IVS Newsletter

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VLBI High on the Azores

– Dirk Behrend, NVI, Inc.

The President of the Azores, Vasco Alves Cordeiro, during the dedication speech for the radio telescope "Colombo" on Santa Maria.

It happened in May. It happened a bit later than usual. But it happened with a number of firsts and without doubt made its way into the VLBI history books. The EVGA (European VLBI Group for Geodesy and Astrometry) organized its 22nd meeting in Ponta Delgada on the island of São Miguel, Azores, Portugal. From May 17 through 21 the geodetic VLBI community assembled on the "Green Island" in the North Atlantic Ocean. São Miguel forms, together with Santa Maria, the Eastern group of the Portuguese archipelago of the Azores. The Azores are nine islands in the North Atlantic about two thirds of the way from North America to Europe. They have a prominent location at the triple junction of the tectonic plates of North America, Eurasia, and Africa. They are also known for a weather phenomenon called the Azores High (or Azores Anticyclone).

Before making the trip, I learned that SATA is not only important for mass storage in VLBI data recording modules, but it also plays a major role in mass transportation to/from the Azores. SATA (Sociedade Açoriana de Transportes Aéreos) happens to be the airline headquartered in Ponta Delgada that services flights to North America and Europe. So, it was a SATA airbus that brought many of the 90 registered participants to the island. The participants originated from 18 countries in five continents. The large attendance ensured that for about a week, the Azores had the highest density of VLBI experts in the world. So, in a way Ponta Delgada was the geodetic VLBI capital of the world.

The EVGA meeting proper took place (after an icebreaker reception in the evening of May 17) from May 18 to 19 in the Teatro Micaelense in the center of Ponta Delgada. The scientific program was packed full with 49 oral and 36 poster presentations. The range of topics went from VGOS developments to status reports of the stations and correlators to geodetic analysis and astrometric questions. In the morning of May 19, a live video feed connected the participants to the Caucasus to witness the inauguration of the new VGOS antenna at Zelenchukskaya. Later the same day, our Russian colleagues presented first fringes with the new antenna.

On May 20, the participants experienced a real first for an EVGA meeting or any IVS meeting for that matter: for the inauguration of the RAEGE station on the island of Santa Maria the group had to take a very early charter flight from São Miguel to Santa Maria. Two buses departed from the meeting hotel at 5:30 am to catch the flight for the island hopping (20 min flight). The ceremony for the dedication of the new VGOS antenna was held in the morning at the RAEGE station. After the bishop had blessed the new telescope for its future operations, the Director of the Spanish IGN and the President of the Azores inaugurated the new radio telescope, which is called "Colombo", as the second of the RAEGE project and the first on Portuguese soil. Hence, with the new antenna we can welcome a new country into the fold of the IVS. The day was completed by some sightseeing of the island. At the end of the day, we island-hopped back to Ponta Delgada. The VLBI week was completed by several splinter meetings on the next two days.

We would like to thank the local organizing team led by Luis Santos and Sara Pavão for their excellent work. The days on São Miguel have been very memorable. More information about the meeting can be found online at http://evga2015.raege.net/.

The Azores Archipelago in the North Atlantic Ocean is part of Portugal and will host two VGOS antennas: one on the island of Santa Maria and a second one on the island of Flores.

Feature

Syowa Station in Antarctica

Syowa is one of the two IVS Network Stations in Antarctica. The Syowa Station is operated by the Japanese institution of the National Institute of Polar Research (NIPR). Koichiro Doi is the Project Co-ordinator for the operation and maintenance of the 11-m antenna at Syowa. Feature Editor Hayo Hase interviewed Doi-san via e-mail to get a better understanding of the particularities of operating an Antarctic VLBI station and its prospects for the future.

Syowa Project Coordinator Koichiro Doi.

Doi-san, you are the responsible person at NIPR for Syowa. How did you get involved in the VLBI business?

I have been a member of the Geosciences Group at NIPR since 1995. When I joined NIPR, Professor Shibuya, the former responsible person for VLBI, began a project to resume geodetic VLBI experiments at Syowa Station. Since there was no staff with a background in geodesy other than Professor Shibuya, I got involved in the VLBI project, though my main background is terrestrial gravimetry. I went to Syowa twice, in 2000 and 2004, as a member of the overwintering team and was responsible for the VLBI experiments.

The NIPR headquarters in Japan.

