WISE

Wide-Field Infrared Survey Explorer

MISSION OVERVIEW

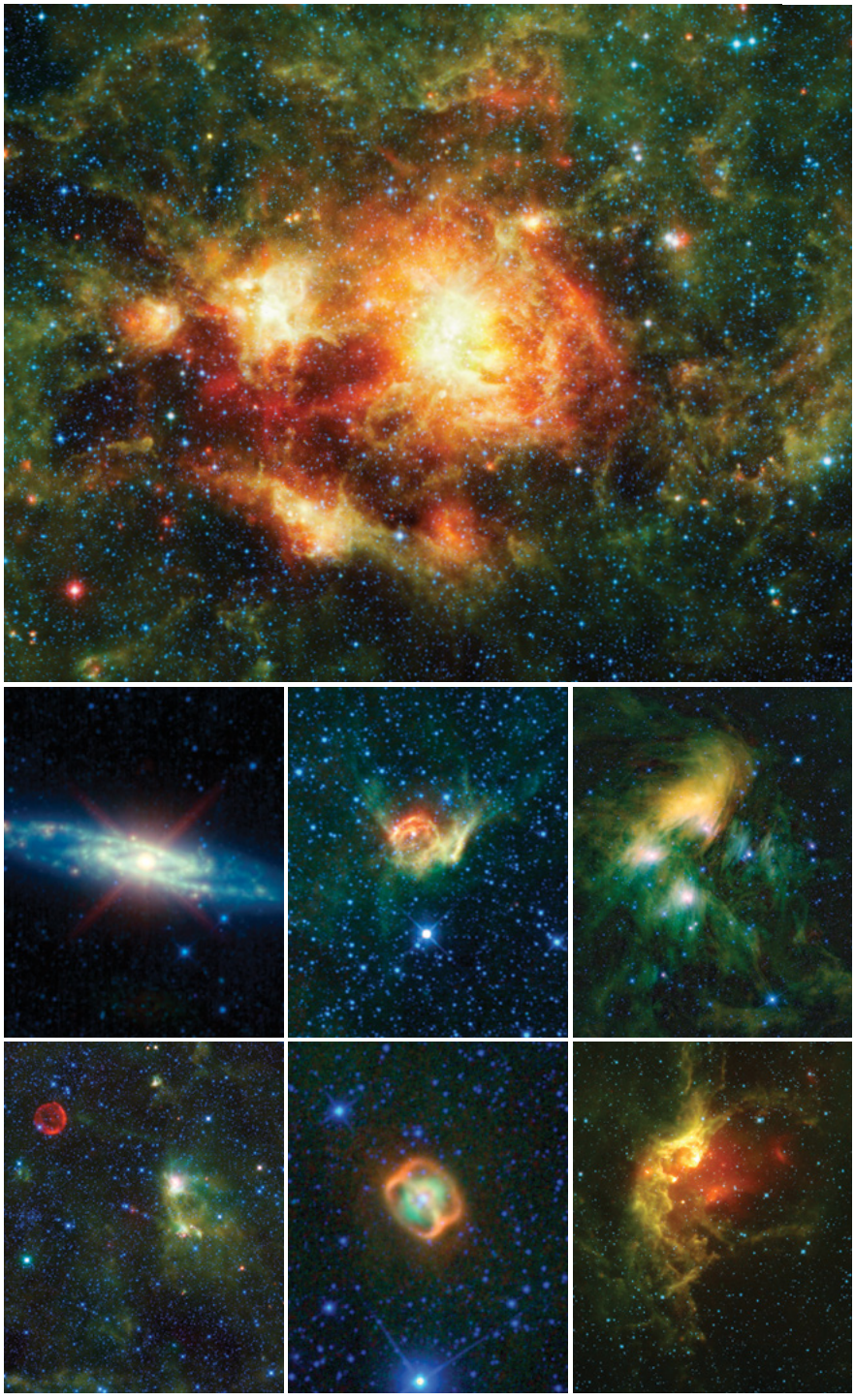
The Wide-field Infrared Survey Explorer (WISE) launched on December 14, 2009. WISE is a highly sensitive astronomical telescope that surveyed the entire sky in four mid-infrared bands spanning from 2.6 to 26 microns. WISE cataloged hundreds of millions of astronomical objects, comprising many asteroids (several hundred of which are located near Earth), brown dwarf stars (including some of the closest stars to our Sun), and ultra-luminous infrared galaxies. In the course of its mission, WISE mapped the entire sky twice.

NASA's Jet Propulsion Laboratory placed WISE in hibernation in 2011 after its primary mission and reactivated it in September 2013 under the name NEOWISE. The NEOWISE mission builds on the work of WISE by identifying and characterizing the population of near-Earth objects (NEOs).

