Kokee Park Geophysical Observatory

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Abstract This report summarizes the technical parameters of the VLBI system at the Kokee Park Geophysical Observatory and provides an overview of the activities that occurred in 2014.

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 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.

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 employed by ITT Exelis under the SCNS contract to NASA for the operation and maintenance of the observatory. Chris Coughlin, Lawrence Chang, Kiah Imai, and Ron Curtis 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. 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 2014.

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.

1. USNO
2. NASA GSFC

5 Recent Activities

The KPGO 20-m antenna has been in service for 22 years and continues to show signs of its age. The frequency of the maintenance activities for monitoring, lubricating, and greasing antenna components was increased to minimize wear and tear on the aging antenna. One of the major signs of wear on the 20-m antenna is axial play in the azimuth bearing. This puts additional strain on the azimuth drive components, especially in high wind conditions. In April 2014, KPGO technicians lowered the south azimuth motor/brake assembly to replace the leaking seals between the gearbox and the brake housing to prevent the oil leak from compromising the brake and/or the motor performance. Plans are in progress to repair and upgrade many of the 20-m antenna components. The plans to upgrade the KPGO 20-m telescope for broadband observation are on hold until after the installation of the new 12-m high-precision VLBI2010-style radio antenna. The new 20-m antenna broadband receiver box built by MIT is in storage in the KPGO operations building. The digital backend has been rack mounted until future use with four RDBEs, four UP/DOWN Converters, one of four Mark 5C recorders, and an Optical ReCeiver/splitter/Amplifier (ORCA). New timing and frequency distribution equipment was installed at KPGO in advance to support the new 20-m digital backend.

The installation of the InterTronic Solutions 12-m high-precision VLBI2010-style radio antenna at KPGO passed the Preliminary Design Review and Critical Design review in 2014. The MIT-designed broadband feed to be used on this 12-m telescope has completed its System Requirement Review in 2014. The project is on schedule for completion by the end of 2015. The e-transfers of the INT1 sessions from KPGO to USNO were being transmitted over the microwave infrastructure provided by the Pacific Missile Range Facility (PMRF) connecting KPGO to DREN. In June 2014, there was an upgrade to the DREN network which requires an upgrade at KPGO to utilize the DREN connectivity. MIT and USNO were working on the required KPGO upgrades and the INT1 sessions were sent via FedEx to USNO beginning in June 2014 through the end of 2014. MIT and USNO will continue to work on the KPGO network upgrades and the plans to migrate to a dedicated fiber connection for KPGO. MIT is working with the Hawaii Internet Consortium (HIC) and DREN to improve the KPGO e-transfer rate. Long term plans are still to make real-time VLBI data transfers from KPGO a reality.

6 Outlook

KPGO will continue with efforts to upgrade the 20-m antenna signal path to VLBI2010 specifications. KPGO staff, Exelis personnel at GSFC, USNO personnel, and MIT personnel are in the process of planning the 20-m antenna modifications and the installation of a new broadband frontend for the KPGO 20-m antenna after 2015. USNO, NASA, InterTronic Solutions, MIT, and Exelis will continue to work throughout 2015 on the construction process for the high precision VLBI2010-style 12-m radio telescope at KPGO. Facility upgrades and construction of a new antenna pad for the 12-m telescope are planned for the first half of 2015. The installation of the new 12-m antenna and signal path is planned for the second half of 2015. The internal network architecture at KPGO will be upgraded to support the network requirements of the new 12-m telescope.

Fig. 1 The KPGO 20-m radio telescope (foreground) with the KPGO 9-m radio telescope in the background.

Table 1 Technical parameters of the radio telescope at KPGO.

Parameter	Kokee Park
owner and operating agency	USNO-NASA
year of construction	1993
radio telescope system	Az-El
receiving feed	primary focus
diameter of main reflector d	$20m$
focal length f	$8.58m$
f/d	0.43
surface contour of reflector	$0.020 inchesrms$
azimuth range	$0\ldots540^\circ$
azimuth velocity	$2^\circ/s$
azimuth acceleration	$1^\circ/s^2$
elevation range	$0\ldots90^\circ$
elevation velocity	$2^\circ/s$
elevation acceleration	$1^\circ/s^2$
X-band	$8.1-8.9\,GHz$
(reference $\nu = 8.4GHz, \lambda = 0.0357m$)	
T_{sys}	$40\,K$
$S_{SEFD}(CASA)$	$900\,Jy$
G/T	$45.05\,dB/K$
η	0.406
S-band	$2.2-2.4GHz$
(reference $\nu = 2.3GHz, \lambda = 0.1304m$)	
T_{sys}	$40\,K$
$S_{SEFD}(CASA)$	$665\,Jy$
G/T	$35.15\,dB/K$
η	0.539
VLBI terminal type	VLBA/VLBA4-Mark 5
Field System version	9.11.1