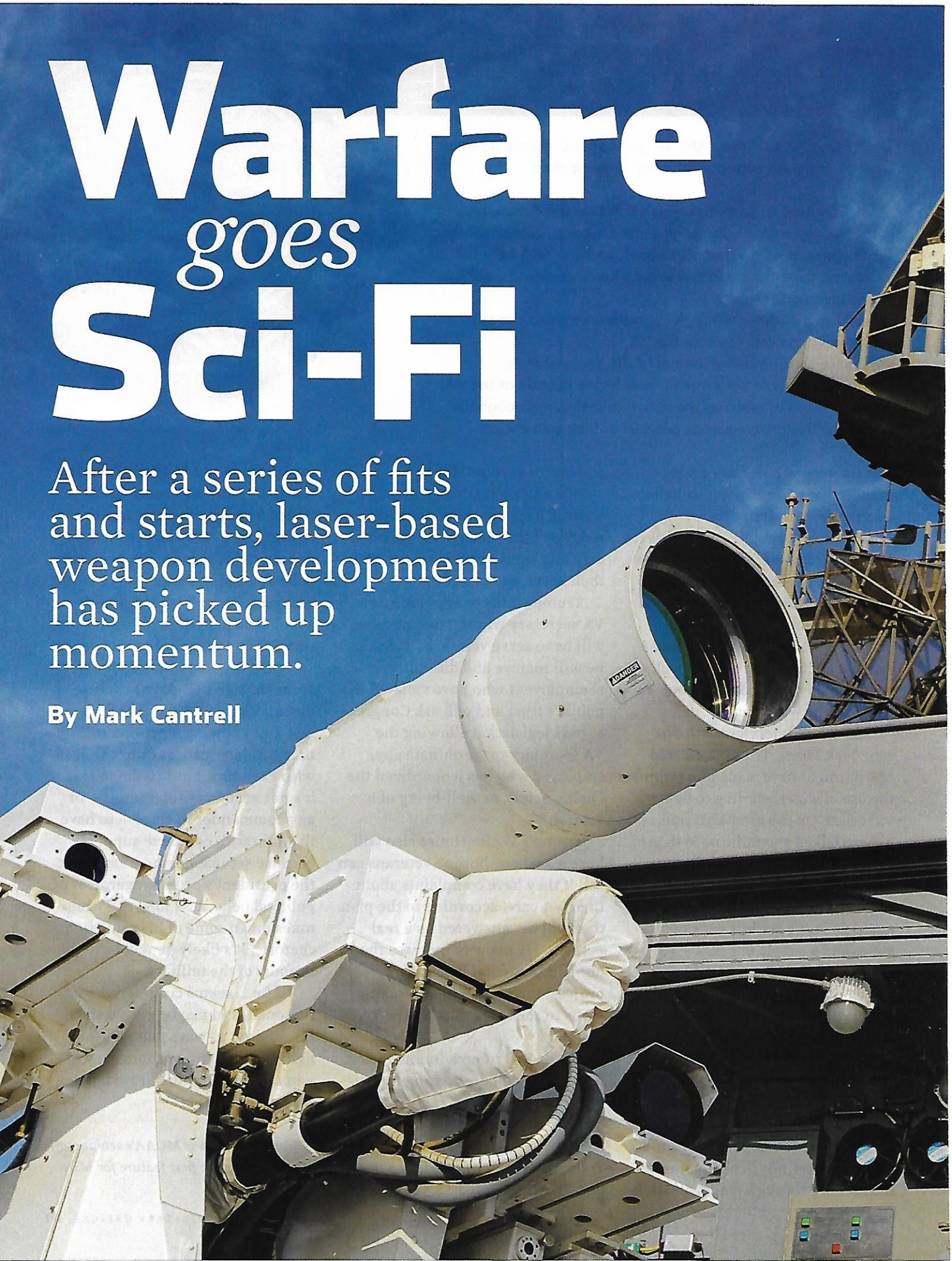
