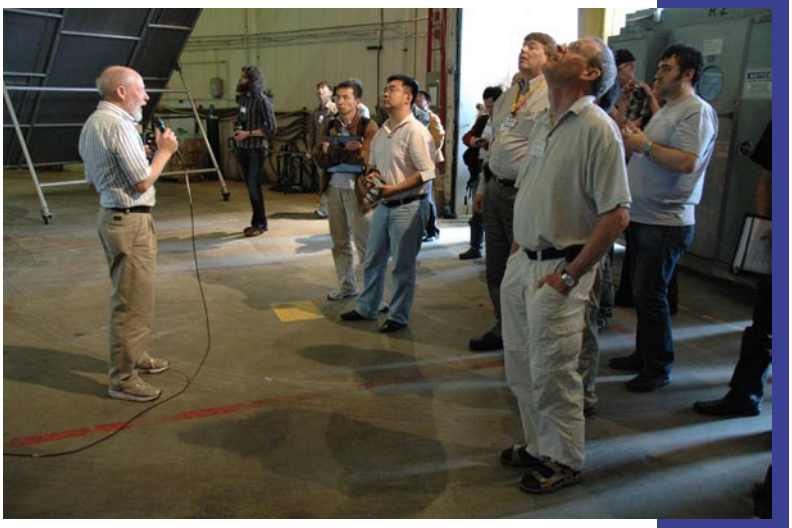
into Linux system administration, timing systems, code writing for the station-specific parts of the NASA Field System (FS) or the timing system, phase calibration basics, e-VLBI, and remote control of the FS. The lectures offered a general overview and provided the red line for the other courses showing future trends like VLBI2010, the near-term future of the FS, or science-relevant issues like operations' impact on data analysis.

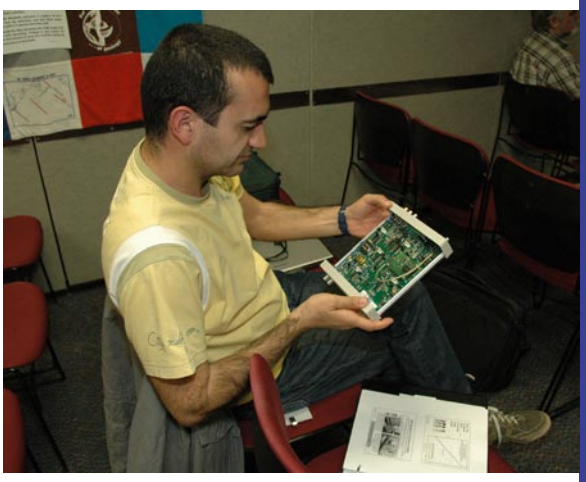
Aside from the courses an all-inclusive program was offered. Daily breakfast and lunch times united the attendees additionally. A wonderful barbecue dinner with the whole group in front of the Haystack radome offered wonderful, fresh burgers and hot dogs and something Heidi called "shredded pork", which was new for some of us. New friendships were formed which will help to keep in touch within the worldwide community. And, not surprisingly, some of the participants joined for collective activities beyond the official program. In an ad hoc pool billiards tournament teams from Norway, Germany, USA, and an all-star team played each other. There were cross-country runs through the forests around Haystack.

A tour of the 37-meter Haystack radio telescope and through the assembly hall where the new dish is put together by a small group of engineers completed the TOW. Not to be forgotten should be the visits to Kimball Farm Ice Cream. With the newly acquired knowledge about units for ice cream sizes, it was fantastic to enjoy a small cup in the tepid spring evening mostly surrounded by swarms of gnats.

At the end of the TOW week there was general consensus that this was one of the best workshops for technical issues for all aspects of running a VLBI site. In addition, the workshop offered a wonderful chance to meet old friends and make new ones, ready to aid one another in the grand challenge of running worldwide VLBI observations at a high quality. After all this, the German guys set forth in their medium-sized car and passed by some of the wonderful coastal villages of Massachusetts before reaching Boston's Logan airport. From there they returned back home with a bag full of useful material and lasting impressions.

(above) This year's TOW Meeting was improved by the addition of a temporary tent for lunch and dinners. (below) Arthur Niell giving a tour of the Haystack telescope.





