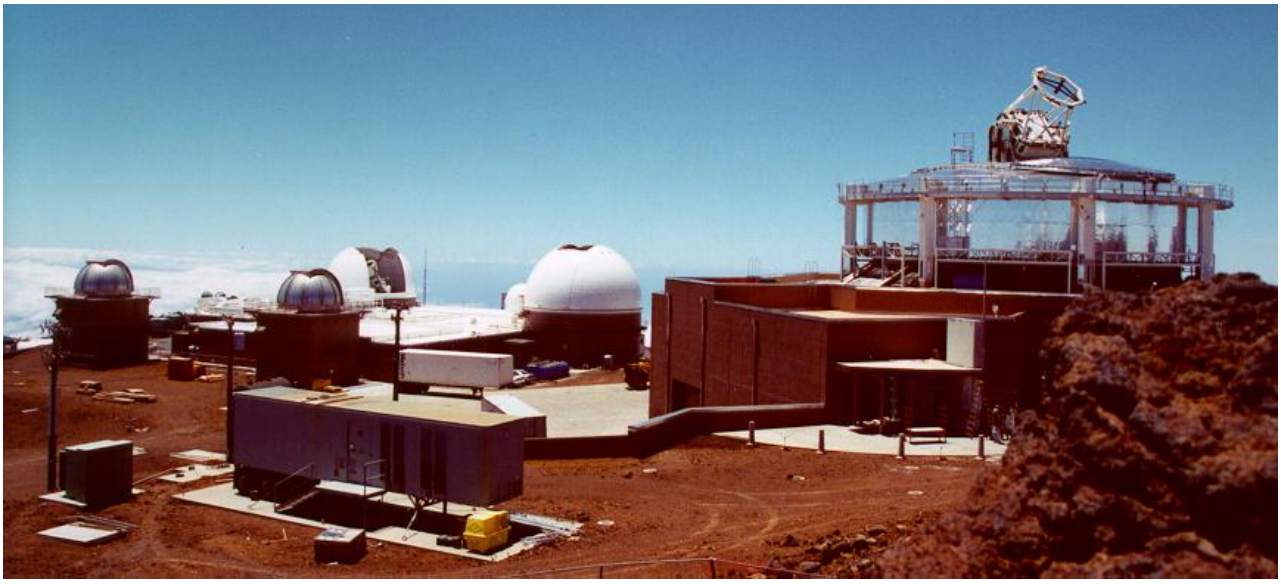
FACT SHEET

UNITED STATES AIR FORCE

Air Force Research Laboratory, Office of Public Affairs, 3550 Aberdeen Avenue S.E., Kirtland AFB NM 87117-5776
(505) 846-1911; Fax (505) 846-0423
INTERNET: http://www.de.afrl.af.mil/pa/factsheets/

Advanced Electro-Optical System



Background. The Advanced Electro-Optical System (AEOS) is a 3.67-meter telescope space surveillance system specifically designed to improve the means of collecting, and the quality of, space data at the Maui Space Surveillance Complex facility in Hawaii. Primarily intended for Department of Defense space surveillance missions, the telescope is also used by scientific and academic astronomy communities from across the United States.

The origins of AEOS began in the middle of the 1980s. At that time, the Air Force was trying to develop a ground-based laser anti-satellite capability. Maui appealed to AEOS planners for several reasons. Its maritime location, coupled with its 10,000-foot altitude, clear visibility, and location near the equator, made Haleakala a very stable environmental candidate. Taken together, these advantages made the site superb for routine observation of space objects. Work in support of the Western Test Range out of Vandenberg Air Force Base, California, and Barking Sands Missile Range on Kauai Island, Hawaii, and restricted airspace in this part of the Pacific Ocean also enhanced the site's ability to meet its mission. The existing facilities at the Maui Space Surveillance Complex included the 1.6-meter telescope, 1.2-meter twin telescopes, Laser Beam Director, Beam Director/Tracker, and the Ground-based Electro-Optical Deep Space Surveillance System, as well as a proximity to the Maui High Performance Computing Center, made Maui even more attractive.