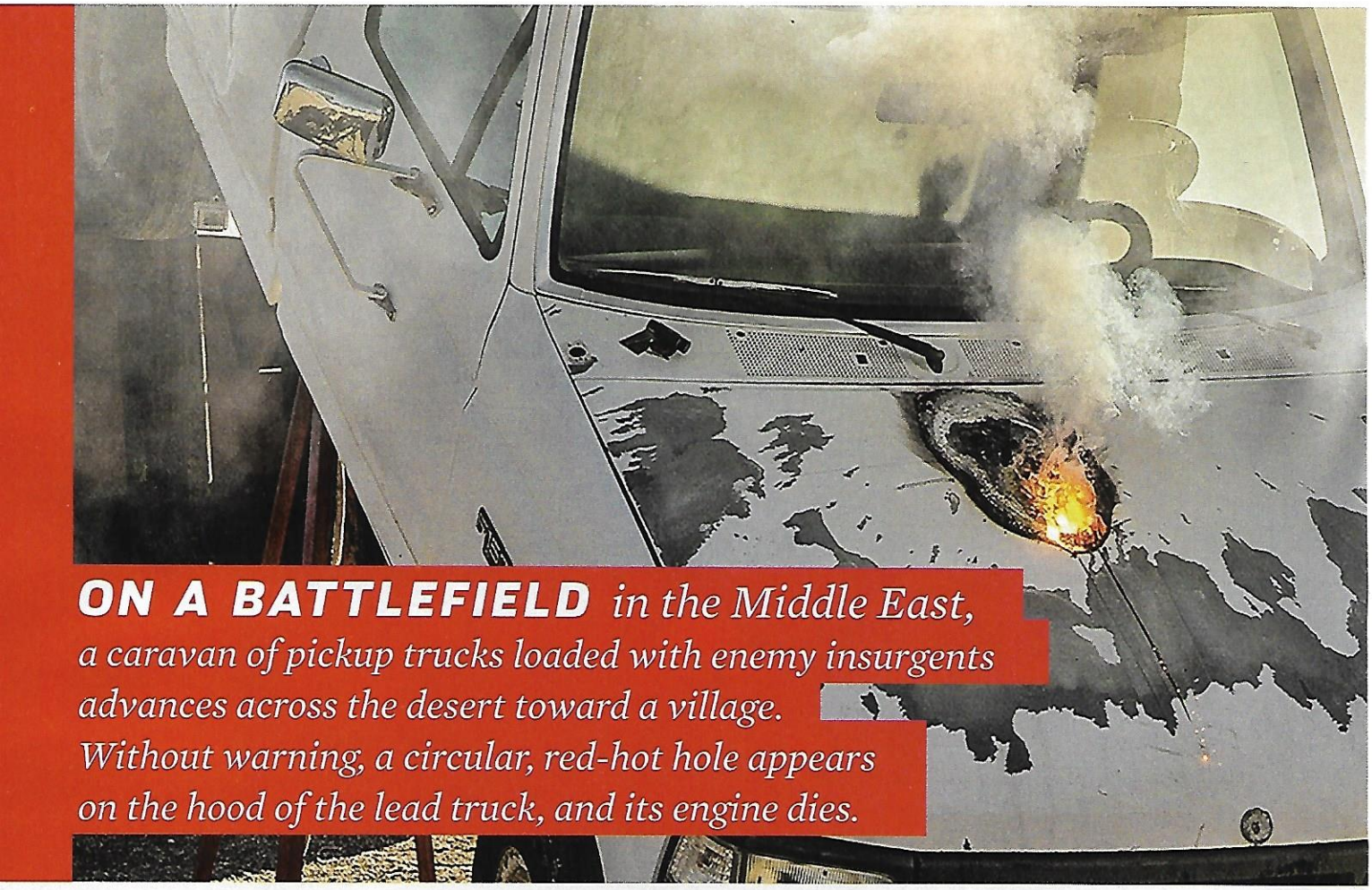
Warfare *goes* Sci-Fi

