SPECIALIZED TELESCOPES

Ball delivers affordable, innovative solutions to solve its customers' toughest planetary, astronomical and space situational awareness challenges.

Kepler & K2

Ball designed and built the photometer and spacecraft and supported mission operations for NASA's exoplanet-hunting Kepler mission. The photometer measured the brightness of 150,000 stars, allowing it to detect changes in brightness due to a passing planet. The pointing precision of the spacecraft was controlled to within a few milli-arcseconds and its photometer featured a focal plane array of 42 charge coupled devices to collect the photons of light observed by Kepler. After 9 years of observations and discovering more than 2,600 planets outside our solar system, Kepler was retired in 2018.

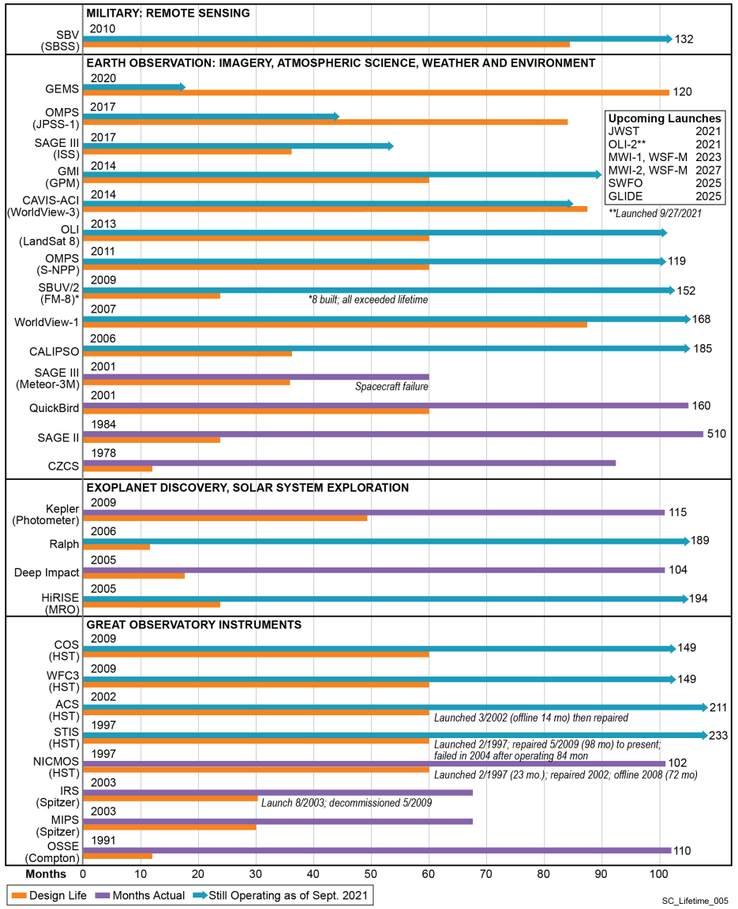
SBSS

Providing critical 24/7 space situational awareness on-orbit, Ball was responsible for delivering the entire space segment for the Space Based Space Surveillance (SBSS) satellite. The SBSS agile gimbaled visible sensor accurately detects space objects with increased capacity and improved timeliness, sensitivity and overall flexibility.

HiRISE

Ball designed and built the High Resolution Imaging Science Experiment (HiRISE) for NASA's Mars Reconnaissance Orbiter mission. HiRISE is the largest telescopic camera ever sent into orbit around another planet and is able to identify images as small as a coffee table.

