Highlights 2013

A compilation of the best papers published within the last year
How to submit your research to EPL

We want to make it as simple as possible for you to submit your research to EPL. Our dedicated Authors’ Access channel at https://authors.epletters.net/ provides full guidelines on how to prepare a manuscript for submission to EPL. Here is a brief summary of our key recommendations.

**How to prepare a manuscript**

EPL publishes original, high-quality letters in all areas of physics. Your letter must contain sufficient argument and supporting information to satisfy other researchers in the field, and must also be of interest and relevance to wider sections of the physics community. You will need to give special care to the introduction and conclusions sections of the article to ensure that it is written in a style comprehensible to the general physics community.

The maximum length for a manuscript is six printed journal pages (in A4 two-column format), including the title, the main text, formulae and figures, captions and tables.

We encourage authors to submit multimedia attachments to enhance the online versions of published articles. They can add to the reader’s understanding and show results in attractive ways that go beyond what can be presented in the print version of the journal. Multimedia can be in the form of video clips and animations. The printed version of EPL remains the archival version, with multimedia items being supplements to enhance a reader’s understanding of the article.

To help you in preparing a manuscript in the style required for EPL, we have provided a macro template, which is available to download from the Authors’ Access channel. We strongly recommend that you prepare your manuscript in a LaTeX format as it will allow you to typeset your letter in the same format as EPL and enable you to see the exact length of your letter.

**How to submit**

You can submit your letter via our online submission system on the Authors’ Access channel. To help with the refereeing process, we encourage you to provide the name and e-mail address of expert scientists who might be suitable referees for your letter, and also to indicate any potential conflicts of interest. We ask you to name three co-editors who you think will be appropriate to handle your manuscript, and you can also attach a cover letter to explain why you chose EPL and why your research is suitable for the journal.

EPL is a member of CrossCheck by iThenticate. iThenticate is a plagiarism screening service that verifies the originality of content submitted before publication. The iThenticate software checks submissions against millions of published research papers, documents on the web, and other relevant sources. Researchers can also use the iThenticate system to screen their work before submission by visiting http://research.ithenticate.com.

To help early career researchers prepare their papers for publication, we have published a digital brochure ‘Introductory guide for authors’ available at iopscience.org/author-guide.
About 80 articles out of 868 published in EPL in 2013 (volumes 101–104), have been selected by the Co-Editors and marked with the Editor’s Choice (EC) label. An appreciable fraction of the EC papers have been directly accepted by the Co-Editor without being refereed, and published with the accepting Co-Editor’s name below the title. Besides being a distinction for the authors, direct acceptance is also a distinctive feature of EPL, which is made possible by the high scientific qualification of its Editorial Board.

Highlights 2013 collect about one half of the EC papers, complemented by other papers that met a quick visibility with more than 1000 downloads in a few months. The aim of this collection is to show, within the limited space available, that EPL excellence covers all the disciplinary and cross-disciplinary sections of physics, as listed in the index of contents. The full series of EC articles may be found in the online version of our highlights. Readers interested in a particular subject are invited to consult the rich and constantly increasing index of EPL compilations.

EPL is a top-tier highly reputable source for novel, original, timely and relevant research letters in physics and physics-related topics. The rapid publication time, six pages of A4 space available, together with significant marketing and promotional activities ensure that your research reaches a worldwide readership in a timely manner.

Advantages of publishing in EPL include peer-review by an Editorial Board of expert active research scientists, knowledgeable in their own field and aware of the hot topics in current research; a not-for-profit publisher aiming to keep your subscription prices low; rapid publication with a fast-track option for excellent articles; numerous web compilations to ease searches by topic; and an online web platform with many useful user features and tools.

Subscriptions are taken in over 2600 institutes covering more than 90 countries. A hybrid open access scheme is available for a low one-time fee with all other published articles having green open access with an embargo period.

I hope that you enjoy the current selection of articles highlighted in this booklet. The full-text content of all the articles is freely available online throughout 2014. Thank you for your support and please continue to strengthen EPL with more top-quality submissions.
Why publish with EPL?

EPL is published by scientists for scientists, to serve and support the international scientific community. We are committed to working with you to gain recognition for your high-quality work through worldwide promotion, visibility and high citations. The Editorial Board invite you to submit your letters to EPL. As an EPL author, you will benefit from:

1. **QUALITY PEER REVIEW**
   The 50+ co-editors, who are experts in their fields, oversee the entire peer-review process, from selection of the referees to making all final acceptance decisions.

2. **IMPACT FACTOR**
   The 2012 Impact Factor was 2.260; your work will be in the right place to be cited by your peers.

3. **SPEED OF PROCESSING**
   We aim to provide you with a quick and efficient service; the median time from submission to acceptance is 68 days with acceptance to online publication an additional 25 days.

4. **INTERNATIONAL REACH**
   More than 2600 institutions have access to EPL, enabling your work to be read by your peers in more than 100 countries.

5. **HIGH VISIBILITY**
   We exhibit at 400+ events each year; EPL staff often attend conferences and many events have sponsorship funding to enable excellent visibility and promotion for your research articles.

6. **OPEN ACCESS**
   If you are required to publish your research as open access, we offer this service for a one-off author payment. In 2014 this price is €1300 ($1733).

---

EPL is published in partnership with: edp sciences, IOP Publishing
Contents

Quantum mechanics, mathematical methods & statistical physics 6

Elementary particles, fields & nuclear physics 9

Atomic & molecular physics 12

Electromagnetism, optics, acoustics, heat transfer, classical mechanics & fluid dynamics 14

Physics of gases, plasmas & electrical discharges 16

Condensed matter: structural, mechanical & thermal properties 18

Condensed matter: electronic structure, electrical, magnetic & optical properties 22

Interdisciplinary topics 27

Geophysics, astronomy & astrophysics 31

Meet the EPL co-editors 32

News coverage for EPL articles 36

EPL subject compilations 37

Conference sponsorship 38

Events calendar 2014 39

Editorial Board 40

EPL’s publishing partners 42

Front cover image: Existence domains of gapless excitons superimposed onto map of graphene single-electron spectrum, adapted from M M Mahmoodian and M V Entin 2013 EPL 102 37012.
Quantum mechanics, mathematical methods & statistical physics

Non-local double-path Casimir phase in atom interferometers

François Impens, Ryan O Behunin, Claudio Ccapa Ttira and Paulo A Maia Neto

2013 EPL 101 60006

We present an open quantum system theory of atom interferometers evolving in the quantized electromagnetic field bounded by an ideal conductor. Our treatment reveals an unprecedented feature of matter-wave propagation, namely the appearance of a non-local double-path phase coherence. In the standard interpretation of interferometers, one associates well-defined separate phases to individual paths. Our non-local phase coherence is instead associated to pairs of paths. It arises from the coarse-graining over the quantized electromagnetic field and internal atomic degrees of freedom, which play the role of a common reservoir for the pair of paths and lead to a non-Hamiltonian evolution of the atomic waves. We develop a diagrammatic interpretation and estimate the non-local phase for realistic experimental parameters. Non-local double-path Casimir phase in atom interferometers.

