

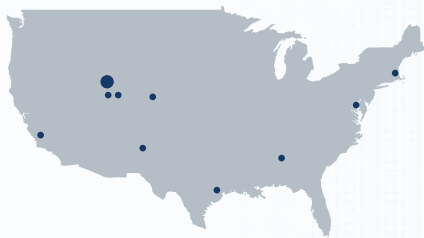
ABOUT SDL

The Space Dynamics Laboratory (SDL) has a five-decade legacy of providing innovative solutions to critical challenges faced in the defense, national security, academic, civil, and commercial arenas. SDL leads the way in electro-optical remote sensing systems, atmospheric and environmental research instrumentation, groundbreaking small satellite technologies, sensor calibration and test capabilities and facilities, data exploitation products, and intelligence, surveillance and reconnaissance solutions.

From concept to development, SDL scientists and engineers have improved, and often defined, the state of the art in optical design, stability control, thermal management, data analysis and management, and mission planning. SDL has unique capabilities to quickly develop prototype and one-of-a-kind remote sensing systems for ground, air, and space-based platforms. We continuously renew our capabilities and grow our business through technology innovation and by expanding our presence in the full lifecycle of our customers' programs.

SDL is a nonprofit research corporation and a unit of the Utah State University Research Foundation (USURF), owned by Utah State University. SDL is one of only 14 University Affiliated Research Centers (UARCs) in the nation. As such, SDL maintains a strategic relationship with the Department of Defense (DoD) in the development of key defense technologies.

Headquartered in North Logan, UT, SDL employs more than 450 dedicated professionals, including university-level student staff, at facilities in Albuquerque, NM; Colorado Springs, CO; Los Angeles, CA; Washington, DC; Huntsville, AL; Bedford, MA; and Houston, TX.



www.spacedynamics.org

HAPPENING NOW

WISE (*Wide-field Infrared Survey Explorer*) - With over 500 times the IR sensitivity of previous survey missions, WISE scanned the entire celestial sky over 1.5 times, capturing more than 2.7 million pictures in four IR bands (over 9 million images) of astral objects. Launched in December 2009, WISE discovered 19 new comets, over 40 ultra-luminous IR galaxies, almost 100 confirmed new brown dwarfs, and more than 33,500 asteroids, including 132 near-Earth objects (NEO). SDL developed the WISE science instrument, which also performed an extended mission, NEOWISE, to hunt for more asteroids and comets during a full sweep of the asteroid belt.

OCO-2 (*Orbiting Carbon Observer-2*) is NASA's mission dedicated to studying atmospheric carbon dioxide. SDL is providing the OCO-2 cryogenic subsystem and a flight spare. OCO-2 will provide the first complete picture of human and natural carbon dioxide sources and sinks, mapping their global geographic distribution and studying their changes over time. OCO-2 replaces OCO-1, which was lost during a launch vehicle failure in 2009.

DICE (*Dynamic Ionosphere CubeSat Experiment*) - With the simultaneous launch and deployment of two identical CubeSats, DICE will measure ionospheric gradients on the edges of Storm Enhanced Density (SED) features. The DICE mission will further understanding of the formation, evolution, and decay of SEDs and their related impact on space weather forecasting.

EMAS (*Enhanced MODIS Airborne Simulator*) - SDL is providing a cooled optical bench assembly (COB) to enhance the MODIS Airborne Simulator (MAS), a wide-band, multispectral, whiskbroom scanner operated by the NASA Airborne Sensor Facility for Earth-observing campaigns aboard high-altitude NASA platforms. The COB contains instrumentation for 12 LWIR bands and one MWIR band, with accommodation for 12 MWIR bands. The MAS spectral bands span from 0.45 to 14.0 μm and are similar to those of the MODIS (Moderate Resolution Imaging Spectroradiometer) instrument aboard the AQUA and TERRA satellites.

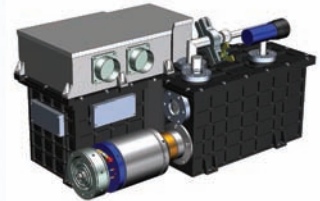
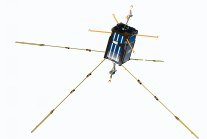
NOVA - SDL's *Nano-Satellite Operation Verification and Assessment* test facility enables pre-launch testing. Its unique capabilities include mass properties testing, magnetic field generation, solar simulation, and the measurement of speed, jitter, and torque for small satellites that weigh less than 10 kilograms.

