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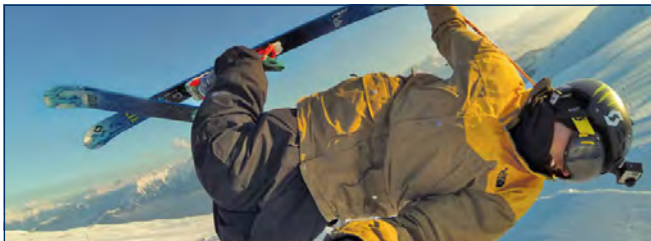
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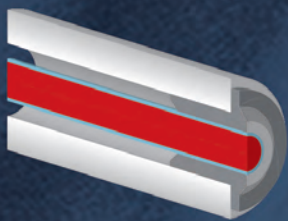
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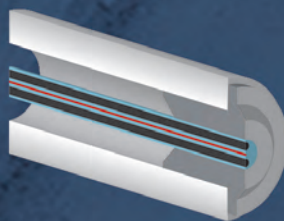
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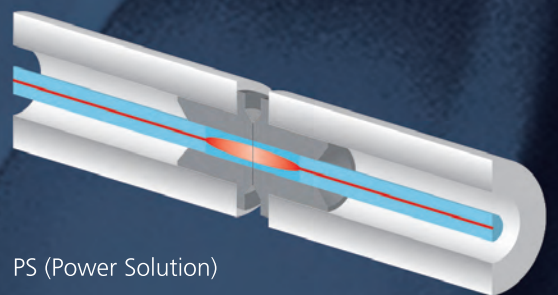
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# Defense giant Leonardo buys QC laser specialist Daylight for \$150M

San Diego company, whose products are used in advanced countermeasure systems, slots into Leonardo's DRS subsidiary.

Leonardo, the Italy-headquartered aerospace and defense giant formerly known as Finmeccanica, is acquiring US-based quantum cascade laser (QCL) technology developer Daylight Solutions for \$150 million.

The deal will see the San Diego firm become part of Leonardo's US subsidiary DRS, which is well known for its infrared imaging expertise. Daylight's founders Timothy Day and Paul Larson are both staying with the company under the new ownership structure.



Photo: Daylight Solutions.

Timothy Day (right) and Paul Larson, who co-founded Daylight Solutions with Sam Crivello.

## Aircraft protection

Daylight has enjoyed particular success in the application of QCLs in advanced infrared countermeasure (IRCM) systems, which are designed to protect aircraft from heat-seeking missiles by confusing the missile's tracking systems.

The novel wavelengths provided by the QCL devices allow them to offer "out of band" emission in the mid-infrared spectrum, meaning that they can operate more stealthily than conventional IRCMs and avoid detection.

Daylight has previously worked with a number of major defense contractors, including the Leonardo subsidiary Selex

Electronics Systems. Founded in 2005, it soon closed a \$7.5 million series A venture round, led by San Diego-based Hamilton Tech Capital Partners, and later won significant development funding from the US Naval Research Laboratory.

Then in July 2011, Northrop Grumman acquired an equity stake in Daylight as part of the company's \$15 million series C round of venture funding. In February 2012, Northrop was selected as one of two contractors – along with Boeing – to develop common IRCM systems for the US Army that are lighter and more portable than conventional IRCMs.

In September 2015, the US Army then awarded a consortium including Daylight and Selex ES a \$35 million contract to further advance lightweight IRCMs for smaller fixed-wing aircraft and helicopters like the US Army's Black Hawks.

Meanwhile, Northrop and Selex Galileo, another part of Leonardo, have enjoyed a long-standing relationship in the area of IRCMs, historically delivering hundreds of the systems to UK and US customers, and signing a memorandum of understanding to expand into other territories in 2011.

## Significant step

Describing the acquisition as a "significant step" towards Leonardo meeting the targets of its new industrial plan, the defense firm's CEO Mauro Moretti said: "This acquisition will allow Leonardo DRS to extend the range of advanced solutions to civil and military customers around the world, integrating the Daylight Solutions laser technology in the core business of electro-optical and infrared sensors and systems."

Leonardo expects to integrate the laser and sensor systems developed by Daylight and DRS for use in a variety of so-called "dual-use" applications, going beyond IRCMs to include medical and industrial applications, including imaging for cancer diagnostics and chemical detection.

Although its main focus has been on IRCMs, Daylight has always worked on

non-military applications as well, and at this week's Pittcon trade show in Chicago, the company launched an updated version of its "Spero" infrared microscope, dubbed "Spero-QT".

