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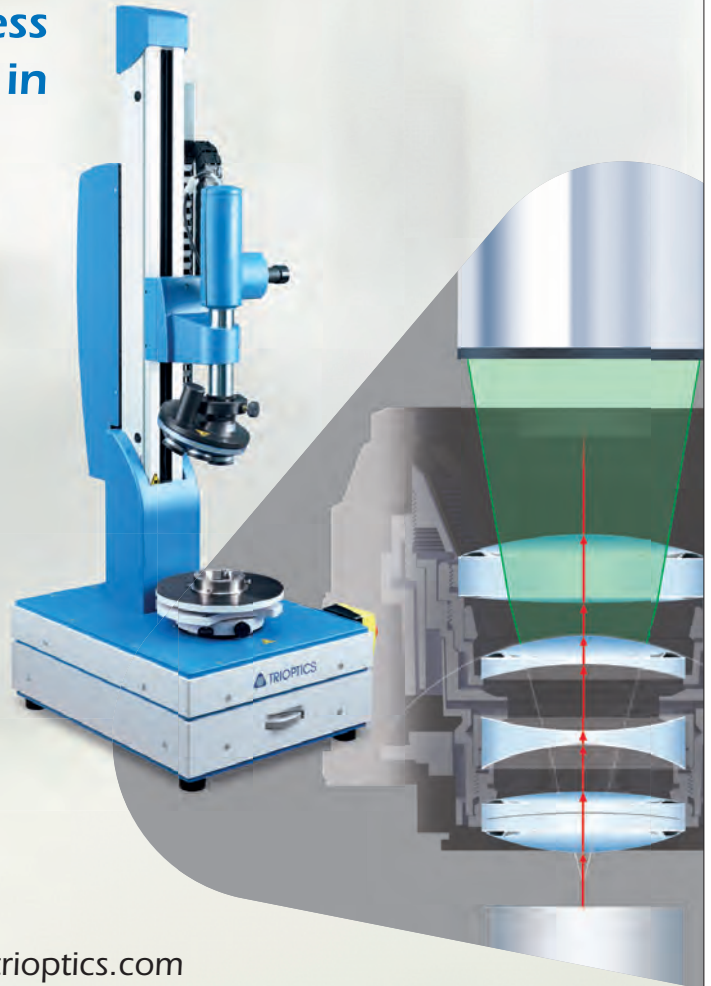


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Rochester accelerator seeks optics startups

Luminate' initiative guarantees \$100k minimum investment for successful applicants, as part of a \$5 million-per-year effort.

A photonics-focused accelerator program based in Rochester and with close links to the AIM Photonics effort is about to begin offering support to startup companies.

The "Luminate" initiative, first announced in January by New York governor Andrew Cuomo as the "Photonics Venture

month, with ten slots available in the first cohort. Successful applicants will be guaranteed a minimum investment of \$100,000, and could bag as much as \$1 million, say organizers.

James Senall, president of High Tech Rochester (HTR), officially launched



AIM Photonics
@AIMPhotonics



Frank Tolic speaks with Tim Palmer, VP @followEBP, about the new home of AIM Photonics TAP Facility at #SEMICONWest.

11:27 PM - 11 Jul 2017



Challenge", is to offer an aggregate \$5 million per year to young companies working in the fields of optics, photonics and imaging.

Now accepting expressions of interest from startup companies, mentors, venture capital firms and corporate partners, Luminate is also looking to hire a managing director and appoint a national advisory board.

Startup firms should be able to start applying for support by the end of this

Luminate last week, with more information available via a new web site at luminate.org.

It states: "Focused on growing the most promising OPI [i.e. optics, photonics and imaging] enabled companies in the world, Luminate seeks visionary entrepreneurs solving challenging problems including but not limited to: machine vision, inspection, biophotonics, security, surveillance, augmented & virtual reality, and autonomous vehicles."

Fragmented industry

Luminate points out that, while ubiquitous, optical technologies and the associated industry are highly specialized and fragmented. "Consequently, most accelerator programs simply do not have the focus or domain expertise to optimally support OPI startups," it says.

The expertise around the local region includes the Rochester Institute of Optics, the Rochester Institute of Technology, AIM Photonics, and over 100 local companies involved in the optics and photonics sector, alongside the history that spawned household names like Eastman Kodak, Bausch & Lomb, and Xerox.

