NASA Infrared Telescope Facility University of Hawaii, Institute for Astronomy

Honolulu, Hawaii 96822

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This report covers the period from 1 July 2003 through 30 June 2004. The NASA Infrared Telescope Facility (IRTF) is a 3.0 m infrared telescope located at an altitude of 4.2 km on the summit of Mauna Kea in Hawaii. It was established by NASA in 1979, primarily to provide infrared observations in support of NASA's programs. The IRTF is managed and operated by the University of Hawaii (UH) Institute for Astronomy (IfA) under a five-year cooperative agreement between NASA and UH that started in February 2001. NASA provides the costs of operation, and NSF provides support for new focal plane instrumentation based on grant applications from IRTF support astronomers. Observing time is open to the entire astronomical community, and 50% of the IRTF observing time is reserved for studies of solar system objects.

1. PERSONNEL

Alan Tokunaga was the IRTF division chief during the report period. Support astronomers were John Rayner, Shelte (Bobby) Bus, and Eric Tollestrup. Tollestrup was the deputy division chief. Rolf Kudritzki was PI of the IRTF cooperative agreement with NASA. George Koenig was superintendent of the telescope day crew, and Lars Bergknut was the foreman. Other members of the day crew were Imai Namahoe (electronics technician), Sammy Pung (mechanical technician), and Maury McOuat. Telescope operators were Bill Golisch, Dave Griep, and Paul Sears. Engineering/technical staff included Peter Onaka (senior electronics engineer), Fred Keske (electronics engineer), Doug Toomey (instrumentation engineer), Greg Ching (electronics technician), Darryl Watanabe (instrument technician), Tony Denault (senior software engineer), Charles Lockhart (embedded software engineer), Miranda Hawarden-Ogata (network engineer), James Pantaleo (systems programmer), and Tim Bond (senior mechanical engineer). Karan Hughes was the administrative assistant, Susan Lemn was the secretary, and Chris Kaukali and Sandra Miyata were the IRTF fiscal officers.

2. COMMITTEES

The NASA Management and Operations Working Group (MOWG) for the IRTF was chaired by Robert Millis (Lowell Obs.) through January 2004, and Robert Williams (STScI) since February 2004. This advisory group to NASA oversees IRTF operations. Other members were Jacques Beckers (National Solar Obs.), William Cochran (McDonald Obs., Univ. of Texas), Heidi Hammel (Space Sci. Inst.), David Koerner (Univ. of Pennsylvania), Theodore Kostiuk (NASA GSFC), David Mozurkewich (NRL), Peter Schloerb (Univ. of Massachusetts), and Neville Woolf (Univ. of Arizona). Cochran, Hammel, Woolf, and Schloerb ended their terms in September 2003. Will Grundy (Lowell), Ann Sprague (Lunar and Planetary Lab), Debra Fischer (Berkeley), and Robert Williams (STScI) were appointed as new members as of January 2004.

Daniel Britt (Univ. of Central Florida), Nancy Chanover (NMSU), Daniel Jaffe (Univ. of Texas), Kevin Luhman (CfA), James Graham (Berkeley), and David Osip (Las Campanas Obs.) served on the TAC. Graham and Osip were replaced by Martha Hanner (Univ. of Massachusetts) and Michael Brotherton (Univ. of Wyoming) in May 2004. The TAC is chaired by IRTF Division Chief Alan Tokunaga, but he does not vote on proposals.

3. USAGE OF THE IRTF

Deadlines for observing proposals are 1 October for February–July, and 1 April for August–January. The IRTF received 108 applications for observing time for the second semester of 2003, and 94 applications for observing time for the first semester of 2004. The average oversubscription factor was 2.6 for solar system programs and 2.1 for non–solar system programs. The scheduled programs involve over 200 U.S. and foreign astronomers each semester. About 26.8% of the scheduled observing time was lost to bad weather, and 2.2% to IRTF instrumentation and other facility problems.

4. THE TELESCOPE

The IRTF has an f/38 Cassegrain focus with two secondary mirror structures, one for tip-tilt and one for chopping. The Cassegrain instruments are mounted on the Multiple Instrument Mount, which allows for the simultaneous mounting of up to four instruments. Under normal circumstances, the IRTF facility instruments are kept mounted and ready for continuous use. Instrument changes can be accommodated in less than 30 minutes. This allows for short programs that require only a partial night.

4.1 Facility Instruments

The present complement of IRTF instruments covers the $\sim$1–25 μm spectral range.

SpeX is a 0.8–5.5 μm spectrograph with low to moderate resolving power (100–2500). It was commissioned in August 2000. The spectrograph section uses a 1024×1024 InSb array with 0.″15/pixel. Five spectroscopic modes are supported. Slit widths from 0.″3 to 3.″0 are available. There is a slit viewer for infrared guiding and imaging capability. It uses a 512×512 InSb array at 0.″12/pixel with a 60″×60″ field of view, and a 15-position filter wheel.

