IVS NEWSLETTER

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Noto Radio Observatory

The Sicilian Connection

The Godfather of the digital backend ended his official working career; he now concentrates on his lab in the hat. The VGOS spectrum got wider with efforts underway to protect its frequencies against unwanted electromagnetic radiation. A new VGOS antenna was erected in Southeast Asia and saw first fringes. It is anticipated that it will put West Java onto the IVS map.

Gino Tuccari Retires as IVS Technology Coordinator

At the end of January 2026, Gino Tuccari retired from the Istituto Nazionale di Astrofisica (INAF) and stepped down from his official position as IVS Technology Coordinator. Nevertheless, he will continue to make his dough at HAT-Lab (and not at Papa Gino's, a regional pizza restaurant chain known as the "Official Pizza of New England" which former TOW participants may be familiar with, including Gino). At any rate, on the occasion of recent events, Newsletter editor Hayo Hase interviewed Gino via email to get his take on the status and future prospects of VLBI technology but also to find out about the origins of Gino's passion.

Gino, how did you get in contact with VLBI, radio astronomy, and/or geodesy?

There are moments where I think that it all began when I was eleven years old. It usually starts to become clear at that age what your interests in life are. I was curious and fascinated by the "mystery of radio" and the mechanisms behind it. I tried to absorb everything I could and built my first radio using some self-built coils and parts from old electronic devices bought at second-hand shops. It was an unexpectedly great success at my home and for my mind.

This was the origin; the rest happened almost automatically. I started buying all the electronic magazines, books, and similar materials I could afford and built a small but efficient laboratory in my room. At university, I studied physics with a specialization in electronics. After that, I spent four years at STMicro-electronics working in the CMOS and LPS-TTL devices field.

However, in the latter part of 1988, the Noto VLBI

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radio telescope (then belonging to CNR, since the 2000s to INAF) was coming into operation. I knew that they would be looking for personnel to operate it. The station was quite far from my home (more than 100 km) with slow roads that required almost two hours of travel each way. Without hesitation, I applied and was selected on 30 December 1988; my VLBI story began right then and there.

We met for the first time some 34 years ago at Noto station, where I noted your big passion for electronics. What fascinates you about it?

For an electronics enthusiast, working at a VLBI station is like being a child left alone in a toy store: the highest technology in the radio field is literally at your fingertips. The large radio telescope is a powerful emotional cathedral, a means of connecting with the universe. Its ability to have two focal points, one at infinity and the other close to the observer, represents a clear demonstration of this connection. This capability deserves the utmost scientific and technical efforts to respect the information that the universe can provide.

The receivers—for me that is everything from the telescope focal point to the type of information we want to use, from a paper recorder plot to VLBI images—are worthy of attention and great care. I felt the need to contribute to these efforts as best as I could.

In the early 2000s, you were thinking about building fully digital baseband converters (DBBCs). What inspired you?

I have been asked this question several times, and I am always surprised, because to me the opposite seemed more obvious: Why had it not been done before? The real question, in my view, was "how" to do it.

In this respect, I suppose I should thank the distance between Noto station and my home: three-and-a-half hours of driving every day gave me plenty of time to think things over. The answer to "how" emerged precisely from this spare time.

DBBC backends are now commercially available in the 4th generation from HAT-Lab in Italy. VLBI is a fairly small market, but today DBBCs are widely used around the world. What were key moments in your career working at different places in different functions?

In the 1990s, my activities were dedicated to Noto station, focusing on the development of instrumentation and supporting VLBI observations to improve their quality and reliability. After its first implementation within INAF in the early 2000s, the development of the DBBC project evolved into a collaboration between the Istituto di Radioastronomia, the Max

Outgoing IVS Technology Coordinator Gino Tuccari.

The BRAND-EVN team at work: Michael Wunderlich (front), Gino Tuccari (center), and Sven Dornbusch (back).

Planck Institute for Radio Astronomy (MPIfR), and HAT-Lab srl (https://www.hat-lab.cloud/), which was founded as an INAF spin-off company in 2009. To realize an instrument that could be produced and deployed within the VLBI community, a research institution alone was not the most appropriate framework, whereas a small commercial company appeared more suitable. As you mentioned, the VLBI community represents a very small market; so a significant degree of collaboration was necessary to support further developments and the growth that the community was seeking.