Dispersed stable states spectrum of the wave equation with space-time periodic potential

B S Alexandrov, A R Bishop, N Zahariev and I Kostadinov

2013 EPL 103 50001

We study the stable states of the wave equation with $d$-spatial and 1-time dimensions and with space-time periodic potential. The dispersed stable states spectrum of such $(d + 1)$-periodic wave equation is due to the incommensurability of the speed of light and the ratio of space and time periods. A Bloch-Floquet analysis leads to a $(d + 1)$-cube as a reduced Brillouin zone, but because of the speed incommensurability the stable states in this cube may form a spectrum of sets with a reduced dimensionality. For electromagnetic waves in photonic crystals the medium may amplify some waves with lengths fitting the crystal lattice. The energy from the external field can be pumped to the waves via the dipole moment oscillations.
Coarse-graining complex dynamics: Continuous Time Random Walks vs. Record Dynamics

Paolo Sibani

2013 *EPL* **101** 30004

Continuous Time Random Walks (CTRW) are widely used to coarse-grain the evolution of systems jumping from a metastable sub-set of their configuration space, or trap, to another via rare intermittent events. The multi-scaled behavior typical of complex dynamics is provided by a fat-tailed distribution of the waiting time between consecutive jumps. We first argue that CTRW are inadequate to describe macroscopic relaxation processes for three reasons: macroscopic variables are not self-averaging, memory effects require an all-knowing observer, and different mechanisms whereby the jumps affect macroscopic variables all produce identical long-time relaxation behaviors. Hence, CTRW shed no light on the link between microscopic and macroscopic dynamics. We then highlight how a more recent approach, Record Dynamics (RD), provides a viable alternative, based on a very different set of physical ideas: while CTRW make use of a renewal process involving identical traps of infinite size, RD embodies a dynamical entrenchment into a hierarchy of traps which are finite in size and possess different degrees of meta-stability. We show in particular how RD produces the stretched exponential, power-law and logarithmic relaxation behaviors ubiquitous in complex dynamics, together with the sub-diffusive time dependence of the Mean Square Displacement characteristic of single particles moving in a complex environment.

Detailed Jarzynski equality applied to a logically irreversible procedure

A Bérut, A Petrosyan and S Ciliberto

2013 *EPL* **103** 60002

A single-bit memory system is made with a Brownian particle held by an optical tweezer in a double-well potential and the work necessary to erase the memory is measured. We show that the minimum of this work is close to Landauer’s bound only for a very slow erasure procedure. Instead a detailed Jarzynski equality allows us to retrieve Landauer’s bound independently of the speed of this erasure procedure. For the two separated subprocesses, i.e. the transition from state 1 to state 0 and the transition from state 0 to state 0, the Jarzynski equality does not hold but the generalized version links the work done on the system to the probability that it returns to its initial state under the time-reversed procedure.
Many-body quantum dynamics from the density

S E B Nielsen, M Ruggenthaler and R van Leeuwen

2013 EPL 101 33001

We present a local control scheme to construct the external potential $v$ that, for a given initial state, produces a prescribed time-dependent density in an interacting quantum many-body system. This numerical method is efficient and stable even for large and rapid density variations irrespective of the initial state and the interactions. It can at the same time be used to answer fundamental $v$-representability questions in density functional theory. In particular, in the absence of interactions, it allows us to construct the exact time-dependent Kohn-Sham potential for arbitrary initial states. We illustrate the method in a correlated one-dimensional two-electron system with different interactions, initial states and densities. For a Kohn-Sham system with a correlated initial state we demonstrate the interplay between memory and initial-state dependence as well as the failure of any adiabatic approximation.

Did you know?
EPL regularly sponsors poster prizes at conferences around the world. Visit our homepage for details of the latest winners

Did you know?
EPL articles were downloaded more than 550,000 times in 2013
Elementary particles, fields & nuclear physics

Tunnelling of the 3rd kind: A test of the effective non-locality of quantum field theory

Simon A Gardiner, Holger Gies, Joerg Jaeckel and Chris J Wallace

2013 EPL 101 61001

Integrating out virtual quantum fluctuations in an originally local quantum field theory results in an effective theory which is non-local. In this letter we argue that tunnelling of the 3rd kind—where particles traverse a barrier by splitting into a pair of virtual particles which recombine only after a finite distance—provides a direct test of this non-locality. We sketch a quantum-optical setup to test this effect, and investigate observable effects in a simple toy model.

Neutrinoless quadruple beta decay

Julian Heeck and Werner Rodejohann

2013 EPL 103 32001

We point out that lepton number violation is possible even if neutrinos are Dirac particles. We illustrate this by constructing a simple model that allows for lepton number violation by four units only. As a consequence, neutrinoless double beta decay is forbidden, but neutrinoless quadruple beta decay is possible: \((A, Z) \rightarrow (A, Z + 4) + 4e^-\). We identify three candidate isotopes for this decay, the most promising one being \(^{150}\text{Nd}\) due to its high \(Q_{0\nu\beta\beta}\)-value of 2 MeV. Analogous processes, such as neutrinoless quadruple electron capture, are also possible. The expected lifetimes are extremely long, and experimental searches are challenging.
Luminosity-independent measurements of total, elastic and inelastic cross-sections at $\sqrt{s} = 7$ TeV

The TOTEM Collaboration

2013 *EPL* **101** 21004

The TOTEM experiment at the LHC has performed the first luminosity-independent determination of the total proton-proton cross-section at $\sqrt{s} = 7$ TeV. This technique is based on the optical theorem and requires simultaneous measurements of the inelastic rate – accomplished with the forward charged-particle telescopes T1 and T2 in the range $3.1 < |\eta| < 6.5$ – and of the elastic rate by detecting the outcoming protons with Roman Pot detectors. The data presented here were collected in a dedicated run in 2011 with special beam optics ($\beta^* = 90$ m) and Roman Pots approaching the beam close enough to register elastic events with squared four-momentum transfers $|t|$ as low as $5 \times 10^{-3}$ GeV$^2$. The luminosity-independent results for the elastic, inelastic and total cross-sections are $\sigma_\text{el} = (25.1 \pm 1.1)$ mb, $\sigma_\text{inel} = (72.9 \pm 1.5)$ mb and $\sigma_\text{tot} = (98.0 \pm 2.5)$ mb, respectively. At the same time this method yields the integrated luminosity, in agreement with measurements by CMS. TOTEM has also determined the total cross-section in two complementary ways, both using the CMS luminosity measurement as an input. The first method sums the elastic and inelastic cross-sections and thus does not depend on the $\rho$ parameter. The second applies the optical theorem to the elastic-scattering measurements only and therefore is free of the T1 and T2 measurement uncertainties. The methods, having very different systematic dependences, give results in excellent agreement. Moreover, the $\rho$-independent measurement makes a first estimate for the $\rho$ parameter at $\sqrt{s} = 7$ TeV possible: $|\rho| = 0.145 \pm 0.091$. 
Measuring Higgs couplings at a linear collider

Markus Klute, Rémi Lafaye, Tilman Plehn, Michael Rauch and Dirk Zerwas

2013 EPL 101 51001

Higgs couplings can be measured at a linear collider with high precision. We estimate the uncertainties of such measurements, including theoretical errors. Based on these results we show an extrapolation for a combined analysis at a linear collider and a high-luminosity LHC.