What was the objective of the foundation of the Syowa base? When did it happen?

Syowa Station was constructed in 1956; scientific activities at the station started the same year. The main objective of the station is to explore Antarctica by means of scientific observations such as meteorological, upper atmospheric, and geophysical observations. Geodetic observations such as triangulation, photogrammetry, and astronomical positioning were also conducted in 1956 by the 1st Japanese Antarctic Research Expedition.

When and why was a radio telescope installed at Syowa?

The radio telescope was built in 1989. The main purpose of the telescope installation was to downlink data from the Akebono satellite (upper atmospheric physics) and remote sensing satellites (JERS-1, ERS-1, ERS-2) that had sensors such as synthetic aperture radars and optical sensors. The telescope was also designed for VLBI and radio astronomy.

Syowa was providing the first VLBI data from Antarctica. Can you give some details about this pioneering work?

The first Antarctic VLBI experiment was carried out in January 1990 (see, e.g., N. Kurihara, T. Kondo, Y. Takahashi, and M. Ejiri: "The results of test VLBI experiments with the Syowa Station in Antarctica," Journal of the Communication Research Laboratory, 38(3), 605–611, 1991). The main pioneers were Noriyuki Kurihara, Fujinobu Takahashi, and Noriyuki Kawaguchi of Communication Research Laboratory (CRL, now called: National Institute of Information and Communications Technology, NICT). Two 24-hour experiments were conducted on January 20 and 25 between Syowa, Kashima (Japan), and Tidbinbilla (Australia) after a test experiment of 14 hours between Syowa and Kashima on January 16. At Syowa, a K4 recorder was used for data acquisition and a Cs clock as the frequency standard.

Since when does Syowa participate in IVS observations on a regular basis?

Syowa has been participating in IVS sessions since 1999. In that year, Syowa was participating in five SYW-ANT sessions and three CORE-OHIG sessions.

What are the future plans of Syowa with respect to the upcoming VGOS network?

The dismantling of the telescope originally scheduled for January 2016 was postponed by four years (currently scheduled for January 2020). We are now requesting funding for a renewal of the telescope and radome from the Ministry of Education, Culture, Sports, Science and Technology in Japan. In the request, we considered introducing a telescope having specifications close to a VGOS antenna.

View of the Syowa site in winter with the radio telescope protected inside the radome.

What are the main challenges or risks for dismantling and erecting a radio telescope in Antarctica?

The biggest concern for the dismantling and construction of a telescope is a blizzard with strong winds. Although not so many blizzards attack Syowa in the austral summer, we have to do the disassembly and assembly work all within one month. Very heavy telescope parts are also a problem for Syowa, because large cranes are needed to lift these parts.

How do you organize the VLBI operations?

Dr. Yuichi Aoyama and I are the staff members responsible for operating VLBI at NIPR. Dr. Hideaki Hayakawa is currently working at Syowa. Dr. Aoyama sends the schedule file to Dr. Hayakawa after editing the original schedule file downloaded from the IVS data center to adapt to the observing system in Syowa. Dr. Hayakawa sets up the observing system on site based on the schedule and keeps watch on the system during the session.

Are there any possibilities to transmit observing data from Syowa by telecommunication rather than by an icebreaker?

At the moment, there is no possibility to transmit the data of a whole observing session by telecommunication from Syowa, because the maximum link rate to Japan is 3 Mbps. We can only e-transfer data of a small number of radio source observations from our K5 recorder via a telecommunication link in order to check the fringe visibility.

We know that you are a very busy person. But what are your personal interests that you enjoy in your leisure time?

There are many hot springs in Japan. In my leisure time, I like to go with my family to the nearby hot springs by car and take an outdoor hot spring bath.

Thank you very much for this interview.

The NIPR VLBI staff (from left to right): Yuichi Aoyama, Koichiro Doi and Kazuo Shibuya.

AGGO Officially Inaugurated

– Claudio Brunini, CONICET and Hayo Hase, BKG

The only geodetic observatory of its kind in Latin America, the Argentinian-German Geodetic Observatory (AGGO), was formally opened by the Argentinian Minister of Science, Technology and Innovation, Dr. Lino Baraño, and the German State Secretary of the Federal Ministry of the Interior, Mrs. Cornelia Rogall-Grothe, on July 23, 2015. The inauguration ceremony was conducted at the new AGGO site and was attended by about 100 representatives from science, government, universities, public administration, and persons involved in the construction of AGGO. The observatory is a joint project of the Argentinian Science Council (CONICET) and the German Federal Office for Cartography and Geodesy (BKG) and is largely composed of the former TIGO instruments, which thus have found their final destination in La Plata. We anticipate that AGGO will start full operations in 2016.

