photonics and lasers
A showcase of cutting-edge research taken from selected journals and Physics World

iopscience.org/photonics-lasers
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When invented more than half a century ago, lasers were considered a solution searching for a problem to solve. Today, together with photonics, the applications seem to be endless in reshaping the way we live.

Lasers are devices that emit coherent light that is amplified through the process of stimulated emission. Their temporal and spatial coherence properties make them particularly desirable for applications and have led to the expansion of the broader field of photonics—the science of light with an emphasis towards applied research and development, with cross-over to areas such as quantum optics where photonic methods are widely employed.

The global research initiative towards lasers and photonics is driven by their ever-growing number of applications across medicine, communications, industry and science. For example, laser or photonic devices are used with optical fibres to make today’s high speed internet possible, in everyday consumer products such as DVD players and barcode scanners, in medicine to perform treatments like laser surgery, in industrial applications such as laser cutting and lithography, and of course to carry out important scientific research.

To showcase some of the cutting-edge research in this area, IOP Publishing has launched a new online platform iopscience.org/photonics-lasers with content from across our portfolio of journals. The articles highlighted in this brochure comprise publications from 10 of our leading journals, covering topics including novel laser sources and photonic devices, applications, nanophotonics, quantum optics and metamaterials. Our aim is to highlight the latest leading research, helping researchers in the field to broadcast their results and keep track of work by other groups in this area.
Owned by an association of 17 European physical societies, EPL publishes Letters that cover the broadest range of physics topics and related scientific fields.

These short publications are focused towards novel, scientifically significant, emerging and developing areas of science including many high-profile topics such as plasma physics, nuclear fusion, quantum simulators, topological insulators, metamaterials, plasmonics, ferro-electrics/magnetics and rheology. Targeted marketing ensures that the Letters published gain recognition within their relevant fields. This is supported on the website, which now hosts several compilation pages providing authors with easy access to recent articles published relating to their specialist areas. The compilation listing can be found at epljournal.org/compilations.

For authors we provide permanent greater visibility for a one-off open access publishing fee. All submissions are supported by a high standard of peer review. Articles are sent to external reviewers, usually two, selected by an expert Co-Editor, one of a truly international team of over 50 active research scientists.

In recent years EPL has gained considerable strength in plasma physics and fusion topics, including visibility and promotion at conferences and workshops, and providing sponsorship funds for best posters or presentations by young researchers at targeted events. Articles published cover theory, fundamental physics, emerging technologies and experimental techniques. Several articles have been selected here to introduce the broad scope available for authors in EPL.

epljournal.org
FEATURED ARTICLE

Analytic study on solitons in gas-filled hollow-core photonic crystal fibers

Wen-Jun Liu, Bo Tian, Hui-Ling Zhen and Yan Jiang
2012 EPL 100 64003

Abstract

An analytic study on controlling the soliton dynamics in the gas-filled hollow-core photonic crystal fibers is presented in this paper. The bilinear method with the auxiliary function is introduced to derive the bilinear forms for the nonlinear Schrödinger equation. With symbolic computation, the analytic soliton solutions are obtained, and the features and properties of solitons are discussed. The influence of the parameters for the soliton solutions obtained are analyzed. The presented results could be used in soliton control in the gas-filled hollow-core photonic crystal fibers.

MORE HIGH-INTEREST ARTICLES

Low-threshold optical bistability in metal-nonlinear dielectric multilayer nanostructure

H J Zhao and Z H Li
2013 EPL 102 24003

Enhancing the absorption of graphene in the terahertz range

N M R Peres and Yu V Bludov
2013 EPL 101 58002

Photon sorters and QND detectors using single photon emitters

D Witthaut, M D Lukin and A S Sørensen
2012 EPL 97 50007

Surface whispering-gallery mode

J J Yang, M Huang, J Yu and Y Z Lan
2011 EPL 96 57003

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Journal of Optics

Journal of Optics actively seeks out the new pioneers of laser and photonic science, providing a platform for innovators in fields such as ultrafast optics, metamaterials, nanophotonics and plasmonics, and communication optics.