Following the first DBBC and DBBC2 implementations, the DBBC3 and BRAND-EVN projects were financed and supported by the European RadioNet programs. This was followed by financial support for DBBC4 from RadioBlocks and the Max Planck Society. Still in the 2000s, I split my activities among the development of the DBBC projects in Noto and Bonn, working with the laboratory groups at both sites, the management of the Noto station (until 2015), and the support of the HAT-Lab spin-off company. Since then, my activities have been mainly based at the VLBI laboratory of the MPIfR in Bonn.

What are the advantages of your DBBC compared with other backends?

I do not like to make comparisons, as they are not particularly useful. It is better to speak in terms of compatibility. To be compatible, different systems should aim to maximize their flexibility. The DBBC family of devices has always followed this approach, and for this reason the hardware was developed to be programmable and capable of accommodating multiple observing modes, ranging from full-band DSC (Direct Sampling Conversion) to wide-band OCT (Octopus Mode), and including the more "traditional" tunable narrow-band DDC (Digital Down Converters) and the fixed narrow-band PFB (Polyphase Filter Banks) modes, all with the

Gino giving a talk at GM2018.

maximum possible bandwidth coverage in order to meet a wide range of requirements.

DBBC2 is still widely used today within the EVN network and for IVS legacy observations. DBBC3 will soon be adapted for use within the EVN as well, while it is already widely employed in VGOS and in OCT mode for Event Horizon Telescope (EHT) and mm-VLBI observations. An increasing number of tri-band receivers will also make use of DBBC3. DBBC4 is now almost fully developed and, either as a complete system or through selected components, can provide unprecedented performance for any VLBI network.

I should add that, beyond the current hardware performance, what I consider truly important is the fact that the DBBC family supports continuous development and ongoing improvements to the existing hardware, firmware, and software. Perhaps this is what really makes the difference.

When the IVS developed the VGOS ideas, your expertise was part of the mix. Then, from 2015 to 2025, you served as the IVS Technology Coordinator. How did you experience the IVS community? What do you remember most?

The experience as IVS Technology Coordinator was very important to me. And I hope this is a mutual feeling. My main goal was to try to harmonize the hardware differences that were present among the VLBI stations. As you are well aware, VLBI networks include different antenna types, different receivers, different backends, different recorders, different phase-calibration systems, and—particularly true for the IVS—the coexistence of two network types: legacy and VGOS.

Achieving harmonization is, therefore, a challenge, but it is also part of the beauty of the VLBI world. We may have different tools and, at times, different opinions, but we share common goals. This has kept us connected in a friendly and collaborative manner for decades, producing valuable and irreplaceable results.

The Noto antenna at night.

The experience gained as VTC Chair, in conjunction with the IVS Technology Coordinator role, was an additional enrichment, thanks to the broader perspective it offered. As Technology Coordinator, I hope that I was able to provide effective support to those who sought assistance, whether during the TOW workshops or at any time throughout our day-to-day activities.

Where do you see possible improvements and further developments of the VLBI hardware?

I see significant room for improvement and adding new capabilities to the existing VLBI hardware. Receivers and data-acquisition hardware have already improved greatly, and, with reasonable coordination, they could support a high degree of flexibility to cope with increasingly challenging RFI conditions. The frequency window could be fully received and sampled, with the selection of the usable portions being dynamically adjusted according to the RFI conditions at the different stations to achieve the best common observing configuration. An automatically generated *a posteriori* schedule could then support the correlation process. Relatively low-level AI techniques could enable such functionality.

As of today, AI applications are under development aimed at mitigating the RFI contribution in VLBI observations using hardware-based neural networks. Embedding such capabilities directly into the VLBI acquisition chain would allow these functions to be implemented as firmware and software applications, similar to how different programs are used within a standard computer environment. This opens a new era of possibilities, including the detection of peculiar natural (and potentially artificial) signatures embedded in the noise.

Looking further ahead, one could also imagine a new class of local antenna arrays for next-generation VLBI geodesy, enabling very fast electronic beam steering—much faster than what is currently achievable with VGOS antennas. Much more can be envisaged, without real limits, provided that good coordination of funding and efforts can be ensured.

Many of us had the pleasure of knowing you as a helpful expert, always listening to technical problems and having advice and solutions. On the occasion of your retirement, I would like to thank you for your kindness and wish you all the best for your future. This leads me to my final question: What are your plans for retirement?