AGGO will contribute to the international services of the IAG (i.e., IVS, ILRS, IGS, IGFS) and to the Time Section of the BIPM. AGGO closes a large spatial gap in the global geodetic observation network in the southern hemisphere. With the presence of AGGO, Argentina is seeking to foster science and service in space-geodetic subjects. This bilateral common effort between Argentina and Germany is in accordance with the recent United Nations Resolution 69/266 on the Global Geodetic Reference Frame for Sustainable Development, adopted on February 26, 2015.

Hayo Hase (right) explaining the VLBI technique during the inauguration event.

News...

TOW2015@MITHAY

– Ming Zhang, XAO-CAS, Urumqi, China

First I would like to thank Dirk Behrend for giving me the opportunity to write this article for the IVS Newsletter. It was a great experience to attend the 8th IVS Technical Operations Workshop (TOW) at MIT Haystack Observatory.

The dining marquee of the TOW horde (with the radome of the Haystack antenna in the background)

It feels like it has been a decade since Urumqi showed up at TOW last time. There are a lot of upgrades going on recently both in the international VLBI community and at our local institute in Urumqi. Fearing that *o-Ur* knowledge about the new era of VLBI was quite out of date, we were eager to join this biennial informational feast for global VLBIers at Haystack Observatory, located in Massachusetts, USA. Though we suffered through last day visas and last-minute flights, we luckily got a free upgrade to first-class seats during this polar cap flyby journey. After landing in Boston, we found the time lag was effectively cancelled by a 12-hour clock. We took all this as a good omen for the upcoming TOW.

Chet guarantees Sekido-san that Mark 6 is quick and short.

There were 74 participants from 14 affiliated countries registered for this workshop. Though some didn't manage to turn up, the real heads that showed up at the workshop were, as I observed, from no less than 15 nations. Some were first-timers like me, but many others had been frequent visitors. Some present teachers were actually previous students here. I fancied this dynamic character; indeed, this is what a historic workshop should build up to be. Most impressively, all the scheduled classes were listed with very concise acronyms, which made us feel like we were in a professional gathering. Personally, I had wished this convention endured as well as the promotional code MITHAY, so VLBIers can travel around and check in nearby hotels any time with a cheaper deal when they come back, just not for a TOW.

We started our journey a day before the start of the TOW. Since we passed the International Date Line en route, we gained an extra day for recovery from the jet lag before the icebreaker. There were five participants all together from China this time. Besides Peng Li and me from Urumqi, there were other Chinese colleagues from Shanghai and Kunming. We occupied a table at the icebreaker. Dirk bumped in and started chatting with us, which made us feel less out of place. The buffet was so hearty that you could easily forget that it was also pay time—not only for the registration but also for the alcoholic beverages.

The workshop program was divided into four categories: operations workshops, maintenance workshops, seminars, and lectures. The operations and maintenance workshops offered hands-on tutorials such as system checks and antenna calibrations, which were very useful for beginner operators and technicians. Many talks about software and hardware developments were given in seminars, and some fundamentals and overviews about VLBI science and technology were given in lectures. However, the borderlines were pretty much blurred since many talks crossed over different categories. I tried to attend nearly all the classes, even though Dirk had limited the number of my favorite classes to 15. Because of the space limitation of this article, let me just highlight a few of the talks. Alan Whitney's old-school-style introduction to VLBI was a perfect appetizer for those who were not very familiar with the VLBI technique yet. Meanwhile, I was very impressed that Ed Himwich had single-handedly maintained the Field System for decades, implementing more functionalities to cooperate with emerging new hardware. Currently he is embracing new ideas like sophisticated remote control and monitoring modules from third parties. Moreover, the idea of developing a Mark 6 system based on non-proprietary software and hardware was sublime; it will definitely suit the taste of the radio-astronomical community. Chet Ruszczyk had convinced us with his effort that Mark 6 would be a prevailing future VLBI recording system.

Gino's DBBC held back by computer technology.