"Rochester has the workforce, technology base, and support resources to optimally launch and grow OPI startups," says Luminate.

Any applicants to the accelerator scheme must be incorporated, have a full-time team, have proven their core technology, and - preferably - developed a working prototype.

Once admitted, companies will receive assistance with capital and a "community of resources", plus a \$100,000 initial convertible note investment. There will also be a chance to receive part of a total \$2 million in funding that will be invested at a "demo day" after six months - with the top investment expected to be \$1 million.

Senall said of the program: "High Tech Rochester has been in the business of growing startup companies for 30 years, and our programs and facilities have evolved over time to rival the top accelerator programs in the country.

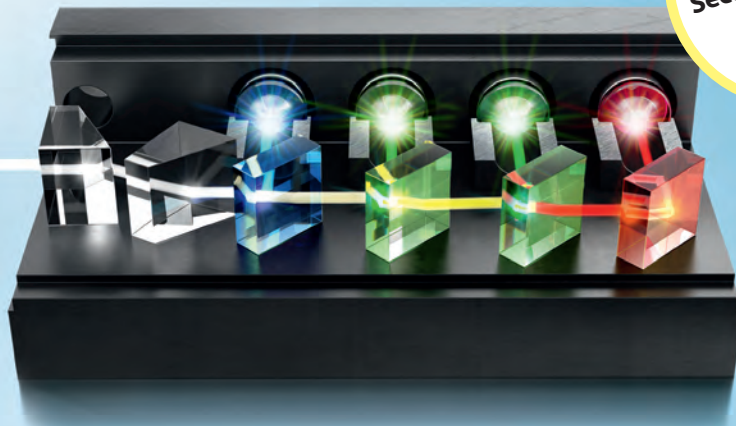
"The timing of the launch of the Luminate accelerator couldn't be better, as we will be opening our brand new downtown location at the Sibley building just as our first Luminate cohort kicks off."

Although it is about to begin operations, Luminate is still looking to appoint a managing director and a nationwide advisory board. Anybody interested in those roles, or in getting involved with Luminate as a startup, mentor, corporate or venture partner, is urged to visit the www.luminate.org web site for more information.

<http://optics.org/news/8/7/17>

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Commercial cannabis grower chooses Heliospectra 'intelligent' lighting

TruGanic Hybrid Cultivation's new Oregon facility sees \$94,000 LED system as key to controlling medicinal profiles and quality.

Heliospectra, a developer of intelligent lighting technology for greenhouse and controlled plant growth environments, has won an interesting order from TruGanic Hybrid Cultivation (THC), valued at \$94,000.

strategies by strain with granular control over far red wavelengths is critical. Heliospectra is the most advanced and flexible sole source lighting solution on the market for our indoor growing environment."



Heliospectra's LX60 reduces a user's carbon footprint while optimizing the quality of products.

movement and cooling. The proprietary optics ensure uniform light distribution with penetration to the bottom of the plant canopy or tier. Heliospectra's energy-efficient 600W LEDs will also deliver immediate cost savings on the construction of the THC facility.

"We realized that installing the Heliospectra lights requires far less HVAC infrastructure and reduces our upfront construction investment," said Miles.

"If you start to think about how our business operations will scale while utility rates continue to rise over the next 10 to 15 years, the opportunity to streamline the electricity demand without sacrificing light intensity also represents significant dollar savings."

Heliospectra's recently announced Cortex control software features energy consumption monitoring and interactive data visualization. THC and other commercial cannabis growers can use the platform's centralized management and scheduling tools to control and automate light strategies or group lights into zones for each stage of plant growth.

The following video "LED Grow Lights: Behind the Scenes of a Commercial Cannabis Operation" details how PinkHouse Blooms decided to deploy Heliospectra's solution and the benefits they have identified.

<http://optics.org/news/8/7/20>



Pinkhouse Blooms, Denver, another cannabis grower, uses Heliospectra's LED system.

The indoor agriculture facility is investing in Heliospectra's lighting system to control the consistency of its medicinal cannabis and standardize crop quality.

THC is building a growing facility in the Portland, Oregon area. The company plans to initiate an extensive breeding program and cultivate eight different strains using a double tier vertical rack system to optimize space.

