THE AIR FORCE RESEARCH LABORATORY
LEAD | DISCOVER | DEVELOP | DELIVER

Air Force Research Laboratory's Directed Energy and Space Vehicles Directorates

Resources Guide

www.kirtland.af.mil/prs

The Air Force Research Laboratory

The mission of the Air Force Research Laboratory is to discover, develop, integrate and deliver affordable technologies for improved warfighting capabilities. Formed in 1997, AFRL consists of eight technical directorates, one wing and a center conducting advanced research in spacecraft, aircraft, directed energy, sensors, information technology, munitions, propulsion, materials and manufacturing, human effectiveness and basic research at sites situated across the nation.

AFRL

THE AIR FORCE RESEARCH LABORATORY

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This booklet is intended as a technology transfer tool for our potential partners in industry and academia. It outlines AFRL resources and partnership tools for educational research agreements, technology transfer and transition, innovative research options and business development opportunities.

How to Contact Us

Technology and Education Outreach Branch:
505-846-2707

Phillips Technology institute (PTi) Collaboration Center:
505-853-7676

Small Business Innovation Research (SBIR):
505-853-7947

Technology Transfer Office:
505-846-6377

Directed Energy Corporate Communications Office:
505-853-3381

Space Vehicles Corporate Communications Office:
505-846-6315

Welcome to the Air Force Research Laboratory's Directed Energy and Space Vehicles Directorates, located at Kirtland Air Force Base, N.M.

Directed Energy Directorate – *Dominance in the Battlespace*

Space Vehicles Directorate – *Technology for the Final Frontier*

Colonel William Cooley

Director, Space Vehicles Directorate
Commander, Phillips Research Site

David A. Hardy, SES

Director, Directed Energy Directorate

The Air Force Research Laboratory's Directed Energy Directorate

Whether used in defense of our nation, defeating our enemies or controlling the battlespace, directed energy technology delivers results at the speed of light. The Directed Energy Directorate concentrates on improving U.S. military forces' capabilities with instant detect and instant defeat through precision engagement, long-range strike, counter electronics, force protection and space situational awareness.

With headquarters at Kirtland AFB, N.M., Directorate researchers develop, integrate and transition technology that includes high-energy lasers, high-power microwaves, millimeter waves, beam control and advanced optical systems. The Directorate also assesses potential applications and effects of systems using directed energy technologies, performs modeling and simulation, and manages space situational awareness data collection and reporting. Additional Directorate sites include the Maui Optical and Supercomputing Site at Maui, Hawaii and North Oscura Peak at White Sands Missile Range, N.M.

There are four core technical competencies at the center of Directed Energy research and development. In each area of competency, the Directorate has world-class personnel, equipment and facilities that enable the Directorate to provide directed energy capabilities to the warfighter.

High-Power Microwaves counter electronics, protect assets and deter aggressors with non-lethal technology. Sub-competencies include: Pulsed Power, Low and High Radio Frequency and Plasma.

Lasers enable precision accuracy with long-range strike capabilities at the speed of light. Sub-competencies include: Gas and Chemical Lasers, Bulk Solid State Lasers, Fiber Lasers and Semiconductor Lasers.

Beam Control propagates high-quality laser beams through air on target and enables high-resolution imaging of objects in space. Subcompetencies include: Atmospheric Propagation, Adaptive Optics, Acquisition, Tracking, Pointing and Space Situational Awareness.

Effects, Modeling and Simulation validates technology development to ensure feasibility of desired results. Sub-competencies include: Systems, Mission, Directed Energy Effects and Directed Energy Physics Modeling.

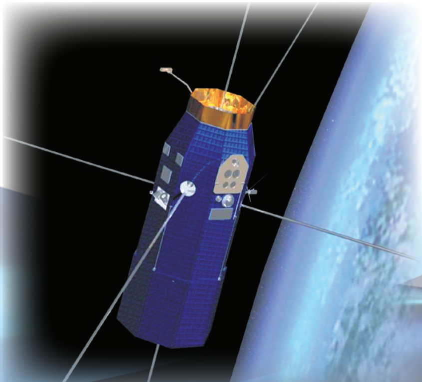
The Air Force Research Laboratory's Space Vehicles Directorate

The Space Vehicles Directorate leads the nation in space supremacy research and development. Our mission is to develop and transition innovative high-payoff space technologies supporting the warfighter, while leveraging commercial, civilian and other government space capabilities to ensure America's advantage in space.

The Directorate is headquartered at Kirtland AFB, N.M. with additional sites at Holloman AFB, N.M., Sunspot, N.M. and Gakona, Alaska. The Directorate is co-located with the Space and Missile Systems Center's Space Development and Test Wing and the Operationally Responsive Space Office. The three Department of Defense, or DoD, organizations form the core of a major initiative to revolutionize DoD's role in space.