At least for a few years following my retirement, I hope things won't change dramatically. I'm going to be an INAF Associate; and I have renewed my Guest Scientist contract with MPIfR in Bonn, where I will continue to work with the VLBI laboratory team. I will also take on the role of administrator and president of HAT-Lab to ensure continuity in the production and field support of the DBBC3, DBBC4, and BRAND receivers. While the development of new firmware and software versions for these systems will continue, I would like to further promote the design and realization of new instruments and tools in support of the geodetic and astronomical VLBI communities. In short, we'll likely meet again somewhere sometime soon, even if it is in a different role!

2026 Meetings

12–17 April 2026	14th IVS General Meeting, Garmisch-Partenkirchen, Germany
3–8 May 2026	EGU General Assembly 2026, Vienna, Austria
28 Sep – 1 Oct 2026	Tracking and Investigating Geodynamics and Earth Rotation (TIGER), Gävle, Sweden
5–7 October 2026	GGOS Days 2026, Gävle, Sweden
7–11 December 2026	AGU Annual Meeting (AGU26), San Francisco, CA, USA

Protecting Geodetic VLBI from Interference: Recent Progress

Hayo Hase, BKG

For more than five years, the IVS (together with the Committee for Radio Astronomy Frequencies, CRAF) has been working to secure greater protection against unwanted interference. Due to the increasing proliferation of mobile communications in the 2–14 GHz range and a growing shift from terrestrial wired communications to wireless communications via satellites in space, observational conditions and potentially the quality of results will deteriorate. Approximately 100,000 active satellites are projected to be in orbit by 2030; the application files for the period starting in 2030 already contain requests for 1,500,000 satellites.

Against this backdrop, it is essential for the IVS, as a passive user of the electromagnetic spectrum, to make its voice heard and articulate the need to protect its observations within the framework of spectrum management. VLBI is the only method capable of measuring the time difference dUT1 between the atomic clock time scale and the Earth's rotational time scale with high precision. This parameter directly contributes to the longitude of the ascending node, one of the six Keplerian elements required to describe the position of any satellite orbiting Earth. Thus, it would be unwise for the space industry to ignore the interests of geodetic VLBI.

Geodetic VLBI stations are globally distributed and simultaneously observe the same quasar. The network of VLBI stations thus constitutes one global sensor whose observation frequencies require identical protection in all three International Telecommunication Union (ITU) regions (Europe/Africa, the Americas, Asia/Australia/Pacific). Geodetic VLBI is classified as part of the Radio Astronomy Service (RAS). As the frequency allocations in the 3–14 GHz range are insufficient, geodetic VLBI is largely unprotected. This protection can be achieved only through an entry in the Radio Regulations of the ITU, which makes its decisions every four years at the World Radiocommunications Conference (WRC). The regional telecommunication unions are authorized to submit proposals on WRC topics; in turn, they review the national proposals and, if approved, advance them within the region.

The next WRC will take place in Shanghai from October 18 to November 12, 2027. At this conference, the agenda for WRC-2031 will be established. Proposals for the WRC-2031 agenda will be discussed at the national and regional levels in 2026 and early 2027. When doing so, the observation channels for the start and stop frequencies must be specified.