2009 - 2010

PEARL (*Pico-satellite Exo-Atmospheric Research Laboratory*) is a spacecraft platform designed from the ground up to provide high capability in a CubeSat form factor. The initial 3U version is a highly capable bus. Increased control of processing and pointing provides the utility necessary for relevant scientific or military missions. The PEARL platform is a set of standard and customizable components that can be assembled into mission-specific configurations while minimizing engineering costs and development schedules.

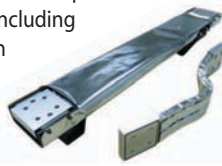
EyePod is an intelligent, geo-aware, day/night imaging sensor system for deployment aboard Class 3 UAVs. EyePod's jitter-stabilized, dual sensor, dual focal length system allows operators to conduct both wide-area survey and high-resolution inspection missions from a single flight pass. Its innovative design solves the challenges of excessive image smear from aircraft jitter, while providing geo-registered, high-quality images for immediate exploitation.

NuSAR is a small, high-bandwidth, synthetic aperture radar (SAR) system that provides large-area surveillance and reconnaissance for small manned and unmanned aircraft. Independent of weather and lighting conditions, NuSAR can detect manmade or metal objects with clarity, even through foliage and topsoil. Its dual-frequency (L- and X-band) design features onboard GPS/INS and embedded real-time image formation.

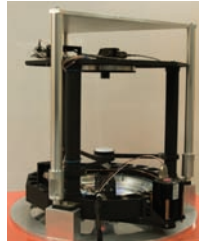


2008

James Webb Space Telescope Thermal Links - SDL has developed flexible thermal links for numerous space applications including NASA's JWST. These innovative links transport heat from JWST's science instruments to their radiators, enabling each instrument to operate at desired temperatures. The JWST, a large IR-optimized space telescope, will find the first galaxies that formed in the early Universe by examining every phase of cosmic history, from the first luminous glows after the Big Bang to the formation of galaxies, stars, planets, and our own solar system.



TWiLiTE (Tropospheric Wind Lidar Technology Experiment) - the first demonstration of a high-altitude, airborne-scanning, direct-detection Doppler lidar. SDL's role was to design and build the holographic lidar telescope. TWiLiTE will help advance our understanding of atmospheric dynamics and improve numerical weather prediction. As part of NASA's Instrument Incubator Program, TWiLiTE is a technology testbed used for studying mesoscale dynamics and storm research. TWiLiTE can also be used for calibration and validation of satellite-based wind systems.



2007

AIM/SOFIE (Aeronomy of Ice in the Mesosphere/Solar Occultation for Ice Experiment) - a study of Polar Mesospheric Clouds (PMCs), thought to be indicators of global climate change. The goal is to resolve why PMCs form and why they vary. AIM launched into Low Earth Orbit from Vandenberg AFB April 25th on a Pegasus XL launch vehicle.



MODAS (Modular Avionics System) - a compact, robust, flexible avionics system made up of a collection of functional building blocks that can be combined to meet a multitude of space systems requirements. MODAS was designed to excel within the harsh environments of LEO, GEO, and deep space missions.



DUSTER (Deployable UAV System for Targeting, Exploitation, and Reconnaissance) - provides the capability of controlling an array of dissimilar UAV platforms while simultaneously processing and exploiting their sensor data. Several UAV platforms can be deployed to investigate a wide area using varied sensor types. DUSTER's primary objective is to control and process sensors doing simultaneous data collections on disparate planes. Sensors are networked to allow their high-speed data to be collected in real time.



2006

FPMU (Floating Potential Measurement Unit) - installed on the ISS August 3, 2006, it was developed quickly to help NASA understand the charging physics of the ISS. FPMU incorporates a Floating Potential Probe, multiple Langmuir Probes, and a Plasma Frequency Probe to monitor ISS charging and to correct the charging models of the station each time a new section is added to the structure.



DISC (Digital Imaging Space Camera) - a 1 mega-pixel visible, monochromatic imager that uses less than 2 watts of power. DISC is designed entirely of radiation-hardened components and is suitable for LEO, MEO, and GEO orbits. DISC includes highly flexible image control, including windowing, adjustable frame rates, and adjustable integration times.