First experimental results of a cryogenic stopping cell with short-lived, heavy uranium fragments produced at 1000 MeV/u


2013 EPL 104 42001

A cryogenic stopping cell (CSC) has been commissioned with $^{238}$U projectile fragments produced at 1000 MeV/u. The spatial isotopic separation in flight was performed with the FRS applying a monoenergetic degrader. For the first time, a stopping cell was operated with exotic nuclei at cryogenic temperatures (70 to 100 K). A helium stopping gas density of up to 0.05 mg/cm$^2$ was used, about two times higher than reached before for a stopping cell with RF ion repelling structures. An overall efficiency of up to 15 %, a combined ion survival and extraction efficiency of about 50%, and extraction times of 24 ms were achieved for heavy $\alpha$-decaying uranium fragments. Mass spectrometry with a multiple-reflection time-of-flight mass spectrometer has demonstrated the excellent cleanliness of the CSC. This setup has opened a new field for the spectroscopy of short-lived nuclei.
Atomic & molecular physics

Anomalous molecular dynamics in the vicinity of a conical intersection

J Larson, E Nour Ghassemi and Å Larson

2013 EPL 101 43001

Conical intersections between molecular electronic potential energy surfaces can greatly affect molecular dynamics and chemical properties. Molecular gauge theory is capable of explaining many of these often unexpected phenomena deriving from the physics of the conical intersection. Here we will give an example of anomalous dynamics in the paradigm E × E ⊆ Jahn-Teller model, which does not allow for a simple explanation in terms of standard molecular gauge theory. By introducing a dual gauge theory, we unwind this surprising behavior by identifying it with an intrinsic spin Hall effect. Thus, this work links knowledge of condensed-matter theories with non-adiabatic molecular dynamics. Furthermore, via ab initio calculations of potential energy surfaces, the findings are as well demonstrated to appear in a realistic system such as the Li₃ molecule.

Interaction of atomic quantum gases with a single carbon nanotube

M Fink, T-O Müller, J Eiglsperger and J Madroñero

2013 EPL 102 33001

We study inelastic processes in the hybrid quantum system constituted by a carbon nanotube (CNT) in contact with an ultracold quantum gas, such as a cloud of thermal atoms or a Bose-Einstein condensate (BEC). We present a parameter-free ab initio approach for the loss rate based on the underlying scattering process, considering the two-dimensional character of the system as well as the exact Casimir-Polder potential. The predicted loss rates are in perfect agreement with recent experimental results, obtained both for a thermal cloud of rubidium atoms and for a BEC. For the trap loss of a thermal cloud, we find that retardation effects become important and contribute significantly, which emphasises the crucial role of the exact interaction potential.
Gray-molasses cooling of $^{39}$K to a high phase-space density

G Salomon, L Fouché, P Wang, A Aspect, P Bouyer and T Bourdel

2013 EPL 104 63002

We present new techniques in cooling $^{39}$K atoms using laser light close to the D1 transition. First, a new compressed-MOT configuration is taking advantage of gray-molasses–type cooling induced by blue-detuned D1 light. It yields an optimized density of atoms. Then, we use pure D1 gray molasses to further cool the atoms to an ultra-low temperature of 6 $\mu$K. The resulting phase-space density is $2 \times 10^{-4}$ and will ease future experiments with ultracold potassium. As an example, we use it to directly load up to $3 \times 10^7$ atoms in a far detuned optical trap, a result that opens the way to the all-optical production of potassium degenerate gases.

Did you know?
If you require your research to be published as open access, we offer this service for a one-off author payment.

Did you know?
All of the articles featured in this booklet are free to read or download online until the end of 2014.
Visit epljournal.org/highlights-2013.
Electromagnetism, optics, acoustics, heat transfer, classical mechanics & fluid dynamics

Interaction of a point charge with the surface of a uniaxial dielectric

Primož Rebernik Ribič and Rudolf Podgornik

2013 *EPL* **102** 24001

We analyze the force on a point charge moving at relativistic speeds parallel to the surface of a uniaxial dielectric. Two cases are examined: a lossless dielectric with no dispersion and a dielectric with a plasma-type response. The treatment focuses on the peculiarities of the strength and direction of the interaction force as compared to the isotropic case. We show that a plasma-type dielectric can, under specific conditions, repel the point charge.

Dynamic jamming fronts

S R Waitukaitis, L K Roth, V Vitelli and H M Jaeger

2013 *EPL* **102** 44001

We describe a model experiment for dynamic jamming: a two-dimensional collection of initially unjammed disks that are forced into the jammed state by uniaxial compression via a rake. This leads to a stable densification front that travels ahead of the rake, leaving regions behind it jammed. Using disk conservation in conjunction with an upper limit to the packing fraction at jamming onset, we predict the front speed as a function of packing fraction and rake speed. However, we find that the jamming front has a finite width, a feature that cannot be explained by disk conservation alone. This width appears to diverge on approach to jamming, which suggests that it may be related to growing length scales encountered in other jamming studies.
Dark zone in the centre of the Arago-Poisson diffraction spot of a helical laser beam

O Emile, A Voisin, R Niemiec, B Viaris de Lesegno, L Pruvost, G Ropars, J Emile and C Brousseau

2013 *EPL* **101** 54005

We report on the diffraction of non-zero Laguerre Gaussian laser beams by an opaque disk. We observe a tiny circular dark zone at the centre of the usual Arago-Poisson diffraction bright spot. For such non-diffracting dark hollow beams, we have measured diameters as small as 20 μm on distances of the order of ten metres, without focalization. Diameters depend on the diffracting object size and on the topological charge of the input Laguerre Gaussian beam. These results are in good agreement with theoretical considerations. Potential applications are then discussed.

Did you know?
Our Editorial Board consists of more than 50 Co-editors, all experienced researchers with expertise covering the full breadth of physics research

Did you know?
Our most downloaded paper of 2013 was read more than 3300 times
Physics of gases, plasmas & electrical discharges

Nonequilibrium stationary state of a current-carrying thermostated system

F Bonetto, N Chernov, A Korepanov and J L Lebowitz

2013 *EPL* 102 15001

We find an explicit expression for the long time evolution and stationary speed distribution of \( N \) point particles in 2D moving under the action of a weak external field \( \mathbf{E} \), and undergoing elastic collisions with either a fixed periodic array of convex scatterers, or with virtual random scatterers. The total kinetic energy of the \( N \)-particles is kept fixed by a Gaussian thermostat which induces an interaction between the particles. We show analytically and numerically that for weak fields this distribution is universal, i.e., independent of the position or shape of the obstacles, as far as they form a dispersing billiard with finite horizon, or the nature of the stochastic scattering. Our results are nonperturbative. They exploit the existence of two time scales; the velocity directions become uniformized in times of order unity while the speeds change only on a time scale of \( O(|\mathbf{E}|^{-2}) \).