After a series of fits and starts, laser-based weapon development has picked up momentum.

By Mark Cantrell



USS Ponce (AFSB[I]-15) conducts a demonstration of the Laser Weapon System (LaWS) while deployed to the Persian Gulf. The armed forces have refocused efforts on developing laser-based weapons due to their accuracy and potential cost advantages.



***ON A BATTLEFIELD** in the Middle East, a caravan of pickup trucks loaded with enemy insurgents advances across the desert toward a village. Without warning, a circular, red-hot hole appears on the hood of the lead truck, and its engine dies.*

The other trucks pile up behind it, and the same mysterious phenomenon disables them one by one. As defenders race out of the village in their own vehicles, the terrorists flee on foot into the desert. Overhead, an orbiting laser-equipped AC-130 gunship reports the engagement and turns back toward base.

Not long ago, this scenario would have been considered science fiction. Today, the use of high-powered lasers in air, land, and sea battle spaces has become an inevitability — but the road there has been a long one.

The Army Ordnance Missile Command began experimenting with laser technology in the early 1960s, and although hopes were high, the tests soon revealed a major stumbling block: There was no way to generate the tremendous power needed to create an effective weapon. The '80s Strategic Defense Initiative, widely known as Star Wars, failed for essentially the same reason. Chemical lasers tested in the '80s turned out to be another dead end, as there were significant logistical problems and safety concerns associated with them.

A proposal to use pulsed lasers to blind enemy soldiers on the battlefield advanced to the prototype stage, but a 1995 update to the Geneva Conventions banned the use of blinding laser weapons, ending the project. Despite the ban, Marines used low-powered lasers — which didn't result in permanent blindness —during the invasion of Iraq. But military lasers still were relegated to a minor role in the DoD arsenal while their proponents awaited the development of a stronger power source.

Technological turning point

Like other branches of the military, the Navy had experimented with chemical lasers in the '80s.

"However, they're not really conducive to use in the close quarters aboard naval vessels," notes Cmdr. Vincent Chernesky, USN, deputy program manager of the Navy's Directed Energy and Electric Weapon Systems Program Office. "We had to wait until the current development of solid-state lasers and for their power to come up to militarily useful levels."

With the emergence of high efficiency, all-electric solid-state laser technology in the early 2000s, research finally got back on track. That led to the Laser Weapon System (LaWS) program, stood up in 2010 as a development test bed "to look at whether you could take commercial welding lasers, put them in a beam-director system, hook it up to a fire-control system, and have a

PHOTOS: THIS SPREAD, CLOCKWISE FROM TOP, LOCKHEED MARTIN, U.S. ARMY, USN; PREVIOUS SPREAD, USN

militarily useful effect at relatively low cost," according to Chernesky. Using commercial off-the-shelf lasers, whose development costs already had been borne by industry, kept down the price and greatly reduced the time between the program's genesis and the production of a working prototype.

The LaWS system first was tested at the White Sands, N.M., High Energy Laser Systems Test Facility (HELSTF) in 2009 and again in 2010 at a simulated maritime environment at San Nicolas Island, Calif., with impressive results. In 2013, the system was mounted on the guided-missile destroyer *USS Dewey* (DDG-105), where it successfully destroyed a series of unmanned aerial vehicles (UAVs) and fast boats. Since September 2014, LaWS has been tested on board *USS Ponce* (AFSB[I]-15) in the Persian Gulf. The system has performed so well the Navy has given *Ponce*'s captain permission to use the laser against any threats the ship might encounter. This is the first time a directed-energy weapon has been deployed. The Office of Naval Research currently is working with Northrup Grumman on a laser-weapon-system demonstrator that will bump LaWS' 15-to-50-kilowatt (kW) capability up to a scorching 150 kW.

Test, tweak, test again

The Army went through its own chemical laser development program but switched to solid-state units once they became available. Prototypes are tested at HELSTF using the Solid-State Laser Test Bed (SSLT), which is "used to collect high-energy laser lethality and beam propagation data," says Richard Da Fatta, acting director of the U.S. Army Space and Missile Defense Command Technical Center.

"The SSLT is also capable of conducting demonstrations against in-flight targets to help verify data