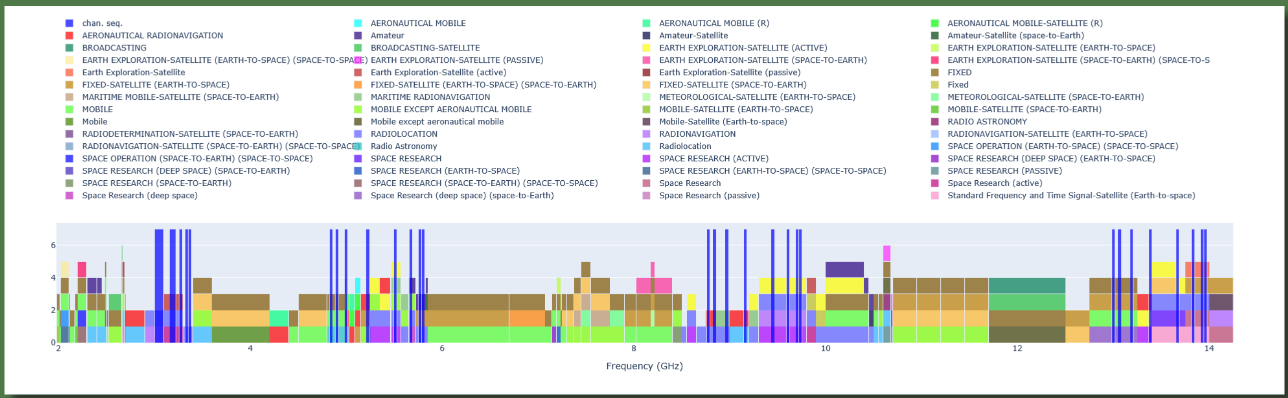
Since the start of VGOS observation activities work has been conducted in the 3.0–10.7 GHz range, because hardware developments in the U.S. made this range possible. Since then, the "benchmark" configuration has generally been maintained to integrate new stations into the network. However, this approach did not fully utilize the potential of the receiving equipment up to 14 GHz. In 2024–2025, test measurements up to 14 GHz were conducted for the first time, demonstrating that the reception range can be expanded accordingly.

The difficulty in defining frequency bands in the 3–14 GHz range (the 2–3 GHz range is already lost to VLBI) lies in the fact that the impact of foreseeable frequency allocations will become fully apparent at VLBI stations only after implementation—that is, when it is too late. At the upcoming WRC-2027, further allocations for mobile telecommunications in the 4.4–4.8 GHz and 7.125–8.4 GHz bands are expected. Consequently, legacy S/X VLBI observations in the X-band are likely to be affected after 2027, and VGOS should also avoid these bands. Based on existing VGOS experience and currently known future developments, a new VGOS frequency setup has been proposed that should be implemented and operational at all VGOS stations by 2028. On February 26, 2026, the IVS Directing Board adopted a resolution specifying these frequencies. In the run-up to this decision several fringe tests were conducted in Europe; these tests will be expanded to other stations around the world. (Should these tests reveal that some of the 32 channels need to be slightly shifted, efforts will be made to incorporate this into the spectrum management process.)

With the IVS decision on future VGOS frequency bands, spectrum management for VGOS can now begin with specific requirements. Germany has taken the lead on this initiative within the IVS. On March 5, 2026, the topic "Frequency protection for geodetic VLBI observations" was presented at the German national meeting on potential topics for WRC-31. The proposal is to be discussed at a roundtable involving several ministries, but there was general agreement to also raise this issue at the European level.

During the week of March 23–26, 2026, the meeting of Project Team C (PTC) "Mobile Satellite Service and General Issues" of the European Conference on Postal and Telecommunications Administrations (CEPT) took place in Edinburgh. "General Issues" covers future agenda items for WRC-2031. At this conference, Germany presented its proposal on "Investigations on the Protection of Geodetic VLBI." Because other European countries such as Norway, Sweden, Finland, Italy, France (Tahiti), Spain, and Portugal also operate VGOS radio telescopes, this proposal specifically addresses them regarding the protection of their own infrastructure. Most have already signaled their support, but there is time for internal national discussions until the next CEPT PTC meeting from September 21–25, 2026. The same applies to representatives from the participating industry companies, who are analyzing the potential impact on their activities.

For the first time in its history, the IVS has articulated its own interests in Europe and submitted a proposal for an agenda item at WRC-2031 to preserve its observation activities. For this initiative to move forward, it is of great importance that this proposal be submitted by countries with VGOS stations in other regions such as the Americas, Africa, the Asia-Pacific region, Russian-speaking countries, and Arab states. The IVS is taking on the task of mobilizing its network stations in this regard. Under the UN-GGIM Subcommittee on Geodesy, a "Frequency Protection" working group has been formed that is attempting to submit the



proposal for the protection of geodetic VLBI to the national spectrum administrations via the national mapping administrations.

The German input document “PTC(26)011” to the CEPT, which is publicly available, may serve as a guide for all stakeholders. It can be accessed at *https://cept.org/ecc/groups/ecc/cpg/cpg-ptc/client/meeting-documents?* under the tree >2026>PTC#4...Hybrid>Meeting documents>Input documents>PTC(26)011.