THz generation by cross-focusing of two laser beams in a rippled density plasma

Monika Singh and R P Sharma

2013 *EPL* 101 25001

A scheme of terahertz (THz) generation by the cross-focusing of two collinear Gaussian lasers is investigated with frequency difference in spatially periodic density plasma (rippled density). For the resonant excitation of THz radiation the ripple wave number is suitably chosen to satisfy the phase matching condition. In this process, the lasers exert a ponderomotive force which imparts an oscillatory velocity to the electrons that couple with the density ripple to generate a stronger transient transverse current due to the spatial variation of their fields, driving THz radiation (with the frequency of the order of the plasma frequency). Various laser and plasma parameters were optimized and we report an efficiency of the order of \( \sim 8 \times 10^{-3} \) for the current scheme.
Time behaviour of discharge current in case of nanosecond-pulse surface dielectric barrier discharge

Tao Shao, Hui Jiang, Cheng Zhang, Ping Yan, Mikhail I Lomaev and Victor F Tarasenko

2013 EPL 101 45002

Nanosecond-pulse surface dielectric barrier discharge is a promising method used for airflow control application. In our letter, atmospheric-pressure plasmas in open air are produced in a configuration of discharge actuators by repetitive nanosecond pulses. The electrical parameters including applied voltage, total discharge current, and transported charge are measured and analysed, especially it is aimed at the time behaviour of the total discharge current. Experimental results show that the total discharge current pulse includes two obvious spikes during the rise time of the applied pulse voltage. According to the simulation, it is concluded that the first current spike is due to the discharge propagation in the form of wave ionization and displacement current. The second current spike is caused by the repeated re-ignition of the surface dielectric barrier discharge on the area covered previously by the wave ionization.
Condensed matter: structural, mechanical & thermal properties

Importance of local force fields on lattice thermal conductivity reduction in PbTe$_{1-x}$Se$_x$ alloys

Takuru Murakami, Takuma Shiga, Takuma Hori, Keivan Esfarjani and Junichiro Shiomi

2013 *EPL* **102** 46002

Lattice thermal conductivity of PbTe$_{1-x}$Se$_x$ alloyed crystals has been calculated by molecular-dynamics simulations with anharmonic interatomic force constants (a-IFCs) obtained from first principles. The a-IFCs of pure PbTe and PbSe were calculated by the real-space displacement method with care of the stability for molecular-dynamics simulations. An empirical mixing rule of a-IFCs has been developed to account for both mass and local force-field differences in alloys. The obtained alloy-fraction dependence of lattice thermal conductivity reduction agrees well with the experiments. The comparative study shows that the local force-field difference significantly impacts the lattice thermal conductivity.

Symmetry detection of auxetic behaviour in 2D frameworks

H Mitschke, G E Schröder-Turk, K Mecke, P W Fowler and S D Guest

2013 *EPL* **102** 66005

A symmetry-extended Maxwell treatment of the net mobility of periodic bar-and-joint frameworks is used to derive a sufficient condition for auxetic behaviour of a 2D material. The type of auxetic behaviour that can be detected by symmetry has Poisson’s ratio $-1$, with equal expansion/contraction in all directions, and is here termed equiauxetic. A framework may have a symmetry-detectable equiauxetic mechanism if it belongs to a plane group that includes rotational axes of order $n = 6$, 4, or 3. If the reducible representation for the net mobility contains mechanisms that preserve full rotational symmetry (A modes), these are equiauxetic. In addition, for $n = 6$, mechanisms that halve rotational symmetry (B modes) are also equiauxetic.
CONDENSED MATTER: STRUCTURAL, MECHANICAL & THERMAL PROPERTIES

Superconductor-insulator transition in a network of 2d percolation clusters

Ginestra Bianconi

2013 EPL 101 26003

In this paper we characterize the superconductor-insulator phase transition on a network of 2d percolation clusters. Sufficiently close to the percolation threshold, for $p \approx p_c$, this network has a broad degree distribution, and at $p = p_c$ the degree distribution becomes scale free. We study the transverse Ising model on this complex topology in order to characterize the superconductor-insulator transition in a network formed by 2d percolation clusters of a superconductor material. We show, by a mean-field treatment, that the critical temperature of superconductivity depends on the maximal eigenvalue $\Lambda$ of the adjacency matrix of the network. At the percolation threshold, $p = p_c$, we find that the maximal eigenvalue $\Lambda$ of the adjacency matrix of the network of 2d percolation clusters has a maximum. In correspondence of this maximum the superconducting critical temperature $T_c$ is enhanced. These results suggest the design of new superconducting granular materials with enhanced critical temperature.

Drainage fracture networks in elastic solids with internal fluid generation

Maya Kobchenko, Andreas Hafver, Espen Jettestuen, Olivier Galland, François Renard, Paul Meakin, Bjørn Jamtveit and Dag K Dysthe

2013 EPL 102 66002

Experiments in which CO$_2$ gas was generated by the yeast fermentation of sugar in an elastic layer of gelatine gel confined between two glass plates are described and analyzed theoretically. The CO$_2$ gas pressure causes the gel layer to fracture. The gas produced is drained on short length scales by diffusion and on long length scales by flow in a fracture network, which has topological properties that are intermediate between river networks and hierarchical-fracture networks. A simple model for the experimental system with two parameters that characterize the disorder and the intermediate (river-fracture) topology of the network was developed and the results of the model were compared with the experimental results.
Polar $P_6\bar{3}c$ cm phase as a marginally stable ground-state structure of $\text{InMnO}_3$: first-principles study

**Jung-Hoon Lee, Seungwoo Song, Min-ae Oak and Hyun M Jang**

*2013 EPL 104 57001*

To resolve a dispute associated with the ferroelectricity in hexagonal $\text{InMnO}_3$ (h-IMO), we have examined the ground-state structure by exploiting density-functional theory calculations. It is shown that the ferroelectric $P_6\bar{3}c$ cm phase is marginally stable over the nonpolar $P3c1$ phase for a wide range of the external pressure. However, the computed Kohn-Sham energy predicts an interesting crossover from the polar $P_6\bar{3}c$ cm state to the nonpolar $P3c1$ state beginning at a compressive strain of $\sim 1\%$. The partial density of states (PDOS) support our previous finding that the In 4$d$-O 2$p$ hybridization is the main bonding mechanism directly related to the manifestation of ferroelectricity in h-IMO. In addition, the computed PDOS do not show any evidence of the In 5$s$-O 2$p$ orbital overlapping which had been asserted to be the main bonding interaction in the nonpolar $P3c1$ phase.

Theory of the STM detection of Wigner molecules in spin-incoherent CNTs

**N Traverso Ziani, F Cavaliere and M Sassetti**

*2013 EPL 102 47006*

The linear conductance of a carbon nanotube quantum dot in the Wigner molecule regime, coupled to two scanning tunnel microscope tips is inspected. Considering the high-temperature regime, the nanotube quantum dot is described by means of the spin-incoherent Luttinger liquid picture. The linear conductance exhibits spatial oscillations induced by the presence of the correlated, molecular electron state. A power-law scaling of the electron density and one of the conductance as a function of the interaction parameter are found. They confirm local transport as a sensitive tool to investigate the Wigner molecule. The double-tip setup allows to explore different transport regimes with different shapes of the spatial modulation, all bringing information about the Wigner molecule.
An experimental evidence-based computational paradigm for new logic-gates in neuronal activity

R Vardi, S Guberman, A Goldental and I Kanter

2013 *EPL* **103** 66001

We propose a new experimentally corroborated paradigm in which the functionality of the brain's logic-gates depends on the history of their activity, e.g. an OR-gate that turns into a XOR-gate over time. Our results are based on an experimental procedure where conditioned stimulations were enforced on circuits of neurons embedded within a large-scale network of cortical cells *in vitro*. The underlying biological mechanism is the unavoidable increase of neuronal response latency to ongoing stimulations, which imposes a non-uniform gradual stretching of network delays.
Condensed matter: electronic structure, electrical, magnetic & optical properties

Self-assembly and switching in ferroelectrics and multiferroics

J F Scott

2013 EPL 103 37001

Molecules of low symmetry often self-assemble in Nature to produce mesoscopic structures of symmetry higher than their constituent building blocks, including “super-cubic” structures. Such self-assembled hexagonal domains have recently been observed in orthorhombic polymeric ferroelectrics, and resemble those known in surfactants and in magnetic bubble domains. Ferroelastic nanodomains in ferroelectric films also self-assemble into bundles of tens of nanometers diameter within each ferroelectric domain that locally average polarization $\langle P \rangle$ and strain $\langle s \rangle$ to small values. Under applied stress or electric or magnetic field these bundles exhibit higher mobility than expected and switch polarization via magnetostriction plus piezoelectricity. The phenomenon is analogous to Anderson’s 1962 model of “vortex bundle” motion in Type-II superconductors.