Therefore, the AEOS would optimize Maui Space Surveillance System research and development capabilities, as well as improve the quality of images taken from the ground of space objects. With the support of Hawaii's senior United States senator, Honorable Daniel K. Inouye, who was an important member of several Senate committees, AEOS could help Hawaii transition from a tourism-based economy to a high-technology-based economy.

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AEOS mission. When the program started, AEOS' mission was to support space test and tracking missions for U.S. Space Command. In the past, radar-based imaging techniques had been favored by U.S. Space Command over electro-optical methods. However, electro-optical systems could produce photographic images, while radar could not. These photographic images were more amenable to the human eye than those produced through radar signatures. Benefits expected from the AEOS and enhanced Maui Space Surveillance System included mission payload assessment and space object identification for Air Force Space Command, adaptive optic research for the Air Force Research Laboratory, and use by government agencies and the national and international astronomy communities.

In the fall of 1995, the AEOS retained its research and development mission for Air Force Materiel Command, while its Air Force Space Command mission had evolved into three main areas: space intelligence, space tracking, and space control. Space tracking called for detecting and tracking objects in space, which led to the development of metrics of space objects for the catalog that the Air Force developed for the nation. Space control demanded high-resolution imagery as well as good signature data to ensure positive identification of an object in space. In addition, space debris, laser experimentation, and atmospheric science work would also be performed out of the AEOS. The Air Force Research Laboratory had a Memorandum of Agreement with the University of Hawaii for cooperative research in astronomy.

AEOS description. At the center of the AEOS is the 3.67-meter telescope, which is the largest in the Department of Defense. The telescope's mirror is of the thin meniscus variety, and offers significant improvements (approximately two-and-a-half-fold) in resolution over what the existing Maui Space Surveillance System mounts could achieve before AEOS. This resolution improvement meant smaller, dimmer objects in space could be seen more clearly after AEOS became operational.

Telescope. The 3.67-meter telescope was constructed by Contraves USA, which is located in Pittsburgh, Pennsylvania. The company also fabricated the mirror for the telescope.

AEOS's design optimizes its ability to track satellites. Therefore, AEOS is able to slew up to 18 degrees per second in the azimuth direction. This allows the telescope to follow a very fast moving low-earth orbit satellite. The 120-ton telescope has a 1-milliradian field of view at the bent Cassegrian position, and a 0.3-milliradian field of view in the coude labs.

Facility/Dome. Like the 3.5-meter telescope at Kirtland Air Force Base, New Mexico, the AEOS is housed in a domed structure that connects to laboratory space. The dome was contracted to COMSAT RSI, based in Fairfax, Virginia. The 40,000-square-foot AEOS facility features a centralized coude room, located in the basement of the facility directly below the telescope. The adaptive optics reside in this coude room, and distribute the light to one of seven optics experiment suites built concentrically around the coude room. The architects for the facility are Hawaii-based Gima-Yoshimori-Miyabara. Facility construction was handled by Kiewit Pacific and overall responsibility for construction management at the site rested with the U.S. Army Corps of Engineers, Honolulu Engineering District.