NSFCAM is a 1–5.5 μm camera with a 256×256 InSb array. It has three selectable image scales of 0″.06, 0″.15, and 0″.30/pixel, and 24 filters. A unique feature of NSFCAM is that it has circular variable filters (CVFs) that provide 1–2% spectral resolution from 1.5 to 5 μm. NSFCAM also features a grism for long-slit spectroscopy. A warm wave-plate rotator assembly allows linear polarization measurements to be obtained. Work started in May 2004 to install a 2048 ×2048 array in NSFCAM for use with the adaptive optics system.

CSHELL is a high-resolution spectrograph that covers the 1–5.5 μm spectral range with 0″.20 pixels. It uses a 256 × 256 InSb array. CSHELL has a 30″ long slit and can also image a 30″×30″ area for easy object acquisition. Slits from 0″.5 to 4″.0 wide can be selected. The 0″.5 slit provides a spectral resolution R = 43,000. An internal CCD is used for guiding.

4.2 Visitor Instruments

The IRTF supports a number of visitor instruments and has encouraged the collaborative use of these instruments by advertising them on its Web site and in the semiannual announcement of observing time. A brief description of these instruments is given here:

TEXES is a high-resolution spectrograph for 5–25 μm. J. Lacy and M. Richter (Univ. of Texas) are the PIs on this instrument. It provides a resolving power of up to 100,000.

MIRSI is an 8–26 μm camera with grisms for the 10 and 20 μm atmospheric windows. The late Dr. Lynne Deustch was the PI; the current scientist in charge is Dr. James Jackson (Boston University).

BASS is a low-resolution spectrograph that can cover the entire 3–13.5 μm spectral range in a single exposure with R = 25–120. It employs two 58-element BIB arrays. D. Lynch (Aerospace Corp.) is the PI.

CELESTE is a high-resolution 5–25 μm spectrograph that provides a resolving power of about 10,000. D. Jennings (GSFC) is the PI.

HIPWAC is a heterodyne spectrometer 9–12 μm with a spectral resolution greater than 1,000,000. T. Kostiuk (NASA Goddard) is the PI.

4.3 Facilities

Approximately two-thirds of the staff is located in the IfA-Hilo building, which is in the University of Hawaii's Hilo Research Park. The remaining staff is located in Honolulu. The IfA-Hilo building has laboratory spaces, a machine shop, remote observing facilities, and laboratory equipment. Instrumentation efforts are conducted in both Hilo and Honolulu.

4.4 New Instruments

A new adaptive optics (AO) relay was installed in May 2002. This is a 36-element curvature-sensing AO system that is similar to the Gemini North Telescope's Hōkūpa‘a AO system, which was developed at the IfA. Engineering tests continued until June 2003, when the AO system was returned to the Hilo laboratory for improvements. Major enhancements and testing were done on the AO system, and plans call for it to be returned to the telescope during the spring 2005 semester.

Since the AO system is installed above the instrument light path, the instrument spool and the acquisition guider have been also replaced. The acquisition guider has a second visible CCD channel that allows for visible photometry. The main objective of this CCD camera is to provide nearly simultaneous visible and thermal infrared photometry of asteroids.

4.5 Image Quality

To enhance image quality, various improvements were made, including (1) replacement of a defective dome chiller, (2) improvements to the dome air-conditioning system, (3) installation of hardware to remove heat from the focal plane electronics, and (4) sealing the gaps in the dome skirt and shutter areas to stop heat infiltration during the daytime. In addition, temperature sensors and a monitoring system were installed.

4.6 Remote Observing

The IRTF provides very flexible remote observing over the Internet. Remote observing from both the IRTF Hilo office and from the observer's home office began in August 2002, and currently about 40% of the observing nights involve some remote observing using our facility instruments. The typical remote observer controls the instrument from his or her office on the mainland with assistance from the telescope operator.

5. BUDGET

For the period 1 February 2003 to 31 January 2004, the IRTF has an operating budget of $3.3 million, which includes support for the equivalent of 21 full-time positions, including the personnel devoted to fabrication and maintenance of instruments. Additional funds are secured from the NSF for instrument development. An NSF grant to upgrade NSFCAM with a 2048 × 2048 array has been awarded to the IRTF. As part of this upgrade, a single 40 milliarcsec per pixel scale will be provided, and a second wave-front sensor will be fabricated. A NASA grant to replace the obsolete telescope control system has funded a 24-month project that began in August 2003.

6. WEB-BASED INFORMATION ACCESS

The IRTF Web site (http://irtfweb.ifa.hawaii.edu/) provides convenient access to IRTF information, including observing time application forms, instrument and telescope manuals, photometric catalogs, and the telescope schedule.

Alan Tokunaga