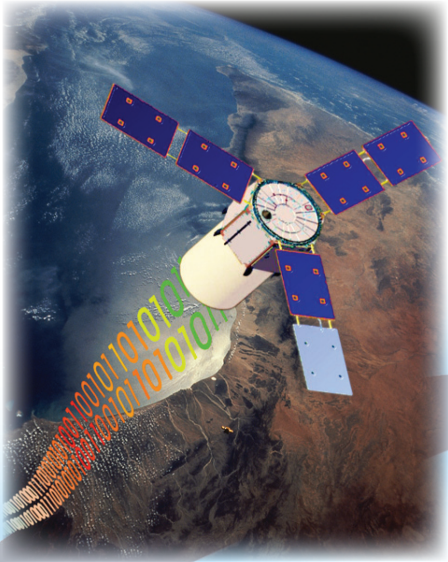
The Space Vehicles Directorate consists of three technical divisions:

The Battlespace Environment Division specifies, forecasts, mitigates and exploits environmental impacts to U.S. space systems and operations. Its main research areas include space weather sensing and modeling, hyperspectral data exploitation, hypertemporal imaging and space object surveillance.



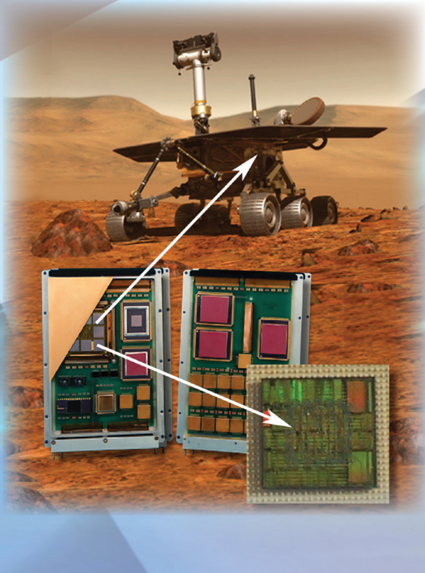
The Spacecraft Technology Division

develops next-generation spacecraft bus and payload technology elements to reduce cost, improve performance and enable new missions. Its main technology research areas include space qualifiable electronics, plug-and-play avionics, spacecraft components such as power generation and management, structural systems, guidance and navigation controls and space-based advanced sensor systems technologies.



The Integrated Experiments and Evaluation Division

works to develop and integrate ground, space and near-space experiments designed to assess and prove emerging technologies and concept of operations for military space applications. This is facilitated by modeling, simulation, technical analysis and military utility assessment, as well as robust satellite integration and testing.



Technology Transfer Opportunities

The Phillips Research Site emphasizes technology transfer: the sharing or transferring of information, data, hardware, personnel, services, facilities or other scientific resources for the benefit of the private or public sector. Congress passed specific legislation encouraging technology transfer in 1980, and has continued to strengthen this program. Many of the Laboratory's technology developments are by their very nature "dual use" and applicable to both the military and the commercial world.

The Technology Transfer Office uses a multitude of ways to accomplish the transfer of technologies to the private or public sector and to work with the Air Force, especially Cooperative Research and Development Agreements, Educational Partnership Agreements, Patent License Agreements and Commercial Test Agreements.

Cooperative Research and Development Agreement

A CRADA is a legal agreement between a federal laboratory and one or more nonfederal parties such as private industry and academia. Mutually beneficial, the parties share the risks and benefits of collaborative research and development. The end objective of a CRADA is to advance science and technology that not only meets Air Force mission requirements but also has viability in other potential commercial applications.

Educational Partnership Agreement

An EPA is a formal agreement between a defense laboratory and an educational institution to transfer or enhance technology applications and provide technology assistance for all levels of education (pre-kindergarten and up). It is open to local education agencies, colleges and universities, and nonprofit institutions dedicated to improving science, technology, engineering and mathematics education.

Patent License Agreement

A patent is a grant issued by the U.S. Government giving an inventor the right to exclude all others from making, using or selling the invention throughout the U.S. or importing the invention into the U.S. PLAs maximize the use of Air Force technology in the private sector, stimulate research, make available new products and processes and create new industries and job opportunities, all which benefit the U.S. economy and provide royalty income to the Air Force.

Commercial Test Agreements

Under CTA, AFRL has the authority to make available, at a prescribed fee, the services of any government laboratory, center, or other select test facilities materials, equipment, models, computer software and other item testing. This agreement is available to any individual; partnership; corporation; association; state, local, or tribunal government; or an agency or instrumentality of the U.S. CTAs can offer a gateway to world-class Air Force laboratories and facilities.

Small Business Innovation Research Program

The SBIR program funds early-stage research and development at small technology companies and is designed to stimulate technological innovation, increase private sector commercialization of federal research and development, increase small business participation in federally funded research and development and foster participation by minority and disadvantaged firms in technological innovation. Among other requirements, a firm must be a U.S. for-profit small business of 500 or fewer employees.

The Department of Defense SBIR program consists of three phases. Based on research and development topics supplied by one of 12 federal agencies, including the Air Force and the Missile Defense Agency, company-submitted proposals are competitively judged. Companies first apply for a six- to nine-month Phase I award of up to $150,000 to test the scientific, technical and commercial merit of a particular concept. If Phase I proves successful, the company may be invited to apply for a two-year Phase II award of up to $1,000,000 (check the solicitation at: www.acq.osd.mil for actual dollar amounts) to further develop the concept, usually to the prototype demonstration phase. Following completion of Phase II, small companies are expected to obtain Phase III funding from the private sector or non-SBIR government sources to develop the concept into a product for sale in private sector or military markets.

The Air Force SBIR Program is a mission-oriented program that integrates the needs and requirements of the AF through research and development topics that have military and commercial potential. The AF portion of the SBIR Program is administered by the Air Force Research Laboratory AF SBIR program manager who is responsible for AF SBIR policy, budget and distribution and the AF portion of the DoD SBIR Solicitation.