It is designed to enable new analytical applications in pharmaceutical and biomedical research, ranging from non-contact, video-rate tablet and powder imaging to intra-operative label-free digital histopathology.

Bill Lynn, the CEO of Leonardo DRS, commented: "With this acquisition, Leonardo DRS reinforces its commitment to remain at the forefront of infrared technology to not only protect our men and women in uniform but also to perform critical tasks across a range of industries, including medical and industrial applications."

## Protecting with light

Leonardo DRS has agreed to pay \$150 million for complete ownership of Daylight, a total including an earn-out provision for Daylight shareholders if financial and operating targets are hit this year.

Leonardo says that its valuation is equivalent to approximately nine times Daylight's anticipated earnings before interest, taxes, depreciation and amortization (EBITDA) this year. Once the deal is closed, Daylight will be one of eight lines of business within Leonardo DRS.

Timothy Day said in response to the agreement: "The mission of Daylight Solutions, 'to protect with light,' will be more fully realized with the combined strength of the people and resources of Leonardo DRS and will enhance our proven ability to transition technology into compelling products for a range of customers and industries.

"We remain committed to continuing the growth of both our defense and instrumentation business for a range of customers and industries."

<http://optics.org/news/8/3/15>

# US Naval Research Lab buys Concept Laser system

Laboratory's first metal additive manufacturing tool set to print prototype stainless steel components.

Concept Laser, the Germany-headquartered laser additive manufacturing systems company that recently became part of General Electric, says that the US Naval Research Laboratory has bought one of its 3D metal printers for rapid prototyping and materials research.

Said to represent the lab's very first purchase of a laser powder-bed metals machine, the "M2 cusing" kit will be used to produce stainless steel components.

Charles Rohde from the Naval lab's acoustics division said in a Concept Laser release: "We require a wide range of additive manufacturing capabilities, ranging from quality monitoring to process parameter development, and need an architecture conducive to that research and development effort."

John Murray, CEO of Concept Laser's US division, added: "There are so many advantages of 3D metal printing that our defense strategy could benefit from, including reduced lead time, less material waste, and printing complex geometries with no required assembly.

"NRL has a history of over 90 years of innovation in naval power and we look forward to hear how they will use 3D metal printing to break boundaries."

## Jet engine nozzles

Aircraft engine provider GE Aviation completed its purchase of a 75 per cent share in Concept Laser for \$600 million in late 2016 having initially announced the deal in October after a prior agreement to buy SLM Solutions fell through.

Parent company GE is investing heavily in additive technology as both a technology



As well as fuel nozzles for the "LEAP" jet engines, GE Aviation is working on additive approaches for Cessna's new turbo-prop engines.

provider and user, saying that it sees the approach as "transformative" for the manufacturing sector. One key additive application is in the production of metal fuel nozzles that are used in new "LEAP" aircraft engines developed by GE Aviation in collaboration with French engineering giant Safran.

The LEAP engines are already powering 20 Airbus A320 "neo" planes flown by six airlines, with 77 of the new engines delivered last year and hundreds more now on order.

GE has now set up a standalone "GE Additive" business division, which is working with GE Capital to offer a wider range of financing options for customers interested in acquiring 3D printing machines.

## 'Democratizing' additive

In January Mohammad Ehteshami, VP for additive integration within GE Additive, said: "Additive manufacturing is the new revolution, changing the way we design and manufacture products faster, more sophisticated and more cost efficient.

"By partnering with GE Capital, we're now able to democratize additive manufacturing, making it easier for businesses to buy additive machines, fostering their competitiveness and accelerating the adoption rate. We're excited to be part of the additive revolution."

• Meanwhile 3D Systems, which sells both laser-based metal additive systems and lower-specification 3D printing equipment, has just reported a year-on-year decrease in sales.

Nevertheless, its CEO Vyomesh Joshi reported: "Continued demand for our production printers and materials reaffirms our belief that our industry is at an inflection point in the transition from prototyping to production."

But with 2017 annual sales growth projected to be only around 5 per cent, markets appeared to react negatively to the results and outlook, sending the Rock Hill, South Carolina, company's stock down by around 10 per cent in the process.

<http://optics.org/news/8/3/2>

Photo: Concept Laser.