2005

NIST MOU - U.S. Commerce Department's National Institute for Standards & Technology (NIST) and USU created a partnership for collaboration in the development and calibration of optical sensors for defense, homeland security, weather prediction, and climate research.

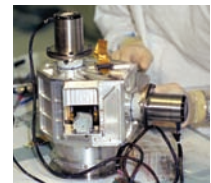


FIRST (Far-Infrared Spectroscopy of the Troposphere) - a long-wave imaging spectrometer that measures between 10-100 μm . Part of NASA's Instrument Incubator Program, the FIRST sensor was launched June 7, 2005. Objectives include measuring the cooling rate of the Earth and improving our ability to determine troposphere water vapor vertical distribution.



2004

TES-FPOMA (Tropospheric Emission Spectrometer-Focal Plane Opto-Mechanical Assembly) - launched on July 15th as part of NASA's Earth Observing System Aura mission to study the Earth's ozone, air quality, and climate. Under contract to the JPL, SDL designed, fabricated, and tested the FPOMA, which measures the spectral range from 3.2 to 15.4 μm , for TES.



2003

DEBI (Dual-mode Experiment on Bowshock Interactions) - launched June 10th from Wallops Island Flight Facility, VA. Captured data supports research on UV and IR bowshock interactions, furthering the understanding of chemistry associated with hypersonic flight in hit-to-kill applications within Earth's atmosphere.

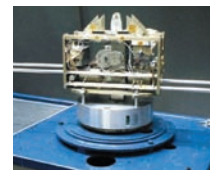


E-Winds - a NASA-funded program to measure the time history of the nighttime E-region neutral winds, launched June 30th from Wallops Flight Facility, VA. Data collected will help researchers discover how these winds relate to the formation and descent of intermediate layers.

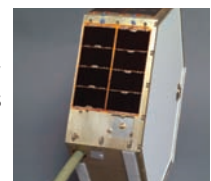


2002

CODA (Coupling of Dynamics and Aurora) - launched February 21, 2002 from Poker Flat, AK, the CODA payload closely followed the launch of three chemical-release rockets to measure the dispersion of chemical plumes from those rockets to provide estimates of turbulent diffusion in the lower E-region.



Combat Sentinel - SDL and USU designed, built, and delivered this micro-satellite for testing in a plasma chamber. The objective was to demonstrate the capability of a satellite to detect and characterize thermal exposures through the use of existing temperature sensors, solar cells, and power changes.



2001

SABER (Sounding of the Atmosphere using Broadband Emission Radiometry) - launched on a Delta II rocket from Vandenberg AFB as one of four instruments on NASA's TIMED mission. SABER, a 10-channel infrared (1.27 to 16.9 μm) radiometer, was designed, built, tested, and calibrated at SDL to globally explore the mesosphere and lower thermosphere and make global day/night vertical profile measurements of atmospheric temperature, density, and pressure.



1999

NSN Horizontal Fusion (*Naval Research Laboratory Sensor Node*) - designed to provide distributed screening of real-time, near real-time, and archived data from the latest electro-optical, infrared, multi-spectral, and radar sensors.

TIS-SPE (*Tactical Input Segment Screener Processor Element*) - hardware and software for the SPE portion of the TIS, a ground station designed to receive, process, and screen tactical imagery. Data received from the sensors pass through the SPE and on to the Common Imagery Processor (CIP). The SPE receives processed imagery and support data from the CIP.



NAVIS (*Navy Input Station*) - a state-of-the-art, real-time reconnaissance imagery receiver and display system. NAVIS demonstrates advanced VIS / IR / multispectral / radar formatting and processing system for airborne sensors.

WIRE (*Wide-field Infrared Explorer*) - a solid-hydrogen cooled imaging telescope designed to study starburst galaxy evolution. As the fifth mission in the SMEX program, WIRE was launched on March 4th from Vandenberg AFB.



GIFTS (*Geosynchronous Imaging Fourier Transform Spectrometer*) - provides new techniques for measuring the temperature, wind, water vapor and chemical compositions of the atmosphere which will be utilized on the Hyperspectral Environmental Suite program to greatly improve weather and climate analysis and predictions.