The order includes Heliospectra's LX60 lighting solutions to give THCCultivation an adjustable spectral range which can be used through the plant growth cycle from vegetation to the development of "a sea of green flowers".

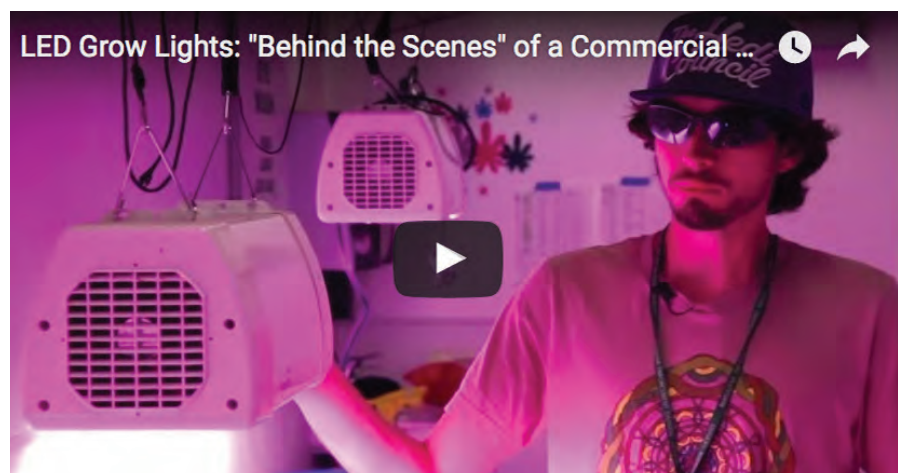
Bruce Caruso, Director of Cultivation at THC commented, "We want to focus on the vegetation stage with the goal of taking clones to one gallon (4.5 liter) plants in four weeks.

"The ability to establish strong, healthy plants from day one and dial in the light

Competitive research

Experienced cultivars, Caruso and THC owner Ryan Miles conducted extensive competitive research on lighting solutions best suited for organic, no-till beds and indoor growing. They concluded that Heliospectra offers a robust, durable solution that is waterproof.

The lamps feature built-in fans to effect air



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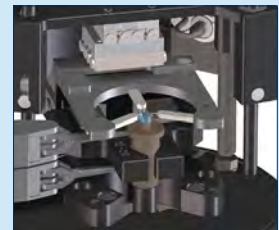
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Resolv4K's higher NA, along with superior aberration correction, gives more precise measurement capabilities than ever.

<https://navitar.com/products/imaging-optics/resolv4k-zoom-system/>



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Giant reference mirror ready for ELI beam expanders

600 mm-diameter flat optic from Optical Surfaces will feature in €60M Thales laser system at Romanian facility.

UK-based component maker Optical Surfaces says it has now produced a 600 mm diameter mounted reference flat mirror that will enable Thales to align beam expanders in the giant laser system being built for the Romanian element of Europe's Extreme Light Infrastructure (ELI) project.

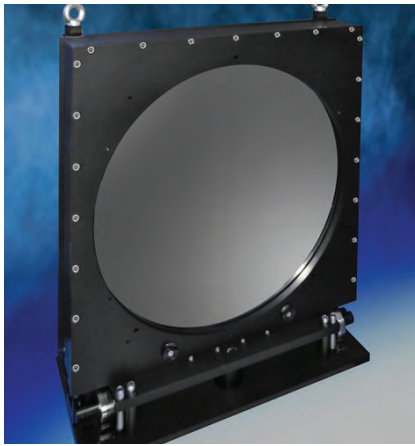


Photo: Optical Surfaces.

This 600mm reference flat from Optical Surfaces will form part of the beam-expanding element of the giant laser system being built by Thales for the ELI-NP facility in Romania.

The silver-coated, two-axis, gimbal-mounted reference flat is said to have a surface accuracy better than 20 nm (rms), and a surface quality of 40/20 scratch/dig to minimize scattering effects.

Smaller spot sizes

The optical system will produce a precisely expanded laser beam to enable smaller laser spot sizes when used in combination with additional focusing optics, states the firm.

The Extreme Light Infrastructure for Nuclear Physics (ELI-NP) facility under construction in Magurele represents the third of the enormous "pillars" of the wider ELI project, all of which are based around huge lasers with unprecedented power, brightness and repetition rate characteristics.