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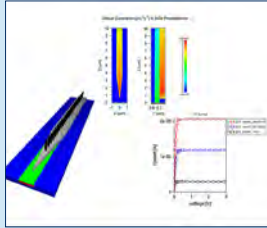
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# Gooch & Housego snaps up infrared lens firm StingRay

**Cash-and-stock deal worth up to \$20M reinforces G&H's diversification and vertical integration strategy.**

UK-headquartered photonics firm Gooch & Housego (G&H) has acquired the US-based infrared lens and opto-mechanical subsystems company StingRay Optics in a deal worth up to \$20 million.

Based in Keene, New Hampshire, StingRay designs high-performance optics equipment used in both military and

supply chain into optical sub-systems and systems, follows the mid-2016 acquisitions of laser diode firm Alflight and military sight specialist Kent Periscopes.

G&H's CEO Mark Webster said that the incorporation of StingRay would increase the company's presence in the aerospace and defense sector. In its most recent annual report, for the year ending

According to G&H, StingRay's products are used in laboratories, as well as ground-based and airborne military platforms, unmanned aerial vehicles (UAVs) and in space applications.

The UK firm said that its expertise in manufacturing infrared precision optics and specialist coatings ought prove particularly beneficial to the StingRay integration.

## Apollo lens for lidar

StingRay's current offering includes both customized and standard lenses, with products spanning the infrared spectrum from the near-IR through 14  $\mu\text{m}$ . Recent launches include the firm's first products aimed specifically at lidar applications, with its "Apollo" lenses said to be inspired by the use of the laser-ranging technology to map the Moon during the Apollo 15 mission of 1971.

The terms of the deal will see G&H pay an initial \$7.5 million in cash from its existing debt facilities, along with \$2.5 million in new G&H ordinary shares that will be 'locked up' for one year from the date of acquisition.

According to its latest annual report G&H's debt currently comprises a \$15 million revolving credit facility and a \$20 million flexible acquisition facility. As of September 30, 2016, the balance drawn on the revolving credit facility was \$15 million.

The StingRay deal includes a deferred consideration of up to \$10 million, payable in cash, that will be dependent on the performance of the business for a period of up to three years, said G&H, adding that StingRay's profitability should enhance overall earnings in the first full year of ownership.

*By Mike Hatcher,  
Editor-In-Chief, optics.org*

<http://optics.org/news/8/2/28>



Photo: StingRay Optics.

*StingRay offers full infrared spectrum coverage with its various lens products. It recently launched a new lens aimed specifically at the lidar sector.*

commercial applications. Founded in 2004 by former Janos Technology director Chris Alexay, it has since increased annual sales to approximately \$7.7 million.

G&H told optics.org that there will be no job losses as a result of the takeover, with all of StingRay's senior management team set to continue in post.

## Defense presence

The deal, which fits G&H's strategic plan to both diversify from its core acousto-optic modulator business, and move up the

September 2016, aerospace and defense revenues accounted for £20 million, or around 23 per cent, of total G&H sales.

"It is a profitable and growing business in its own right, which has established an excellent reputation in the US defense industry for the high quality of its custom optical assemblies," added Webster. "As part of the bigger G&H family we believe it will be able to fulfil its true potential by leveraging our greater reach and our complementary manufacturing and technical capabilities."



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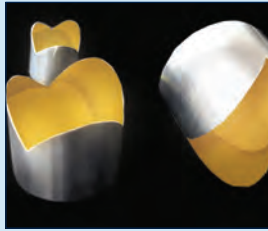
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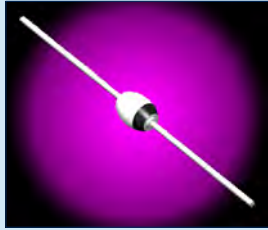
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# Infrared camera captures lightning storms from geostationary orbit

Enhanced imager on board GOES-16 satellite expected to improve weather forecasting and climate modeling.

The US National Oceanic and Atmospheric Administration (NOAA) has released the first images of lightning to be captured by an image sensor flying in a geostationary orbit.

On board the Lockheed Martin-built "GOES-16" satellite that was launched last November, the Geostationary Lightning Mapper (GLM) is a single-channel, near-infrared optical transient imager that detects momentary changes in an optical scene, indicating the presence of lightning.

While those kinds of imagers have been used in low-Earth orbiting satellites previously, this is the first to be able to detect lightning storms across the entire Western hemisphere at once.

According to NOAA, the instrument makes both detecting and predicting lightning much easier, meaning that forecasters will be able to alert the public to dangerous weather more effectively, and help route aircraft away from thunderstorms over oceanic regions where current data is relatively scarce.

