# 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 2013.

## 1 Location

The Kokee Park Geophysical Observatory (KPGO) is located at 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 (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, with Amorita Apilado providing 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 sessions including IVS R4 and R1. KPGO also participates in the RDV, CRF, and OHIG sessions. KPGO averaged two experiments of 24-hour duration each week, with daily Intensive experiments, in 2013. KPGO began supporting the Saturday INT2 weekend Intensive experiments in May 2013 while the Tsukuba VLBI station was performing repairs. The KPGO support of the weekend Intensive experiments concludes in January 2014.

Kokee Park hosts other systems — a Doppler Orbitography and Radiopositioning Integrated by Satellite (DORIS) beacon and remote control, a Quasi-Zenith Satellite System (QZSS) monitoring

1. USNO
2. NASA GSFC

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 20-m antenna has been in service for 21 years and continues to show signs of its age. In April 2013, the KPGO 20-m antenna construction contractor, GD Satcom, made a site visit to KPGO to implement some changes to the KPGO 20-m antenna configuration in an effort to reduce the wear on the azimuth bull gear teeth due to the axial play in the azimuth bearing. Those changes included re-alignment of the azimuth drives to improve teeth mesh between the azimuth pinions and the bull gear. They also tuned the servo system to decrease the acceleration and deceleration of both the azimuth and elevation drive systems. Plans are moving forward to upgrade the KPGO 20-m telescope for broadband observation. KPGO received a new broadband receiver box from MIT under contract from USNO in October 2013. The digital backend is in the process of being configured with four each RDBE's, UP/DOWN converters, and Mark 5C recorders in addition to an Optical Receiver/Splitter/Amplifier (ORCA). Only one of the four Mark 5C recorders has been received so far. InterTronic Solutions was awarded a contract to build and install a 12-m high precision VLBI2010-style radio antenna at KPGO in support of USNO. The broadband feed to be used on this 12-m telescope will be of MIT design. Installation is projected for completion in 2015.

The e-transfer of the INT1 sessions from KPGO to USNO continues to be transmitted over the microwave infrastructure provided by the Pacific Missile Range Facility (PMRF) and connects KPGO to DREN. Plans to migrate to a dedicated fiber connection to DREN at PMRF have been delayed due to damage to the fibers by a wildfire. MIT is working with the Hawaii Intranet 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, ITT 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 front end for the KPGO 20-m antenna.

PMRF is working on acquiring funding for repairs to the fiber runs that were damaged by a wild fire in 2012. Those repairs, as well as the dedicated fiber path to HIC/DREN for KPGO e-transfers, are on hold until funding is acquired. USNO, NASA, InterTronic Solutions, MIT, and Exelis will continue working throughout 2014 on the construction process for the high precision VLBI2010-style radio telescope at KPGO.

**Fig. 1** 20-m digital backend.

**Fig. 2** 20-m broadband feed.

**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 $\nu = 8.4GHz, \lambda = 0.0357m$) | |
| $T_{sys}$ | $40\,K$ |
| $S_{SEFD}(CASA)$ | $900\,Jy$ |
| $G/T$ | $45.05\,dB/K$ |
| $\eta$ | 0.406 |
| S-band | $2.2-2.4GHz$ |
| (reference $\nu = 2.3GHz, \lambda = 0.1304m$) | |
| $T_{sys}$ | $40\,K$ |
| $S_{SEFD}(CASA)$ | $665\,Jy$ |
| $G/T$ | $35.15\,dB/K$ |
| $\eta$ | 0.539 |
| VLBI terminal type | VLBA/VLBA4-Mark 5 |
| Field System version | 9.11.1 |