

# Lasers – From warning to attack

Laser technology, namely a highly focused beam of light, has come a long way in recent years, making its way well into the forefront of new military and defence architectures. With resources being spread across a wide range of new laser activities, it's an exciting time to be in the field.

*Amy Saunders, Editor, Global Military Communications*

**The use of laser technology in the aerospace and defence** sectors is spread across a range of applications, including but not limited to weapons, targeting, defence systems and communications. A long time in the making, these directed energy beams are both highly promising in accuracy, speed, and cost, but also plagued by challenges, most notoriously thermal blooming i.e., the beam's speed, direction and intensity being altered by travelling through air, an effect which is amplified with fog, rain, smoke, etc. While laser weapon systems have garnered the most attention in the defence media, they have remained 'one year away...' until this year that is.

## Laser weapons

In recent years, laser weapons have advanced from the shadowy world of science fiction, testing in top secret defence and academic labs, through to full field deployment in locations across the world. For example, earlier this year, two RAF Typhoon FGR4 British fighter jets destroyed two Islamic State fighter cells with laser-guided bombs hidden in caves near Baiji, Iraq.

In January, Germany's Federal Office for Bundeswehr Equipment, Information Technology, and In-Service Support (BAAINBw) awarded a consortium (ARGE) consisting of MBDA Deutschland GmbH and Rheinmetall Waffe Munition GmbH a contract to fabricate, integrate and support testing of a laser weapon demonstrator in the maritime environment. The order value is in the low double-digit million Euro range.

Rheinmetall is in charge of the laser weapon station, the beam guiding system, cooling, and integration of the laser weapon system into the project container of the laser source demonstrator. MBDA Deutschland is responsible for tracking, the operator's console and linking the laser weapon demonstrator to the command-and-control system. The laser weapon demonstrator is to be fabricated, tested, and integrated by the end of this year. Trials onboard the German Navy frigate F-124 Sachsen are expected to take place in 2022.

"The contract is an important step on the path to an operational high-energy laser system," said Doris Laarmann, head of laser business development at MBDA Deutschland. "Our two companies will apply their respective strengths to make this project a success on behalf of the German Navy. Once it's installed, the demonstrator will also be used to test important aspects such as the interaction and function of the sensor suite, combat management system and effector as well as rules of engagement."

"The contract marks a systematic extension of the functional prototype laser weapon successfully tested in recent years, with the experience gained now dovetailing into one of the most ambitious projects in the field of laser weapon development in Europe," said Alexander Graf, head of Rheinmetall Waffe Munition's laser weapons programme, and Dr Markus Jung, who leads the company's laser weapon development effort.

A breakthrough development in the history of defence technology, lasers engage targets at the speed of light, operating

with great precision and producing very little collateral damage. A demonstrator system featuring these capabilities will soon be put to the test under highly realistic operating conditions onboard a German frigate.

Across the pond, the US Air Force has been exploring the use of high energy lasers to strike against drones. One weapon testing program has been overseen by the Directed Energy Combined Test Force (DE CTF). The experiment is assessing five Directed Energy Weapon (DEW) and has involved deploying systems at ranges and in the field for training, testing and evaluation over the past year. Three laser weapons and two high-power microwave systems are part of the experiment; four were tested during 2020, three of which have already been deployed in the field.

The latest system tested, the High Energy Laser Weapon System 2, (HELWS or H2) is the second version of a laser developed by Raytheon. The H2 is more rugged ensuring transportability and survivability, has a new beam director for more accurate targeting, and features a robust power system compared to its predecessor.

"This experiment has many notable US Air Force firsts, including the complete training of and operation of the system by Security Forces Airmen, the first directed energy c-UAS capability, and the first integration with a base," said DE CTF director, Lt. Col. Jared Rupp. "The locations were selected as to significantly enhance c-UAS capability through the use of these DEWs, helping to prevent enemy airborne intelligence, surveillance and reconnaissance (ISR), and attacks."

The first phase of H2 testing validated the laser weapon's basic functionality including lethality and determined that the system was ready to enter the second phase of testing. The second phase involved deployment in the field overseas and included H2 setup, operator training and an initial performance assessment. Another assessment of the H2 will be conducted in 6-12 months after the initial assessment concludes this year.

Later this year, the US Navy is set to field the first acquisition program to deploy the High Energy Laser with Integrated Optical-dazzler and Surveillance (HELIOS), laser weapon system with high-energy fibre lasers for permanent fielding by the US DoD. While it will be 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 amphibians with the Ship Self-Defence System (SSDS).