The most exciting part of this TOW was that we got to know the very frontier of the digital backend development and their implementations. The RDBE from Haystack and the DBBC from the EVN branched off with different aspects for geodetic and astronomical VLBI observations. Together with Mark 6 and FlexBuff, they could do fairly the same for future high speed recording and e-transfer. As men-

tioned by Harro Verkouter, they offered different choices for stations to upgrade to the next generation VLBI system. I speculated that a fusion of these two digital backends could happen in the coming years. Colin Lonsdale's closing talk on the future of VLBI was absolutely mind-blowing. I was amazed not by his delectable British accent but by his collection of cutting-edge technologies that could significantly change the face of VLBI in 20 years. I look forward to witnessing them become reality before my retirement.

Colin's hitchiker's guide to VLBI2020 – Don't panic!

Another thing that I have to mention is the fantastic Red Sox evening. It was the first time for most non-American TOW participants to witness a live baseball match. I'd rather prefer soccer, but the atmosphere of the game and passionate young spectators really let us blend in and enjoy this particular part of American culture in a chilly evening breeze.

As a radio astronomer, it is a must for me to see the radio telescope when I am at a radio observatory; therefore, we asked for a quick tour of the Haystack 37-m radio telescope. Being equipped with both transmitters and receivers made it a unique antenna, which was able to work as either an active radar or a passive telescope. It was in a surprisingly good condition although it was built decades ago. The continuous maintenance and upgrade should be a paradigm for other VLBI stations.

My favorite check-it-out duo: Mike Poirier and Rich Strand.

The workshop lunch every day was good. The athletic girl caterer with a charming smile always assured us the food was healthy. Although I adapted to western food very well, my Chinese colleagues and I were frustrated by too many sandwiches and rolls. However, the stewed beef on one of the days conquered our picky stomachs. It was my best taste memory at Haystack.

Enounter with a barefoot science student at the Great Court.

Having soaked up VLBI technicalities deep in the forest for almost a week, we eventually decided to visit the owner of Haystack and the cradle of scientists and engineers: MIT as a pilgrimage. Indeed, you should not be surprised by seeing a barefoot science student in this cradle.

Finally, it was very hard for us to say farewell to Haystack, to MIT, and to Boston. For me, TOW2015 was far more than a VLBI workshop to transfer knowledge or build up collaborations between global VLBIers; it was a life experience!

Big thanks to the workshop organizers Heidi Johnson and Dirk Behrend and to all the workshop speakers, without whom the TOW cannot carry on its excellence.

Home team win is a must when TOW is present.

Cinco de Mayo has female Red Sox fans patrolling Fenway Park in sombreros.

GSI Retires GARNET Gem, Establishes Ishioka as VGOS Jewel

– Ryoji Kawabata, Geospatial Information Authority of Japan

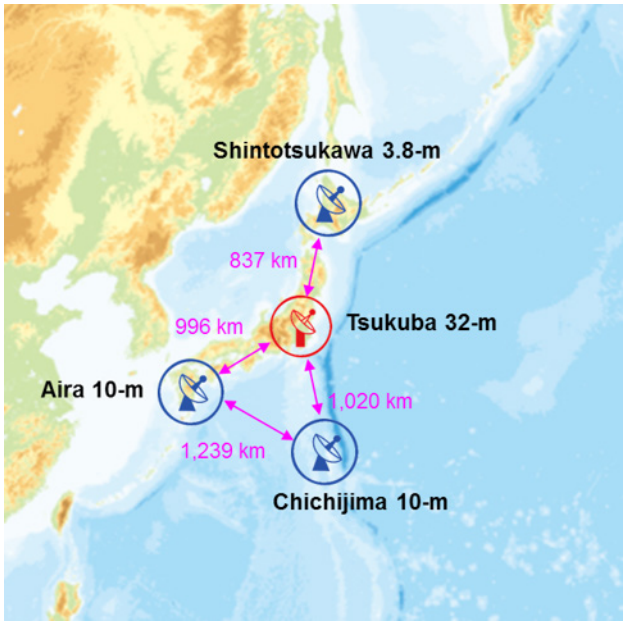
The smaller GARNET stations Shintotsukawa 3.8-m (left), Aira 10-m (middle), and Chichijima 10-m (right).