"The GLM is transmitting data never before available to forecasters," the administration reported. "The mapper continually looks for lightning flashes in the Western Hemisphere, so forecasters know when a storm is forming, intensifying and becoming more dangerous.

"Rapid increases of lightning are a signal that a storm is strengthening quickly and could produce severe weather."

## Early warning

The instrument is also able to detect in-cloud lightning, which NOAA says often occurs 5-10 minutes or more before potentially deadly cloud-to-ground

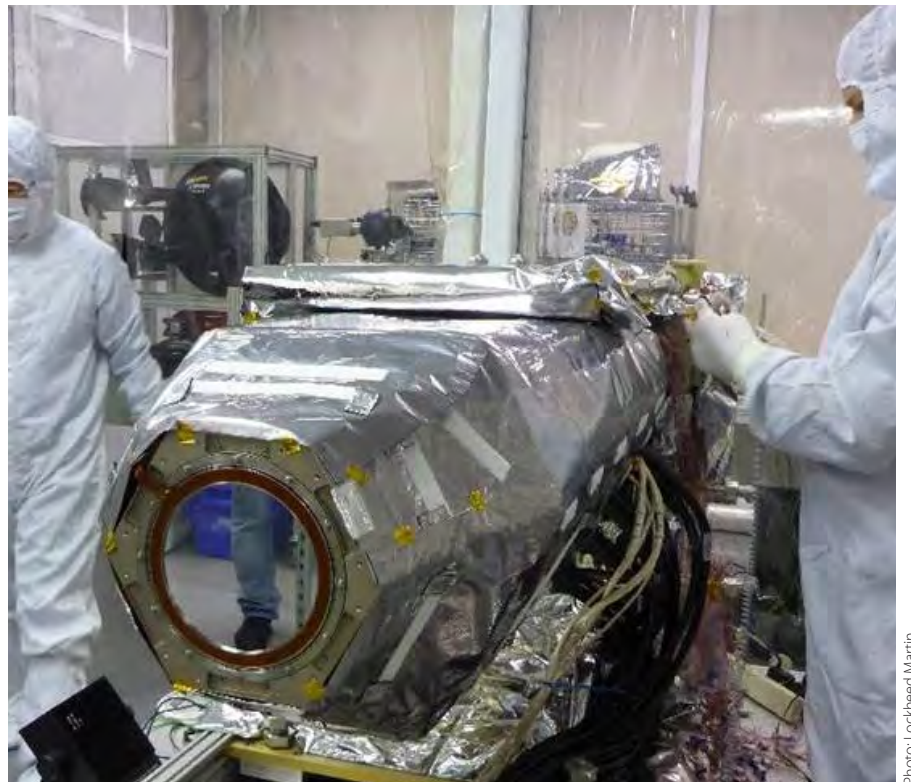


Photo: Lockheed Martin.

*The GLM instrument, shown here just prior to thermal tests in 2014, launched on board the GOES-16 satellite in November 2016 and is the first to send images of lightning activity back to Earth from a geostationary orbit.*

strikes. "This means more precious time for forecasters to alert those involved in outdoor activities of the developing threat," it added.

During heavy rain, GLM data will also show when thunderstorms are stalled or if they are gathering strength. NOAA says that when that information is combined with radar and other satellite data, it can help forecasters anticipate severe weather and issue flood and flash flood warnings more quickly.

"In dry areas, especially in the western United States, information from the instrument will help forecasters, and ultimately firefighters, identify areas prone to wildfires sparked by lightning," it says.

At the heart of the GLM is a staring CCD imager, operating in a single wavelength band at 777.4 nm and with a frame rate of 2 milliseconds.

It can measure "total lightning" (i.e. in-cloud, cloud-to-cloud and cloud-to-ground) activity continuously over the Americas and adjacent ocean regions with near-uniform spatial resolution of approximately 10 km.

As well as providing short-term weather forecasting advantages, data from the instrument will also be used in a database to track any decadal changes in lightning activity. NOAA says that this is important

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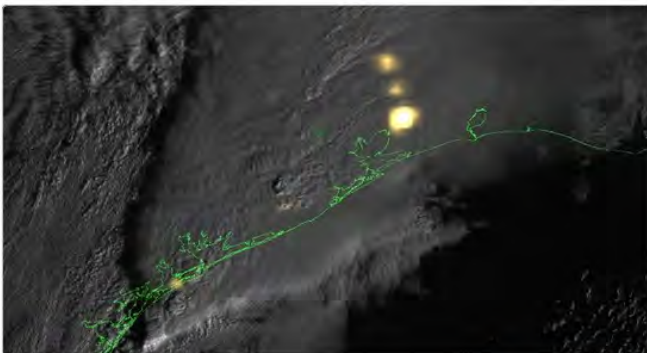
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## Infrared camera captures lightning storms from geostationary orbit

because of the key role lightning plays in maintaining electrical balance between the Earth and the atmosphere.