Topological phase transition and Dirac fermion transfer in $\text{Bi}_2\text{Se}_3$ films

Guang Bian, Xiaoxiong Wang, Thomas Miller and Tai-Chang Chiang

2013 EPL 101 27004

Topological surface states, while protected by time-reversal symmetry in the bulk limit, can be missing in films with thicknesses much greater than the decay lengths of the surface states. This novel effect is demonstrated theoretically in $\text{Bi}_2\text{Se}_3$, the best known topological insulator. When the spin-orbit-coupling strength is tuned through the quantum critical point (realizable experimentally by low-Z element substitution), there is a wide dead zone where the film is topological but without topological surface states within the projected bulk gap. This dead zone can be suppressed by interfacial bonding.
Evidence for nodeless superconducting gap in NaFe$_{1-x}$Co$_x$As from low-temperature thermal conductivity measurements

S Y Zhou, X C Hong, X Qiu, B Y Pan, Z Zhang, X Li, W N Dong, A F Wang, X G Luo, X H Chen and S Y Li

2013 EPL 101 17007

The thermal conductivity of optimally doped NaFe$_{0.972}$Co$_{0.028}$As ($T_c$~20 K) and overdoped NaFe$_{0.925}$Co$_{0.075}$As ($T_c$~11 K) single crystals were measured down to 50 mK. No residual linear term $\kappa_0/T$ is found in zero magnetic field for both compounds. Applying a field $H = 3 T$ ($\approx H_{c2}/12$) does not noticeably increase $\kappa_0/T$ in NaFe$_{1.972}$Co$_{0.028}$As. The $\kappa_0/T$ of overdoped NaFe$_{1.925}$Co$_{0.075}$As shows a field dependence similar to the optimally doped BaFe$_{1.85}$Co$_{0.15}$As$_2$. All these results suggest nodeless superconducting gaps in NaFe$_{1-x}$Co$_x$As from the optimal doping to the overdoped regime, with low anisotropy or ratio between the magnitudes of different gaps.

Superconductivity in HfCuGe$_2$: A non-magnetic analog of the 1111 iron pnictides

Leslie Schoop, Daigorou Hirai, Claudia Felser and R J Cava

2013 EPL 101 67001

Bulk superconductivity with a transition temperature $T_c = 0.6$ K is reported for the intermetallic compound HfCuGe$_2$. HfCuGe$_2$ is structurally related to the “1111” iron pnictide structure, which hosts a large number of Fe-based superconductors. It can therefore be viewed as a non-magnetic analog to the “1111”-type Fe-based superconductors.
Nonlocal current-voltage characteristics of gated superconducting sketched oxide nanostructures

J P Veazey, G Cheng, S Lu, M Tomczyk, F Bi, M Huang, S Ryu, C W Bark, K H Cho, C B Eom, P Irvin and J Levy

2013 EPL 103 57001

Effects from nonequilibrium superconductivity play a major role in the physics of superconducting nanoelectronics. Notably, charge imbalance arising from the point at which the superconducting device contacts normal-metal leads is prevalent, particularly in reduced dimensions. We investigate nonlocal transport signatures in quasi-1D nanostructures formed at the LaAlO$_3$/SrTiO$_3$ interface. The nonlocal resistances correlate with the bias, magnetic field, and back gate dependence of the superconducting state. We attribute these signatures to charge imbalance or spin-dependent excitations. Understanding and control over these effects are important for further development of superconducting nanoelectronics in this material system, including the ability to probe the interaction of superconductivity and other rich physics in LaAlO$_3$/SrTiO$_3$ on the nanoscale.

Signature of proximity-induced $p_x + ip_y$ triplet pairing in the doped topological insulator Bi$_2$Se$_3$ by the s-wave superconductor NbN

Gad Koren, Tal Kirzhner, Yoav Kalcheim and Oded Millo

2013 EPL 103 67010

In the search for Majorana fermions in proximity-induced topological superconducting junctions, we happened to find a signature of same-spin triplet superconductivity which appears to dominate these elusive elementary excitations. Thin-film junctions and bilayers of the doped topological insulator Bi$_2$Se$_3$ and the s-wave superconductor NbN exhibit conductance spectra with coexisting prominent zero-bias and coherence peaks. Various tunneling models with different pair potentials have failed to fit our data, except for the triplet $p_x + ip_y$ pair potential, which breaks time-reversal symmetry, that yielded reasonably good fits. This provides supporting evidence for proximity-induced triplet superconductivity in the Bi$_2$Se$_3$ layer near the interface with the NbN film.
Time crystals: Can diamagnetic currents drive a charge density wave into rotation?

Philippe Nozières

2013 *EPL* **103** 57008

It has been recently argued that an inhomogeneous system could rotate spontaneously in its ground state—hence a “time crystal” which is periodic in time. In this letter we present a very simple example: a superfluid ring threaded by a magnetic field which develops a charge density wave (CDW). A simple calculation shows that diamagnetic currents cannot drive rotation of the CDW, with a clear picture of the cancellation mechanism.

Momentum-resolved electronic structure at a buried interface from soft X-ray standing-wave angle-resolved photoemission


2013 *EPL* **104** 17004

Angle-resolved photoemission spectroscopy (ARPES) is a powerful technique for the study of electronic structure, but it lacks a direct ability to study buried interfaces between two materials. We address this limitation by combining ARPES with soft X-ray standing-wave (SW) excitation (SWARPES), in which the SW profile is scanned through the depth of the sample. We have studied the buried interface in a prototypical magnetic tunnel junction La$_{0.7}$Sr$_{0.3}$MnO$_3$/SrTiO$_3$. Depth- and momentum-resolved maps of Mn 3$d^6$ $e_g$ and $t_{2g}$ states from the central, bulk-like and interface-like regions of La$_{0.7}$Sr$_{0.3}$MnO$_3$ exhibit distinctly different behavior consistent with a change in the Mn bonding at the interface. We compare the experimental results to state-of-the-art density-functional and one-step photoemission theory, with encouraging agreement that suggests wide future applications of this technique.
Oriented gap opening in the magnetically ordered state of Iron-pnictides: an impact of intrinsic unit cell doubling on the Fe square lattice by As atoms

Ningning Hao, Yupeng Wang and Jiangping Hu

2013 EPL 104 57007

We show that the complicated band reconstruction near Fermi surfaces in the magnetically ordered state of iron-pnictides observed by angle-resolved photoemission spectroscopies (ARPES) can be understood in a meanfield level if the intrinsic unit cell doubling due to As atoms is properly considered as shown in the recently constructed $S_4$ microscopic effective model. The (0,π) or (π,0) collinear antiferromagnetic (C-AFM) order does not open gaps between two points at Fermi surfaces linked by the ordered wave vector but forces a band reconstruction involving four points in unfolded Brillouin zone (BZ) and gives rise to small pockets or hot spots. The $S_4$ symmetry naturally chooses a staggered orbital order over a ferro-orbital order to coexist with the C-AFM order. These results strongly suggest that the kinematics based on the $S_4$ symmetry captures the essential low energy physics of iron-based superconductors.
Interdisciplinary topics

Maintain the structural controllability under malicious attacks on directed networks

Bingbo Wang, Lin Gao, Yong Gao and Yue Deng

2013 *EPL* **101** 58003

The directedness of the links in a network plays a critical role in determining many dynamical processes among which the controllability has received much recent attention. The control robustness of a network against malicious attack and random failure also becomes a significant issue. In this paper, we propose a novel control robustness index motivated by recent studies on the global connectivity and controllability. In its general form, the problem of optimizing the control robustness index is computationally infeasible for large-scale networks. By analyzing the influence of several directed topological factors on the dynamical control process, we transform the control robustness problem into the problem of transitivity maximization for control routes, and propose an efficient greedy algorithm to make control routes transitive. A series of experiments on real-world and synthetic networks show that the global connectivity and controllability can be improved simultaneously and we can mitigate the destruction of malicious attack through backing up the control routes.