AFRL's key interrelated technology disciplines are organized as nine technology directorates including Directed Energy and Space Vehicles Directorates located at Kirtland AFB, N.M. Each directorate performs and procures basic research, and exploratory and advanced technology development with a clear mandate to provide integrated solutions to customer requirements. The AF SBIR program is part of AFRL and serves the AFRL mission.

More information on the SBIR Program is available at these websites:

- DoD SBIR program: www.acq.osd.mil/osbp/sbir
- AF SBIR program: www.sbirsttrmall.com/Overview/Default.aspx

Air Force SBIR/STTR

Contact us:

505-853-7947
SBIR@kirtland.af.mil.

Phillips Technology Institute

Energize and facilitate a community of innovation for AFRL

The Phillips Technology Institute, or PTi, is part of AFRL and serves the Lab by bringing in collaborative partners from academia, industry, and government and applying AFRL resources (funding, people and facilities) to develop products that meet both Air Force and partner needs.

The Phillips Technology Institute's goals are to:

Educate the local community about AFRL needs and business opportunities
Energize the local S&T environment to meet Air Force needs
Collaborate with academia, industry and government to develop innovative solutions to Air Force requirements
Create the physical and business environment for mutually beneficial collaborations with academia, industry and government.
Leverage the Air Force's strategic investment in science and technology.
Develop a well qualified workforce for AFRL and its collaborative partners.

Phillips Technology institute (PTi):
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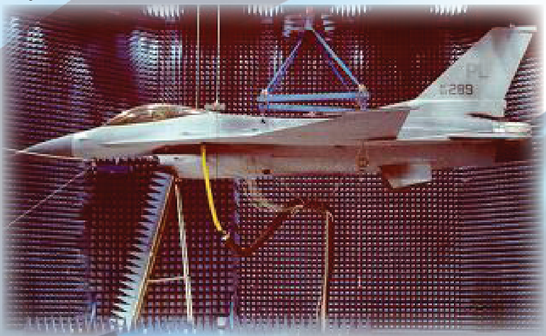
PTi
PHILLIPS TECHNOLOGY INSTITUTE
Academia | Industry | Government

Directed Energy Research Facilities

Donald L. Lamberson Laser Research Facility

The Donald L. Lamberson Laser Research Facility is an advanced research facility containing four laboratories (one with access to a range), recently renovated office space and a hangar bay large enough to house a Boeing 747. The four laboratories are used to house cutting-edge research in high-power fiber lasers to include power scaling of photonic crystal fiber and the government high power fiber testbed which was put in place to test various coherent beam combination schemes. The state-of-the-art office space houses part of the Laser Division to include personnel associated with the Electric Laser on a Large Aircraft project. Finally, the hangar bay is utilized for a variety of functions to include the Advanced Tactical Laser project.

High Energy Microwave Laboratory



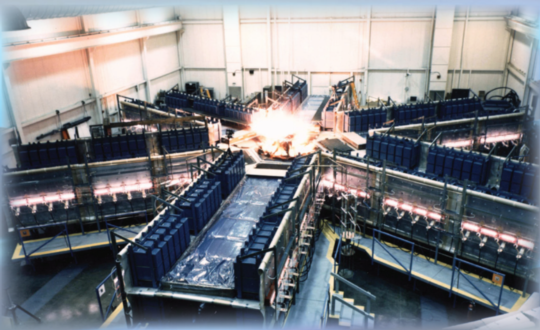
Used for developing/testing high-power microwave systems and performing vulnerability studies, the HEML has a large anechoic chamber (echo and reverberation free) that holds airplanes for electronic-system tests. Shielded rooms contain advanced instrumentation for operating HPM sources and measuring pulsed radiation characteristics and electrical responses. HEML includes a suite of narrow- to wide-band sources that produce output in the frequency range of the anechoic quiet zone. HEML hosts joint experiments with the Navy, Army, Marine Corps, other government agencies and foreign countries.

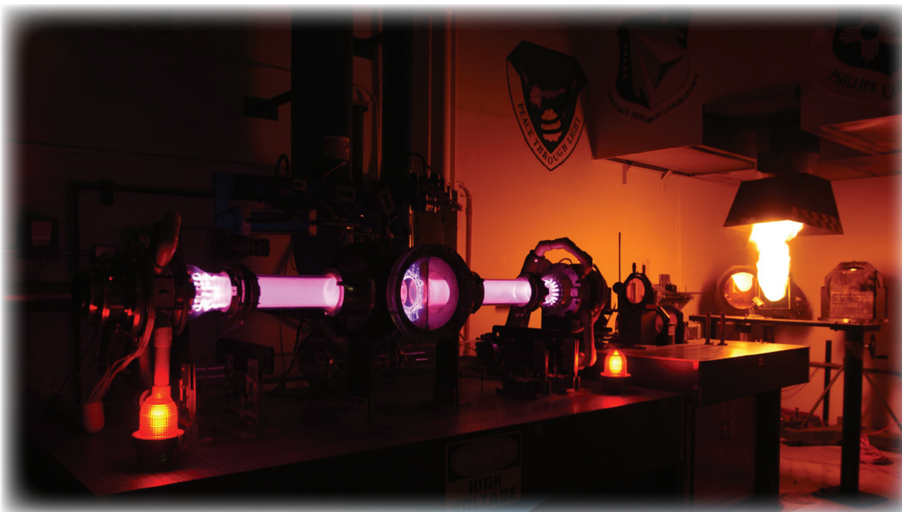
High Energy Research and Technology Facility

HERTF is a state-of-the-art laboratory used for research and development and for transitioning advanced high power microwave weapon technologies. HERTF provides unique capabilities for developing and testing those technologies with its remote location, and unique construction that can withstand blasts and intense radiation from a variety of sources, including high-energy microwaves and X-rays.