(left) Inside the assembly building for the new Haystack dish. (above) Carlo Migoni of INAF Cagliari inspecting a circuit board from the new timing system being built by Richard Hambly and Tom Clark.

Science and Technology of Long Baseline Real-Time Interferometry

– Francisco ("Paco") Colomer, Instituto Geográfico Nacional, Spain

The Instituto Geográfico Nacional (IGN) of Spain, in cooperation with the EXPReS (Express Production Real-time e-VLBI Service, http://www.expres-eu.org/) project, hosted the 8th International e-VLBI Workshop in Spain's capital region during the week of June 22−26, 2009. People working on the science and technology of real-time, long-baseline radio interferometry got together at the premises of the National Astronomical Observatory (OAN) in Madrid and, for one day, at the Center for Technological Development in Yebes to discuss the state-of-the-art and future prospects.

The Yebes site as seen from a distance.

In recent years, real-time radio interferometry over very long baselines has developed from a technical possibility to a mature technique by using optical fiber networks. Scientifically, real-time operation is more important for long baselines, with their high spatial resolution, than for short baselines. However, until recently the required technology has not been readily available. Technical advances and the explosive increase of connection capacity have now radically changed the situation. Emerging radio interferometers (e-MERLIN, E-LOFAR, e-EVN, and other e-VLBI arrays) do and will exploit mixed private/shared networks to achieve wide-bandwidth real-time operation. Mirroring developments in other wavebands of astronomy, these new real-time radio instruments are being optimized to study transient phenomena. Moving data transport to fiber also gives the prospect of rapidly expanding observing bandwidth and sensitivity as network capacity continues to increase.

The workshop covered both the scientific applications and the technical implementation. A part was devoted to a joint science/technology session. Specific topics included:

- Scientific: Applications of real-time operation to astronomy, geodesy, and other fields. Coordination of emerging e-VLBI arrays for best scientific return. Connections to transient monitoring in other wavebands.
- Technical: e-VLBI test experiments, use of new long distance links, development in techniques including selective packet dropping and novel protocols, the search for higher bandwidths, network status and monitoring, distributed processing, and future developments.
- Scientific/Technical: Technical possibilities of interest in planning future instruments. Desired technical requirements to fulfill scientific goals, science priorities for development.

Taking advantage of the gathering of so many experts, discussion panels were organized in order to discuss future organization/multi-wavelength coordination to maximize science impact of e-VLBI, network issues, and VDIF specifications. A meeting of the Internet (academic) national providers (NREN) took place on Thursday, as part of the workshop's regular agenda. Chaired by the DANTE representative, John Chevers, there were discussions about the coordination of the European GEANT high-capacity data transport infrastructures with the NREN—who provide connectivity to the VLBI radiotelescopes—and links to non-European partners such as Australia, having a great impact on the scientific return of the e-VLBI network.

The participants had a chance to visit the historic OAN site in Madrid as well as the new 40-m radiotelescope plus all laboratories (including the LNA lab) in Yebes. The proceedings of the 8th International e-VLBI Workshop will be published soon as EXPReS09 conference in "Proceedings of Science" (PoS; http://pos.sissa.it/).

Participants of the 8th International e-VLBI Workshop at the Yebes antenna (left) and in the meeting room (right).

Cables and Connectors: The Pipeline for Our Data

– Mike Poirier, MIT Haystack Observatory

Our sites are composed of a mass of complex technical instrumentation all connected together by cables. These cables range from ribbon type to coax and even optical fiber. Every day we acquire data by sending signals over these cables. Care must be taken to make sure that all of these types of cables are protected and secured so that they do not cause data loss.

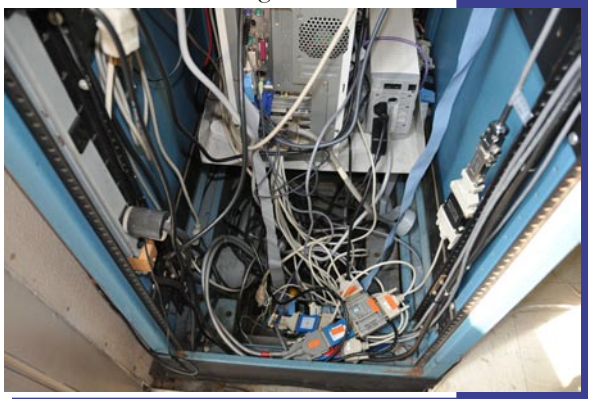
Ribbon cables have been used within our VLBI systems for basic RS-232 communication, data to and from the formatter, decoder, and tape drive. This type of cable must be supported and strain relief should be used at the ends near the connector.