Once completed, ELI-NP will feature the most powerful laser system ever built: a 2x10 PW design. And Optical Surfaces points out that the €60 million contract

awarded to Thales to produce it is the largest contract award by a national research institute under a European-funded program.

The other two ELI "pillars" – constructed in the Czech Republic and Hungary – are at a more advanced stage, with the various systems at ELI Beamlines near Prague and ELI-ALPS in Szeged set to open to users partially in 2018, ahead of full operation at Szeged in 2020.

High-level delegations

In late May ELI-ALPS, home to an attosecond pulse laser system that will give scientists from a variety of fields completely new ways to investigate ultrafast physical phenomena, was officially inaugurated.

The event featured speeches from the Hungarian prime minister Viktor Orbán and attosecond science pioneer Ferenc Krausz, director of the Max Planck Institute of Quantum Optics near Munich.

The three ELI pillars also shared an exhibition booth at last month's LASER World of Photonics trade show, with the project's leaders welcoming more dignitaries – this time in the form of

Lithuanian economy minister Mindaugas Sinkevicius and Algis Piskarskas, president of the Lithuanian Laser Association.

Lithuanian company Ekspla is one of the key laser providers involved the ELI-ALPS project, and the country's representatives were in Munich partly to discuss the possibility of Lithuania becoming a founding member of a European Research Infrastructure Consortium (ERIC) dedicated to ELI.

Meanwhile ELI Beamlines officials recently welcomed Ofir Akunis, Israel's minister of science, technology and space, to discuss future Czech-Israeli cooperation within the ELI and HiLASE projects.

As with ELI-ALPS, user operations at the Beamlines facility are slated to begin in 2018 on the "L1" laser, one of four optical systems. L1 is aimed at materials and biomolecular applications, and is designed to produce 100 mJ pulses of less than 20 fs duration, at a repetition rate of 1 kHz.

The optical parametric chirped pulse amplifier (OPCPA) chain features seven amplifier stages, and is pumped by a state-of-the-art thin-disk Yb:YAG laser system designed in-house by the ELI Beamlines team.


The L2 and L3 lasers at the Czech facility will offer petawatt-scale pulse powers at unprecedented repetition rates of 10 Hz, while the L4 beam will scale to 10 PW pulses delivering 2 kJ of energy in 130 fs pulses at a rate of approximately one pulse per minute.

<http://optics.org/news/8/7/18>



Photo: ELI-ALPS.

It won't be open to users until next year, but the ELI-ALPS facility in Szeged, Hungary, welcomed the Hungarian prime minister Viktor Orbán (second from left) to its official inauguration in May. This part of the ELI project will be focused on attosecond science, exploiting state-of-the-art laser technology to deliver new insights into ultrafast structural and chemical reaction dynamics.



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La Palma telescope joins gravity-wave search

New wide-field observing platform will search for transient optical signals associated with gravitational wave events.

A set of wide-field optical telescopes designed to search the night sky for signs of cosmic phenomena causing gravitational waves is now up and running.

Built at the popular astronomy observational location at the summit of La Palma, an island off the west coast of Africa, the Gravitational-wave Optical Transient Observer (GOTO) was officially inaugurated July 3, having captured "first light" imagery three weeks earlier.

The multinational project involves universities in the UK, Australia and Thailand, and will scan large areas of the sky for any unusual activity following alerts of gravitational-wave detection from laser interferometer facilities.

Elusive signals

As of today, scientists working at the two giant Laser Interferometer Gravitational-wave Observatory (LIGO) facilities in the US have confirmed three separate detections of the elusive waves, typically described as "ripples in space-time," that were generated by collisions between black holes.

But because there are only two working facilities, currently it is impossible to pinpoint the precise origin of the waves and the location of the cosmic collision. A third interferometer called VIRGO, near Pisa in Italy, is now joining the search and will enable scientists to triangulate the source of the wave signals with much greater precision, but astronomers also want to search for electromagnetic evidence.

The big challenge is that the gravity-wave signals appear out of the blue without warning, while it also takes months to confirm each "event" from the data collected, by which point any transient optical evidence of the event will have long disappeared from view.

This is where the GOTO project comes in: it is set up to react swiftly to any indication of a possible gravity-wave event emanating from the LIGO and VIRGO facilities, point at the area of sky where the signal is believed to have originated, and look for any sudden changes.



Photo credit: GOTO/University of Warwick.