## Long range intelligence

More than just a high energy laser, HELIOS's multi-mission capabilities include long range intelligence, surveillance, reconnaissance (ISR) and Counter UAS-mounted ISR (C-ISR) Dazzler. The HELIOS system's deep magazine, low cost per kill, speed of light delivery, and precision response enables it to address fleet needs now and its mature, scalable architecture supports increased laser power levels to counter additional threats in the future. HELIOS leverages technology building blocks from significant, long term internal research and development projects that continue to advance the Navy's goal for fielding laser weapon systems aboard surface ships and putting the Navy on the right side of the cost curve for threat engagements.

Lockheed Martin was awarded the Surface Navy Laser Weapon System (SNLWS) Increment 1, known as HELIOS, contract in January 2018 and has made steady progress on this rapid Directed Energy prototype which will be delivered later this year. In 2020, Lockheed Martin completed the Critical Design Review and Navy Factory Qualification Test milestones, 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

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laser design architecture spectrally combines multiple kilowatt fibre lasers to attain high beam quality at various power levels.

In early 2021, the US Navy will field test the Department of Defence's first acquisition program to provide warfighters with permanent laser weapon system capability.

"Completing these significant critical milestones for the HELIOS team and the US Navy brings us much closer to delivering the system to the Navy and providing the Fleet with the capability to counter unmanned aerial threats and fast attack boats today. This puts us on the path to counter anti-ship cruise missiles in the future," said Hamid Salim, Vice President, Advanced Product Solutions at Lockheed Martin Rotary and Mission Systems. "This is a transformational new weapon system. Laser weapon systems are no longer years away; they're here now."

### Laser warning systems

As the use of laser technology in military circles expands, new fields of application have become commonplace. Laser warning systems, a passive military defence which detect, analyse, and locate directions of laser emissions, are coming into being across the world.

Indeed, Persistence Market Research has reported that demand for laser warning systems is growing linearly with the 'imminent laser threat' from countries like North Korea, Russia, and China, among others. The global market for laser warning systems has now reached US\$454 million and is expected to grow at a CAGR of 5.8 percent to US\$345.1 million by 2028, with systems being installed on aircraft, helicopters, naval ships, warships, and tanks. Developments in electronic warfare products and the rising demand for detection, surveillance and other applications are driving demand.

Laser warning systems with three of four sensors are expected to remain the leading segment with more than 73 percent of the market by 2028 end. The high demand is such that manufacturers are expected to move production bases to developing nations to strengthen production lines.

The Air Force segment is anticipated to be the most significant, accounting for more than 75 percent of the total market value by 2028. Regionally, Europe and North America currently comprise more than 58 percent of global market share; however, in the next eight years, Europe, North America and East Asia are expected to see CAGR of six percent in this

segment. The leading companies producing laser warning systems – Elbit Systems, Saab Group, Thales Group, BAE Systems, Leonardo S.p.A. and Collins Aerospace make up almost 75 percent of the production market.

In the US, Lockheed Martin will soon begin formal integration and testing of the Army's combat vehicle protection system intended to keep warfighters safer and more secure from battlefield threats while utilising laser warning systems.

Lockheed Martin will provide its Modular Active Protection System (MAPS) base kit, which includes an open-architecture processor that integrates vehicle sensors and countermeasures in a common framework to detect, track and defeat rocket-propelled grenades and anti-tank guided missiles. Sensors include Northrop's PICS IR sensor and Iron Curtain's L3 Mustang, as well as several laser warning systems.

"Lockheed Martin partnered with the US Army in 2014 to develop MAPS as a safe and secure vehicle defence system that protects warfighters from a variety of anti-armour threats," said David Rohall, Program Manager for Advanced Ground Vehicle Systems at Lockheed Martin. "Since then, the MAPS base kit has proven itself in multiple live-fire demonstrations. We're ready to support integration and testing on a variety of Army combat vehicles, the final step before the Army makes a formal decision on fielding this capability."

Under the 36-month contract, Lockheed Martin will deliver five production-ready base kits with an option for up to 20, and support Army integration and testing on Abrams, Armoured Multi-Purpose Vehicle, Bradley, and Stryker vehicles. The contract also covers developing base kit support for vehicle protection capabilities beyond active protection, such as underbelly blast protection. Lockheed Martin's MAPS base kit supports the rapid integration of MAPS-compliant sensors and countermeasures. It is designed to protect current combat vehicles and support future vehicle protection system capabilities.

### The future beams

While not taking off at quite the speed of light, the popularity of laser technology throughout the government and military sectors is growing about as fast as it can within the spending boundaries of defence organisations. With laser technology proving extremely useful for attack, defence, detection and communications, the field is only set to widen, with more innovative solutions making waves in the years to come. **GMC**



Artist's rendering of Lockheed Martin's HELIOS system. Photo courtesy of Lockheed Martin