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iopscience.org/jopt
FEATURED ARTICLE

Modeling of causality with metamaterials

Igor I Smolyaninov
2013 J. Opt. 15 025101

Abstract
When a metamaterial is built and illuminated with a coherent extraordinary laser beam, the stationary pattern of light propagation inside the metamaterial may be treated as a collection of particle world lines, which represents a complete ‘history’ of this 2 + 1-dimensional space–time. While this model may be used to build interesting space–time analogs, such as metamaterial ‘black holes’ and a metamaterial ‘big bang’, it lacks causality: since light inside the metamaterial may propagate back and forth along the ‘timelike’ spatial coordinate, events in the ‘future’ may affect events in the ‘past’. Here we demonstrate that a more sophisticated metamaterial model may fix this deficiency via breaking the mirror and temporal (PT) symmetries of the original model and producing one-way propagation along the ‘timelike’ spatial coordinate.

MORE HIGH-INTEREST ARTICLES

Three-dimensional staggered herringbone mixer fabricated by femtosecond laser direct writing

Di Lin, Fei He, Yang Liao, Jintian Lin, Changning Liu, Jiangxin Song and Ya Cheng
2013 J. Opt. 15 025601

Chiral metamaterials: from optical activity and negative refractive index to asymmetric transmission

Zhaofeng Li, Mehmet Mutlu and Ekmel Ozbay
2013 J. Opt. 15 023001

Optical properties of Ag nanoparticle layers deposited on silicon substrates

Eshwar Thouti, Nikhil Chander, Viresh Dutta and Vamsi K Komarala
2013 J. Opt. 15 035005

Long range surface plasmons in a symmetric graphene system with anisotropic dielectrics

K V Sreekanth and Ting Yu
2013 J. Opt. 15 055002

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Progress in exploring the fundamentals of atoms, molecules and clusters depends significantly on novel developments in optical and laser physics.

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**Fast publication**

In 2012, all receipt-to-acceptance decisions for our Fast Track Communications were made in **less than 60 days**.
FEATURED ARTICLE
Resonant transmission enhancement at one-dimensional metal gratings
Alex C Han and Moshe Shapiro

Abstract
An analysis of phenomena leading to high transmission at a one-dimensional metal grating is presented. It is shown that high resonant transmission can be obtained either for thick or thin gratings for a wide range of filling factors and that the origins of the enhanced transmission are different in each case. We analyse the optical response of structures with subwavelength slits and of various thicknesses. The role of different pure (dielectric cavity modes, surface plasmon polaritons) and coupled resonances on the enhanced transmission is presented.

MORE HIGH-INTEREST ARTICLES
Linear response in the strong-field domain: ultrafast wave packet interferometry in the continuum
Alex C Han and Moshe Shapiro

Effects of a laser beam profile on Zeeman electromagnetically induced transparency in the Rb buffer gas cell
S N Nikolić, M Radonjić, A J Krmpot, N M Lučić, B V Zlatković and B M Jelenković

Controllable behaviours of rogue wave triplets in the nonautonomous nonlinear and dispersive system
Chao-Qing Dai, Qing Tian and Shi-Qun Zhu

High-order harmonic generation with μJ laser pulses at high repetition rates
C M Heyl, J Güdde, A L’Huillier and U Höfer

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Research in photonics and lasers has fuelled some of the most exciting and prevalent applications of physics for more than 50 years and *Journal of Physics D: Applied Physics* (JPhysD) is proud to publish high-quality articles in this innovative field.

We showcase here a selection of the wide variety of research that we publish in this field. In addition to regular articles and Fast Track Communications, JPhysD has well regarded special issue and review programmes.