The GOTO team has built an initial four-telescope system at its observatory on La Palma. The system achieves a very wide field of view, so that wide swathes of the sky can be searched quickly for transient optical phenomena related to potential gravity-wave events, following automatic alerts from the LIGO or VIRGO interferometers.

'New observational opportunity'

The two key partners in the GOTO project are the University of Warwick in the UK and Monash University in Australia, working under the "Monash-Warwick Alliance". Warwick's Danny Steeghs and Duncan Galloway at Monash are the two principal investigators on the team.

"GOTO is very significant for the Monash Centre for Astrophysics," commented Galloway in a release from the consortium. "We've invested strongly in gravitational wave astronomy over the last few years, leading up to the first detection

announced last year, and the telescope project represents a fundamentally new observational opportunity."

Steeghs added: "After all the hard work put in by everyone, I am delighted to see the GOTO telescopes in operational mode at the Roque de los Muchachos observatory. We are all excited about the scientific opportunities it will provide."

According to the GOTO web site, the new facility at La Palma will target the early stages of gravity-wave follow-up, when the origin of a signal is not well established,

continued on next page

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La Palma telescope joins gravity-wave search

and large swathes of the sky must be searched quickly for any signs of transient events.

"Targeting the earliest (and likely brightest) phases will allow for rapid localization of viable candidates and trigger further follow-up on other, larger facilities," states the team.

"A key component is a synoptic survey mode when not pursuing an event trigger. This ensures very recent reference images are available across the visible sky."

Adaptable hardware

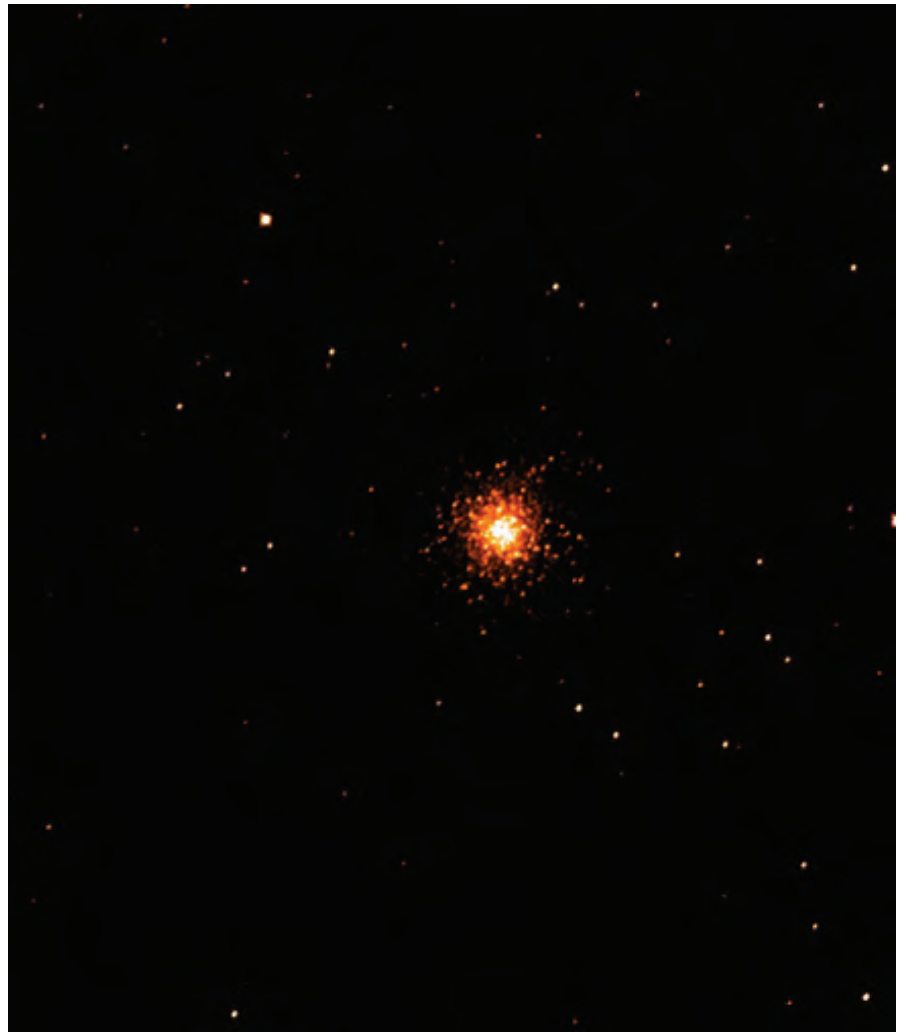
The hardware deployed on GOTO is described as scalable, adaptable and upgradable, using 'off-the-shelf' components to minimize costs, including an array of 40 cm diameter astrographs to achieve a large, instantaneous field of view.