Instrument Lifecycle



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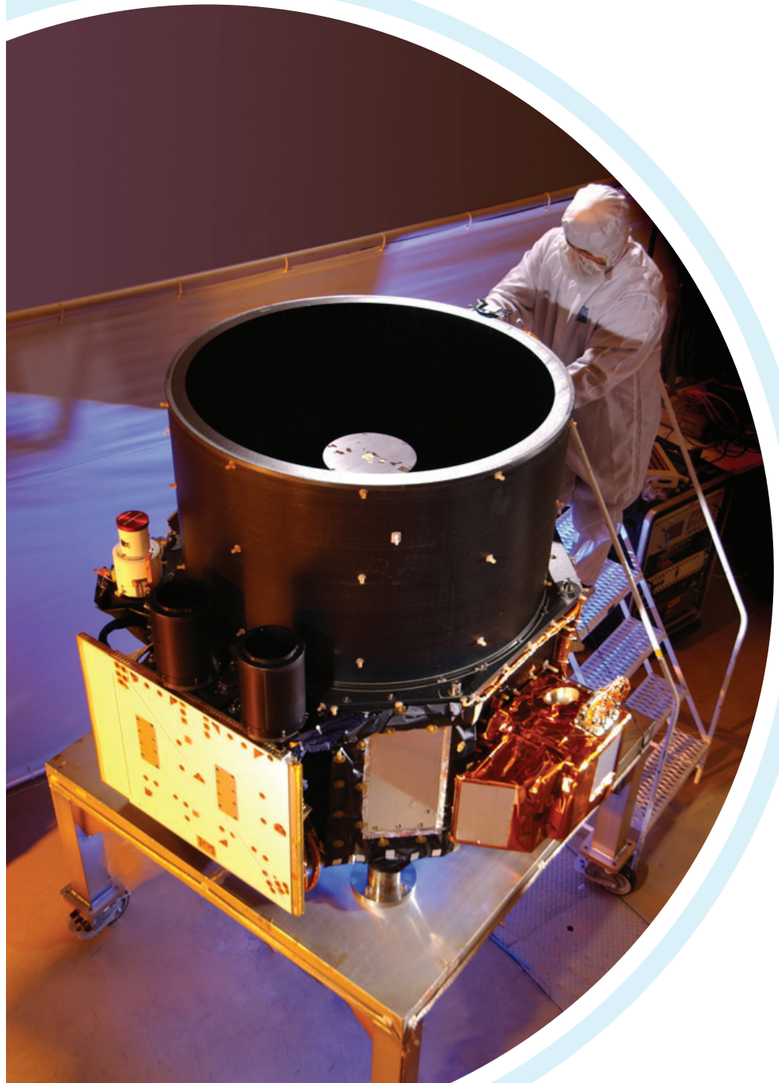
INSTRUMENTS

For more than 60 years, Ball Aerospace has been the provider of choice for leading-edge imaging systems. We deliver reliable and affordable instruments that span the electromagnetic spectrum for a wide range of defense and intelligence, civil and commercial applications.

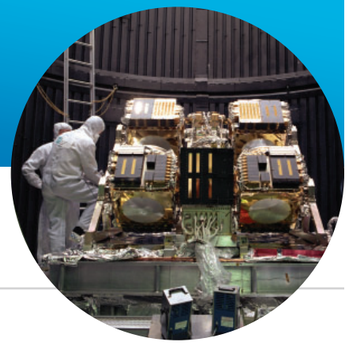


Images (Left): CALIPSO; (Right Top to Bottom): HiRISE; SBSS

GO BEYOND WITH BALL.®

Overview

As both a spacecraft and instrument developer, Ball has a unique understanding of instrument integration and experience delivering end-to-end systems. This knowledge gives Ball a mission systems expertise that translates into a proven ability to fulfill our customers' most challenging requirements. Ball specializes in providing advanced electro-optical, infrared and multispectral imaging systems for a variety of missions.



GREAT OBSERVATORIES

Ball is proud to have contributed to all four of NASA's Great Observatories, including the Compton Gamma Ray Observatory, the Hubble Space Telescope, the Chandra X-ray Observatory and the Spitzer Space Telescope. NASA designed the Great Observatories to make astronomical studies over many different wavelengths (visible, gamma rays, X-rays and infrared) to provide a greater understanding of the universe.

Compton Gamma Ray Observatory

Ball built the Oriented Scintillation Spectrometer Experiment (OSSE) and two star trackers for the Compton Gamma Ray Observatory. OSSE, along with three other instruments, detects high-energy radiation.

Hubble Space Telescope

This Great Observatory almost never observed clearly without the assistance of the Ball-developed corrective optics that acted as Hubble's eyeglasses. After the telescope was launched, a spherical anomaly distorted its imagery, and Ball was called upon to solve the problem. Since restoring the telescope's imaging capability in 1993, Ball has built six more instruments for Hubble. Currently, all of the scientific instruments aboard the telescope are Ball-built.