High Power Systems Facility with Shiva Star

The High Power Systems Facility consists of 34,261 square feet of workspace for research into military applications of high-energy, pulsed-power systems. The facility houses the Shiva Star fast capacitor bank, the Air Force's largest pulsed power system. Shiva Star is a unique national asset that allows the simulation of large explosive, pulsed-power generator systems and nuclear weapons effects. By using Shiva Star, various studies and improvements of explosive pulsed power can be made much quicker and for less cost than using actual explosives.





Laser Effects Test Facility

The Laser Effects Test Facility conducts experiments for the AFRL, the Department of Defense and the Department of Energy, as well as other government agencies, U.S. industry and universities. The primary objective is to perform research to better understand the physics of laser interactions with various materials and systems.

The test facility has a variety of unique test equipment to support these experiments, which include continuous-wave lasers such as the 15-kW Chemical Oxygen Iodine Laser (COIL) and two Yb+3 fiber lasers: 50- and 20-kW. Several pulsed laser systems are also used for effects testing. The lasers span the electromagnetic spectrum from the ultraviolet to the far infrared.

Directed Energy Research Facilities, cont.

Maui Space Surveillance System

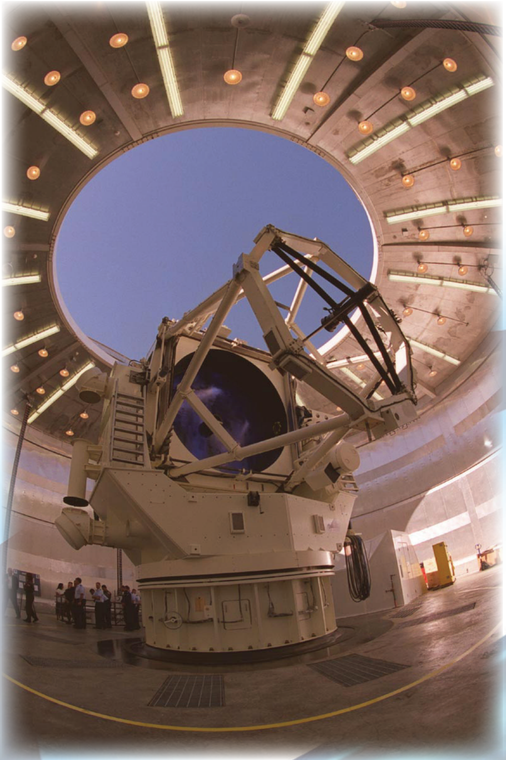
The Maui Space Surveillance System is an exceptional electro-optical facility combining operational satellite-tracking facilities with a research and development facility, the only one of its kind in the world. The MSSS houses the largest telescope in the Department of Defense, the 3.6-meter Advanced Electro-Optical System, as well as several other telescopes ranging from 0.4 -1.6 meters. MSSS supports the Air Force's Space Surveillance Network as a contributing sensor for space object identification and orbital cataloguing. Remote sites house additional space surveillance telescopes.

Maui High Performance Computing Center

Provides a large-scale parallel computing platform with thousands of nodes, hundreds of terabytes of disk and petabytes of on-line tape storage. Users can connect directly to multiple networks including the Defense Research and Engineering Network and process information at the highest classification and sensitivity levels. The MHPCC also provides a new visualization laboratory with 3-D display capability. High Performance Computing is a key enabling technology in advancing U.S. technological dominance into the 21st Century.

Maui Space Surveillance System Mirror Coating Facility

The facility provides accommodations for transporting, staging, removal, coating and recoating of mirrors up to 4.5 meters in diameter. Consisting of a 7,314 square-foot, two-story facility at the summit of the 10,000-foot extinct volcano, Haleakala, on Maui, Hawaii, the facility features an open-bay area designed as a recoating facility for the 3.6-meter telescope mirror also housed at the Haleakala summit. It also houses space for science and technology laboratories. The building was completed in 2008 and the 3.6-meter mirror was successfully recoated in December 2008.



Molecular Beam Epitaxy Facility

This state-of-the-art laboratory includes a Molecular Beam Epitaxy system to grow semiconductor crystals used in building lasers. The system is specifically configured for the growth of alloys in support of mid-infrared laser technology used in various countermeasure programs including aircraft self protect. To complete the functionality of the facility and to enable rapid advancement of the technology, the MBE is accompanied by a plasma-enhanced chemical vapor deposition system for optical coatings and several diagnostic tools including a high resolution x-ray diffractometer.

Richard W. Davis Advanced Laser Facility

The Richard W. Davis Advanced Laser Facility is a cutting-edge facility used for research and development of high-power laser systems. This facility includes six major laboratories with four used for fiber and gas laser research. Research is conducted using a miniature chemical oxygen iodine laser in support of the Airborne Laser and Advanced Tactical Laser programs. A chemistry laboratory electronics laboratory and fiber-processing laboratory are included. A significant range for propagation experiments exist and several clean rooms are available for solid-state and fiber laser development.