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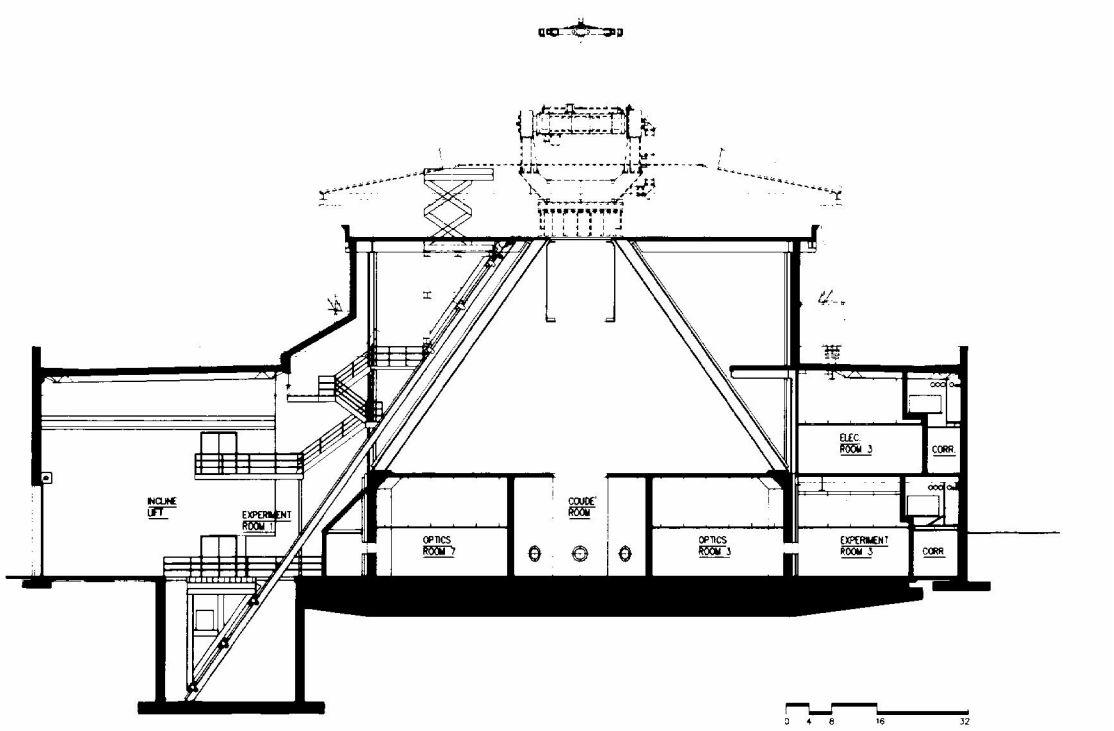
AEOS building section



Sensors. There are three mission sensors associated with AEOS. The first sensor is a long-wave infrared imager which produces spatially resolved thermal images of space objects. Hughes Aircraft Company of El Segundo, California, fabricated this imager. The second sensor, a radiometer, contracted to Mission Research Corporation of Santa Barbara, California, is a multi-spectral sensor instrument ranging from visible through the very-long-wave infrared spectral range.

The third sensor is a visible imaging camera constructed as part of the adaptive optics system built by Hughes Danbury Optical Systems. Requirements for these sensors derived from stated Air Force Space Command requirements.

