



● ● Active laser deployed on the USS Ponce amphibious transport ship. Video/ image courtesy of CNN/US Navy

## Lasers - The weapon of the future ● ●

Despite the fact that laser weapons are a relatively new invention, still under development to become actual viable weapons systems, we're all readily familiar with the concept thanks to science fiction books and films. A simple point and shoot model, with no re-loading, and a flash of red, green or blue light marks the ends of foes through television. The reality is, of course, far from what is depicted on our screens, but reality is exactly where we're headed.

**The concept of laser weapons is centuries old; H. G. Wells' 1898 novel 'War of the Worlds'** famously brought the idea of the raygun into the literary world, while the Star Wars franchise has truly brought laser weapons to the masses, complete with bright lights and fanfare. The reality is very different from the fiction, of course.

We've come a long way since the first laser was demonstrated in 1960 at Hughes Research Laboratories. Today, military laser programmes are based around creating weapons that can disable or destroy enemy targets like vehicles, communications systems, equipment, and power supplies. Unlike fiction, laser weapons are not currently being designed for use on enemy combatants; under the US Defence Department policy and the United Nation's (UN) Convention on Certain Conventional Weapons (CCW), the use of laser weapons on humans is currently banned.

A laser weapon which focuses a huge amount of energy into a single point has received massive interest from government and military groups around the world – not only is it a 'cool' new toy popular with younger engineers and designers, but it turns out that they also have the capacity to be extremely effective.

The advantages compared with traditional kinetic weapons include:

- Accuracy: Laser weapons are highly accurate, and are expected to drastically reduce civilian deaths and collateral damage compared with conventional weapons.
- Speed: Travelling much faster than traditional weaponry, laser beams provide an extremely rapid form of defence or attack.
- Cost: A traditional single-use missile may cost anywhere from thousands to millions of US Dollars, while lasers can be fired for as little as US\$0.59/use, and are fully reusable.
- Stealth: Lasers can wreak considerable damage on enemy targets with no sound or other warning from miles away.

Accordingly, billions of US Dollars have been invested over the past decades into moving lasers from a scientific principle to an actual functioning weapon. Investments have fluctuated with the political landscape and in line with scientific developments, peaking at US\$2.4 billion in 1989 during the height of the Strategic Defense Initiative (SDI), also known as Star Wars, and falling shortly after when it became clear that MegaWatt-sized lasers, capable of massive destruction, were an unrealistic goal. As with all things, laser weapons also have their limitations:

- Size, weight and Power (SWaP): Lasers require massive amounts of power, which can make them large and unwieldy, limiting their mobility. While advancements are being made in this area, there's still a lot of room for improvement.
- Line-of-sight: Line-of-sight must be maintained between laser and target.
- Atmospheric conditions: Fog, smoke, clouds, natural turbulence and other atmospheric events alter the way the laser travels, reducing its effectiveness.
- Maintenance: A reusable weapon must be regularly maintained.
- Cooling: Lasers generate vast quantities of waste heat, which can damage the system if it is not dispersed rapidly enough.
- Counter-weapons: As research into laser weaponry

becomes more advanced, so too do counter-measures that can reduce or nullify their effects.

Despite the limitations, the benefits of laser weapons have proven too great to be ignored, and, as usual, military arms of the US Government have been keen to be at the forefront of the technology.

### Lockheed Martin beats records with 60kW-class laser for US Army

Lockheed Martin has been involved in the laser weapons systems sphere for more than 40 years, making advances in precision pointing and control, line-of-sight stabilization and adaptive optics – essential functions in harnessing and directing the power of a laser beam – and in fibre laser devices using spectral beam combining.

The company plans to develop a family of laser weapon systems capable of various power levels tailored to address missions across sea, air and ground platforms.

In March 2017, Lockheed Martin completed the design, development and demonstration of a 60kW class beam combined fibre laser for the US Army. During testing, the laser produced a single 58kW beam, representing a world record for a laser of this type. The Lockheed Martin team met all contractual deliverables for the laser system and is preparing to ship it to the US Army Space and Missile Defense Command/Army Forces Strategic Command in Huntsville, Alabama.

