



SUCCESS STORY

TOPIC NUMBER: N02-139

SBIR INVESTMENT: \$849,960

PHASE III FUNDING: \$211,702,243



HIGH ENERGY SOLID STATE LASER (SSL) FOR SHIP SELF-DEFENSE

Aculight Corporation leveraged a Phase I SBIR award to create a high-power electrically driven high beam quality laser based on spectral beam combining that found its home on Lockheed Martin's HELIOS integrated weapon system.

Aculight Corporation

POC: Thomas Loftus
425-482-1100
Bothell, Washington 98021

www.aculight.com

THE CHALLENGE

Megawatt power lasers are preferred for many military weapons applications. For such lasers to have unlimited time of operation in the field, however, they should be electrically driven. The power output of current solid-state lasers is limited to kilowatt levels due to thermal issues and degraded beam quality. While chemical lasers can produce power levels in excess of a megawatt, the wavelengths at which they operate are not suitable for maritime propagation. Kilowatt class laser systems have been demonstrated, but the systems developed all had relatively poor beam quality. Solid-state lasers (SSLs) hold the solution; however, the power output must be amplified to effectively optimize lethality effects in the maritime environment. Because of this, the Navy sought a way to scale up the average power of solid-state laser systems through the SBIR program.

THE TECHNOLOGY

Aculight Corporation demonstrated the feasibility of scaling the power level of solid-state laser technology orders of magnitude beyond their current state. The company used a novel beam combination scheme which allows straightforward beam combination from hundreds of individual lasers. This allows high power generation to go beyond the limitations imposed by the complexity of coherent beam combination and the thermal limitations of conventional solid-state lasers. Aculight then applied spectral beam combining (SBC) to large mode area fibers to enable power scaling to the 100kW level while maintaining the excellent beam quality provided by a single fiber laser. The result is a beam-combined fiber laser system, and the subsequent design of 10 kilowatt and 100 kilowatt systems.

THE TRANSITION

After completing its SBIR project, Aculight was acquired by Lockheed Martin, where technology evolved into Lockheed Martin's High Energy Laser and Integrated Optical-Dazzler with Surveillance (HELIOS) integrated weapon system. In 2018, Lockheed Martin Aculight Corp. was awarded a \$150,022,901 cost-plus-incentive-fee Phase III contract from NAVSEA. Under contract N00024-18-C5392, the company will develop, manufacture, and deliver two HELIOS test units.

THE NAVAL BENEFIT

This technology provides a practical alternative to chemical lasers, which were the only means of generating weapons-class power from a laser. Solid-state lasers have considerable advantages for the maritime environment, including operating wavelengths more suited for the maritime environment, potential for scaling to high powers, pulsed waveforms that may offer lethality advantages over conventional lasers, and a compact total system size that can be packaged for the Navy. In addition, the HELIOS system provides multi-mission capabilities for the Navy including 60kW+ high energy laser for counter fast inshore attack craft (FIAC) and counter unmanned aircraft system (UAS), long range intelligence, surveillance and reconnaissance (ISR) and counter UAS-mounted ISR dazzler.

THE FUTURE

The current Phase III contract includes the production of one test unit for DDG Flight IIA Aegis combat system and one for land-based testing, along with the option of up to 14 production units. This contract includes options which, if exercised, would bring the cumulative value of this contract to nearly \$1 billion. Lockheed Martin Aculight Corp. completed the critical design review and Navy factory qualification test milestones for HELIOS, demonstrating the value of system engineering rigor and proven Aegis system integration and test processes on the way to delivering an operationally effective and suitable laser weapon system that meets the Navy's mission requirements. During factory testing in Moorestown, New Jersey, HELIOS routinely demonstrated full power operation above 60 kW. The scalable laser design architecture spectrally combines multiple kilowatt fiber lasers to attain high beam quality at various power levels. While it was initially integrated into an operational West Coast-based Arleigh Burke Flight IIA destroyer with the Aegis Combat System, HELIOS is also adaptable to other ship types and combat systems, such as aircraft carriers and big-deck amphibious ships with the Ship Self-Defense System (SSDS). The ultimate goal of HELIOS is to provide the fleet with the capability to counter unmanned aerial threats and fast attack boats, putting the Navy on the path to counter anti-ship cruise missiles in the future.