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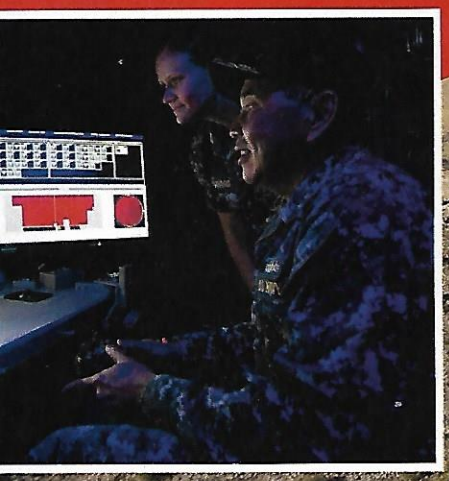
(clockwise from above) A fiery hole glows from the engine of a now-disabled truck, hinting at the lethal accuracy of Lockheed Martin's ATHENA laser weapon system. Boeing's High-Energy Laser Mobile Demonstrator, which aims to refine a rugged, mobile solid-state laser system for the Army, uses a 10-kilowatt laser mounted on a customized heavy expanded mobility tactical truck; the laser can be directed by an Xbox game controller. Rear Adm. Peter A. Gumataotao, commander, Naval Surface Force, U.S. Atlantic Fleet, operates the LaWS installed on board *USS Ponce* (AFSB[I]-15).



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collected in static engagement and to anchor models and simulations," Da Fatta continues.

The SSLT's current focus is the Boeing-designed High-Energy Laser Mobile Demonstrator (HEL MD), which uses a modified 10 kW commercial laser mounted on a customized heavy expanded mobility tactical truck. That would have been impossible for earlier chemical-laser systems, such as the tactical high-energy laser, which required three large semitrailers to contain all the necessary equipment. What's more, the system is operated by a Panasonic Toughbook laptop and can be controlled by a Microsoft Xbox game controller.

"In 2014, the HEL MD was used to shoot down 69 of 94 small-caliber mortars and a target UAV," says Da Fatta. "We will integrate a higher-power laser source and supporting subsystems at the 50 kW level in 2017 and at 100 kW in 2020."

Those higher-powered lasers now are being developed by Lockheed Martin Space Systems as part of the company's accelerated laser-demonstration initiative, which has resulted in a laser demonstrator known as the Advanced Test High-Energy Asset (ATHENA). The current prototype grew out of the earlier Area Defense Anti-Munitions (ADAM) system, which used a laser weapon designed to defeat close-in rocket, unmanned aerial system, and small-boat threats.

"ADAM used a 10 kW commercial laser," explains Paul Shattuck, Lockheed Martin's director of directed-energy systems. "For ATHENA, we're using a 30 kW Lockheed-developed laser. The difference between most of the other systems and this one is that ATHENA uses a single fiber-optic laser, versus multiple 10 kW lasers that must converge on a target." By the end of 2016, Lockheed Martin plans to deliver a laser system that will double ATHENA's power.

In tests off the California coast, the Lockheed Martin Area Defense Anti-Munitions laser system burns through the hull of a military-grade boat.

The benefits of beaming

Despite the time, energy, and money being expended on the development of laser weapon systems, the service branches doggedly pursue them because they offer several important advantages over traditional kinetic weapons.

"The first is that they offer an extremely deep magazine," says Chernesky. "As long as you can generate electricity, there's no resupply [and] no ammunition required for lasers other than fuel." He explains that traditional artillery shells aren't as accurate due to windage and tumbling problems, which create the danger of collateral damage. Lasers, on the other hand, can be directed exactly where they can do the most to nullify a threat. Chernesky notes most modern laser systems also can be used as high-powered telescopes, giving users an observational advantage as well.

Da Fatta points out another big advantage: cost. "A high-energy laser weapons system reduces the logistics chain and offers a very affordable counter to UAV, rocket, artillery, and mortar threats in terms of cost-per-kill," he says. A single Excalibur artillery shell costs more than $100,000, while laser weapons eventually will be able to do just as much damage "for tens of dollars per engagement."

On the other hand, lasers can't do everything. Although exceedingly accurate against incoming threats such as UAVs, they require a clear line of sight to the target and can't be used for hidden or over-the-horizon targets. "They're not an end-all system," says Shattuck. "They'll be used to complement the current kinetic energy munitions we now have."

As with any new weapon system, there has been some internal resistance in the services, says Chernesky. "People grew up with the promise of lasers, and until recently, that promise had not been kept. We're trying to overcome that organizational inertia and bring people around to the reality that lasers are here, they work, and they're already militarily useful." MO

— Mark Cantrell *is a North Carolina-based freelance writer. His last feature article for* Military Officer *was "Servicemember Superheroes," December 2016.*

PHOTO: LOCKHEED MARTIN