### Multispectral imager

However, the GLM is not the main instrument on board GOES-16, which carries several other pieces of equipment. The Advanced Baseline Imager (ABI) represents the primary kit, and once fully calibrated and operational it will capture Earth imagery across 16 spectral bands – stretching from 450 nm to 13.6 μm - at high spatial resolution.



NOAA @NOAA

Flashy first images arrive from NOAA's #GOES16 #Lightning Mapper. SEE animation at --> nesdis.noaa.gov/content/flashy... @NOAASatellites

2:36 PM - 6 Mar 2017

82 117

ABI is a multi-channel passive imaging radiometer designed to provide variable area imagery and radiometric information of Earth's surface, atmosphere and cloud cover. The instrument has two scan modes: a default setting that will take a "full-disk" image of the Western Hemisphere every 15 minutes, an image of the continental US every five minutes, and two smaller, more detailed images of any areas where storm activity is present, every minute.

The imager can also operate in "continuous full disk" mode, providing uninterrupted scans of the entire hemisphere disk every five minutes – said to be five times faster than current capability on board other GOES satellites.

It will be used for a wide range of applications related to weather, oceans, land, climate and hazards, like spotting fires, volcanoes, floods, hurricanes and storms that spawn tornadoes.

Other instruments on board GOES-16 include a solar ultraviolet imager to analyze potentially dangerous solar flares, an X-ray irradiance sensor to monitor solar irradiance in the upper atmosphere, a magnetometer, and ion flux sensors.

<http://optics.org/news/8/3/11>

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# Latest 'SBIRS' infrared payload responding: Lockheed

Third geosynchronous satellite in the Space-Based Infrared System constellation launched successfully.

US defense contractor Lockheed Martin says that the third geosynchronous satellite in the US Air Force Space Based Infrared System (SBIRS) constellation, known as "GEO Flight 3", is responding as expected following its January 20 launch on board an Atlas V rocket.

The payload, which comprises powerful scanning and staring sensors that collect and transmit infrared surveillance information to ground stations, follows the launch of GEO-1 in May 2011 and GEO-2 in March 2013.

With three more launches planned, the completed SBIRS network will feature six geosynchronous satellites to provide complete global coverage, enabling the US

military to detect events including missile launches by virtue of the thermal infrared signatures that they produce.

## MWIR capability

Each GEO satellite features what Lockheed Martin and sub-contractor Northrop Grumman describe as a three-color infrared payload, using Schmidt telescopes with dual optical pointing for both scanning and fixed surveillance.

The hardware includes both short-wave and mid-wave infrared (SWIR and MWIR) sensors, gathering raw unprocessed data signals that are then sent to a ground station via a high-speed downlink for processing and analysis.

David Sheridan, the VP of Lockheed Martin's "overhead persistent infrared (OPIR)" systems

mission area, said in a company release: "After a successful launch, signal acquisition is the first critical event in SBIRS' mission to support the Air Force with early missile warning and defense.

"With communications now established, our job begins to deliver SBIRS to its final orbit so we can complete deployments and operational testing in anticipation of the satellite's formal acceptance by the Air Force."

Robert Mehlretter, VP of Northrop Grumman's military and civil space division, added: "We are looking forward to seeing our sensors capture the first light of real-time world events shortly, and seeing this data delivered to the warfighter will make us proud."

## High priority

According to the United Launch Alliance – a joint venture between Lockheed and Boeing that provides rocket launch services – the latest addition to the SBIRS constellation is considered one of the highest-priority space programs in the US.

GEO-3 is now set to transition to its final location in geosynchronous orbit, where the satellite's solar arrays, light shade and antennas will be deployed to begin early on-orbit testing.

Lockheed says that the SBIRS GEO-1 and GEO-2 sensor pointing accuracy and sensitivity for target detection have "significantly exceed specifications" so far. "While SBIRS' primary mission is strategic missile warning, infrared data will also be made available for new qualified military and civilian applications at the Air Force's recently opened Tools, Applications and Processing Lab in Boulder, Colorado," the company said.