“Delivery of this laser represents an important milestone along the path to fielding a practical laser weapon system,” said Paula Hartley, Vice President, Owego, New York General Manager and Advanced Product Solutions within Lockheed Martin’s Cyber, Ships and Advanced Technologies (CSAT) business. “This milestone could not have been achieved without close partnership between the US Army and Lockheed Martin; we are pleased to be able to deliver this system for their further integration and evaluation.”

The beam combined fibre laser brings together individual lasers generated through fibre optics to generate a single, intense laser beam. This allows for a scalable laser system that can be made more powerful by adding more fibre laser subunits.

The laser is based on a design developed under the DoD’s Robust Electric Laser Initiative Program, and further developed through investments by Lockheed Martin and the US Army into a 60kW class system.

“The inherent scalability of this beam combined laser system has allowed us to build the first 60kW-class fibre laser for the US Army,” said Robert Afzal, Senior Fellow for Laser and Sensor Systems. “We have shown that a powerful directed energy laser is now sufficiently light-weight, low volume and reliable enough to be deployed on tactical vehicles for defensive applications on land, at sea and in the air.”

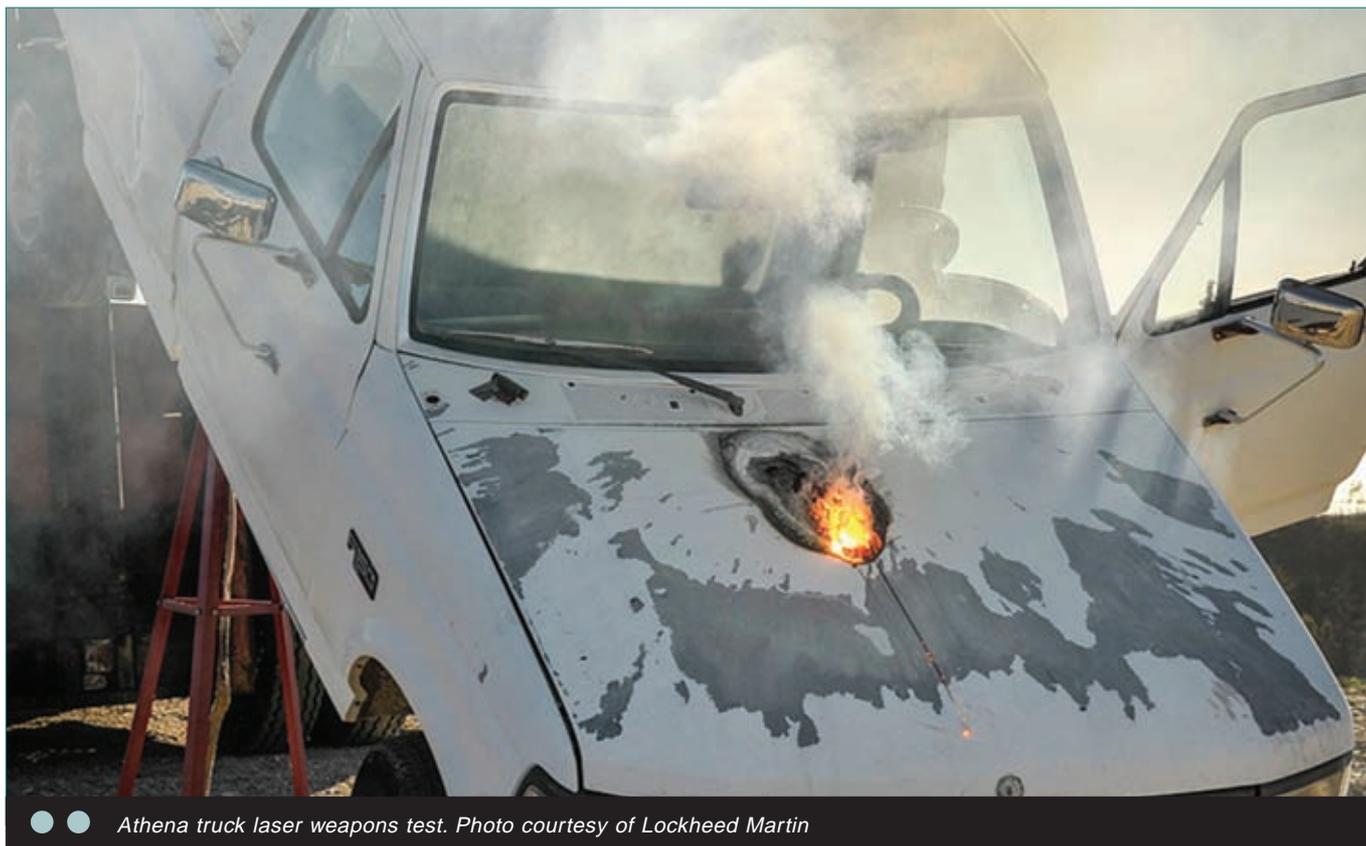
According to Afzal, the Lockheed Martin team created a laser beam that was near ‘diffraction-limited,’ meaning it was close to the physical limits for focusing energy toward a single, small spot. The laser system also proved to be highly efficient in testing, capable of translating more than 43 percent of the electricity that powered it directly into the actual laser beam it emitted.

