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 2019–2020.

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.

Fig. 1 KPGO site logo.

Fig. 2 KPGO site overview.

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 backup, and a NASA NR Maser providing a second backup. Monitoring of the station frequency standard performance is

1. USNO
2. NASA GSFC

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	$2^\circ/\mathrm{s}$	$12^\circ/\mathrm{s}$
Azimuth acceleration	$1^\circ/\mathrm{s}^2$	$1^\circ/\mathrm{s}^2$
Elevation range	$\pm 90^\circ$	$\pm 90^\circ$
Elevation velocity	$2^\circ/\mathrm{s}$	$6^\circ/\mathrm{s}$
Elevation acceleration	$1^\circ/\mathrm{s}^2$	$1^\circ/\mathrm{s}^2$
Receiver System		
Focus	Primary Focus	Cassegrain
Receive Frequency	2.2–8.9 GHz	2–14 GHz
T_{sys}	40 K	40 K
$S_{SEFD\ Range}$	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	10.0.0	10.0.0

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 employees and one part-time person employed by Peraton Corporation under the SENSE contract to NASA for the operation and maintenance of the observatory. Chris Coughlin (KPGO Station Manager), Kiah Imai (KPGO Lead Engineer), Lawrence Chang, and Morgan Goodrich conduct VLBI operations and maintenance. Ben Domingo is responsible for antenna maintenance, and Amorita Yaris provides administrative and logistical support. Kelly Kim also supports VLBI operations and maintenance during 24-hour experiments and as backup support.

4 Mission Support

Kokee Park participates in many VLBI experiments for both Legacy and VGOS Networks. KPGO (Kk) participates in the R4, R1, RDV, CRF, APSG, RD, and OHIG 24-hour sessions along with the INT1 one-hour sessions. KPGO (Kk) averaged two experiments of 24-hour duration each week, with weekday Intensive experiments in 2019 and 2020. KPGO (K2) participates in the VO 24-hour sessions along with the V2 one-hour sessions. KPGO (K2) averaged one experiment of 24-hour duration each week, and two Intensive experiments per week in 2019 and 2020.

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

KPGO Staff and General Dynamics Mission Systems (GDMS) completed the refurbishment of the 20-m frontend focus system in July 2019. This refurbishment effort restored the capability to adjust the focal point for the 20-m Frontend Receiver. This ability will allow us to upgrade to the new VGOS broadband signal chain when ready.

The original 26-year-old 15-kW GenSet of the 20-m telescope, used for backup power for cryogenics and frontend electronics, was replaced with a new

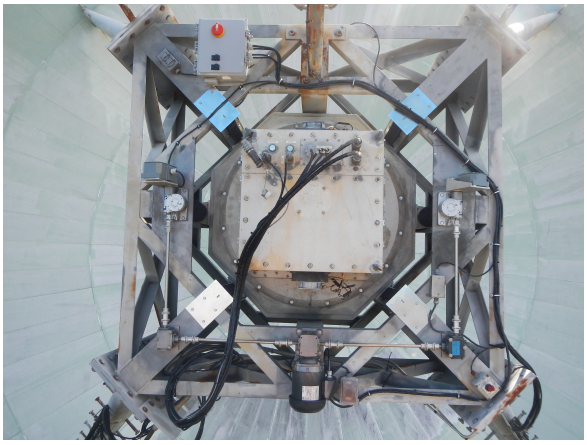

Fig. 3 New 20-m telescope prime focus frontend system.

Cummin's 60-kW GenSet in December 2019. This allowed for the newly installed M700 Helium Compressor to be on the standby power circuit, limiting warm-ups due to site power outages. This upgrade effort restored the reliability of operations for the KPGO 20-m system.

Fig. 4 New 20-m telescope 60-kW GenSet.

KPGO completed a major site network upgrade in 2019 to new compliant network configuration, hardware, and protocols. Network upgrade not only improved our overall site network performance, but also our data e-transfer speeds. KPGO e-transfer speed capabilities improved from 80 Mbps to 700 Mbps. This particular improvement from the Site Network Upgrade allows us to e-transfer the majority of our VLBI data and cut back on FedEx shipping of modules to correlator sites.

KPGO staff and ISI rebalanced the 12-m reflector counterweights in late 2019 along with a controller modification to allow more connections to the 12-m antenna controller over the network. This achieved a more desirable reflector misbalance towards zenith, and allowed us to connect our MAS system to the 12-m antenna controller for archiving of system data. Much of 2020 was limited as far as major site activities due to the COVID-19 pandemic. KPGO staff was able to report to the site and continue our mission during the pandemic achieving excellent data acquisition metrics on both 20-m and 12-m systems, and all the while staying safe and healthy. We are grateful for that!

Fig. 5 12-m telescope counterweight rebalance effort.

6 Outlook

KPGO is still planning numerous site improvements in the future. When funding is acquired, we are still planning to perform several upgrades to our 20-m system including VGOS Broad Band Signal Chain Install, New Servo System and Cabling, Reflector Backup Structure Refurbishment, Elevation Gearboxes and Gear Replacement, and Reflector RF Alignment. For the 12-m VGOS system we are planning to fine-tune our reflector counterweight balance to ensure longer life for the elevation drive train components. KPGO staff will be working on this with ISI in 2021.

NASA is working with Japan for the installation of a new QZSS system at KPGO. Install of a new QZSS system is planned for late 2021 or early 2022.

NASA is working with the French DORIS team for a visit to KPGO to upgrade the KPGO DORIS Beacon. The DORIS visit time frame is still TBD.

Peraton is working with NASA Network Engineers to optimize the speeds for our newly upgraded e-transfer circuit. We are hoping to improve the e-transfer speeds from 700 Mbps to 1.5 Gbps in the near future. This will allow us to e-transfer even our largest VGOS data sets to the correlator sites.