The Space Dynamics Laboratory (SDL) designed, built, tested, and calibrated the WISE instrument. Following delivery of the payload, SDL provided support for instrument-spacecraft integration, pre-launch operations, and on-orbit operations throughout the mission.

FEATURES

- 40 cm aperture, six-mirror afocal telescope, a single-axis scanner, and a six-mirror aft optics imager assembly
- Four 1024 x 1024 infrared focal plane arrays (3.4 µm, 4.6 µm, 12 µm, 22 µm)
- Two-stage, solid-hydrogen cryostat to keep the instrument at ~11 K (-440°F)
- Aperture shade to protect the telescope from the heat of the Sun and Earth during operation
- Electronics to digitize the detector analog outputs and perform sample-up-the-ramp processing



WISE images courtesy of NASA, http://wise.ssl.berkeley.edu/gallery_images.html.

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SDL/10-137 Rev. A

OPTICS

The WISE telescope has a 40 cm aperture with a field of view of 0.78° x 0.78°, imaging the sky at four infrared wavelengths covering 2.6 to 26 μm. Its design uses a total of 10 powered and two flat mirrors, all made of aluminum and coated in gold to improve their ability to reflect infrared light. In addition, a scan mirror moving opposite WISE's orbital motion effectively "freezes" the sky over the 10 seconds it takes to capture an image. L-3 SSG-Tinsley manufactured the WISE telescope.

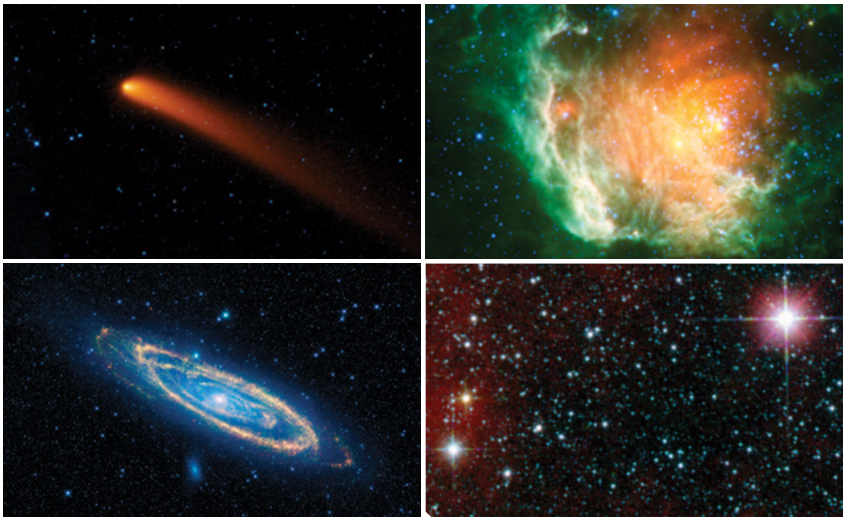
DETECTORS

With a million pixels each, the four WISE focal plane arrays are a significant technological leap over prior infrared survey missions. WISE can distinguish features about five times smaller than the Infrared Astronomical Satellite (IRAS) could, at 12 and 25 μm, and many hundred times smaller than the Cosmic Background Explorer (COBE) could, at 3.5 and 4.9 μm. The 3.4 and 4.6 μm focal plane arrays are HgCdTe detectors manufactured by Teledyne Imaging Systems. The 12 and 22 μm focal plane arrays are arsenic-doped silicon (Si:As) detectors manufactured by DRS Sensors and Targeting Systems.

CRYOSTAT

To detect infrared radiation from cool objects, the WISE telescope and detectors had to be kept at extremely cold temperatures to avoid picking up their own signal. During the WISE mission, the operational temperatures were 32 K (-402°F) for the HgCdTe detectors, 7.3 K (-446°F) for the Si:As detectors, and ~11 K for the telescope. A cryostat, manufactured by Lockheed Martin Advanced Technology Center, housed the optics to maintain these temperatures. The WISE cryostat featured two tanks filled with frozen hydrogen. The smaller, primary tank cooled the Si:As detectors. A larger, secondary tank protected the primary tank from the heat of the outer structure of the cryostat and cooled the telescope and the HgCdTe detectors. Even after the frozen hydrogen evaporated, the design of the cryostat has kept the instrument at ~75 K (-325°F), cold enough for the HgCdTe detectors, allowing NEOWISE to discover new comets and near-earth objects as it continues to map the sky.

The WISE instrument



WISE images courtesy of NASA, http://wise.ssl.berkeley.edu/gallery_images.html.