The WISE Flight System and NEOWISE Operations

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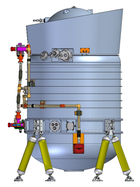
Flight System

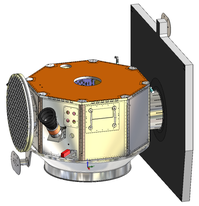
System Description

The cryostat, telescope, infrared detectors, and supporting electronics make up the science instrument, which was designed and delivered by Utah State University's Space Dynamics Lab.



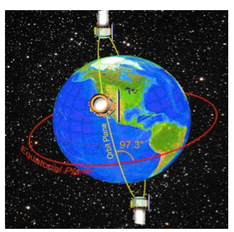
- Two stage solid hydrogen cryostat
- 4 imaging channels centered at 3.4, 4.6, 12, and 22µm
- 40 cm telescope operating at < 8 K on the 12, and 22µm detectors and 32K for 3.4 and 4.6 µm detectors during the cryogenic mission
- Now passively maintaining < 75K for the post-cryogenic mission

The Spacecraft element is built on the heritage of the Ball Aerospace Technologies Corporation's Orbital Express architecture.



- Shared heritage with OE, Deep Impact, and Kepler
- Single string bus with select redundancy
- Reaction wheels and torque rods for control
- No propulsion for orbit maintenance

Science Collection



The spacecraft scans the sky at orbit rate – keeping the telescope pointed near zenith, keeping the sun and earth shine out of the telescope.

A scan mirror freezes a portion of the sky on the detectors for each exposure, taken every 11 seconds.

Successful Prime Mission

WISE launched December 14, 2009, and mapped the entire sky as of July 17, 2010. The solid hydrogen in the outer secondary tank was depleted August 5, 2010; the solid hydrogen in the primary tank was depleted September 29, 2010. The mission operated using the 3.4 and 4.6 um bands of the passively cooled telescope as NEOWISE through Feb 1, 2011.

WISE was put into a hibernation state in February 2011, with the hope of reviving the system for a new mission at a later date.

NEOWISE Mission

Reactivation of the WISE Flight System

The WISE flight system was re-commissioned in the fall of 2013 for a revival of its asteroid-hunting mission.

- First contact September 2013
- Telescope required 3-month cool-down to operational temperatures
- Start of new survey operations Dec 23, 2013

Flight System Performance

System performance is comparable to prime mission performance.

- Power, thermal, flight software, and command and data handling were nominal on restart
- Attitude control required re-characterization and re-calibration
- Alignments were determined to be consistent with prime mission measurements
- Scan mirror calibration, in which spacecraft rate equal and opposite to that of instrument scan mirror is determined, resulted in minor tweak to rate calibrated during prime WISE mission

Two Anomalies In the New Mission

A small reduction in system pointing performance resulted in ~5% decrease in image frames passing quality tests.

A prime contributor was increased occurrence of star tracker drop-outs, in which the tracker cannot provide a useable attitude estimate for a brief time.

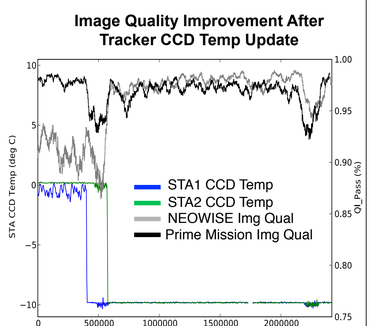


Image quality data courtesy of Tim Conrow, IPAC

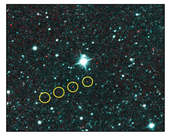
Compensated by cooling the star tracker CCDs for lower-noise performance, which improved system performance to prime mission levels.

A separate software anomaly forced ~3 weeks of downtime in April 2014.

Root cause has been identified, and the anomaly is sufficiently mitigated that it is not expected to result in significant further downtime.

Future Plans

Two More Years of NEOWISE Survey



Survey through December 2016
Three data releases: 3/26/15, 3/2016, 4/2017

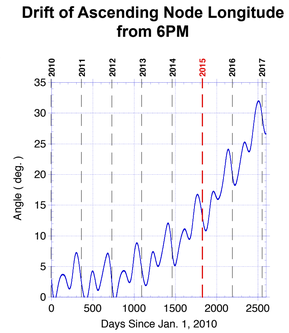
Orbit Drift Limits Remaining Mission Life

Due to drag, the NEOWISE orbit plane is drifting away from its original and ideal orientation with a 6PM ascending node.

No propulsion system for orbit maintenance.

Once NEOWISE starts seeing the Earth limb during winter solstice, science return is impacted

- Too much Earthlight scattering into images
- Increased telescope temperatures due to heating from Earth IR



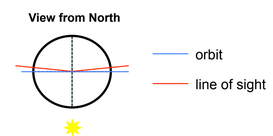
Courtesy Dan Lyons and David Jefferson, JPL

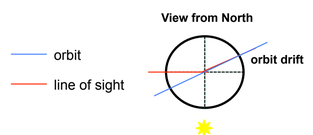
Predict no significant impact to mission return before the end of 2016.

Survey Plan Periodic Updates For Orbit Drift

Original survey design:

- Scan near zenith at constant angular rate
- Look ahead on the 6PM side of the orbit in case safehold results in a gap in coverage
- Look behind on the 6AM side to provide margin from the Sun





New survey strategy:

- On the side of the orbit that has rotated toward night, point near zenith
- On the side of the orbit where the node crossing has rotated toward Sun, point normal to the Sun line

Team continuing to analyze impact of the changing environment on operations and performance.

- Mission duration longer than WISE's design life
- Lower altitude, changing environmental heating

Thus far, margins and performance predictions look good through end of mission.