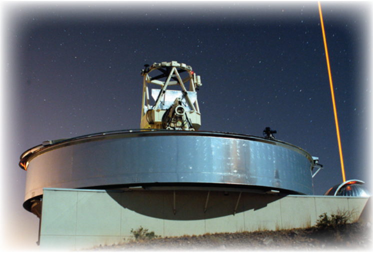
Satellite Assessment Center

The National Security Decision Directive Number 258, signed by President Reagan in 1987, led to the formal establishment of the Satellite Assessment Center. This facility conducts high-fidelity assessments of directed energy effects on space systems through natural and other manmade energy sources. In addition, space situational awareness is fused with modeling codes for exploitation of space intelligence, integrating military and civilian space-community expertise.

Simulation Laboratory for Directed Energy

The Simulation Laboratory is a unique facility supporting assessments and modeling efforts of directed energy weapon systems using real-world scenarios. Established in 2008, it enables wargaming events such as the annual AFRL Directed Energy Advanced Concept Event. The Laboratory is fast becoming an integral source for wargaming to determine utility assessments from operational personnel.

Starfire Optical Range



The SOR is a world-class optical research facility. Its mission is to develop optical wavefront control technologies to support missions in laser propagation, imaging and advanced tracking. Equipment includes a 3.5-meter telescope, a 1.5-meter telescope, a 1-meter beam director, and smaller atmospheric measurement telescopes. All three major mounts are equipped with high-order adaptive optical systems and all are capable of high-speed satellite tracking, including low Earth orbiters. Pioneering research in adaptive optics is performed at the SOR and major advances continue to be achieved.

Telescope and Atmospheric Compensation Laboratory

The TACLab includes extensive optics, electronics, computer and mechanical laboratory space for equipment design, construction and testing prior to integration with telescopes and other experiment hardware. The facility also includes a large chamber for the required periodic recoating of the Starfire Optical Range's 3.5-meter telescope's primary mirror and other large mirrors from area astronomical observatories.

White Sands Missile Range Laser and Optics Laboratories (North Oscura and Salinas Peaks)

North Oscura Peak is designed to evaluate advanced sensor, tracking and atmospheric compensation systems in support of high-energy laser applications. The site's goal is to improve the tracking of threats and the ability to efficiently transmit laser energy through the atmosphere to destroy targets.

Space Vehicles Research Facilities

Aerospace Engineering Facility

The 16,500 square-foot facility includes a 60-foot tall, 4,500-square-foot high-bay laboratory for assembly testing of space flight hardware, including an overhead rail system with two 7.5-ton cranes.

The facility includes a 600 square-foot, class-100 clean room, a class-10,000 clean tent, three environmental chambers, a thermal vacuum chamber, three vibration tables, a copper screenroom for electromagnetic testing and a machine shop for hardware fabrication.

Battlespace Environment Laboratory

The 145,000 square-foot laboratory includes high-vacuum environments, environmental calibration, chemistry and spectrometry, computer modeling, processing of space data, space operations, remote sensing and quantum computing.

Distributed Architecture Simulation Laboratory

The Distributed Architecture Simulation Laboratory is a 1,500-square-foot, state-of-the-art modeling and simulation laboratory. It is an open storage facility capable of supporting both unclassified and classified system simulations. The DASL is a modular, human-and-hardware in the loop, end-to-end system simulation testbed capable of evaluating technology models, hardware and space experiment mission software. The DASL operates interactively in real or regimented time and can perform both parametric and “Monte Carlo” evaluations.

The Data Center warehouses both simulation and experimental data and supports information mining by on-site and remote customers. Recent upgrades include 48 core clusters used to support modeling and simulation and a modernized audio-visual display system. Most recently, the DASL served as the focal point for space during the 2009 Advanced Concept Event exercise.

High Frequency Active Auroral Research Program

HAARP provides capabilities for conducting experimental research on high-power, radio wave interactions in the ionosphere and space, including related other applications. The facility for experimental research is located in Gakona, Alaska. The high-frequency transmitting system, completed in February 2007, consists of 180 antenna elements arranged as a rectangular array of 15 columns by 12 rows with a radiated power of 3,600 kW. The program is jointly managed by the Air Force Research Laboratory, Space Vehicles Directorate, Kirtland AFB, N.M. and the Office of Naval Research, Arlington, Va.

Infrared Radiation Effects Laboratory

The Infrared Radiation Effects Laboratory provides radiometric and radiation characterizations for focal plane arrays, or FPAs ,and associated devices using government-furnished equipment. The data and analyses produced by this laboratory are vitally important in determining the overall performance and radiation hardness of devices for use in space applications. This effort includes developing innovative techniques to advance state-of-the-art characterization of infrared and visible FPAs and associated devices, including the development of characterization and analytical techniques, test hardware, and operational and test procedures that advance the experimental capabilities of the IRREL.