Chandra X-ray Observatory

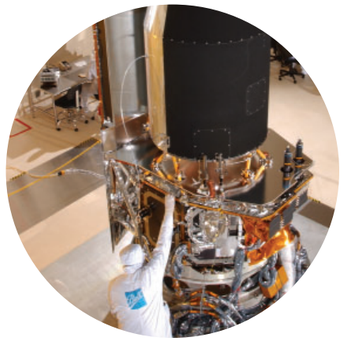
For the Chandra X-ray Observatory, Ball built the Aspect Camera and Science Instrument Module to help identify hot spots in the universe, such as exploded stars and matter near black holes.

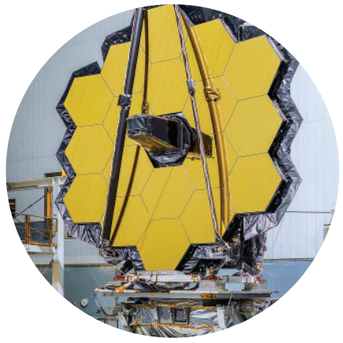
Spitzer Space Telescope

Ball built the "eyes" of Spitzer – called the Cryogenic Telescope Assembly – and two of the three science instruments onboard this infrared observatory.

James Webb Space Telescope

Carrying on the legacy of the Great Observatories, Ball developed the entire optical system for NASA's James Webb Space Telescope, the world's next-generation space observatory. The system includes 18 1.3-meter hexagonal mirror segments to compose the 6.5-meter primary mirror, making it the largest mirror ever flown in space.





Images (Right Top to Bottom): OSSE, COSTAR, Spitzer and Webb

EARTH OBSERVATION

Predicting weather and monitoring the Earth's environment for civil and military needs alike, Ball has a consistent track record of delivering affordable instruments to its customers and experience with both fixed-price and cost-plus Earth observation instruments.

MOIRE

Ball completed the Membrane Optical Imager for Real-Time Exploitation (MOIRE), a Defense Advanced Research Projects Agency (DARPA)-funded program that aimed to provide persistent, real-time tactical video to the warfighter using a large aperture telescope. The program demonstrated Ball's ability to manufacture large collection area telescopes (up to 20 meters); the large structures needed to hold the optics tight and flat; and the additional optical elements needed to turn a diffraction-based optic into a wide bandwidth imaging device.

CAVIS

The Ball-built Cloud, Aerosol, Water Vapor, Ice, Snow (CAVIS) atmospheric instrument aboard WorldView-3, a commercial imagery satellite built by Ball, provides atmospheric correction data to improve WorldView-3's imagery. Ball provided the CAVIS instrument at a fixed-price and substantial cost savings by using a modular and command product for the electronics designs, focal plane detectors and spectral filter.

GMI

The Global Precipitation Measurement-Microwave Imager (GMI) is the standard for calibration for the scientific community's radiometer needs. This imager is central to the Global Precipitation Measurement (GPM) mission's success by allowing for temporal sampling of rainfall accumulations, as well as more frequent and higher quality data collection.

Operational Land Imager

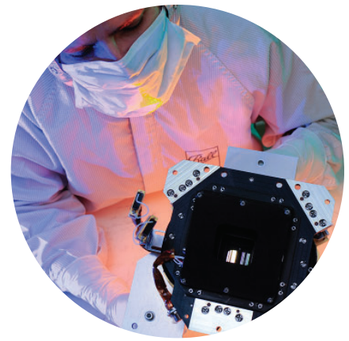
To continue more than 45 years of land data records and meet the nation's imaging requirement, Ball was called upon to build the Operational Land Imagers (OLI) for Landsat 8 and 9. The OLI instruments are highly-calibrated, precise, multispectral imagers that enable better spatial resolution and greater sensitivity to brightness and color than previous Landsat missions.

WorldView-1

Ball built the fixed-price WorldView-1 60-centimeter telescope and assembled the entire instrument to provide high resolution imaging capabilities. The WorldView-1 spacecraft was also built by Ball and is capable of collecting up to 500,000 square kilometers (200,000 sq. mi.) of half-meter imagery per day with extremely precise geolocation accuracy.

CALIPSO

The Cloud-Aerosol Lidar and Infrared Pathfinder Satellite Observations (CALIPSO) mission is dedicated to studying the impact that clouds and aerosols have on the Earth's climate. The lidar scans the atmosphere with green and infrared laser light and detects backscatter from clouds and aerosols.



Images (Right Top to Bottom): MOIRE, CAVIS, GMI and OLI