### US Navy demonstrates LaWS for drone interception

The US Navy has been trialling laser weapons systems for several years now, having installed the AN/SEQ-3 Laser Weapon System (XN-1 LaWS), a defensive energy weapon, on the USS Ponce in 2014. The solid-state laser array was such a success that the expected one-year operation period was extended, and the US Navy awarded Northrop Grumman a US\$53 million contract to develop a more powerful ship-board laser.

In July 2017, the US Navy demonstrated LaWS with a live fire test recorded by Cable News Network (CNN). During the test, crew on the USS Ponce launched an unmanned aerial system (UAS) as a target. The weapons team is capable of responding immediately with no need to lead a target, i.e. shooting ahead of its position, since the weapon travels at the speed of light. Accordingly, LaWS was used to heat one of the UAS wings to thousands of degrees, causing the aircraft to crash into the sea.

“It is more precise than a bullet,” Captain Christopher Wells told CNN. “It’s not a niche weapon system like some other weapons that we have throughout the military where it’s only good against air contacts, or it’s only good against surface targets, or it’s only good against, you know, ground-based targets



● ● Athena truck laser weapons test. Photo courtesy of Lockheed Martin

- in this case this is a very versatile weapon, it can be used against a variety of targets.”

LaWS provides a significant advantage over traditional kinetic weapons systems, travelling at some 50,000 times the speed of an intercontinental ballistic missile. “It is throwing massive amounts of photons at an incoming object,” said Lt. Cale Hughes, Laser Weapons System Officer on the USS Ponce. “We don’t worry about wind, we don’t worry about range, we don’t worry about anything else. We’re able to engage the targets at the speed of light.”

The LaWS system, which cost some US\$40 million, requires a source of electricity derived from its own generator to operate, and a crew of three. According to Hughes, it costs around US\$1 per shot, whereas traditional missiles cost anywhere from thousands to millions of US Dollars. In addition, the high level of precision also means that collateral damage is vastly reduced compared with traditional weapons systems. “I can aim that at any particular spot on a target, and disable and destroy as necessary,” said Wells. “It reduces collateral damage — I no longer have to worry about rounds that may go beyond the target and potentially hurt or damage things that I don’t want to hurt or damage.”

LaWS has been designed to disable or destroy aircraft and small boats, countering many airborne or surface-based threats. The system has proved itself over the last three years as being incredibly effective at that, according to Hughes. However, the US Navy is also developing a more powerful second-generation system which would enable missiles to be taken down by laser.