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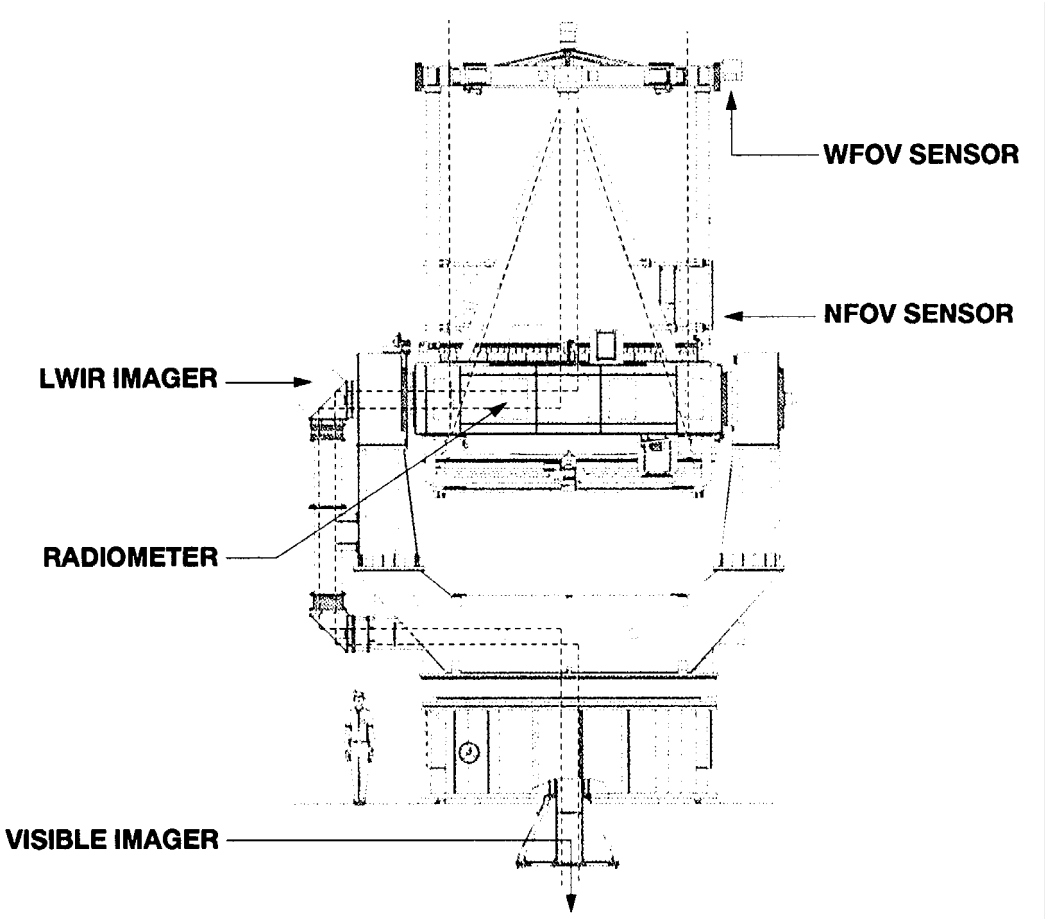
AEOS Sensors



Adaptive Optics. The Air Force Research Laboratory awarded the adaptive optics contract to Hughes Danbury Optical Systems, Danbury, Connecticut, on August 22, 1994. This system has very broad system applications. It features a closed loop bandwidth capability up to 200 hertz. This allows both military and civilian users to meet their needs: military users slewing across the sky use the higher bandwidths, while civilians, staring at a point in the sky, use the lower bandwidths. The adaptive optics package also includes a deformable mirror with 940 actuators. This is the largest such mirror made, and also the greatest number of actuators on a single such mirror.

Observatory Control System. The Observatory Control System is a command, control, communication, and data system that integrates and connects the various elements of AEOS. In addition, this system provides for physical and electronic security for all the AEOS assets. Because this system is highly interoperable and well integrated throughout the Maui Space Surveillance System, the Laboratory program office and Air Force Space Command have coordinated closely to develop the specifications for this upgrade. This allows for the Laboratory to require a standardized data format as part of the contract, which allows new equipment brought to the facility in the future to be readily integrated with the Observatory Control System. The Observatory Control System contract was awarded to Rockwell Power Systems, later renamed Rocketdyne Technical Services, which is also the site contractor at Maui.

Support Contractors. Other contractors were involved with AEOS as well. The University of Hawaii, for example, built one of the instruments AEOS uses for astronomical applications. Lincoln Laboratory has provided technical support, particularly in relation to the adaptive optics and the sensors for the AEOS. In Albuquerque, the Air Force Research Laboratory's Directed Energy Directorate is supported by Pantera Consulting, a small business that provides scientific and technical advisory engineering support. Logicon RDA, another Albuquerque-based system engineering and technical advisory company, has provided AFRL support on the telescope, the adaptive optics system, system engineering, sensors and the Observatory Control System. Rocketdyne Technical Services, also provides support to the Air Force Research Laboratory for system engineering, integration and test.

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(Current as of July 2002)