Coax cables carry many types of signals through our system. From RF, timing and reference signals, this type of cable has been the heart of our system. Damage can occur by obvious means of crushing and cutting, but one must pay attention to the connector end of these cables. Care must be taken when replacing these cables comparing the specifications for frequency, loss, impedance, and temperature coefficient to the old cable (see, e.g., http://www.rfcafe.com/references/electrical/coax-chart.htm).

Network cables have become a part of the new VLBI system. Communication between the Mark 5 system and the Field system is using the network. Cat5E cables usually have the RJ-45 connectors on each end, which allow connections to be made through network switches. These cables can be damaged by having bends with too sharp of radius. More information about how to wire Ethernet cables can, for instance, be found at http://www.ertyu.org/steven_nikkel/ethernetcables.html.

The next generation VLBI system (VLBI2010) will use fiber optics to carry the RF signals between the receiver and the data acquisition system. Extreme care must be taken when installing and connecting these types of cables: too much force in any direction can damage them, connector choice and cleanliness are critical.

Repair of coaxial, communications, and fiber cables are beyond the scope of this newsletter, but station staff should be aware of maintenance issues and handling of all varieties of cables found at our observatories. Early detection of problems with IF cables coming from the telescope using the phase cal signal is a good example where operators can help identify and prevent data loss.



VLBI deals with a plethora of cables and connectors, as this photo of cable clutter exemplifies. Some tidying up would be in order here.

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ICRF2 Adopted at IAU General Assembly

The Second Realization of the International Celestial Reference Frame (ICRF2) was adopted at the XXVII General Assembly of the International Astronomical Union (IAU) in Rio de Janeiro, Brazil as Resolution B3. The ICRF2 will replace the currently used first realization (ICRF) effective 1 January 2010. The International Earth Rotation and Reference Systems Service (IERS) published Technical Note #35 (http://www.iers.org/MainDisp.csl?pid=46-25772) about the computation of the ICRF2. The ICRF2 was an effort of a joint IERS/IVS working group and was overseen by an IAU working group. ICRF2 contains precise positions of 3,414 compact extragalactic radio sources, more than five times the number in the ICRF. Further, the ICRF2 is found to have a noise floor of ~40 microarcseconds, some 5−6 times better than ICRF, and an axis stability of ~10 microarcseconds, nearly twice as stable as ICRF. Alignment of ICRF2 with the International Celestial Reference System (ICRS) was made using 138 stable sources common to both ICRF2 and ICRF-Ext2.

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IVS Contributes to IYA2009

– Dirk Behrend and Cynthia Thomas, NVI Inc./GSFC

It is well know that this year we celebrate the International Year of Astronomy 2009 (IYA2009). IYA2009 is a global celebration of astronomy and its contributions to society and culture and marks the 400th anniversary of the first use of an astronomical telescope by Galileo Galilei. The aim of the Year is to stimulate worldwide interest, especially among young people, in astronomy and science under the central theme "The Universe, Yours to Discover". IYA2009 events and activities will promote a greater appreciation of the inspirational aspects of astronomy that embody an invaluable shared resource for all nations. Please find more information at the URL: http://www.astronomy2009.org/.

The IVS will contribute to the IYA2009 activities by organizing a special observing session (IYA09SS, sometimes referred to as supersession) with emphasis on astrometry. It is envisioned to have as many stations participating as possible, making it the largest session of its kind ever observed. While establishing the 2009 IVS master observing plan, a slot was set aside for a 24-hour session commencing on November 18, 2009 at 1800 UT. A call was sent to the stations requesting participation in IYA09SS and at the time of writing 22 stations have confirmed.

The purpose of IYA09SS will be twofold: first we will hopefully have the largest observing session for astrometry to date and secondly it is anticipated to have public outreach activities running at various sites. The details are currently being discussed in a special task force established by the IVS Directing Board and headed by Patrick Charlot. The schedule for the session will be written by John Gipson. The correlation will be done either at the Bonn correlator or at Haystack Observatory or in a shared effort. More information will be posted on the IVS Web site when it becomes available.

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