Kokee Park Geophysical Observatory

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Abstract This report summarizes the technical parameters of the VLBI systems at the Kokee Park Geophysical Observatory and provides an overview of the activities that occurred in 2017–2018.

1 Location

The Kokee Park Geophysical Observatory (KPGO) is located in Kokee State Park on the island of Kauai in Hawaii at an elevation of 1,100 meters near the Waimea Canyon, often referred to as the Grand Canyon of the Pacific. KPGO is located on the map at longitude 159.665° W and latitude 22.126° N.

2 Technical Parameters

The 20-m receiver is of NRAO (Green Bank) design (a dual polarization feed using cooled 15 K HEMT amplifiers). The antenna is of the same design and manufacture as those used at Green Bank and Ny-Ålesund. A Mark 5B+ recorder is currently used for all data recording.

The 12-m receiver is of MIT design. The ultra wideband receiver uses a Quadruple-Ridged Flared Horn (QRFH) and LNAs, developed at the California Institute of Technology, cooled to ∼15K and is dual polarization. The antenna is a prototype that was developed by InterTronic Solutions Inc. A Mark 6 recorder is currently used for all data recording.

Timing and frequency is provided by a Sigma Tau Maser with a second Sigma Tau Maser as a backup and a NASA NR Maser providing a second backup. Monitoring of the station frequency standard performance is provided by a CNS (GPS) Receiver/Computer system. The Sigma Tau performance is also monitored via the IGS Network.

3 Staff

The staff at Kokee Park consists of six full time people and one part time person employed by Peraton Corporation under the SCNS contract to NASA for the operation and maintenance of the observatory. Chris Coughlin, Lawrence Chang, Kiah Imai, and Morgan Goodrich conduct VLBI operations and maintenance. Ben Domingo is responsible for antenna maintenance, and Amorita Yaris provides administrative, logistical, and numerous other support functions. Kelly Kim also supports VLBI operations and maintenance during 24-hour experiments and as backup support.

4 Mission Support

Kokee Park has participated in many VLBI experiments including IVS R4 and R1 experiments. KPGO also participates in the RDV, CRF, APSG, RD, and OHIG experiments. KPGO averaged two experiments of a 24-hour duration each week, with weekday Intensive experiments in 2017 and 2018.

1. USNO
2. NASA GSFC

Fig. 1 Newly installed 12-m VGOS telescope at KPGO.

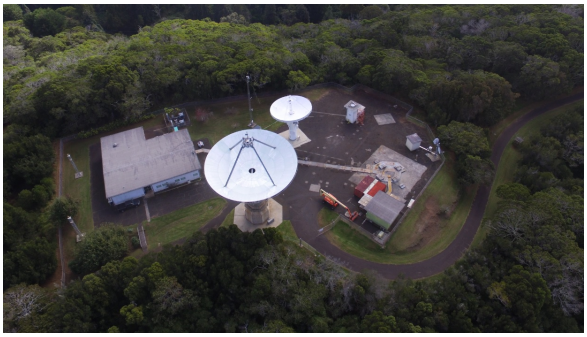

Fig. 2 KPGO site overview after installation of the 12 m, removal of the 9 m, and removal of the 7 m.

Kokee Park hosts other systems, including the following: a Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) beacon and remote control, a Quasi-Zenith Satellite System (QZSS) monitoring station, a Two-Way Satellite Time and Frequency Transfer (TWSTFT) relay station, and a Turbo-Rogue GPS receiver. Kokee Park is an IGS station.

5 Recent Activities

The KPGO VGOS 12-m radio telescope passed the operational readiness review (ORR) early in 2017 and officially joined the VGOS Observing Schedule in May of 2017. Since May of 2017 there have been several improvements for the 12-m system. The most significant was having InterTronic Solutions Inc. (ISI) onsite in 2018 to perform antenna controller modifications introducing active torque bias. This dramatically improved the antenna servo performance and provided more reliable operations for the system. The KPGO 12-m system successfully completed many VT sessions in 2017 and 2018, yielding very good data acquisition metrics thus far.