1998

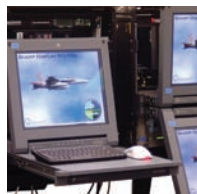
RAMOS (*Russian American Observational Satellites*) - an international cooperative program with the Russian Federation under the MDA-sponsored UARC contract. RAMOS was planned as a two-satellite constellation that would operate in approximately the same plane and altitude of around 500 kilometers. As prime contractor, SDL oversaw development activities for the US and Russian engineering teams.



TARPS-CD (*Tactical Air-borne Reconnaissance Pod System - Completely Digital*) - digital imagery integrated with real-time digital recording, data link transmission and display to provide real-time transmission of step framing imagery to a ground station with real-time/near real-time image display capabilities.

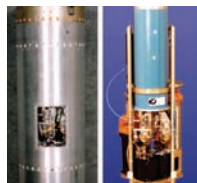


SHARP (*Shared Reconnaissance Pod*) - a multifunctional reconnaissance pod, adaptable to several airborne platforms for tactical manned airborne reconnaissance. Capable of simultaneous airborne and ground screening, the SHARP system is significantly improving the US Navy's ability to rapidly gather, exploit, and disseminate tactical imagery.



1997

METEORS (*Mesosphere-Thermosphere Emissions for Ozone Remote Sensing*) - a NASA Langley sounding rocket program launched from White Sands Missile Range on August 8th. SDL provided a 9.6 μm CFV spectrometer, a 2-channel near-IR Warm Infrared Radiometer, and an atomic oxygen resonance-fluorescence/absorption experiment.



1996

GEMS (*Gas Exchange Measurement System*) - designed to measure temperatures, light levels, gas concentrations, transpiration rates, and net photosynthesis of plants grown on the Russian Mir Space Station. The 25-year experiment demonstrated that serial plant propagation in space is possible.



1996

SPIRIT III (*Spatial Infrared Imaging Telescope*) - a long-wave infrared instrumentation package, with a high spatial resolution radiometer, a high spectral resolution interferometer-spectrometer, and an extremely high-off-axis-rejection telescope. Developed, built, and calibrated by SDL, SPIRIT III was the primary sensor aboard the MDA Midcourse Space Experiment which launched from Vandenberg AFB on April 24, 1996.



Viper Dart - an initiative to develop and miniaturize a small inexpensive, suborbital payload that can be used to probe the Earth's mesosphere.



Skipper - an international program funded by MDA to produce an atmospheric research satellite launched in October from the Baikonur Cosmodrome in Kazakhstan. As prime contractor, SDL designed, built, integrated, and operated the spacecraft, wrote flight software, and developed flight electronics and ground-based data handling and display hardware.



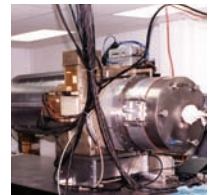
1993

SPEAR III (*Space Power Experiments Aboard Rockets*) - successfully launched March 15, 1993 from NASA's Wallops Flight Facility. The mission investigated methods of grounding spacecraft to LEO plasma, and obtained quantitative data on various charging effects observed on spacecraft in LEO.



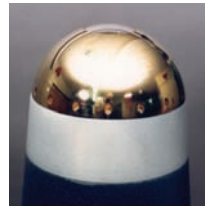
1992

BEPoP (*Brilliant Eyes Proof of Principle*) - designed, built, and calibrated by SDL, the BEPoP sensor incorporated an imaging radiometer with three focal planes for collecting measurements at visible, LWIR, and VLWIR wavelengths. BEPoP imaged space-based targets aboard a sounding rocket launched on April 13, 1992, from the Firepond, MA, observatory.



1991

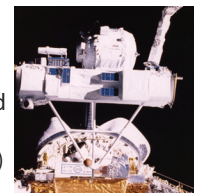
Bowshock I & II - funded by MDA to provide the predictive capability to design and deploy effective sensor systems for target acquisition and tracking in future atmospheric interceptor systems. Bowshock I and II launched on February 18, 1991, and December 28, 1995, respectively, and provided data needed to improve predictive capabilities in UV wavelengths by four orders of magnitude.



CIRRIS-1A (*Cryogenic Infrared Radiance Instrumentation for Shuttle*) - launched on April 28, 1991, aboard the Space Shuttle Discovery. SDL developed, built, and calibrated this infrared telescope to obtain simultaneous spectral and spatial measurements of atmospheric emissions, to characterize targets of opportunity such as LEO satellites passing within range of the sensors, and to assess shuttle contamination.