At JPhysD we are committed to staying one step ahead in publication speed and quality, and we would like to invite you to submit your high-quality work to the journal. With our strong Impact Factor (2.528), and our fast decision times (average 45 days to first decision), there has never been a better time to publish with JPhysD to achieve worldwide visibility for your work.
# Featured Article

Efficiency-optimized monolithic frequency stabilization of high-power diode lasers

**P Crump, C M Schultz, H Wenzel, G Erbert and G Tränkle**

*2013 J. Phys. D: Appl. Phys. 46 013001*

**Abstract**

High-power GaAs-based diode lasers produce optical energy with extremely high efficiencies, but their spectrum is too broad for many applications (4–5 nm with 95% power content). Narrow spectra (<1 nm) can be achieved using monolithically integrated gratings and recent advances in semiconductor technology have largely eliminated the losses associated with this step. However, it remains challenging to develop designs that simultaneously achieve high power, high efficiencies and narrow spectra over a wide operation range. We review here the design choices necessary for optimized performance, using 975 nm broad-area lasers with uniform overgrown distributed feedback (DFB) gratings as a worked example, focusing on the role of the grating coupling strength.

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# More High-Interest Articles

A gain-coefficient switched Alexandrite laser

**Chris J Lee, Peter J M van der Slot and Klaus-J Boller**

*2013 J. Phys. D: Appl. Phys. 46 015103*

Integration of bandpass guided-mode resonance filters with mid-wavelength infrared photodetectors

**I R McKerracher, L Fu, H H Tan and C Jagadish**

*2013 J. Phys. D: Appl. Phys. 46 095104*

Efficiency of optical sensing by a plasmonic photonic-crystal slab

**A V Baryshev, A M Merzlikin and M Inoue**

*2013 J. Phys. D: Appl. Phys. 46 125107*

Charge-sensitive infrared phototransistors with integrated plasmonic photocouplers

**Zhihai Wang, Koji Ishibashi, S Komiyama, Mikhail Patrashin and Iwao Hosako**

*2013 J. Phys. D: Appl. Phys. 46 165107*

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Laser Physics

Founded on the initiative of Alexander M Prokhorov, a Nobel Laureate in Physics and a pioneer in laser research, Laser Physics seeks to publish the top research in this cutting-edge area of science.

The journal thrives under the direction of an esteemed Editorial Board boasting three Nobel Laureates, and reports on every aspect of modern laser physics and quantum electronics, covering interdisciplinary subjects across the physical and biomedical sciences. The articles in this collection give a preview of the high-end research that the journal publishes. In particular we draw your attention to the tutorial by V I Yukalov, a new article type for the journal in 2013 designed to provide insight of a pedagogical nature on a topic of high interest.

In partnership with Astro Ltd, IOP Publishing is delighted to provide high visibility in Laser Physics to some of the most important developments in laser and photonic science through a top-class programme of research papers, topical reviews and tutorial articles. The ongoing growth of the journal is a testament to the healthy state of laser research worldwide.

iopscience.org/lp
FEATURED ARTICLE

Theory of cold atoms: basics of quantum statistics
V I Yukalov
2013 Laser Phys. 23 062001

Abstract
The aim of this tutorial is to present the basic mathematical techniques required for an accurate description of cold trapped atoms, both Bose and Fermi. This tutorial is the first of several, giving general mathematical techniques for both types of particle statistics. Carefully explaining basic techniques is important in order to avoid the numerous misconceptions which propagate in the literature.

MORE HIGH-INTEREST ARTICLES

Rydberg excitation of a Bose–Einstein condensate
M Viteau, M Bason, J Radogostowicz, N Malossi, O Morsch, D Ciampini and E Arimondo
2013 Laser Phys. 23 015502

Hohlraum target for overcoming refractive losses in plasma x-ray lasers
Leili Masoudnia and Davide Bleiner
2013 Laser Phys. 23 056003

Cell death induced by direct laser activation of singlet oxygen at 1270 nm
F Anquez, I El Yazidi Belkoura, P Suret, S Randoux and E Courtade
2013 Laser Phys. 23 025601

A tunable multi-wavelength laser based on a Mach–Zehnder interferometer with photonic crystal fiber
2013 Laser Phys. 23 055105

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Laser Physics Letters

As one of the leading journals for laser research, *Laser Physics Letters* publishes many of the most timely and exciting breakthroughs in the field.

This photonics and lasers collection of articles provides only a glimpse of the broad outreach of the journal covering all aspects of laser physics from the foundations of lasers through to the development of novel laser sources and their applications across chemistry, biology, engineering, and medicine.