The KPGO 20-m radio telescope has been in service now for 26 years and was able to get another upgrade completed in 2018. The 20-m Frontend Cryogenics System was completely overhauled in December of 2018. This included replacement of all rigid and flex helium lines, a newly refurbished Coldhead, and a new Trillium M700 Helium Compressor. The 20-m system successfully participated in the VLBI Observing Schedule for 2017 and 2018 while maintaining a very high data acquisition metric throughout.

USNO, MIT, KPGO, and DREN were able to work together in 2017 and 2018 to ensure that e-transfer capability at the site was functional. There were no major e-transfer link outages during 2017 or 2018, providing quicker delivery of INT1 data to the WACO Correlator and better latency results.

For the majority of 2018, the site Ops Building underwent a major upgrade that was in planning for many years, finally getting completed in January 2019. The Ops building HVAC System was upgraded along with the site Utility Power Electrical Infrastructure. This was a major effort involving many contractors and vendors spanning May 2018 to January 2019. The Ops building is now equipped with a new redundant HVAC system to ensure that operational equipment is in a suitable environment.

Fig. 3 Newly installed HVAC system for KPGO Operations Building.

Table 1 Technical parameters of the radio telescopes at KPGO.

Parameter	20-m	12-m
Owner and operating agency	USNO-NASA	USNO-NASA
Year of construction	1993	2015
Diameter of main reflector d	20 m	12 m
Azimuth range	$\pm 270^\circ$	$\pm 270^\circ$
Azimuth velocity	$2^\circ/s$	$12^\circ/s$
Azimuth acceleration	$1^\circ/s^2$	$1^\circ/s^2$
Elevation range	$\pm 90^\circ$	$\pm 90^\circ$
Elevation velocity	$2^\circ/s$	$6^\circ/s$
Elevation acceleration	$1^\circ/s^2$	$1^\circ/s^2$
Receiver System		
Focus	Primary Focus	Cassegrain
Receive Frequency	2.2–8.9 GHz	2–14 GHz
T_{sys}	40 K	40 K
$S_{SEFDRange}$	500–2000 Jy	1500–3000 Jy
G/T	40 dB/K	43 dB/K
VLBI terminal type	VLBA4	RDBE
Recording media	Mark 5B+	Mark 6
Field System version	9.11.7	9.12.2

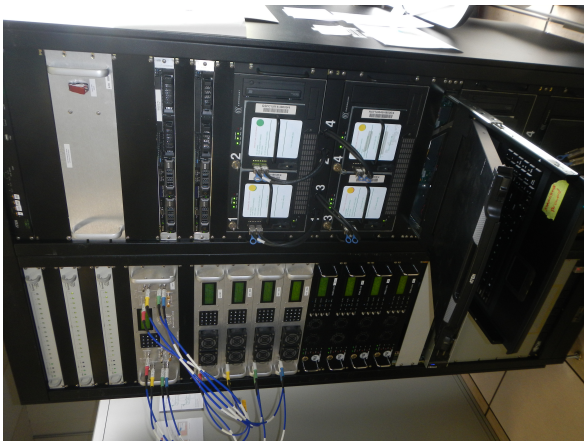

Fig. 4 MIT Digital Backend for KPGO 12-m VGOS System.

6 Outlook

KPGO has several improvements planned for the site in the near future. General Dynamics Mission Systems (GDMS) is scheduled to be at KPGO in July of 2019 to refurbish the 20-m Frontend Focus System. Once completed, this will restore the ability to adjust the focal point for the 20-m Frontend Receiver. This ability will also allow us to upgrade to the new Broadband Signal Chain when ready. The original 20-m 15kW backup genset used for backup power for cryogenics and frontend electronics is due to be upgraded to 60kW genset. This will allow for the newly installed M700 Helium Compressor to be on the standby power circuit, limiting warmups due to site power outages. This upgrade is tentatively scheduled for August of 2019. The site network upgrade to new compliant network configuration, hardware, and protocols is due to take place in September of 2019. The network upgrade should improve operational data e-transfer speeds, as well as the general network speed for the site. For the KPGO 12-m system, we are planning to rebalance the antenna counter weights so the reflector will be misbalanced towards zenith rather than the horizon. The 12 m rebalance effort is due to take place in late 2019 along with a controller modification to allow more connections to the 12-m antenna controller over the network.