IBSS (*Infrared Background Signature Survey*) - launched April 28, 1991, and flew on the space shuttle SPAS platform. The primary sensor, which consisted of a high-off-axis rejection telescope, a spatial radiometer, and an Ebert-Fastie grating spectrometer, was calibrated by a portable multifunction infrared calibration source (MIC 1) designed and fabricated by SDL.





EARLY HISTORY

Directly following World War II, scientists who had been working in the military began returning to academia. The US had captured a number of German V-2 rockets, and the Physics Department at the University of Utah began performing research using some of the rockets. In 1948, the predecessor to SDL, the Upper Air Research Laboratory (UARL), was founded at the University of Utah to coordinate this research. Early experiments measured electron density in the upper atmosphere, with the first of UARL's experiments launched via V-2 from White Sands Missile Range, NM, on March 21, 1949. UARL was gradually transferred to Utah State University in Logan to become the Space Dynamics Laboratory, now celebrating five decades of delivering innovative remote sensing technologies for the DoD and the science community.

In the decades following that milestone V-2 launch, SDL developed a series of sounding rocket experiments for air- and electron-density measurements, polar cap absorption experiments, solar eclipse and auroral data collection, and ionospheric/mesospheric studies. During the 1950s and 1960s, SDL developed instrumentation and performed integration and operations for nearly 200 experiments, most sponsored by the Air Force. SDL's sensors still play a role in today's sounding rocket-based research conducted by DoD, the National Science Foundation and NASA, and offer a training ground for the next generation of scientists and engineers.

Highlights of SDL's work during the 1970s include a key role in discovering the atmospheric effects that result from nuclear detonation during such campaigns as Satellite Transmission Effects Simulations (STRESS), sponsored by the Defense Nuclear Agency. SDL also developed sensors for several ICECAP campaigns, which investigated aurora and polar substorms and their effects on the performance of military weapons and communications systems.

SDL's relationship with NASA solidified in the 1980s as a natural progression from the Lab's sounding rocket work for the DoD. Many SDL-developed technologies could also be applied to NASA interests, such as auroral measurements, electron density studies, equatorial irregularity detection, solar eclipse

observations, and atmospheric chemistry investigations. Numerous NASA-sponsored sounding rocket experiments developed by SDL collected extraordinary data. SDL took early advantage of the Space Shuttle program with its first Shuttle-borne experiment, Vehicle Charging and Potential (VCAP), launching aboard STS-3, and worked with Utah State University on a dozen diverse student Get-Away Special experiments, also performed aboard the Shuttle.

During the 80s, SDL also executed a number of programs for the DoD. SPEAR I and II were designed to investigate different methods of grounding spacecraft to Low Earth Orbit plasma, and to obtain quantitative data on various charging effects observed on such spacecraft. The infrared instruments SDL developed at this time included the Spatial Infrared Rocketborne Interferometer Telescopes (SPIRIT I and II), which measured the spectral radiance of auroras throughout the long-wave IR region, and the Atmospheric Excitation via Controlled Energy Disposition Experiment (EXCEDE III), which determined reactions and measured IR radiance produced in the atmosphere through controlled dosing.

Increasingly complex sensors amplified the remote sensing community's need for more accurate calibration and characterization, a challenge that SDL has met for such instruments as the Infrared Background Signature Survey (IBSS) and the Diffuse IR Background Experiment (DIRBE) that flew aboard the Cosmic Background Explorer (COBE). Scientific achievements enabled by COBE garnered two US physicists a Nobel Prize in physics. SDL continues to lead the way in calibration, working closely with NIST, and hosting several annual calibration conferences and workshops such as CALCON.

Known for its contributions in support of space and Earth science, and national security and intelligence programs, SDL continues to build upon its heritage to deliver the next generation of best-value solutions for electro-optical remote sensing systems, atmospheric research instrumentation, groundbreaking small satellite technologies, sensor calibration and test, data exploitation products, and IS&R solutions.

For more information about any of SDL's programs, facilities, or capabilities, or to inquire about potential collaboration, please contact us:

Business Development: bd@sdl.usu.edu • **Public Relations:** pr@sdl.usu.edu • **General Information:** spacedynamics.org • info@sdl.usu.edu