

# New Zealand VLBI Station Warkworth

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**Abstract** The Warkworth Radio Astronomical Observatory for the period 2021–2022 was operated by the Institute for Radio Astronomy and Space Research (IRASR), Auckland University of Technology (AUT), Auckland, New Zealand. It is anticipated that this arrangement will change in 2023 and is briefly discussed. Also a review of the characteristics and performance of the VLBI station facilities are presented.

## 1 General Information

The Warkworth Radio Astronomical Observatory 12-m antenna, shown in Figure 1, is located some 60 km north of the city of Auckland, near the township of Warkworth, on the North Island of New Zealand. Specifications of the Warkworth 12-m and 30-m antennas are provided in Table 1.

The 12-m antenna is equipped with an S/X dual-band, dual-circular polarization feed at the secondary focus, and an L-band feed at the prime focus. Backend data digitizing is handled by a digital baseband converter (DBBC) manufactured by the HAT-Lab, Catania, Italy [2].

The 30-m antenna is currently equipped with an un-cooled C-band dual-circular polarization receiver and an un-cooled X-band dual-circular polarization receiver. In addition, a 4.8-GHz un-cooled band dual-circular polarization receiver was built for RadioAstron

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**Fig. 1** Photo of the Warkworth 12-m antenna during the southern winter of 2020 (image courtesy of Stuart Weston).

**Table 1** Specifications of the Warkworth 12-m and 30-m [1] antennas.

	12-m	30-m
Antenna type	Dual-shaped Cassegrain	wheel-and-track, Cassegrain beam-waveguide
Manufacturer	Cobham/Patriot, USA	NEC, Japan
Main dish diam.	12.1 m	30.48 m
Secondary refl. diam.	1.8 m	2.715 m
Focal length	4.538 m	10.44 m
Surface accuracy	0.35 mm	1.2 mm
Mount	alt-az	alt-az
Azimuth axis range	$90^\circ \pm 270^\circ$	$-179^\circ$ to $+354^\circ$
Elevation axis range	$7.2^\circ$ to $88^\circ$	$6.0^\circ$ to $90.1^\circ$
Az. axis max speed	$5^\circ/\text{s}$	$0.37^\circ/\text{s}$
El. axis max speed	$1^\circ/\text{s}$	$0.36^\circ/\text{s}$

participation. We also have a separate DBBC for backend data digitizing for this antenna.

The station frequency standard is a Symmetricom Active Hydrogen Maser MHM-2010 (75001-114). We have now moved to Flexbuffs (Super-Micro servers) running jive5ab [3] for recording and data storage connected to the DBBC via fiber which allows parallel real-time streaming and recording of data. The observatory network is directly connected to the national network provided by Research and Education Advanced Network New Zealand Ltd (REANNZ) via a 10-Gbps fiber link to the site [4].

## 2 Status and Activities

A breakdown of IVS session types scheduled and observed over this two-year period by the Warkworth 12-m antenna is presented in Table 2 grouped by experiment type.

**Table 2** Warkworth 12-m antenna participation in IVS sessions in 2021 and 2022.

Experiment	2021		2022	
	Scheduled	Observed	Scheduled	Observed
AOV	12	12	11	10
AUA	11	11	12	11
AUM	21	21	6	6
CRDS	6	5	6	5
OHIG	6	5	6	4
R1	23	12	26	18
R4	22	22	27	26
T2	2	2	–	–
Total	103	90	94	80

In 2021, the number of IVS sessions scheduled (103) for Warkworth 12-m was significantly increased w.r.t. 2019 and 2020 (59 and 41 sessions, respectively). In 2022, the number of scheduled sessions was initially scaled back, to reduce the wear and tear on the antenna. With the uncertain status of the station in the latter half of 2022, it was decided to significantly increase our commitment to IVS from that originally planned with the 12-m to try and maximize its usage in the possible time remaining. During this period we also had an extended outage due to the elevation jack screw boot being ingested inside the elevation bevel ball drive. This negatively impacted the sessions we observed compared to the number of sessions scheduled. Weather events also impacted the sessions we could observe: 13

sessions were lost in 2021 (13%) and 14 sessions were lost in 2022 (15%).

In addition, both antennas continue to be available for Australian LBA sessions each semester, with a choice of antenna dependent on frequency. Cooperation with various space agencies and companies for spacecraft tracking has also continued using the 12-m antenna, with some interest shown in using the 30 m in the future.

## 3 Future Status

The Auckland University of Technology decided to divest of the station in mid 2022, taking effect on the 16th of December 2022. Currently (beginning of 2023), interim funding has been provided for the next six months of operations by the New Zealand Government Ministry of Business, Innovation & Employment (MBIE), providing time to establish a consortium and new funding mechanism to assume and continue the operation of the observatory.

## 4 Acknowledgements

The IRASR would like to thank the IVS and other international geodetic organizations and institutes for their tremendous support in 2022 with submissions and letters of support to the New Zealand Government and others about the importance of the Ww Observatory for the global reference frame. It is felt that, to a great degree, these letters helped to inform the New Zealand Government and have allowed the observatory to continue working for at least the next six months, and it is hoped for a more extended period after June 2023. We also express our gratitude to Land Information New Zealand and the Royal Astronomical Society of New Zealand for their letters of support and invaluable assistance during the critical period and beyond.

## References

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