IVS NEWSLETTER

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Down South

While the astronomy community assembles in South Africa for its triennial meeting, we feature the VLBI station at Katherine to make this part of Terra Australis more known. The cover image shows part of the southern sky over Katherine. For TOW 2025, VLBI folks will come together at a rather well-known location. More information is provided inside this edition.

Inside this issue

Election Season Is Coming

Dirk Behrend, NVI, Inc./NASA GSFC

It is that time again. The IVS will close out the year 2024 with elections for five positions on the Directing Board for the governing period starting in February 2025. One of the first actions of the new Board will be the election (or reconfirmation) of the IVS Chair for the next four-year period. The positions to be refilled include two Representative and three At-Large positions. In the Representative category (four-year term) the positions to be renewed are: one of the two Network Representatives (currently held by Pablo de Vicente) and one of the two Analysis Center Representatives (currently held by Oleg Titov). In the At-Large category (two-year term) the three incumbents are Hayo Hase, Masafumi Ishigaki, and Fengchun Shu; both Masafumi and Fengchun are eligible for re-election.

The plan is that the current Board will name an Election Committee that will distribute a call for nominations as well as detailed information about the election procedure in September/October 2024. Now is the time for the IVS community to get prepared and to consider current and/or new nominees for the five positions. Keep in mind that the nominees need to be IVS Associate Members. Therefore, ensure that the membership list is up-to-date and contact the Coordinating Center if an update is needed. You can find a copy of the list as well as how the Board is composed (with affiliation and term information) on the IVS website.

AuScope's Katherine Station

The Australian continent meanwhile features three operational VGOS stations that are distributed strategically over its landmass. The northernmost point of this Australian triangle is located in Katherine, Northern Territory, while the central management facility for the entire AuScope array lies in the far south at the University of Tasmania in Hobart. This setup poses some interesting logistical challenges. Newsletter editor Hayo Hase interviewed Jamie McCallum, the AuScope VLBI Array Manager, to learn more about the station's history and its current status. The exchange was slightly edited for clarity and brevity.

Katherine telescope at night (credit: Shelley Urquhart).

Jamie, where and what is AuScope? What is the role of UTAS?

The AuScope array consists of three 12-m telescopes, built as a dedicated geodetic array for the Australian continent. There are three of these antennas in Hobart (Tasmania, co-located with the Hobart26), Katherine (Northern Territory), and Yarragadee (Western Australia, co-located with the MOBLAS5 SLR site).

The AuScope project commenced in 2007, supported by an NCRIS (National Collaborative Research Infrastructure Strategy) grant. Jim Lovell was the project leader at UTAS and organized the site selection and overall design of the telescope systems. With wideband feeds and sampling systems still in development, the original design used S/X feeds on the 12-m Az/El telescopes supplied by COBHAM—these have a jackscrew design and "slow" slew speeds of 5°/s in azimuth and 1.5°/s in elevation. We joined in regular IVS observations from 2011 and built up our expertise and research group over the next few years. We then began the development of the VGOS system in 2015 with a prototype receiver and DBBC3. After some design iterations and troubleshooting, by 2017 we were able to install this on the Hobart12 permanently. Katherine followed in 2019; and Yarragadee was upgraded at the end of 2023 after the COVID disruptions and some problems during the installation.

What were the criteria for selecting the Katherine site?

The AuScope sites were selected based on the array geometry, site geology, and, most critically, the availability of power and networking infrastructure. The Katherine telescope is located on the Katherine Rural Campus which is operated by Charles Darwin University (*http://www.cdu.edu.au/locations/katherine-campus*). They've been very helpful to us throughout with giving us Internet access through their network, providing accommodation, and assistance from local staff.

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When was Katherine built and put into operation?

The construction started in 2010 and we were operational in 2011, although we were still shaking things out. The tropics are very hard on equipment, and we did have a few failures due to overheating, condensation, or during power outages. Or wildlife—we did have one power supply fail after a young grass snake crawled inside and some climbing frogs seemed to confuse the telescope for a tree…

How far is Katherine from Hobart? Who is part of the VLBI team? And how well does the remote operation work?

Getting to Katherine from Hobart takes about a day and a half, as there's at least two stops and six hours flying and then three-and-a-half hours driving from Darwin to Katherine. When we're making a site visit, it's two people at least between Brett Reid, Warren Hankey, and myself. We stay on site at the CDU Rural campus and work with our local support people as well, who are handling the regular station checks and module/disk shipping. We've moved to recording on a Flexbuff, but we're still shipping sets of hard drives/SSDs back to Hobart for e-transfer. When the fiber comes in, things will be a lot simpler (I hope). But for the majority of the year, it's operated fully remotely with no VLBI personnel on site.