The Geospatial Information Authority of Japan (GSI) has been operating geodetic VLBI since the 1980s. From 1986 to 1993, a transportable VLBI instrument with a 5-m telescope was used in conjunction with the Kashima 26-m telescope (see the August 2003 issue of the Newsletter) to perform VLBI observations at a number of locations in Japan. In the late 1990s, GSI installed four stationary VLBI antennas in Japan: the Shintotsukawa 3.8-m (1995), Aira 10-m (1997), Chichijima 10-m (1997), and Tsukuba 32-m telescopes (1998)—forming a domestic VLBI network called GARNET (GSI Advanced Radio telescope NETwork). The 32-m telescope at Tsukuba, about 50 km northeast of Tokyo, has observed in many IVS sessions owing to its high sensitivity and fast slewing rate. Tsukuba has become one of the cornerstone VLBI telescopes in the IVS observing program.

The smaller GARNET telescopes initially participated only in the Japanese domestic VLBI sessions named JADE (JApanese Dynamic Earth observation by VLBI) together with the Tsukuba 32-m telescope. The JADE sessions, whose purpose is to monitor the plate motions around Japan, have been scheduled, correlated, and analyzed by GSI on a monthly basis. From 2008 onward, the three smaller telescopes have been added to other IVS sessions such as the global IVS-T2s and the regional APSGs. Thus, the smaller antennas have contributed well to the IVS. Between 1995 and 2015, Shintotsukawa observed in 110 IVS sessions, Aira in 213 sessions, and Chichijima in 196 sessions. Another point worth mentioning is that Aira observed in the IVS-R1 sessions for about six months in 2013 replacing Tsukuba which was down for rail track repair. In addition, we have performed co-location surveys at the regional sites in order to measure the local ties between VLBI and GNSS. These results have been submitted to the IERS in order to contribute to the construction of the ITRF.

In 2012, GSI started to discuss the continuation of the GARNET telescopes, because the maintenance and repair costs were getting higher due to aging systems. Another factor was the need to secure funds for the operation and maintenance of a new VGOS telescope in Ishioka. Furthermore, the dense GNSS network of GSI (GEONET), composed of about 1,300 GNSS antennas covering Japan, had become able to monitor the crustal movement of Japan instead of VLBI. Given all that, it was decided to first stop the operations of the Shintotsukawa telescope (in December 2013), because it was the smallest of the GARNET telescopes and not operational in winter due to heavy snow. We then finally decided to retire the telescopes at Aira and Chichijima in March 2015. This more or less coincided with the start of operations of the new Ishioka station.

At about the same time a new project started in the Asia-Oceania region: the activities of the Asia-Oceania VLBI Group for Geodesy and Astrometry (AOV). GSI is now actively involved in the AOV activities using both the Tsukuba 32-m and the Ishioka 13-m telescopes. Once Ishioka becomes fully operational for VGOS observations and following a sufficient overlap operation with Tsukuba, we will cease operating the Tsukuba telescope with its role taken over by the Ishioka telescope. Then all GARNET telescopes will have been retired and GSI's VLBI observations will be concentrated at Ishioka.



Geographical distribution of the GARNET stations.

Getting VGOS Ready

– Rich Strand, NVI, Inc.

The classes that Mike Poirier and I taught during the Technical Operations Workshop (TOW) held at MIT Haystack Observatory during the first week of May 2015 seemed to hold the attention of the students this year. The main reason was the addition of new VLBI observing techniques for VGOS (VLBI Global Observing System). This article describes the basic material in the classes that we taught during TOW 2015 and "How To" get ready and understand the VGOS operations when it comes to your station.

In order to reach measurement accuracies of 1 mm in position and 0.1 mm/yr in velocity for the IVS network, the VGOS will switch from the legacy S/X-system with 24-hour sessions using large telescopes to a broadband digital backend receiving system with smaller, fast-slewing antennas. Currently, MIT Haystack Observatory (using the Westford station) and Goddard Space Flight Center (using GGAO) are testing VGOS using the RDBE (ROACH [Reconfigurable Open Architecture Computing Hardware] Digital BackEnd). The RDBE will replace the video or baseband analog converters in the DAT rack, which we now have at many stations, and sample directly from the receiver IF outputs. The VGOS receiver will provide four 512-MHz-wide channels configured for linear X and Y (H and V) to the four RDBEs by new UpDown converters. The Mark 5 has been replaced by the 16 Gbps next-generation disk-based recording system Mark 6.