In the initial phase just started, four telescopes featuring 50 megapixel detectors are deployed on a single mount, yielding a field of view of five degrees square per telescope.

Depending on how clear the skies are, and the phase of the moon, the setup should be able to image to brightness magnitudes of 20 or 21 within five minutes.

Since the gravitational wave events detectable by the LIGO and VIRGO facilities relate to distant black-hole collisions, GOTO would likely be looking for any sudden changes in the apparent position of stars and galaxies caused by gravitational lensing effects.

In the planned second phase of the project, an additional four telescopes should extend the field of view to 40



First light image from GOTO, showing the Hercules Globular Cluster (Messier 13, NGC 6205), taken in the night of June 10-11 2017 with GOTO at La Palma.

degrees square, providing for a much more rapid scan of the sky.

Another set of telescopes in a second dome at La Palma and an entirely new facility in Australia to search the southern skies are also planned for the future.

As well as the GOTO observatory, the University of Warwick's astronomical facility at La Palma also includes the "SuperWASP" camera for detection of exoplanets. Described as "the most successful ground-based exoplanet discovery project in existence", it is another wide-field, multi-

telescope optical design, and uses eight cameras fitted with CCD sensors from Andor Technology to capture exoplanets as they transit in front of their host stars, from the Earth's point of view.

The other partners in the GOTO project are the UK's University of Sheffield and University of Leicester, alongside Armagh Observatory in Northern Ireland and the National Astronomical Research Institute of Thailand.

<http://optics.org/news/8/7/7>

Observation credits: Danny Steeghs, Krzysztof Ulaczyk, James McCormac and Paul Chote.

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Twente develops 'world's most narrowband' diode laser on chip...

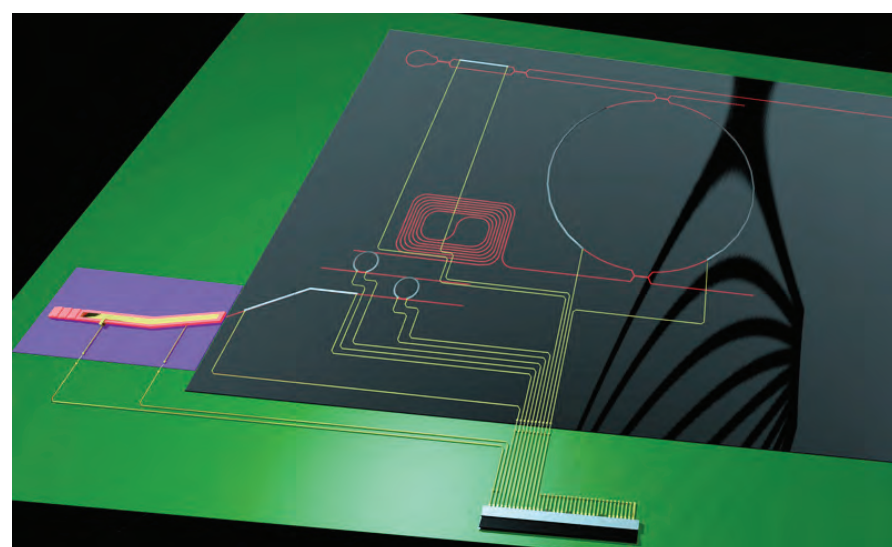
...while Braunschweig's PTB claims to have made "sharpest laser ever".

Researchers from the Netherlands' University of Twente's MESA+ research institute, working in collaboration with Lionix company, have developed what they are calling the world's most narrowband diode laser on a chip.

clean – than any other laser on a chip."

The new laser is a tunable hybrid laser, which means that it essentially consists of two different photonic chips, that are optically connected to each other.

Prof Boller added, "It will bring countless



University of Twente's narrowband diode laser chip.