Co-published with Astro Ltd, *Laser Physics Letters* prides itself in reporting high-impact research through the rapid publication of letters, complemented with a programme of review articles on topical subjects. In 2013 *Laser Physics Letters* has experienced a high increase in submitted articles—a tribute to the strong research output of the laser physics community.

As lasers continue to reshape future science and technology, we look forward to disseminating your most important research results and findings.

iopscience.org/lpl
FEATURED ARTICLE

Clinical coherent anti-Stokes Raman scattering and multiphoton tomography of human skin with a femtosecond laser and photonic crystal fiber

Hans Georg Breunig, Martin Weinigel, Rainer Bücke, Marcel Kellner-Höfer, Jürgen Lademann, Maxim E Darvin, Wolfram Sterry and Karsten König

2013 Laser Phys. Lett. 10 025604

Abstract

We report on in vivo coherent anti-Stokes Raman scattering spectroscopy (CARS), two-photon fluorescence and second-harmonic-generation imaging on human skin with a novel multimodal clinical CARS/multiphoton tomograph. CARS imaging is realized by a combination of femtosecond pulses with broadband continuum pulses generated by a photonic crystal fiber. Examples of healthy as well as cancer-affected skin are presented.

MORE HIGH-INTEREST ARTICLES

Chirped pulse amplification of a femtosecond Er-doped fiber laser mode-locked by a graphene saturable absorber

G Sobon, J Sotor, I Pasternak, W Strupinski, K Krzempek, P Kaczmarek and K M Abramski

2013 Laser Phys. Lett. 10 035104

Monoclinic LaGaGe₂O₇:Nd³⁺—a novel SRS- and SE-active crystal with high-order Stokes and anti-Stokes picosecond \(\chi^{(3)}\)-nonlinear lasing


2013 Laser Phys. Lett. 10 075803

Carrier-envelope phase stabilized high temporal contrast femtosecond laser source at 1053 nm

Y Y Li, Y S Huang, J Z Wang, Y Xu, X M Lu, D Wang, Y X Leng, R X Li and Z Z Xu

2013 Laser Phys. Lett. 10 075403

A pure silica ytterbium-doped sol–gel-based fiber laser

Assaad Baz, Hicham El Hamzaoui, Ihsan Fsaifes, Géraud Bouwmans, Mohamed Bouazaoui and Laurent Bigot

2013 Laser Phys. Lett. 10 055106

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Measurement and the collection of results is a core function for all experimental researchers. Ninety years since it was first published under the name *Journal of Scientific Instruments*, *Measurement Science and Technology* (MST) continues to provide a valuable resource for sharing research methodology and measurement technology across disciplines.

In addition to regular papers, MST produces special issues and features across all areas of optics, including: laser systems and applications, optical sensors, imaging, interferometry, optical tomography, microscopy and other optical measurement techniques.

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In 1924 the journal was known as *Journal of Scientific Instruments* and changed to its current name in 1990
FEATURED ARTICLE

Identification of inhomogenous optical absorptive response by chaotic photonic signals in Au nanoparticles
J C Muñoz-César, C Torres-Torres, J Moreno-Valenzuela, D Torres-Torres, G Urriolagoitia-Sosa and M Trejo-Valdez

Abstract
A chaotic circuit allows us to identify with a high sensitivity the optical absorption associated with a highly transparent sample with Au nanoparticles embedded in a TiO₂ thin film prepared by a sol–gel method. The measurements are based on a comparison of the correlation between a controlled optical irradiance that propagates through different zones of the sample. Nanosecond nonlinear optical measurements were obtained by monitoring the transmittance and the amplitude modification for the vectorial components of the electric fields in a two-wave mixing interaction. In addition, we theoretically study chaotic physical behavior exhibited by optical signals under nonlinear optical absorption. Our numerical results point out that small intensity fluctuations related to excitations of the absorptive nonlinearity can be described using a simple fractal model.