How do you deal with technical problems over such a distance? Do you travel frequently to the site?

A lot of the early design work went into building up a robust remote operations model. All the critical devices are backed up with network-controlled UPS systems and switches. We also have a lot of monitoring through sensors and remote cameras. The sites have generator backup too, which is essential for Katherine where there are quite frequent outages. We've also been very fortunate in having excellent local support from CDU staff and ex-staff who live in Katherine. That said, we make one or two in-person trips a year for maintenance and repair.

Over time several upgrades and technical improvements have been made. Tell us about your success in modernizing Katherine!

Katherine telescope and an approaching storm.

The S/X receiver came out of Katherine in 2019 and was replaced with the wideband receiver and DBBC3 to enable VGOS and AUS mixed-mode observing. It took a while to get everything working due to an RFoF unit failing and restricted travel during COVID, but we've finally joined the regular VO sessions. We're still reliant on shipping for data transport (although we do send it via Hobart than going overseas), but the next big change will be when the fiber optic connection becomes available in the next 12 months or so.

(continues on p. 9)

IVS Network Corner

Alexander Neidhardt, IVS Network Coordinator

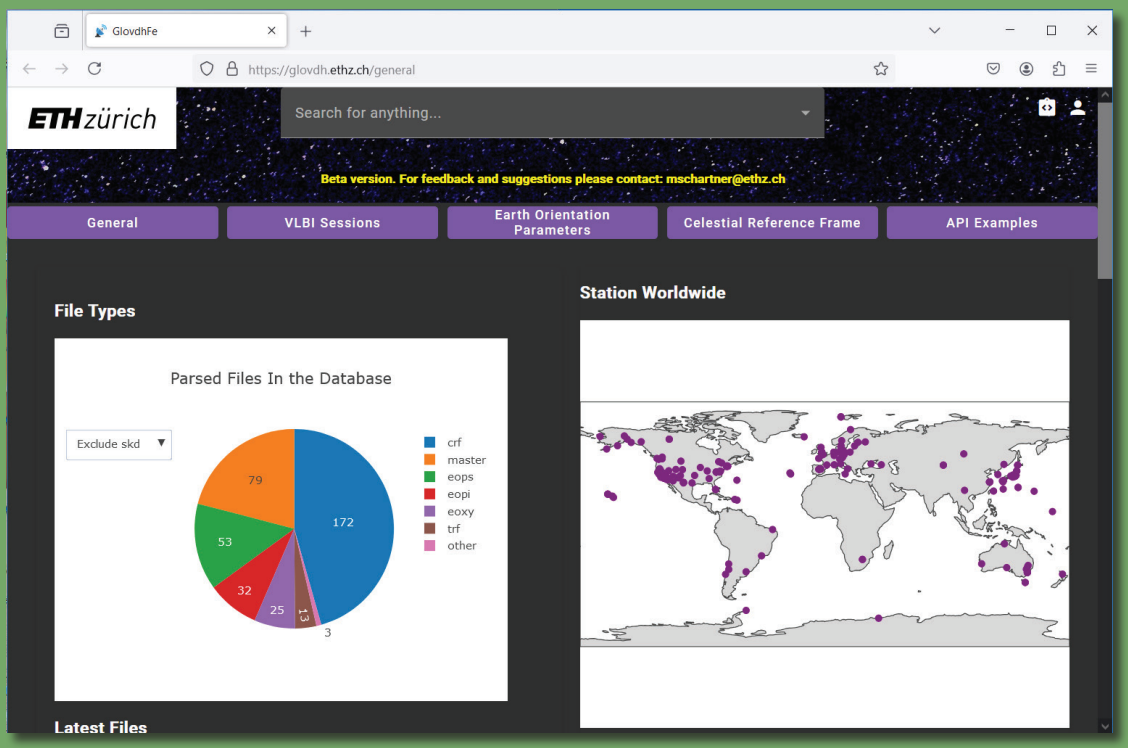
It is time again for a short look at the IVS station network. Thanks to the tireless efforts of the staff at the Network Stations, the IVS can look back on stable products. Meanwhile, the number of antennas participating in VGOS sessions is almost comparable to regular legacy observations. While legacy products like the 24-hour R1/R4 sessions have a turnaround time from observation to finished product of less than two weeks, VGOS struggles to cope with the large amount of data for a fast turnaround. Most VGOS sessions cannot be finalized within a month. Security constraints in computer networks are becoming more and more of a challenge. VGOS devices are currently not as fault tolerant as legacy technology and require more IT knowledge. Therefore, the cadence of the VGOS sessions can only be increased carefully. Other issues, like the wildfires near Kokee, are fortunately much rarer events.