The team says that the laser "represents a breakthrough in the fast-growing field of photonics, and will bring applications such as 5G internet and more accurate GPS closer". Research leader Professor Klaus Boller presented the research results during the scientific congress in Munich during LASER World of Photonics 2017.

The new laser announcement recently published, stated, "For photonic chips to function as efficiently as possible, it is necessary to properly control the light signals. This means that all the light particles being transmitted must have, as closely as possible, the same frequency.

"The University of Twente researchers have managed to develop a minuscule laser on a chip with a maximum bandwidth (the maximum uncertainty of frequency) of just 290 Hertz. By some distance, this is the most accurate laser on a chip that has ever been created," added Prof Boller. "Our signal is more than ten times more coherent – or

applications within reach, such as controlling movable antennae on phone masts for 5G mobile internet, faster data flows through glass fiber networks, or more accurate GPS systems and sensors for monitoring the structural integrity of buildings and bridges."

The research was carried out by Youwen Fan and Klaus Boller of the Laser Physics & Nonlinear Optics department at the University of Twente MESA+ research institute, Applied Nanophotonics, in collaboration with Ruud Oldenbeuving, Chris Roeloffzen, Marcel Hoekman, Dimitri Geskus, and René Heideman of the company LionixInternational.

Twente is one of the world's leading regions when it comes to photonics. The region is, for example, the birthplace of the TriPLeX technology – a key standard for photonic chips. At the heart of Twente's strong position is the deep expertise and strong chemistry between all stakeholders.

PTB claims to have made sharpest ever laser

Braunschweig's Physikalisch-Technische Bundesanstalt creates a laser with a linewidth of only 10 mHz (pictured below).



High precision: useful for applications such as optical atomic clocks, precision spectroscopy, radio-astronomy and for testing the theory of relativity.

With a linewidth of only 10 mHz, the laser that researchers from the German research organisation PTB have developed together with US researchers from JILA, a joint institute of the National Institute of Standards and Technology (NIST) and the University of Colorado, Boulder, has established a new world record.

They say that such precision is useful for applications such as optical atomic clocks, precision spectroscopy, radio-astronomy and for testing the theory of relativity. The work has been published in *Physical Review Letters*.

"The smaller the linewidth of the laser, the more accurate the measurement of the atom's frequency in an optical clock. This new laser will enable us to decisively improve the quality of our clocks", commented PTB physicist Thomas Legero.

In addition to the new laser's extremely small linewidth, Legero and his colleagues found out by means of measurements that the emitted laser light's frequency was more precise than what had ever been achieved before. Although the light wave oscillates approximately 200 trillion times per second, it only gets out of sync after 11 s. By then, the perfect wave train emitted has already attained a length of approx. 3.3 million km.

<http://optics.org/news/8/7/3>

Light manipulated to make 2D surfaces appear as 3D objects

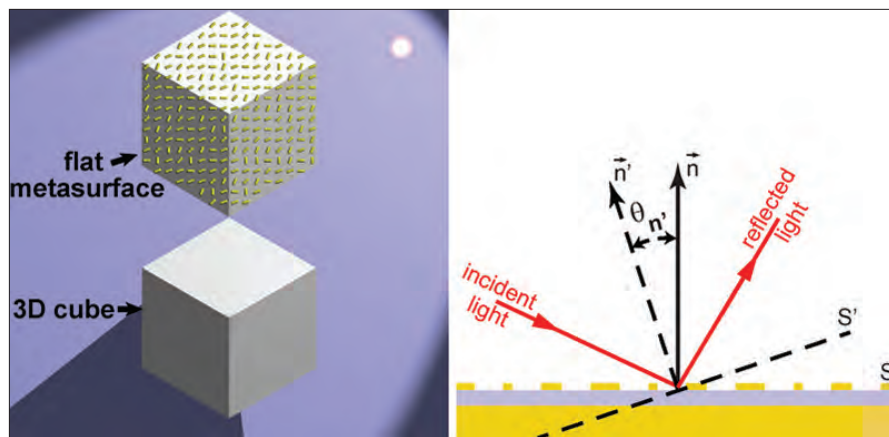
Video game technique encodes 3D images into wafer-thin surfaces; method could benefit phone cameras, TV screens, security.

Scientists have created new types of 2D nanostructured surfaces which appear as realistic 3D objects – including shading and shadows – using nano-engineering techniques.