Phase diagram of sustained wave fronts opposing the flow in disordered porous media

Sandeep Saha, Severine Atis, Dominique Salin and Laurent Talon

2013 *EPL* **101** 38003

Using lattice Boltzmann simulations, we analyze the different regimes of propagation of an autocatalytic reaction front in heterogeneous porous media. The heterogeneities of the porous medium are characterized by the standard deviation of its log-normal distribution of permeability and its correlation length. We focus on the situation where chemical reaction and flow field act in opposite directions. In agreement with previous experiments we observe upstream, downstream fronts as well as static, frozen ones over a range of flow velocity which depends drastically on the heterogeneities of the flow field. The transition between the static regime and the downstream one account for large enough low-velocity zones, whereas the transition from static to upstream regime is found to be given by a kind of percolation path.
Bending or buckling: Compression-induced phase transition in a semi-flexible polymer brush

Andrey Milchev and Kurt Binder

2013 *EPL* **102** 58003

Molecular-dynamics simulations are presented for systems of densely grafted semiflexible macromolecules grafted to a planar non-adsorbing substrate. We focus our attention on the case where the first bond must orient perpendicularly to the substrate (so the structure resembles a “Fakir’s bed” for short chains and a “polymer bristle” for longer chains). When such layers are exposed to uniform compression, the pressure vs. distance relationship exhibits two stages: i) for very small compression the chains exhibit “buckling” yet maintain their average orientation perpendicular to the surface. In this stage the pressure rises rapidly, and the components of the last bond vectors in the plane parallel to the compressing piston remain randomly oriented. ii) For larger compression, the pressure decreases after a slight overshot, and then stays constant before the pressure starts to slowly rise again. In this stage, the bond vector components (of the bonds adjacent to the compressing piston) exhibit a symmetry breaking, XY-model–like orientational order develops, which then determines the orientation characterizing the collective bending of the whole chains. Surprisingly, the resilient response of stiff polymer brushes to pressure turns out to be much weaker than that of ordinary brushes made of totally flexible polymer chains.

Community detection and graph partitioning

M E J Newman

2013 *EPL* **103** 28003

Many methods have been proposed for community detection in networks. Some of the most promising are methods based on statistical inference, which rest on solid mathematical foundations and return excellent results in practice. In this paper we show that two of the most widely used inference methods can be mapped directly onto versions of the standard minimum-cut graph partitioning problem, which allows us to apply any of the many well-understood partitioning algorithms to the solution of community detection problems. We illustrate the approach by adapting the Laplacian spectral partitioning method to perform community inference, testing the resulting algorithm on a range of examples, including computer-generated and real-world networks. Both the quality of the results and the running time rival the best previous methods.
Node-weighted interacting network measures improve the representation of real-world complex systems

M Wiedermann, J F Donges, J Heitzig and J Kurths

2013 EPL 102 28007

Many real-world complex systems are adequately represented by networks of interacting or interdependent networks. Additionally, it is often reasonable to take into account node weights such as surface area in climate networks, volume in brain networks, or economic capacity in trade networks to reflect the varying size or importance of subsystems. Combining both ideas, we derive a novel class of statistical measures for analysing the structure of networks of interacting networks with heterogeneous node weights. Using a prototypical spatial network model, we show that the newly introduced node-weighted interacting network measures provide an improved representation of the underlying system’s properties as compared to their unweighted analogues. We apply our method to study the complex network structure of cross-boundary trade between European Union (EU) and non-EU countries finding that it provides relevant information on trade balance and economic robustness.

Outbreaks of coinfections: The critical role of cooperativity

Li Chen, Fakhteh Ghanbarnejad, Weiran Cai and Peter Grassberger

2013 EPL 104 50001

Modeling epidemic dynamics plays an important role in studying how diseases spread, predicting their future course, and designing strategies to control them. In this letter, we introduce a model of SIR (susceptible-infected-removed) type which explicitly incorporates the effect of cooperative coinfection. More precisely, each individual can get infected by two different diseases, and an individual already infected with one disease has an increased probability to get infected by the other. Depending on the amount of this increase, we prove different threshold scenarios. Apart from the standard continuous phase transition for single-disease outbreaks, we observe continuous transitions where both diseases must coexist, but also discontinuous transitions are observed, where a finite fraction of the population is already affected by both diseases at the threshold. All our results are obtained in a mean-field model using rate equations, but we argue that they should hold also in more general frameworks.
Geophysics, astronomy & astrophysics

Violation of non-Gaussianity consistency relation in a single-field inflationary model

Mohammad Hossein Namjoo, Hassan Firouzjahi and Misao Sasaki

2013 EPL 101 39001

In this paper we present a simple, toy model of single-field inflation in which the standard non-Gaussianity consistency condition is violated. In this model the curvature perturbations on super-horizon scales are not conserved and the decaying modes of perturbations are not negligible in the non-attractor phase. As a result a large local non-Gaussianity can be obtained in the squeezed limit which violates the standard non-Gaussianity consistency condition for the single-field models.

Inertia from an asymmetric Casimir effect

M E McCulloch

2013 EPL 101 59001

The property of inertia has never been fully explained. A model for inertia (MiHsC or quantised inertia) has been suggested that assumes that 1) inertia is due to Unruh radiation and 2) this radiation is subject to a Hubble-scale Casimir effect. This model has no adjustable parameters and predicts the cosmic acceleration, and galaxy rotation without dark matter, suggesting that Unruh radiation indeed causes inertia, but the exact mechanism by which it does this has not been specified. The mechanism suggested here is that when an object accelerates, for example to the right, a dynamical (Rindler) event horizon forms to its left, reducing the Unruh radiation on that side by a Rindler-scale Casimir effect whereas the radiation on the other side is only slightly reduced by a Hubble-scale Casimir effect. This produces an imbalance in the radiation pressure on the object, and a net force that always opposes acceleration, like inertia. A formula for inertia is derived, and an experimental test is suggested.
Annular cracks in thin films of nanoparticle suspensions drying on a fiber

F Boulogne, L Pauchard and F Giorgetti-Dauphiné

2013 EPL 102 39002

We report an experimental study of the crack pattern formed during the drying of a colloidal suspension. A horizontal fiber, which provides a one-dimensional, boundary-free substrate, is coated by a film of micronic thickness. The geometry imposes a remarkable annular crack pattern and allows precise measurements of the crack spacing over a short range of film thickness (between 2 and 10 μm) which varies linearly with the film height. We compare our experimental data with a model proposed by Kitsunezaki which suggests that the variation of the crack spacing with the film thickness depends on the ratio between a critical stress at cracking and a critical stress for slipping on the substrate. By measuring the friction force of the colloidal gels on a hydrophobic surface through a cantilever technique, we can deduce the critical crack stress for these colloidal gels simply by measuring the crack spacing of the pattern.

