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 2015–2016.

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 $\sim$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 NASA NR Maser providing 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 Harris Corporation under the SCNS contract to NASA for the operation and maintenance of the observatory. Chris Coughlin, Lawrence Chang, Kiah Imai, and Robert Christensen conduct VLBI operations and maintenance. Ben Domingo is responsible for antenna maintenance, and Amorita Apilado 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, and OHIG experiments. KPGO averaged two experiments of 24 hour duration each week, with weekday Intensive experiments in 2015 and 2016.

1. USNO
2. NASA GSFC

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

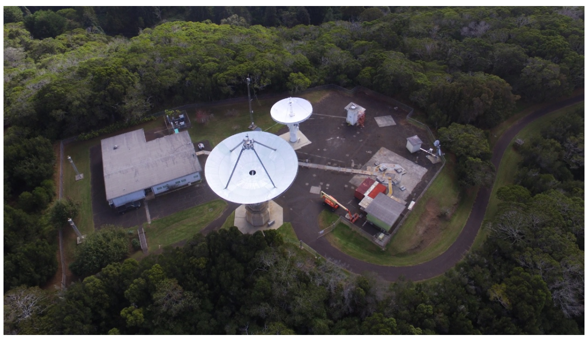

Fig. 2 KPGO site overview after installation of the 12-m, removal of the 9-m, and removal of the 7-m.

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 TurboRogue GPS receiver. Kokee Park is an IGS station.

5 Recent Activities

The installation of the InterTronic Solutions 12-m VGOS radio telescope started in May of 2015 and was completed in October of 2015. The MIT-designed 12-m broadband signal chain installation started in November of 2015 and was completed by February 2016. Fringe tests were successful with GGAO and Westford antennas after the installation was complete. Both the antenna system and the signal chain have suffered failures since installation. The system is currently undergoing endurance testing, problem detection, and problem resolution in an effort to get the 12-m system to a status where it can pass the operational readiness review (ORR) and join the VGOS observing schedule.

The KPGO 20-m telescope has been in service for 24 years and was able to get some much needed upgrades in 2016. In April of 2016 GD-MS, the manufacturer of the 20-m, arrived at Kauai and began the azimuth bearing replacement effort. Over a span of three months we removed the old azimuth bearing from the 20-m and installed a new azimuth bearing. This was done by constructing a very large steel jacking frame around the pedestal of the antenna and jacking the upper half of the antenna up 18″ with a large hydraulic jacking system. All internal cabling had to be removed to allow bearing removal and installation. Once the upper half of the antenna was jacked up off the bearing, a shelf system was installed to slide the old bearing out and the new bearing in with the assistance of a crane. Once the new bearing was in and the surface flatness was machined to an allowable threshold, the upper half of the antenna was lowered down onto the new bearing, and hardware was installed to secure all parts of the antenna again. During this effort we also installed new azimuth gearboxes, upgraded the azimuth cable wrap system, and cleaned up wiring configuration when re-installing cabling. Muliple system tests were performed afterwards to ensure correct operation.

USNO, MIT, KPGO, and DREN were able to work together to upgrade the KPGO e-transfer network and restore e-transfer capability at the site in February of 2016. The site is still limited to a 100 Mbps transfer rate due to its microwave link down the hill to PMRF. High speed fibers are currently being repaired by PMRF to replace the microwave link up the hill. Plans are to work with PMRF, Hawaii Internet Consortium (HIC), and DREN to see if we can get a dedicated fiber connection to KPGO for our e-transfer network. Current plans are to still make real-time VLBI data transfers from KPGO a reality.

From August of 2016 through the end of the year we performed a major site clean-up effort and electrical upgrade at KPGO. The NASA 9-m Unified S-band antenna was removed from the site, as well as all supporting sub-systems and cabling for the 9-m. We also removed other various unused systems at the site during this effort, including the 7-m antenna that sup-

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

ported the UH GOES-7 program, the old UH 3-m antenna system, and the VHF SATAN antenna system. All unused material in the site yard was also removed. Electrical panels that feed the site as well as the 20-m telescope were upgraded with new panels that meet current electrical code. This effort not only cleaned up the site but also cleared some of the horizon mask for the 12-m telescope to widen its usable azimuth range.

Fig. 3 20-m telescope azimuth bearing replacement effort.

Fig. 4 9-m telescope demolition effort, with the 20-m and the 12-m operating in the background.

6 Outlook

KPGO will continue with efforts to get the 12-m system through the operational readiness review and to a point where it can join the VGOS observing schedule full time. The hope is to resolve all issues and participate in the 2017 VGOS observing schedule. We will continue planning with USNO and MIT for upgrading the 20-m signal chain to the broadband front end and backend systems currently being stored at KPGO. Before installing the broadband receiver on the 20-m, the Apex Focus System will have to be replaced due to rust and inability to move. The replacement of the focus system is also being planned as part of the broadband upgrade for the 20-m system. Now that the high speed fibers up the hill are being repaired the hope is to negotiate a dedicated fiber line for KPGO e-transfer that will give us high speed e-transfer capability.