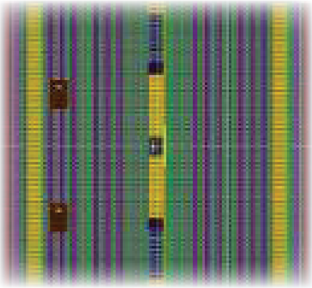
Microelectronics Test and Measurement Laboratory

The Microelectronics Test and Measurement Laboratory contain numerous X-ray producing sources to accomplish a variety of radiation-effects testing on advanced microelectronic devices. The facility contains a low-energy X-ray source and the ARACOR for both packaged parts and integrated circuits residing on wafers, a Cesium-137 source to simulate the dose rates achieved on orbit, a Flash X-ray source driven by a Febetron Pulser to simulate an enhanced radiation environment and an electric pulser-driven e-beam vacuum tube. In addition, the facility also owns and operates a source to produce a relatively robust fluence of gamma rays to provide significant doses to integrated circuits, packaged parts, systems and even satellites if necessary.

Photovoltaic Laboratory

Provides all necessary tools to characterize photovoltaic cells, including advanced multijunction and thin-film photovoltaic technologies and using solar simulation, spectral response and temperature-related current/voltage measurements.

Radiation Hardening Test Facility



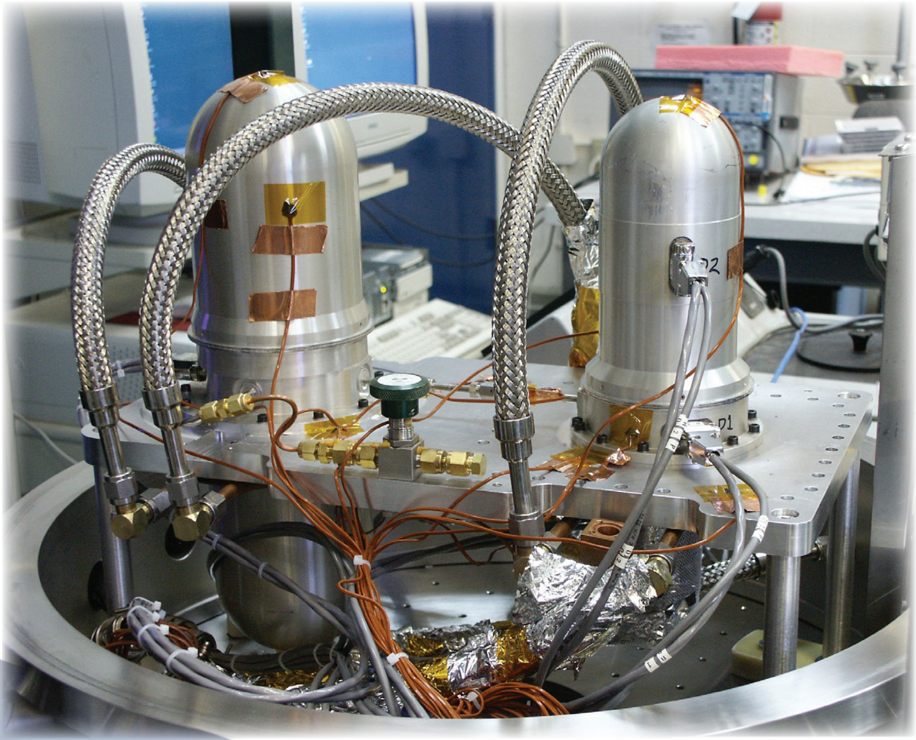
This 3,000-square-foot facility includes five ionizing-radiation sources: Cobalt-60, Cesium-137, Low-Energy X-Ray, Flash X-Ray, ARACOR X-Ray system and electronic test equipment and expertise.

Radio Frequency/Microwave Laboratory

The Radio Frequency/Microwave Laboratory consists of a radio frequency anechoic chamber with equipment, supporting measurements from 50 MHz to 30 GHz. Tests include antennas, sensors and analog circuits supporting space communications, proximity sensing, analog-to-digital devices, power amplifiers and millimeter wave systems. Programs supported are radar warning receivers, communication antennas and technology for space radar.

Spacecraft Component Laboratory

The laboratory contains a 7,500-square-foot composites-fabrication laboratory, a machine shop with various prototyping equipment (including computer-controlled machining), a 2,200-square-foot room with multiple ovens and autoclaves, an 800-square-foot materials testing laboratory, a 8,600-square-foot space structures-testing laboratory with large-scale static load frames, a 2,000 square-foot photovoltaic laboratory and a Responsive Space Testbed, a facility where contractors can bring Plug-and-Play (PNP) technologies to try them out with other PnP systems.



Spacecraft Component Thermal Research Laboratory

The laboratory is a 10,000-square-foot facility with a 1,500-square-foot high-bay that includes 17 vacuum chambers (ranging from 24 inches to six feet in diameter), a 10-ton crane, two forklifts (10,000-pounds and 6,000-pounds) and cryocooler thermodynamic research capabilities. Additional research capabilities include finite element thermal modeling of orbiting spacecraft payloads, computational fluid dynamics modeling and a particle image velocimetry system which allows for empirical fluid flow characterization.