Did you know?
EPL is abstracted in a number of places, including ISI, Scopus and the NASA Astrophysics Data System. For the full list visit epljournal.org

Did you know?
Our rejection rate was more than 60% in 2013
Meet the EPL co-editors

EPL is proud to be a journal run by scientists for the international scientific community. The Editorial Board, which includes the Editor-in-Chief and a team of truly international co-editors, is responsible for overseeing the review process, selecting referees for every manuscript and making publication decisions.

Full information on the EPL Editorial Board, including the research interests of all of its members, is available on the Editorial Office website at www.epletters.net. Here we introduce some of our co-editors.

**Professor Lesley F Cohen**
Professor Lesley Cohen is Head of Solid State Physics at Imperial College. Her interests include the study of superconductors (in particular gap structure and vortex pinning), narrow gap semiconductors (transport properties and the use of high mobility materials for sensor applications), magnetic materials (for solid-state cooling using magnetocaloric properties) and highly spin polarised magnetic materials for spintronic application.

**Professor Frédéric Mila**
Professor Mila is currently working on several aspects of the problem of strongly correlated electronic systems, with current emphasis on frustrated magnetism and low-dimensional conductors, in the context of several transition metal oxides as well as organic conductors and carbon nanotubes. The problems addressed are always of experimental relevance, and he is collaborating with experimental chemistry and physics teams all over the world, in particular in France and Japan.

**Professor David Wands**
Professor Wands is Professor of Cosmology and Director of the Institute of Cosmology and Gravitation at the University of Portsmouth. He is interested in the physics of the very early universe, less than a second after the Big Bang, and his research investigates what primordial fluctuations in the density and metric of spacetime can tell us about the physical processes at work at such early times and high energies. Professor Wands also teaches undergraduate courses in the Faculty of Technology and on the Applied Physics degree in the Faculty of Science.
Professor Chin-Kun Hu
Professor Chin-Kun Hu is a research fellow at the Institute of Physics, Academia Sinica, Taipei, Taiwan. He has received numerous awards throughout his career, including several Outstanding Research Prizes from the National Science Council, Taiwan. His main research interests are statistical and computational physics, nonlinear science and theoretical biophysics.

Professor Misao Sasaki
Professor Misao Sasaki is the Director of the Yukawa Institute for Theoretical Physics, Kyoto University. He has been a member of the EPL Editorial Board since 2009, working primarily in cosmology and general relativity and gravitation.

Professor Dr Dieter Zeppenfeld
Professor Dr Zeppenfeld is currently based at the Institute for Theoretical Physics at the Karlsruhe Institute of Technology, Germany. His general research interests are high-energy physics, collider phenomenology, perturbative QCD, Higgs physics, electroweak interactions and beyond the Standard Model physics.

Professor Che Ting Chan
Professor Chan was a co-winner of an Outstanding Scientific Accomplishment Award (Solid State Physics) in the US Department of Energy Materials Science Research Competition. He has been a Fellow of the American Physical Society since 1996. In 1999, he was awarded the Michael Gale Medal for Distinguished Teaching, HKUST. In 2000, he was awarded the Achievement in Asia Award by the Overseas Chinese Physics Association. Professor Chan’s main research interests include application of first principles and related methods to study the electronic, structural and other physical properties of matter, surface physics, photonic band gaps and material physics.

Professor James Scott
Professor Scott is a member of the Physics Department at the University of Cambridge, where he serves as a Director of Research. He was elected FRS (physics) in May 2008. His citation refers to him as “the father of integrated ferroelectrics”. In December 2008 he was awarded the Materials Research Society (MRS) gold medal “for fundamental contributions to the materials science of oxides underlying current and future electronic devices”, and in March 2009 the Jozef Stefan Medal from Slovenia (previous recipients include Nobel prize winners P-G DeGennes and Abdus Salam).
**Professor Stefano Atzeni**

Professor Atzeni is Associate Professor of Physics, Facoltà di Ingegneria, Università di Roma “La Sapienza”. His main research interests are plasma physics, nuclear fusion and computational fluid dynamics. In 2001 he was the recipient of the Edward Teller Medal of the Fusion Energy Division of the American Nuclear Society for “pioneering research and leadership in inertial fusion sciences and applications”. He was then made a Fellow of the American Physical Society in 2010 for “contributions to the theory and simulation of inertial confinement fusion, leading to advances in ignition schemes, energy gain models, implosion symmetry and implosion stability”.

---

**Professor Marek Cieplak**

Professor Cieplak received his MSc at the University of Warsaw in 1973 and his PhD at the University of Pittsburgh in 1975. He is currently a head of the Biological Physics Group at the Institute of Physics of the Polish Academy of Sciences in Warsaw. Professor Cieplak has published more than 180 peer-refereed publications since 1975 and his work has been cited in over 2700 publications. His research interests include topics in theoretical condensed matter physics (spin glasses, porous media, river networks, atomic friction, molecular dynamics studies of wall-fluid phenomena) and biological physics (e.g. molecular dynamics of folding and stretching of proteins, interpretation of data coming from genetic micro-arrays).

---

**Professor Shlomo Havlin**

Professor Shlomo Havlin graduated from Bar-Ilan and Tel-Aviv universities with Highest Distinction. He obtained an academic position at Bar-Ilan University in 1972 where he became a full Professor at 1984. He established four research centres at Bar-Ilan, the Gonda-Goldschmiedt Medical Diagnostic Research Center (1994), the Minerva Center for Mesoscopics, Fractals and Neural Networks (1998), Science Beyond 2000 – Science Education Unit (1996) and Israel Science Foundation National Center for Complex Networks (2003). He has obtained numerous prizes for his outstanding research, including the Landau Prize for Outstanding Research in Physics (1988), the Humboldt Award – Germany (1992), the Nicholson Medal of the American Physical Society (2006) and the Julius Edgar Lilienfeld Prize (2010). His main research interests are statistical physics, percolation, networks, time series analysis, physics of disordered systems and fractals.
Professor Gora Shlyapnikov

Professor Shlyapnikov obtained his doctorate in theoretical physics in 1975 from the Kurchatov Institute, a national research centre in Moscow, Russia. In 1989–2003, he worked as group leader at the FOM Institute AMOLF, and in 2003 he picked up a position in France as CNRS director of research at the Laboratory of Theoretical Physics and Statistical Models (LPTMS) at the Université Paris-Sud in Orsay, where he is head of a theoretical physics group. Since then he has been a part-time professor at the University of Amsterdam, where he collaborated closely with the Quantum Gases group of Professor Jook Walraven. He has received several prestigious awards, such as the Humboldt Prize (1999) and the Senior Bose-Einstein Condensation Award (2011). His research interests are low-temperature physics, low-dimensional systems, and condensed matter. His work focuses primarily on spin-polarized hydrogen in a liquid helium environment, and then on various aspects of the theory of ultracold quantum gases.
News coverage for EPL articles

As part of our ongoing commitment to promoting authors and their work, we highlight published articles that are considered newsworthy to the media, resulting in a broad range of print, online and broadcast coverage.