MORE HIGH-INTEREST ARTICLES

Laser-induced breakdown spectroscopy in a partially premixed turbulent jet flame
Johannes Kiefer, Zhongshan Li and Marcus Alden

Surface temperature measurements in a porous media burner using a new laser-induced phosphorescence intensity ratio technique
A Jaber, L Zigan, A Sakhrieh and A Leipertz

Assessing ranging errors as a function of azimuth in laser trackers and tracers
Bala Muralikrishnan, Vincent Lee, Christopher Blackburn, Daniel Sawyer, Steve Phillips, Wei Ren and Ben Hughes

A methodology for laser diagnostics in large-bore marine two-stroke diesel engines
J Hult and S Mayer

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In nanomaterials, incident optical wavelengths outsize structural features, so that interactions with light differ wildly from bulk matter. The observed changes in properties such as transmittance, reflectance and absorbance, as well as resonances for enhanced interactions with light, have proved enormously stimulating for researchers in photonics and lasers.

Advances in nanotechnology allow the manipulation of light with ever-increasing levels of dexterity. In addition, developments in nanofabrication techniques make producing and tailoring these structures increasingly more accessible, allowing optimisation of photonic device designs as well as systematic investigations to better understand the interactions involved.

The plasmon-induced transparency demonstrated by researchers in Asia and the US in the featured article provides an analogy for a similar phenomenon, electromagnetically induced transparency, previously investigated for optical switching, pulse delay, and storage for optical information processing. Here the researchers demonstrate the effect over a bandwidth that dwarfs previous reports, in the technologically pertinent terahertz region of the electromagnetic spectrum.

As well as state-of-the-art research our comprehensive portfolio makes Nanotechnology a key point of call for researchers pushing the frontiers in photonics and lasers.
### FEATURED ARTICLE

Broadband plasmon induced transparency in terahertz metamaterials  
**Zhihua Zhu, Xu Yang, Jianqiang Gu, Jun Jiang, Weisheng Yue, Zhen Tian, Masayoshi Tonouchi, Jiaguang Han and Weili Zhang**  
2013 *Nanotechnology* **24** 115202

**Abstract**  
A presentation of the simulation, implementation, and measurement of a broadband PIT metamaterial functioning in the terahertz regime. By integrating four U-shape resonators around a central bar resonator, a broad transparency window across a frequency range greater than 0.40 THz is obtained, with a central resonance frequency located at 1.01 THz. Such PIT metamaterials are promising candidates for designing slow light devices, highly sensitive sensors, and nonlinear elements operating over a broad frequency range.

### MORE HIGH-INTEREST ARTICLES

Er-doped light emitting slot waveguides monolithically integrated in a silicon photonic chip  
**J M Ramírez, F Ferrarese Lupi, Y Berencén, A Anopchenko, J P Colonna, O Jambois, J M Fedeli, L Pavesi, N Prtljaga, P Rivallin**  
2013 *Nanotechnology* **24** 115202

Two-dimensional photonic crystal arrays for polymerfullerene solar cells  
**Sungho Nam, Jiyoung Han, Young Rag Do, Hwajeong Kim, Sanggyu Yim and Youngkyoo Kim**  
2011 *Nanotechnology* **22** 465403

Fabrication and optical characterization of light trapping silicon nanopore and nanoscrew devices  
**Hyunjong Jin and G Logan Liu**  
2012 *Nanotechnology* **23** 125202

A route for fabricating printable photonic devices with sub-10 nm resolution  
**Carlos Pina-Hernandez, Valeria Lacatena, Giuseppe Calafiore, Scott Dhuey, Konstantin Kravtsov, Alexander Goltsov, Deirdre Olynick, Vladimir Yankov, Stefano Cabrini and Christophe Peroz**  
2013 *Nanotechnology* **24** 065301

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Now in its 80th year of publication as a prestigious source of authoritative review articles in all areas of physics, *Reports on Progress in Physics* continues to fulfil a vital role in serving the needs of graduate students, researchers entering new fields, and as experts interested in work from other areas.

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FEATURED ARTICLE

Lunar laser ranging: the millimeter challenge

**T W Murphy**
2013 *Rep. Prog. Phys.* 76 076901

Abstract
Lunar laser ranging has provided many of the best tests of gravitation since the first Apollo astronauts landed on the Moon. The march to higher precision continues to this day, now entering the millimeter regime, and promising continued improvement in scientific results. This review introduces key aspects of the technique, details the motivations, observables, and results for a variety of science objectives, summarizes the current state of the art, highlights new developments in the field, describes the modeling challenges, and looks to the future of the enterprise.