Laboratory Facilities

Aerospace Engineering Facility (Bldg 595)

- Cincinnati Sub-Zero Environmental Chamber
- Thermodynamic Environmental Chamber
- Eaton Bake-out Chamber
- Thermatron Environmental Chamber
- XL Systems 7’ x 9’ Thermal Vacuum Chamber
- Thermal Vacuum Bell Jar
- Ling 4022LX Vibration Table
- Ling 612U Vibration Table
- Class 100 Clean Room
- Class 10,000 Clean Room
- Electromagnetic Interference (EMI) Screen Room
- Spin Table
- Space Electronics KGR300 Center of Gravity/Moment of Inertia Machine
- Xenon Solar Simulation Lamp
- Multi-layer Insulation (Thermal Blanket) Sewing Machine
- 10-ton bridge cranes (2)
- Other equipment including, but not limited to: power supplies, transmitters, receivers, signal
- generators, network analyzers, hand tools, power tools, light machining tools, multimeters

Integration Facility (Bldg 277)

- Blue Thermal Chamber
- XL Systems 16’ x 20’ Thermal Vacuum Chamber
- Thermal Vacuum Bell Jar
- Unholtz-Dickie Vibration Table
- Class 10,000 Clean Room
- Portable Clean Room
- EMI Chamber
- 5-ton bridge crane
- Other equipment including, but not limited to: power supplies, transmitters, receivers, signal generators, network analyzers, hand tools, power tools, light machining tools, multimeters

Composite Fabrication Lab (7500 FT2) (Bldg 472)

- 5 axis En-Tec Winder, 78” diam. 22’ bed, CMC controlled, 12 tow capacity
- 3 axis En-Tec Winder, 36” diam. X132” bed, CMC controlled, 6 tow capacity
- CadWind Pro winding software with many advanced programming modules for control of both winders. Will accept .dxf input files.
- Gerber Cutting Edge 1500, 82” x 96” bed PC controlled tape/fabric cutter. Will accept .dxf input files.
- 10-ton overhead crane.
- Leesona model 987 tow rewinder (prepreg or dry).
- 2 Walk-in freezers, 12’ x 12’ x 8’, sub zero, with alarm monitors.
- Heated resin removal baths (cured or uncured).

Machine Shop (Bldg 472)

- Haas VF-9 3 axis CNC mill machining center, 84” x-axis travel, 40” y-axis travel, 30” z-axis travel, with a 4th programmable axis on 12” rotary table. 24 tool automatic changer.
- Haas TM-1 3-axis CNC mill, 30” x-axis travel, 12” y-axis travel, 16” z-axis travel.
- Dyna Path 20 CNC mill, standard vertical 40” travel x axis.
- Hardinge Conquest T 42 CNC lathe, 14” diam. 18” z-axis travel.
- Bridgeport Manual milling machine, standard vertical 50” travel x axis.
- Monarch lathe, 10” diam. 24” travel on z axis manual lathe.
- Clausing lathe, 15”diam. 50” travel z axis manual lathe.
- Brown & Sharp precession grinder, 12” w x 48”.
- WF Wells horizontal band saw, 16” capacity.
- WF Wells Vertical band saw, 40” capacity.
- Dyna-Cut Precession wet diamond composites cut off saw 14” diam.
- Do-All Drilling and tapping center.
- Metal working equipment, 48” metal break, 48” metal shear, 48” metal form roller.
- Miller Delta Feed 452 wire feed welder.
- Miller Syncrowave 500 tig welder.
- Miller Spectrum 1250 Plasma Cutting System.
- 60 ton hydraulic press.
- Sand blaster, 30”w x 36”hx48”w.

Oven Room (2200 FT2) (Bldg 472)

- Tenney Autoclave, 9' diameter x 18' length, 150 psi @ 500 °F.
- Baron Autoclave, 4' diameter x 10' length, 600 psi @ 410 °F.
- Grieve Oven, 25"d x 50"h x 36"w, 400 °F.
- Grieve Oven, 26"d x 36"h x 50"w, 1100 °F.
- Grieve Oven, 36"d x 36"h x 25"w, 600 °F.
- Blue-M Oven, 20"d x 18"h x 25"w, 400 °F, with rotisserie.
- Hot Press, 7-ton capacity, 18" x 18" heated plates x 17" height travel, 400 °F.
- Astro Furnace, 12"h x 6"diam. specimen size carbon carbon furnace, 5000 °F @ 600 psi.
- Hitco –7E, Chemical Vapor Deposition Furnace, 10'h x 60" diam. chamber size, 5000 °F @ -1 atmosphere.
- Lindbergh Furnace, 20"d x 12"h x 12"w, 5000 °F.
- Keith Oven, 68"d x 60"h x 138" w, 1400 °F, with rotisserie capability.
- Various small research ovens.
- Epcon Afterburner, 750 scfm, 500°F. Most ovens connected to this afterburner for EPA compliance.
- Oven room controlled by Aerospace Services & Controls CPC PC based control software and hardware. Enables precise control of oven and autoclave cure cycles. CPC controls vacuum, pressure, and temperature on each piece of equipment. Providing traceable and complete cure documentation. High-end vacuum control enables sandwich core composites to be cured while protecting cores; Smart Cure thermocouple cure cycles can be controlled by CPC software as well.

Materials Testing Lab (800 FT2) (Bldg 472)

- MTS axial-torsional machine, 20"w x 48"h frame size, 250 kN, 55 Kip.
- MTS axial machine, 20"w x 48"h frame size, 250 kN 55 Kip.
- MTS Model 651 Environmental chamber, -200 - 600°F range, hydrothermal capability.
- MTS QTest 1L Electromechanical test frame. 225 lbf capacity, .1 lbf resolution.
- Sintech 1 Electromechanical test frame. 1 kip capacity.

Materials Testing Lab (800 FT2) (Bldg 472)cont...