But there are new ideas to increase the resilience of Intensive sessions. One idea is to use different VGOS and/or legacy S/X baselines every six hours, so that the failure of one antenna does not endanger the entire product series (here: UT1-UTC). Using AUS mixed mode becomes more and more relevant in this scenario. Another discussion is underway with the IERS Combination Centers, as they request to change the start time of the VGOS-OPS sessions to 00 UT to simplify the combination work with other techniques. A concluding decision is still pending. Nevertheless, automation will become more and more important to avoid constraints stemming from personnel planning.

VGOS frequency tests are ongoing, and the first results should be available soon. The right frequency selection might simplify the procurement of feeds and accompanying frontend filters. Frequencies also play a large role for co-location with DORIS and other techniques such as terminals for ACES (Atomic Clock Ensemble in Space), which is under investigation at Wettzell, or for GENESIS. The support for GENESIS plays an essential role, exemplified by IVS joining a kick-off meeting with ESA's Genesis Scientific Exploitation Team (GSET) just recently. The team will provide advisory support for things like maximum transmission power, frequency use in VGOS backends, and possible workflows.

New VGOS sites coming online soon are Matera and Metsähovi. Therefore, it is necessary to plan the DOMES and CDP numbers and other official registrations. While this was spearheaded by Axel Nothnagel and then transitionally by Dirk Behrend so far, it will be managed by the Network Coordinator going forward. I will re-establish contacts with the site responsible and work on naming new antennas by filing the official forms. Additionally, historic gaps will be filled by registering existing sites currently lacking official DOMES and/or CDP numbers.

Special activities. There is a nice development with respect to feedback to and success analysis of the network. Matthias Schartner (ETH Zurich) got funding for software development to parse available station, correlator, and analysis files offering to display existing content graphically on the webpage *https://glovdh.ethz.ch/general*. The software and page are still under development,



Screenshot of the GLOVDH Restful API under development at ETH Zurich.

but it already offers a nice way to get feedback about performance and session results. The final webpage will be hosted at ETH Zurich and TU Munich.

Related to this, the log file parser and parts of the RFI monitor have been extended, so that this utility can finally be installed on a server at TU Munich—which is currently underway. The parser will offer feedback for each station directly after each session using log file content. It will be combined with the webpage described above.

The questionnaire for correlator staff and about updating the Network Configuration Files is still under development and is planned to be put onto the new server. Contact to possible new sites will also be established.

At the last Technical Operations Workshop (TOW) station staff identified the coordinated use of web services as an important element. To address this major task, the consensus was to start a group for web presence. The idea is to use *vlbi.org* as a centralized link collection and research possibility to address other web content of the IVS, like the IVSCC and CDDIS web pages, GIT repositories, and other file collections on the web.

What else? Please take note of upcoming workshops that might be of interest to your station staff. This includes the 9th International VLBI Technology Workshop (October 2024) and the 13th TOW (May 2025), both at MIT Haystack Observatory.