The PC Field System (FS) has been updated to support VGOS; however, the new Pre-Check procedures are still under development. Each RDBE has a server, which the FS verifies to be ready, to load the firmware that sets up the logic in the ROACH board. The Mark 6 control programs cplane and dplane are then initialized. The FS sets time as normal using FMSET for each RDBE unit, and each RDBE has a monitoring program available that provides system time, Tsys, and PhaseCal rail display. Pre-checks continue using the normal station check-off list such as Fivept and Onoff used to test the telescope pointing and overall sensitivity. The Mark 6 recorder is verified to be operational with a test recording.

The innards of the RDBE.

VLBI operations are expected to change under VGOS. The normal 24-hour session using the present 14 channels in two microwave bands during the experiment will change to observing continuously using four 512-MHz-wide bands and quickly going from source to source. Hopefully this will also solve the RFI problems we now have at many stations causing lost channels using bandwidth synthesis and provide a long-term operational program for the IVS community.

It is expected that there will probably be both legacy VLBI and VGOS observing for the IVS until full deployment of the new system is completed. Station staff now scheduled for the VGOS upgrade can expect to install a new four-channel linear X and Y (H and V) cryogenic receiver, UpDown converters, a digital backend that will replace your current Mark-4/VLBA rack, and the new Mark 6 data recorder that will replace the Mark 5s. VGOS specifications also calls for a fast slewing telescope. The Field System currently supports VGOS using the standard 24-hour observing sessions, but the operational guidelines might change once the testing is completed and the analyses verify that the new VGOS data provides a useable measurement set for determining the Earth Orientation Parameters.

Upcoming Meetings...

XXIXth IAU General Assembly Honolulu, HI, USA August 3-14, 2015	VLBI Training School Hartebeesthoek, South Africa March 9-12, 2016
AGU Fall Meeting San Francisco, USA December 14-18, 2015	9th IVS General Meeting Johannesburg, South Africa March 13-17, 2016

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

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Please send contributions to
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All Aboard!

– Dirk Behrend, NVI, Inc.

The IVS Directing Board met for its 33rd meeting in Ponta Delgada, Azores, Portugal at the Direção Regional das Obras Públicas e Comunicações (DROPC) of the Government of the Azores. This was the first Board meeting after the recent Board elections (see the April issue of the Newsletter) and both the new Board and the outgoing Board members were invited to participate. The outgoing Board members (Hayo Hase, Fengchun Shu, and Shinobu Kurihara) were presented with commemorative plaques (Kurihara-san in absentia). Harald Schuh announced that his term as IAG Representative on the Board would end with the IUGG General Assembly in Prague in June 2015 and that the IAG would determine a successor to Harald on the IVS Board at its Prague meeting.

The Board approved the establishment of a WG on Satellite Observations with VLBI to be chaired by Rüdiger Haas. This new WG will be denominated as WG7. Daniel MacMillan presented a proposal for a new WG on Galactic Aberration. The purpose of this planned working group would be to investigate issues related to incorporating the effect of aberration into IVS analysis, to consider arguments regarding a redefinition of the ICRS to account for aberration, to investigate what value of secular aberration to apply in an a-priori model of aberration, to study the problem of the effect of aberration on the radio-optical tie, and to formulate a recommendation to be conveyed to the IAU. It is anticipated that the aberration WG will be officially established at the next Board meeting in October 2015 in Penticton, BC, Canada. The Penticton Board meeting will be preceded by a planned two-day retreat of the Board plus selected invited guests. A major goal of the retreat is to develop a strategic plan on where the IVS should be in 2030 and how to get there.

We would like to thank Luis Santos and his team at DROPC for the excellent organization and great hospitality. Muito obrigado!

Second VLBI Training School to be Held in South Africa

– Rüdiger Haas, Onsala Space Observatory

The IVS Committee for Training and Education (IVS CTE) currently puts together the program for the 2nd IVS VLBI School. It will be held March 9–12, 2016 at HartRAO in South Africa, just before the IVS GM 2016 meeting. The previous VLBI school in 2013 attracted more than 40 students, so we anticipate again a similar number of students, or maybe more. Since 2013 the development of VGOS proceeded dramatically and, for instance, several dedicated VGOS radio telescopes have been built and VGOS technical equipment has been developed. Thus, the upcoming VLBI training school will try to prepare the young researchers for the upcoming VGOS era and to educate them in using this novel technical equipment and to guide them towards the new and advanced research that can and will be done with VGOS. To arrange the training school in connection with the 9th IVS General Meeting in South Africa is the perfect arrangement and will pave the way for a wide international participation of students and young researchers.

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