The research has been carried out by King's College London alongside Rheinische

imitating lighting and shading effects of a 3D cube (see above).

The researchers commented that the technique “could have huge implications for the optical industries, including in TV screens and photography, as well as in security labels for protecting goods and banknotes from counterfeiting.”



(L) Illustration of a flat metasurface (top) to imitate shading and lighting effects of a 3D cube through the normal mapping and an actual 3D cube (bottom). Light source location is marked by a small bright ball. (R) Schematic illustration of reflection from a metasurface with a linear phase gradient.

Friedrich-Wilhelms-Universität Bonn, Germany, and is published in Nano Letters.

When light hits an object, the colour, texture, and shape of that object affect how the light is absorbed and reflected, allowing a viewer to perceive the object. By altering the surface to change how light is reflected, it is possible to manipulate how it appears.

The KCL and Bonn researchers developed layered materials, incorporating precisely designed nano-features smaller than the wavelength of light, called metasurfaces. This allowed them to precisely control how light is reflected, so that a 2D surface reflects light just as a 3D object would.

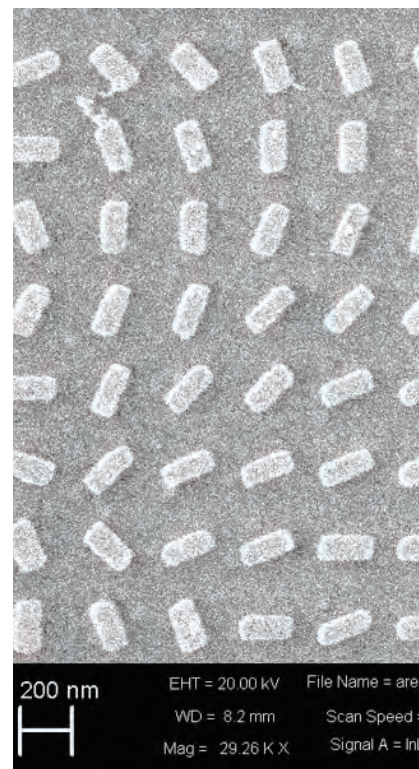
Borrowing a technique from 3D computer graphics called Normal Mapping, researchers encoded shadow effects into the image, creating 3D images said to be “more realistic than holograms or 3D cinema”. As a proof of concept, the researchers fabricated a flat metasurface

‘Amazing surface’

Professor Anatoly Zayats of KCL said, “Metasurfaces are amazing. They open up unprecedented freedom in directing and manipulating light. One might ultimately imagine a TV screen which appears exactly the same as you move around it, or a new movement of 3D art.”

The ability to control light could bring new functionality to small camera lenses. A flat surface can be made to appear optically convex by designing appropriate metasurface properties. Future generations of smartphone cameras could use the tiny flat metasurfaces to mimic the properties of sophisticated curved camera lenses, allowing much greater control of angle and depth field.

“Metasurfaces could also replace heavy optical lenses in applications such as satellites, where weight and size have a big impact on efficiency.”



SEM image of the fabricated metasurface.

More immediately, the novel nano-materials can already be used to create unique complex 3D images for security and anti-counterfeiting applications, as well as for new measurement applications requiring precise control of light.

‘More than holograms’

The researchers added that the metalens-formed image is “much more than a hologram”. Unlike holograms, which require a coherent light source such as a laser to be viewed, these surfaces manipulate the reflection of normal light so they appear as a realistic 3D object in any light condition and from any angle.

For the proof of concept, the researchers designed a cube using the normal mapping technique, which was encoded into the metasurface. When illuminated, the metasurface instantaneously “computes” how a 3D representation of the image should look and displays it.

Dr Alexander Minovich, The Royal Society Newton International Fellow at King's College London, commented, “The normal mapping demonstrated with our metasurface is a completely new concept, but it could have very important implications for a wide range of optical industries, both in introducing new functionality and making products smaller and lighter.”

<http://optics.org/news/8/7/12>

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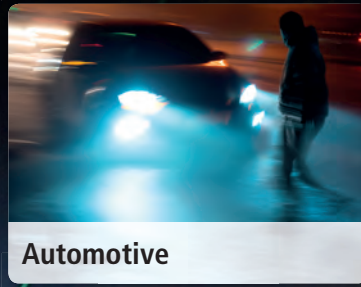
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