Board Endorses VGOS Frequency Sequence

On February 26, 2026, the IVS Directing Board adopted IVS Resolution 2026-01 to endorse the usage of a specific frequency sequence for future VGOS operations. A driving factor for fixing a sequence was to be able to pursue frequency protection steps with the International Telecommunication Union (ITU). The resolution is available on the IVS website at *https://ivscc.gsfc.nasa.gov/about/resolutions/IVS-Res-2026-01-VGOS-freq.pdf* and is reprinted below.

IVS Resolution 2026-01
Frequency Sequence for Future VGOS Operations

The IVS Directing Board proposes using the frequency channels listed in the table below for future VGOS operations. The frequency setup consists of thirty-two channels of 32-MHz bandwidth each, organized in four frequency bands. The frequency channels may be adjusted slightly to improve geodetic products; however, there is no guarantee to obtain frequency protection by spectrum management. The IVS Directing Board further requests that IVS components providing VGOS infrastructure take appropriate steps to use these frequencies operationally by 2028 as best as they can. Caveat: In the event that a band becomes unusable for the entire station network or major parts of it, for instance due to strong RFI, an alteration to the frequency setup may become a necessity.

Frequency Channel	Band-A f_{start} (MHz)	Band-B f_{start} (MHz)	Band-C f_{start} (MHz)	Band-D f_{start} (MHz)
1	3000.4	4824.4	8760.4	12984.4
2	3032.4	4888.4	8824.4	13048.4
3	3064.4	4984.4	8952.4	13176.4
4	3160.4	5208.4	9144.4	13368.4
5	3192.4	5496.4	9432.4	13656.4
6	3256.4	5656.4	9592.4	13816.4
7	3320.4	5752.4	9688.4	13912.4
8	3352.4	5784.4	9720.4	13944.4

New VGOS Radio Telescope Built in Indonesia

Tauriq Hidayat, ITB, and Jinling Li, SHAO

At Bosscha Observatory in Lembang, Indonesia, the Institut Teknologi Bandung (ITB) is developing a new VLBI research facility involving a new 13-m aperture VGOS radio telescope. With this facility, Bosscha Observatory will be able to join a global network of radio telescopes that operate synchronously to observe cosmic radio sources with high precision. This initiative underscores ITB's commitment to advancing cutting-edge astronomy and geodesy, while highlighting Indonesia's growing participation in the international scientific community. The construction commenced in November 2024, following an extensive period of preparation, and is presently approaching completion.

Indonesia's first VLBI radio telescope is being constructed through a collaborative partnership between ITB and the Shanghai Astronomical Observatory (SHAO) of the Chinese Academy of Sciences (CAS). This project is part of a broader cooperation framework between both governments, Indonesia and China, which has steadily advanced over the past two decades.

Lembang was selected as the location because of a century-long tradition in astronomical observation, albeit primarily in the optical domain. A hundred years ago, Bosscha Observatory was one of only three observatories operating in the Southern Hemisphere, and throughout its history it has made significant contributions to the study of the southern skies. Today, the observatory is recognized as a national vital object, designated as a cultural heritage site, and situated within a strategic national area—underscoring its exceptional institutional significance. Having developed radio astronomy on a smaller scale since 2008, the introduction of advanced instruments such as the VGOS radio telescope marks a decisive step forward in strengthening radio astronomy research at this historic observatory.

Following a series of meetings held between 2020 and 2021, the two institutions signed a Memorandum of Understanding in August 2022. However, the commencement of construction was delayed due to the COVID-19 pandemic. While the telescope design and its supporting facilities were thoroughly discussed, the site survey could only be conducted at the end of 2023, once travel restrictions had been eased.

The first significant milestone was reached on July 9, 2025, when the VGOS telescope's 85-ton antenna was successfully lifted and installed by crane. This operation concluded the structural phase of construction, bringing the telescope's total height to 22 meters. To acknowledge the importance of this big

Key personnel involved in the VGOS Project at Bosscha Observatory (from left to right): M. Irfan, Yuwei Liu, Cong Liu, Taufiq Hidayat, Widjaja Martokusumo, Jinling Li, Zhengxiong Sun, and Yang Zhen.