Evaluating PCAL in Your Control Room

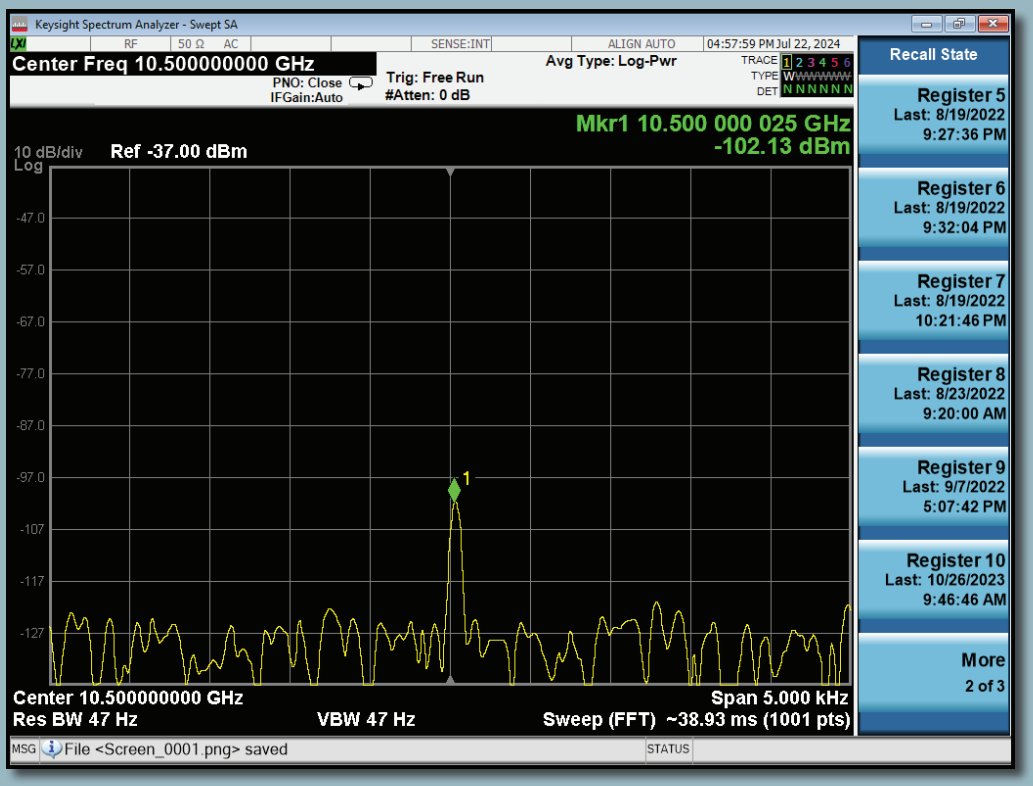
Mike Poirier and Alex Burns, MIT Haystack Observatory

PCAL (or "phase calibration," "phase cal," pcal) is an injected signal at your feed which is comprised of narrow tones every 5 MHz (or 10 MHz, depending on your unit) throughout your observing band. This critical signal allows the analysts to measure the phase of the RF signals received by your telescope and facilitates the correlation of signals and generation of fringes. It is vitally important that the phase cal is confirmed before each session and is found to be at the appropriate amplitude levels throughout each band and each polarization of your system. At Westford, for example, we come down on four single mode fibers, with one fiber each per polarization, and split into a high band and a low band which is connected to our RF distributor.

There are multiple ways to confirm these signals being present. One simple way is by using the Field System, which has a monitoring window that reports your pcal amplitude and phase for RDBE (a great quick check, coming soon for R2DBE).

The second way is by using a Python engineering utility called "mona" (or "monb," "monc," etc. for the bands you want to inspect). This is a direct connection to the digitizer and checks both the IF spectrum and the PCAL tones. This utility should not be left running: it should be used only as a snapshot view of the system and then shut off.

Both methods are good software interpretations. But we have found cases in which further investigation and troubleshooting is needed to confirm that the PCAL signals do actually exist throughout all signal paths.



Sample screenshot of a spectrum analyzer for one pcal tone.

(continues)

To institute a "live view" similar to that, we can use the spectrum analyzer to inspect individual pcal tones. Remember, there is a tone every 5 MHz throughout your observing band. The peak value itself is not as important as learning what is normal or usual for your system. Because of our configuration at Westford, we measure in four connection points at the output of our RF distributor. Our low band is 2.2 to around 5 GHz, and our high band is from 4.5 to 12 GHz. I am attaching a picture of one pcal tone; but the idea here is to measure tones throughout your frequency band, especially in the frequencies that you will be observing. This signal level data will give you a great benchmark in detecting problems within your receiver system.

You can see the settings in this screen capture that you can use on your spectrum analyzer. Let me point out a few things: First of all, you will notice the span is very small. The signal we are looking for is relatively weak or even not noticeable if you are looking across a wide span. You can also see that we have adjusted the video bandwidth of the scope for this narrow span. We have removed all attenuation in the instrument, and we are implementing some averaging to help us see the signal out of the noise. If you are a wizard with LabView or similar, you can also do as some at Haystack have done—create a routine that controls the spectrum analyzer, steps the instrument through your frequency band at close intervals, and records the peak value of the 5-MHz tones. These can then be plotted to make comparing the data week-to-week easier. By using a real live view like this, you can be certain that the signal is present in your system and will be found by your correlator.