#### **UK Ministry of Defence awards Laser Directed Energy Weapon contract to UK Dragonfire**

Following the progress made by the US Government, the UK

has shown itself to be eager to get a foothold in the laser weapons sphere.

In January 2017, it was announced that the UK’s Ministry of Defence (MoD) had awarded a £30 million contract to produce a prototype laser weapon to determine whether the technology could be of practical use to the armed forces on land and at sea.

The Laser Directed Energy Weapon (LDEW) Capability Demonstrator contract was awarded to UK Dragonfire, a consortium consisting of MBDA, Qinetiq, Leonardo-Finmeccanica GKN, Arke, BAE Systems and Marshall ADG UK. Together, the companies will develop technology for a high energy defensive laser weapon system in the 50kW class. MBDA will build the system and assess how it can acquire and track targets at range and under a variety of weather conditions. Meanwhile, Qinetiq will provide the high-powered laser system and conduct the trial at one of the ranges it manages for the MoD as part of the Long Term Partnering Agreement.

According to the MoD, the laser weapon system could complement or replace existing weapons systems, potentially with great benefits, and could be deployed to protect both maritime and land forces from missiles or enemy mortars.

“Under MBDA lead, UK Dragonfire will put the UK at the forefront of high energy laser systems, capitalising on the experience of joint MoD/Industry working in the complex weapons environment,” said Dave Armstrong, Executive Group Director Technical and Managing Director at MBDA. “Furthermore, it advances the UK towards a future product with significant export potential, as well as providing opportunities for partnerships with other nations’ armed forces that have similar requirements.”

A demonstration of the system is expected in 2019. **GMC**

## Major order for Rheinmetall: 104 German Leopard 2 MBTs to be modernized ●●

Rheinmetall will soon be modernizing part of the Bundeswehr’s fleet of Leopard main battle tanks, implementing a comprehensive array of upgrade measures. The Düsseldorf-based technology group for mobility and security will be responsible for key parts of a combat performance upgrade programme that will bring 104 Leopard 2 tanks up to state-of-the-art design status. Coupled with additional services, the modernization package is worth a total of euros118 million. The first serially retrofitted Leopard 2 A7V tanks will reach the Bundeswehr starting in 2020.

Rheinmetall will be transforming a total of 68 Leopard 2A4, 16 Leopard 2A6 and 20 Leopard 2A7 main battle tanks, bringing them up to A7V standard. In the process, Rheinmetall specialists will be eliminating obsolescent features in the fire control computers and control consoles as well as installing a new laser rangefinder and thermal imaging device.

In addition, Rheinmetall will be supplying the new L55A1 gun for the 68 Leopard 2A4 MBTs to be modernized. These tanks will therefore be able to fire the latest generation of armour piercing ammunition in the upper pressure zone. All 104 Leopard 2A7V tanks will be capable of using Rheinmetall’s new programmable DM11 multipurpose round.

The order underscores once again Rheinmetall’s leading role in tank main armament design and electronic components for modern fighting vehicles. **GMC**

## Former Special Operations Commander Australia to join EM Solutions board ●●

Highly decorated soldier Major General Jeff Sengelman DSC, AM, CSC is joining the Board of EM Solutions following his recent retirement from the Australian Army.

In announcing the appointment, EM Solutions CEO Dr. Rowan Gilmore said “General Sengelman has had an outstanding and highly decorated career as a soldier, and we are delighted he will bring his experience and strategic insights to our Board of Directors. His leadership credentials and drive to modernize defence capability are well known, and will accelerate our company’s ability to develop and deliver continuously improving capability to our customers”.

Major General Sengelman served in the Australian Army for 37 years, most recently as the Special Operations Commander of Australia where he was responsible for Special Forces units such as the SAS Regiment and Commandos operating across the globe. In this position, he was the trusted senior adviser to Government and the Chief of the Defence Force on security issues of the highest national significance, and a principal adviser on Counter Terrorism. **GMC**



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