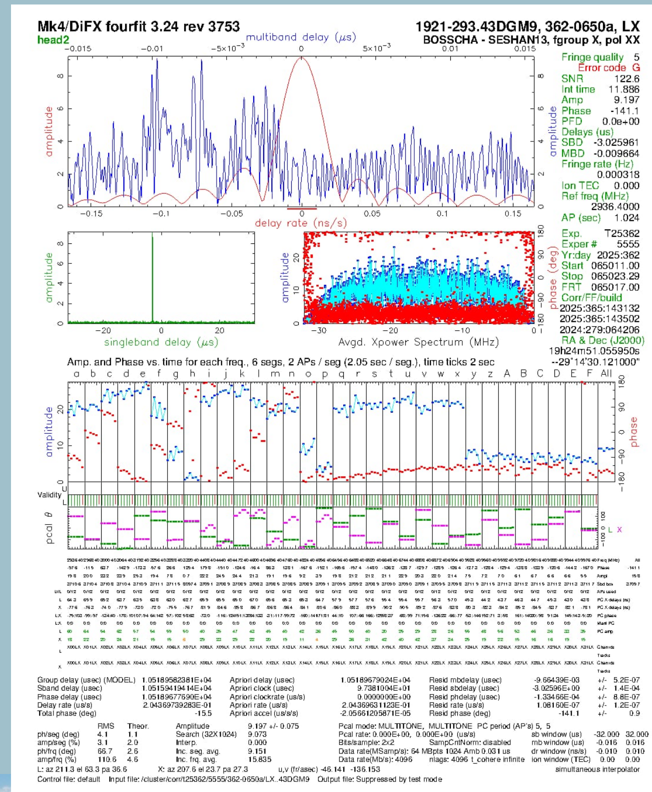
lift event, a dedicated ceremony was held, bringing together distinguished ITB leaders and individuals who played pivotal roles in making the achievement possible. Bosscha Observatory Director and head of the VGOS Radio Telescope Development Team Hesti Retno Tri Wulandari expressed her gratitude to ITB's former Rector Prof. Reini Wirahadikusumah, current Rector Prof. Tatacipta Dirgantara, and all supporters of the project. She highlighted that the successful installation of the antenna signifies the completion of the VGOS tower construction and shared her vision of a more advanced and meaningful future for astronomy. Taufiq Hidayat, Coordinator of the ITB–SHAO VGOS collaboration, stressed the importance of the big lift phase. He remarked that this milestone reflects ITB's dedication to its top resources to establish this facility, which will support the work of researchers, enrich ITB students' learning, and strengthen partnerships both nationally and internationally.

This achievement would not have been possible without the dedication of highly committed individuals—architects, civil engineers, electrical engineers, astronomers, geodesists, and many others—who worked tirelessly to see the project through.

By August 2025, the telescope tower had been finalized—a three-level structure built on a reinforced concrete foundation, equipped with an anchor ring for the antenna's steel pedestal, and complemented by a supporting facility to enable telescope operations. Following the installation of the antenna, during September – November 2025, the integration and installation of the signal chain components were successfully completed, marking the transition to the next stage of RF and backend instrumentation deployment in the VGOS system. Following its completion, the facility was officially named the ITB–Bosscha VLBI Station. This achievement was validated through a successful fringe test between Sheshan Station and the newly established station on December 28, 2025. It represents the second major milestone and stands as the finest New Year's gift for Bosscha Observatory.

The VGOS telescope at Bosscha Observatory will serve as a strategic node along the equatorial eastern longitude, complementing a global network of telescopes that is still largely concentrated in the Northern Hemisphere. Its equatorial position strengthens the baseline for worldwide observation, linking the Northern and Southern Hemispheres. The facility will be integrated with telescopes already operating in the existing Chinese VLBI Network and to the greater network coordinated by IVS.

The research facility is outfitted with multiple GNSS receivers supported by eight dedicated pillars, a weather station, a holography antenna, and an absolute gravimeter. It is further equipped with a double backup power system and a networking infrastructure, with bandwidth upgrades planned to support VLBI activities. We are confident that this will provide an excellent platform for multidisciplinary research that spans radio astronomy, geodesy, geodynamics, and a variety of other applications. Currently, the telescope is undergoing astronomical and geodetic commissioning, with the official inauguration ceremony of the Bosscha Observatory's new facility expected to take place before July this year.



The first fringe between Sheshan and ITB-Bosscha Stations on December 28, 2025.

Big lift event for the VGOS telescope and subsequent ceremony at Bosscha Observatory on July 9, 2025.

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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