2024 Meetings

6–15 August	IAU XXXII General Assembly, Cape Town, South Africa
14–15 August	Focus Meeting 11: Multi-wavelength Astrometry, Cape Town, South Africa
10–11 October	GGOS Days 2024, Potsdam, Germany
21–23 October	9th International VLBI Technology Workshop, Westford, MA, USA
9–13 December	AGU Fall Meeting, Washington, DC, USA

2025 Meetings

6–9 April	27th EVGA Working Meeting, Matera, Italy
27 April–2 May	EGU General Assembly 2025, Vienna, Austria
4–8 May	Thirteenth IVS Technical Operations Workshop, Haystack Observatory, Westford, MA, USA

The "TOW-Together Zone" for VLBI Folks

Alexander Neidhardt, TU Munich, and
Chet Ruszczyk, MIT Haystack Observatory

Every odd-numbered year, a very special event takes place that draws VLBI station operators from all over the world to a specific location in the US—the MIT Haystack Observatory at Westford near Boston. The reason for the joy of traveling is the Technical Operations Workshop (TOW). From the first workshop in 2001, the courses and training material have undergone a great evolution reflecting the fast-changing world of VLBI technology. But while other workshops are filled with series of presentations, TOW focuses on practical training and skills development for station personnel and operators. For them, being flexible has always been a necessity when dealing with technical requirements. This has become even more important in the era of broadband VLBI with its high sampling rates and highly digitized workflows. TOW has always been a great help and inspiration. For that, the next installment of this workshop is on the horizon in the coming year (May 4–8, 2025). We anticipate that it will again attract interested people from all IVS stations worldwide for a special feeling of "TOW-getherness."

Everyone who works at a VLBI station should save the dates. This is especially true for newcomers to the IVS family. In addition to the practical operations, hands-on approach, and inclusion of almost all facets of VLBI technology, the social aspect of getting in contact with the global partners is not to be underestimated. Therefore, try to convince your station chiefs and managers to support this ideal way of exchanging experiences and learning from experts, because VLBI only works as a network.

In May 2025, another incarnation of the special "TOW-together zone" will be upon us.

Rest assured that others are struggling with the same or similar problems and challenges.

The organizers offer different types of courses. Operations Workshops are hands-on sessions with a maximum of about 5 participants each. Each member of the class will have an opportunity to participate actively in the training. Maintenance Workshops are presentations to an audience of 10–20 people. The classes will begin with instructions and demonstrations, and there may be some training portion as well. A large fraction of the time is allowed for discussion. Seminars are presentations including demonstrations to an audience of 20–60 people, depending on the topic at hand. Finally, lectures are intended for a general audience. The subject matter includes topics that are of interest to everyone and include announcements or information that everyone should be aware of.

We are sure that the TOW is a great experience for station folks who will return to their stations with a better understanding of what good VLBI operation is all about.

(continued from p. 3)

What is the climate like at Katherine throughout the year? Would it be a nice spot to visit on a trip through Australia?

It's in the tropics, so there's a very clear wet season (spring/summer) and dry season (winter/autumn). But being inland, the wet season humidity is more like 80% rather than 100% at ~35°C... So, we normally try to go in the dry season. It's fairly close to Nitmiluk National Park (Katherine Gorge) and Katherine's a major center for the Northern Territory.

On a more personal note, what are your leisure activities when in Katherine or Hobart?

Since having kids, I've started traveling with one of their toys so I can send photos back when I'm away. Looking out for interesting spots for a shot has meant I've seen a bit more of the campus now. Otherwise, it's mostly just trying to cool off.

Traveling rainbow slug toy exploring AuScope's nature.

Increase of Intensive Data Rate

Dirk Behrend, NVI, Inc./NASA GSFC

On July 1, the data rate of the legacy S/X Intensive series IVS-INT-1 and IVS-INT-00 ("midnight Intensives") was changed from 256 Mbps to 512 Mbps. The first session with the doubled rate was i24183. The change holds true for sessions run on the baseline Kk–Wz; however, any Intensives using the baseline Mk–Wz retained the lower rate. The data rate for the IVS-INT-1 may have to be scaled back temporarily to 256 Mbps (to fulfill timeliness requirements when copying data to disk for physical shipment), because wildfires at Kokee Park severed the station's fiber connection. Once the fiber is restored, the IVS-INT-1 will use the rate of 512 Mbps.

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 the General Editors; the deadline is one month before the publication date. The editors reserve the right to edit contributions.

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