NASA Infrared Telescope Facility
University of Hawaii, Institute for Astronomy

Honolulu, Hawaii 96822

[S0002-7537(93)22941-9]

This report covers the period from 1 January through 30 June 2001. 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. SCIENTIFIC HIGHLIGHTS

T. Kostiuk *et al.* (2001, Geophysics Research Letters, 28, 2361) reported the detection of the winds of Titan using a heterodyne spectrometer with a resolving power of 10^6. A wind speed of >130 m/s in the prograde direction was measured. R. Binzel *et al.* (2001, Meteoritics Plan. Sci., 36, 1167) obtained a spectrum of 1998 SF36, a near-Earth asteroid that will be visited by the MUSES-C spacecraft. The surface material resembles that of a typical LL-chondrite meteorite. Yanamandra-Fisher *et al.* constructed 4.6–5.4 μm spectral-image data cubes of Saturn at a resolving power of R = 1000 and at a spatial resolution of 5000 km (1″). Phosphine was detected across the southern hemisphere in the 4.8–5.0 μm region and ammonia in the 5.1–5.3 μm region. Weaker signatures of CH_3D and AsH_3 are also observed.

2. PERSONNEL

Alan Tokunaga was the IRTF division chief during the period. Support astronomers were John Rayner (deputy division chief), and Shelte (Bobby) Bus. Rolf Kudritzki was PI of the IRTF cooperative agreement with NASA to operate the facility. George Koenig became superintendent of the telescope day crew after Paul Jensen retired in December 2000. Other members of the day crew were Lars Bergknut, Imai Namahoe, Sammy Pung, Danley Lee, and Paul Fukumura-Sawada, who resigned as of February 6, 2001. Telescope operators were Bill Golisch, Dave Griep, and Paul Sears, who joined the IRTF on April 16, 2001. Engineering/technical staff included Peter Onaka (electronics engineer), Doug Toomey (instrumentation engineer), Greg Ching (electronics technician), Darryl Watanabe (instrument technician), Tony Denault (instrumentation software engineer), and John Sender (observatory software engineer), who resigned as of April 12, 2001. Karan Hughes was the IRTF secretary/project assistant, Susan Lemn was the clerk-typist, and Chris Kaukali was the IRTF fiscal officer. The total IRTF staff numbered 24 full-time equivalents.

3. COMMITTEES

The NASA Management and Operations Working Group (MOWG) for the IRTF was chaired this year by Robert Millis (Lowell Obs.). This is an advisory group to NASA that provides oversight of IRTF operations. Other members were Jacques Beckers (National Solar Obs.), William Cochran (McDonald Obs., Univ. of Texas), James L. Elliot (MIT), Heidi Hammel (Space Sci. Inst.), Ken Johnston (U.S. Naval Obs.), Y. Terzian (Cornell Univ.), and Peter Schloerb (Univ. of Massachusetts). Ex-officio members were Vernon Pankonin (NSF) and Tom Morgan (NASA).

Timothy Brooke (JPL), William Cochran (McDonald Obs., Univ. of Texas), Christopher Johns-Krull (Berkeley), Neill Reid (Univ. of Pennsylvania), David Turnshek (Univ. of Pittsburgh), and Faith Vilas (NASA JSC) served on the six-member IRTF Time Allocation Committee. The TAC is chaired by IRTF Division Chief Alan Tokunaga, but he does not vote on proposals.

4. USAGE OF THE IRTF

Deadlines for observing proposals are 1 October for February–July and 1 April for August–January. The IRTF received 106 applications for observing time for the first semester of 2001. The oversubscription factor was 1.6 for solar system programs and 3.2 for non–solar system programs. The scheduled programs involve over 200 U.S. and foreign astronomers each semester. About 22% of the scheduled observing time was lost to bad weather and 1.5% to IRTF instrumentation and other facility problems.

5. THE TELESCOPE

The IRTF has an f/37 Cassegrain focus with two secondary mirror structures, one for tip-tilt and one for chopping. An f/120 coudé focus is also available. 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.

5.1 Facility Instruments

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

SpeX is a 0.8–5.4 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: (a) 0.8–2.4 μm, cross-dispersed, R = 2000, 0″.3×15″ slit; (b) 1.9–5.4 μm, cross-dispersed, R = 2500, 0″.3×15″ slit; (c) 0.8–2.5 μm, single order, R = 2000, 0″.3×60″ slit; (d) 2.7–5.4 μm, single order, R = 2500, 0″.3×60″ slit; (e) 0.8–

2.5 μm, prism, R = 250, 0.″3×60″ slit. Slit widths from 0.″3 to 0.″3 are available. There is a slit viewer that can also provide infrared guiding and imaging capability. It has a 512×512 InSb array with 0.″12/pixel, 60″×60″ field of view, and a 15-position filter wheel. Currently, SpeX is scheduled for 45% of all observing time.

NSFCAM is a 1–5 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 μm. NSFCAM also features two grisms that provide long-slit spectroscopy. One covers the 0.9–1.8 μm range at a resolution of R = 100, while the other works in the *H*, *K*, or *L* bands at R = 300 (double sampled). A warm waveplate rotator assembly allows linear polarization measurements to be obtained. The DSP-based array controller provides real-time shift-and-add for image sharpening and a movie-mode for high-duty-cycle, short-exposure observations such as occultations. It is scheduled for about 25% of all observing time.

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

MIRLIN is a 10–20 μm camera that is available as a facility instrument for up to four months per semester by arrangement with its developer, Mike Ressler (JPL). The camera utilizes a 128×128 Si:As BIB array. The pixel scale is 0.″46/pixel. The user interface is similar to that of NSFCAM, CSHELL, and SpeX.

5.2 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 8–25 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.

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.

5.3 New Hilo Facilities

In August 2000, the IRTF staff moved into the new IfA-Hilo building, which is located in the University of Hawaii at Hilo Research Park. New laboratory spaces, a new machine shop, remote observing facilities, and new laboratory equipment are available for IRTF operations.

5.4 Image Quality

Work on improving the image quality, including improvement of the primary mirror support system, installation of a tip-tilt secondary mirror, improvement of the dome cooling system, and improvement of the dome air flushing, has been continuing for several years. Work continues on (a) an adaptive optics system that should be ready for engineering tests by early 2002, and (b) improvements to the dome and primary mirror thermal environment.

5.5 Remote Observing

The IRTF has started to implement remote observing over the Internet. There have been two remote observing runs using NSFCAM and one run using SpeX. The observer controls the instrument from his or her office on the mainland with assistance from the telescope operator. Based on the success of these experiments, we are planning for remote observing from both our Hilo office and from the observer's home office.

6. BUDGET

For the period 1 February 2001 to 31 January 2002, the IRTF has an operating budget of $3.2 million, which includes support for the equivalent of 24 full-time positions. This includes 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 1024 × 1024 array was awarded to the IRTF. As part of this upgrade, two pixel scales will be provided (40 milliarcsec and 80 milliarcsec), and a second wave-front sensor for use on extended objects will be fabricated.

7. WEB-BASED INFORMATION ACCESS

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

Alan Tokunaga