The next satellite, GEO Flight 4, is set to undergo final assembly, integration and test prior to its planned launch later this year.

Lockheed adds that the final additions to the constellation, SBIRS GEO-5 and GEO-6, which are currently in production, incorporate a new common spacecraft bus that will dramatically reduce costs and cycle times while increasing the potential to incorporate future, modernized sensor suites.

The multi-billion-dollar SBIRS program overran its initial budget estimates significantly, prompting the US Air Force to set up the Alternative Infrared Satellite System a decade ago as a contingency plan. But with the SBIRS project apparently now on track for completion, that back-up plan has been shelved.



Photo: Lockheed Martin via Flickr.

SBIRS GEO-3, shown here in final assembly and test at Lockheed Martin's facility in Sunnyvale, California, ahead of the January 20 launch.

<http://optics.org/news/8/1/32>



Photo: BAE Systems.

On target: US Army investing initial \$10.5m in BAE's thermal weapon sights.

# US Army contracts BAE Systems to supply thermal weapon sights

**\$384m deal to provide machine gunners with sights that deliver target information to a HUD whatever the lighting conditions.**

The US Army has awarded BAE Systems a seven-year contract worth up to \$384 million to provide specialized weapon sights that improve soldiers' ability to accurately engage targets at extended ranges.

The Family of Weapon Sights – Crew Served (FWS-CS) system is designed specifically for machine gunners and operates during daylight, darkness, adverse weather, and obscured visibility conditions. The technology combines high-resolution sensors with a lightweight laser range-finder and wirelessly transmits weapon sight imagery in real time to a helmet-mounted display.

BAE Systems' launch statement said, "On today's battlefield, army gunners need to accurately identify targets at greater ranges despite challenging battlefield conditions.

## 'Surveillance advantages'

"At the same time, they need compact, lightweight, and energy efficient solutions. BAE Systems' FWS-CS sight is designed to meet these needs and provide significant advantages in surveillance, situational awareness, engagement, lethality, and survivability."

The FWS-CS system provides an unprecedented level of targeting speed, precision, and field of view based on BAE's established high-resolution thermal imaging technology, combined with an automatic range-adjusted, targeting reticle that eliminates the need for manual weapon offset calculations.

Designed for integration with the M2 0.50-caliber rifle, MK19 grenade launcher, and M240 machine gun, the FWS-CS

system is equipped with a laser range finder that provides automatic adjusted crosshairs directly in the gunner's helmet-mounted display. With an initial development order of \$10.5 million, work will be performed at the company's facilities in Hudson, New Hampshire and Austin, Texas.

Marc Casseres, director of Imaging and Aiming Solutions at BAE Systems, added, "Supplying the US Army with gunner-specific weapon sights builds on our heritage as a long time provider of weapon sight solutions."

"Our innovative 12 $\mu$ m sensor technology allows us to provide soldiers with superior clarity and range to dominate the battlefield through increased situational awareness in all operational environments and conditions."

<http://optics.org/news/7/12/7>

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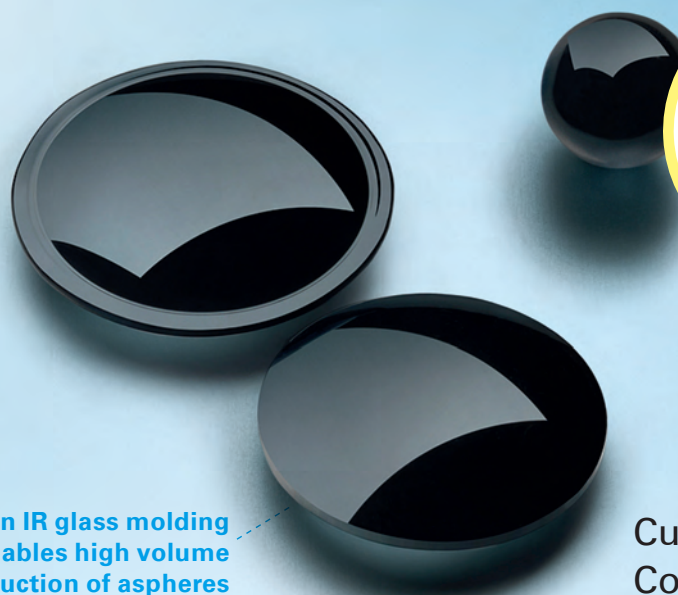
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