- Instron Model 1122 Electromechanical test frame. 1 kip capacity.
- MTS Model LX300 Laser Extensometer, 0.2 – 0.32" capacity.
- Composite Triaxial Electromechanical Test Facility, ±30 Kip capacity, combinations of σ1-σ2-σ3 stress space possible.
- 14 Vishay Model 2300 Signal Conditioning Amplifiers for strain gage-based transducers.
- Wilson/Rockwell hardness tester.
- Fiber volume and void volume testing of cured composites.
- Triaxial Test Facility has test fixtures to perform standardized ASTM mechanical tests for tension, shear, flexural, and compression.

Large Area Space Structures Lab (LASS) (8600 FT2) (Bldg 472)

- MTS Aero90Lt Multi-Channel test frame. Simultaneous control of 20 servo-hydraulic actuators and 256 data acquisition channels. 12.5' x 12.5' test bed x 40' reaction frame, capacity in excess of 500 kip. In excess of 40 load cells (5 kip – 100 kip), 30 hydraulic actuators (1.5 kip – 100 kip), and 50 LVDTs (0.2 in – 3.0 in) and necessary hydraulic hoses and fixturing.
- 84"l x 48"h x 48"w vacuum chamber for testing cryogenic tanks under thermal and mechanical loads with liquid helium.
- 10-ton overhead crane.

Mix Room – Lay-Up Rooms (1000 FT2) (Bldg 472)

- 5 PC controlled fume hoods 24"d x 60"w x 48"h.
- Bagging material racks, large assortment of bagging films, peel-plys and bleeders, materials stocked in many sizes and thickness.
- controlled environment lay-up room.
- Hazardous material storage cabinets.
- Numerous vacuum pumps.
- Large electric resin mixer.
- Precision scales for weighing mixes.

Photovolactics Lab (Bldg 472)

Solar Simulation

- 3000W AM0 X-25 simulator with 8"x16" exposure area
- 1000W AM0 Oriel simulator with 8" diameter exposure area
- 1000W UV filtered AM0 Oriel simulator with 6" exposure area

Spectral Irradiance Measurement

- Optronic Labs OL-750 spectrometer, 250-2500 nm range, fiber optic 3" integrating sphere attachment.

LIV/DIV Characterization

- Keithley Source Meter driven by custom LabVIEW control software. Hundreds of data points, or rapid scan of <1 second, depending on application. 100 Volts, and up to 8A capability with two units connected in tandem.

Accelerated UV Exposure

- High vacuum chamber, with accelerated UV exposure levels typically 6 suns, but up to 8 is possible. 1000 equivalent sun hours in 8 days.

Light Degradation in a-Si (Staebler-Wronski) Test System

- Autonomous operation with minimal operator intervention for extended test periods beyond a month long. Automatically captures LIV test data sets for 4 samples sequentially with the click of a mouse. High vacuum, thermally controlled chuck. In-situ balloon flight standard intensity monitor. Fail-safe controls handle PC lock-up (reboot, reinitialize control software) and temperature control.

Spectral Response (Quantum Efficiency)

- 400 to 1100 nm range, soon to be extended out to 1800 nm. Flood lamps and filters for measuring multi-junction samples.

Spectroradiometery (Transmission, Reflectance, Absorptivity)

- New Lambda 950 spectrometer, range of 200-3000 nm. In-sphere sample holder accessory; Universal Reflectance Accessory for changing angle of reflectance measurement without moving sample.

Laboratory Facilities, cont.

Emissivity

- Surface Optics instrument for measuring thermal performance of solar cell coatings or backing material.

Light Microscopes & SEM

- Hitachi S-4300SE
- EDS (EDAX) & EBSD systems

Zygo Surface Characterization

Thermal Cycler System

- *Ultra fast thermal cycle with a range of +/- 150 C. Thin-film cycling in two minutes per cycle at +/- 100 C. Accommodation of approximately 1 foot square coupon size. Continual cycling to the 10's of thousands.*

Miscellaneous

- Optics benches, radiometer, quantum efficiency measurement system, assorted optics equipment, associated cables, charge amplifiers and calibrators, detectors.
- Optical microscopes, associated optics and computerized dedicated data acquisition system.
- Scanning Electron Microscope (SEM) and Energy Dispersive XRD Detector.
- Various PC compatible computers for digital data storage, monitoring, and analysis.
- Digital camera
- Thermal processing equipment including but not limited to; thermal cycler and number of ovens.
- High and ultrahigh vacuum equipment for PV components testing and qualification.
- Tools and equipment for electrical circuitry work, welders and solders.
- Basic electronic instruments including, but not limited to: multimeters, power supplies, oscilloscopes, function generators, frequency generators, counters and filters
- Data acquisition units and systems including but not limited to: strip chart recorders, multiplexers, interfaces and LAB VIEW software

How to Work With Us

If you would like to discuss options and mechanisms further, please contact us. The Space Vehicles Directorate has numerous facilities available for possible private commercial or academic research and development entity use. The facilities are available to collaborating organizations in a contractual arrangement on a research and development project, and permit those organizations to use the Space Vehicles facilities rather than having to construct their own. (However, not all facilities are included in this due to their sensitive nature or overwhelming usage).

To work with our facilities, please contact our Technology Transfer Office at 505-846-6377 or www.vs.afrl.af.mil/TechOutreach/TT/

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