MORE HIGH-INTEREST ARTICLES

Engineered quantum dot single-photon sources

**Sonia Buckley, Kelley Rivoire and Jelena Vučković**
2012 *Rep. Prog. Phys.* 75 126503

Photonic crystal light-emitting sources

**Aurélien David, Henri Benisty and Claude Weisbuch**
2012 *Rep. Prog. Phys.* 75 126501

X-ray lasers for structural and dynamic biology

**J C H Spence, U Weierstall and H N Chapman**
2012 *Rep. Prog. Phys.* 75 102601

Exploiting aperiodic designs in nanophotonic devices

**Enrique Maciá**
2012 *Rep. Prog. Phys.* 75 036502

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Semiconductor Science and Technology

Semiconductor Science and Technology (SST) is one of the top niche journals specialising in semiconductors. This collection reflects some of the high-quality research that SST publishes and commissions.

Semiconductor lasers are attractive for many reasons, including their low-cost, compact nature, potential for mass production, and their capacity to easily integrate with other systems. SST’s scope covers many aspects of this research such as the modelling, design and fabrication of semiconductor laser structures, and different types including quantum dot, quantum well, nanowire and external-cavity lasers.

Since the first demonstration of lasing in semiconductors over 50 years ago, the interest in such devices has grown enormously and this is reflected in our recent celebratory special issue dedicated to the 50th anniversary of the diode laser. It contains historical perspectives alongside invited research papers and is intended to tell some of the story of the last 50 years of laser development as well as to provide evidence of the current state of semiconductor laser research.

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FEATURED ARTICLE

Quantum-cascade lasers as local oscillators for heterodyne spectrometers in the spectral range around 4.745 THz

L Schrottke, M Wienold, R Sharma, X Lü, K Biermann, R Hey, A Tahraoui, H Richter, H-W Hübers and H T Grahn
2013 Semicond. Sci. Technol. 28 035011

Abstract
Local oscillators in terahertz heterodyne spectrometers have to be operated in continuous-wave mode at precisely defined target frequencies. In particular, for advanced airborne instruments, several specifications such as operating temperature and cooling requirements are necessary to be considered. We have developed a quantum-cascade laser (QCL) applicable as a local oscillator for heterodyne spectroscopy of the OI line at 4.745 THz, which is of particular interest for astronomy. We demonstrate a distributed-feedback QCL operating in continuous-wave mode up to about 60 K, which can be tuned precisely to the target frequency when operated in a mechanical cooler.

MORE HIGH-INTEREST ARTICLES

Simultaneous two-color lasing in a single CdSSe heterostructure nanosheet
F Fan, Z Liu, L Yin, P L Nichols, H Ning, S Turkdogan and C Z Ning
2013 Semicond. Sci. Technol. 28 065005

A nonlinear gain model for multiple quantum well transistor lasers
Iman Taghavi, Hassan Kaatuzian and Jean-Pierre Leburton
2013 Semicond. Sci. Technol. 28 025022

Wavelength switching dynamics of two-colour semiconductor lasers with optical injection and feedback
S Osborne, P Heinricht, N Brandonisio, A Amann and S O’Brien
2012 Semicond. Sci. Technol. 27 094001

Resonant-phonon depopulation terahertz quantum cascade lasers and their application in spectroscopic imaging
P Dean, M Salih, S P Khanna, L H Li, N K Saat, A Valavanis, A Burnett, J E Cunningham, A G Davies and E H Linfield
2012 Semicond. Sci. Technol. 27 094004

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Quantum-control pioneers bag 2012 Nobel Prize for Physics
Relive the day news broke that Serge Haroche and David Wineland picked up the 2012 Nobel Prize.
physicsworld.com/quantum-control-pioneers

Cold-atom random laser simulates stellar clouds
How a random laser created in a cloud of cold atoms under laboratory conditions could improve our understanding of astrophysics.
physicsworld.com/cold-atom-random-laser
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**Plan**
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