This article was the subject of a press release in 2013:

**Sculplexity: Sculptures of Complexity using 3D printing**

D S Reiss, J J Price and T S Evans

2013 *EPL* 104 48001

We show how to convert models of complex systems such as 2D cellular automata into a 3D printed object. Our method takes into account the limitations inherent to 3D printing processes and materials. Our approach automates the greater part of this task, bypassing the use of CAD software and the need for manual design. As a proof of concept, a physical object representing a modified forest fire model was successfully printed. Automated conversion methods similar to the ones developed here can be used to create objects for research, for demonstration and teaching, for outreach, or simply for aesthetic pleasure. As our outputs can be touched, they may be particularly useful for those with visual disabilities.

For comparison, the most downloaded article published during 2013 was “Theory of the STM detection of Wigner molecules in spin-incoherent CNTs”, N Traverso Ziani, F Cavaliere and M Sassetti 2013 *EPL* 102 47006 (on p20), which reached 2000 downloads in 170 days. The next most downloaded article was:

**A singlet-triplet extension for the Higgs search at LEP and LHC**

L Basso, O Fischer and J J van der Bij

2013 *EPL* 101 51004

We describe a simple extension of the standard model, containing a scalar singlet and a triplet fermion. The model can explain the possible enhancement in the decay H -> γγ at the LHC together with the excess found in the Higgs boson search at LEP2. The structure of the model is motivated by a recent argument, that was used to explain the number of fermion generations. For the sake of completeness we also considered the contributions from higher multiplets.
EPL subject compilations

To ensure that researchers find the articles that they need quickly and simply, we publish a series of subject compilations to showcase high-quality articles in specific areas. Each compilation has its own co-editor, who is a leading scientist in that field and responsible for overseeing the review process, selecting referees and making publication decisions for every manuscript to ensure that the very best quality research is published. In several compilations the expert co-editor has written a brief introduction to the topic.

The following compilations can be found on the website at epljournal.org/compilations. The content is made free to read during relevant conferences and events.

- Astrophysics & Astroparticle Physics
- Atomic, Molecular & Optical Physics
- Biophysics & Medical Physics
- Casimir Forces
- Complex Networks
- Disordered Systems
- Ferroelectric & Ferromagnetic Material
- Graphene
- High Energy and Nuclear Physics
- Higgs Related
- High-Temperature Fe-based Superconductors
- Liquid Crystals
- Magnetic Properties
- Majorana Physics in Condensed Matter
- Materials Science
- Mathematical Methods
- Metamaterials
- Optics, Quantum Optics & Lasers
- Plasma Physics & Fusion
- Plasmonics & Photonic Structures
- Quantum Simulators
- Rheological Processes
- Soft Matter, Liquids, Polymers & Gels
- Topological Insulators
- Ultra-cold Matter
Conference sponsorship

In 2013, EPL expanded the number of events that received sponsorship funding. Several conferences were awarded funding to assist with registration, travel and/or accommodation fees to allow young researchers to attend. However, at most of the events awards were given for best poster and/or oral presentations. All recipients received a cash award, a certificate and an invitation to submit their poster or next article to EPL. Sponsorship was available at the following conferences, schools or workshops.

- Asian/Pacific School on Gravitation & Cosmology, Korea
- Thin-Film Transistors, Japan
- Single Quantum Dots, Spain
- MECO 38, Trieste
- Bose-Einstein Condensations, Leiden
- AERC Rheology, Leuven
- Biophysics, DPG Spring, Regensburg
- AES & META’13, Dubai
- SUPERSTRIPES, Ischia
- Graphene Week, Chemnitz
- Ultracold atoms, Varenna
- QIPC, Florence
- French Physical Society meeting, Marseille
- Majorana Physics in Condensed Matter, Erice
- Formula VII, Mulhouse
- Enrico Fermi courses, Varenna
- CEWQO, Stockholm
- POLATOM, Italy
- Iberian Rheology (IBEREO), Malaga
- Optics of Surfaces & Interfaces (OSI 10), Chemnitz
- International Liquid Crystal Elastomers (ILCEC), Shanghai
- Swiss/Austrian Physical Societies meeting, Vienna
- Transport in Interacting Disordered Systems (TIDS), Spain
- International Soft Matter (ISMC), Italy
Events calendar 2014

The EPL team regularly attends conferences around the world to meet the research community and promote the journal. If you would like EPL to attend or support your event, please contact the Executive Editor, Graeme Watt, at info@epljournal.org. The following provisional list of conferences may be supported by EPL or exhibit EPL material. As this listing changes frequently when new events arise, please keep up to date by viewing epljournal.org/events.

PHOTOPTICS 2014, Lisbon, Portugal, 7–9 January
International Thin-Film Transistor Conference, Delft, the Netherlands, 23–24 January
XVII Workshop on Quantum Information Processing (QIP), Barcelona, Spain, 3–7 February
Asia-Pacific School & Workshop on Gravitation & Cosmology, Taipei, 17–21 February
GrapheSP, Lanzarote, Spain, 18–21 February
DPG AMOP Meeting, Berlin, Germany, 17–21 March
DPG CM Spring Meeting, Dresden, Germany, 30 March – 4 April
European Rheology (AERC), Karlsruhe, Germany, 8–11 April
MEC039, Coventry, UK, 8–10 April
The Physics of Soft & Biological Matter, Cambridge, UK, 14–16 April
International Conference on Superconductivity & Magnetism (ICSM2014), Antalya, Turkey, 27 April – 2 May
Nuclei & Mesoscopic Physics, East Lansing, Michigan, USA, 5–9 May
Graphene, Toulouse, France, 6–9 May
META’14, Singapore, 20–23 May
E-MRS Spring, Lille, France, 26–29 May
Graphene Week, Gothenburg, Sweden, 23–27 June
Physics of Magnetism, Posnan, Poland, 23–27 June
Central European Workshop on Quantum Optics (CEWQO), Brussels, Belgium, 23–27 June
EPS Conference on Plasma Physics, Berlin, Germany, 23–27 June
Annual Swiss Physical Society meeting, Fribourg, Switzerland, 30 June – 2 July
EPS Conference on High Energy Physics, Valencia, Spain, 2–9 July
International School of Physics “Enrico Fermi”, Varenna, Italy, (4 courses), July
Multi-condensates Superconductivity, Erice, Sicily, 19–25 July
Nuclear Structure 2014, Vancouver, Canada, 20–25 July
Liquids 2014, Lisbon, Portugal, 21–25 July
SUPERSTRIPES 2014, Erice, Sicily, 26 July – 1 August
Epioptics 13. The Physics of Silicene, Erice, Sicily, 26 July – 1 August
24th International Conference on Atomic Physics (ICAP), Washington DC, USA, 3–8 August
International Workshop on Disordered Systems (IWDS), San Antonio, Texas, USA, 17–22 August
EPS-QEOD EUROPHOTON Conference, Neuchatel, Switzerland, 24–29 August
Metamaterials 2014, Copenhagen, Denmark, 25–28 August
Photon 14, London, UK, 1–4 September
E-MRS Fall, Warsaw, Poland, 15–19 September
Annual Austrian Physical Society meeting, Poellau, Austria, 21–25 September
Advisory Editors

- E Bertel, Austria
- V E Fortov, Russia
- P Ch Ivanov, USA
- P M Jacobs, USA
- A Kastberg, France
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- M Schreiber, Germany
- D Mathur, USA
- A Kastberg, France
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain
- D Mathur, India
- F Pegoraro, Italy
- G A Sawatzky, Canada
- C M Schneider, Germany
- D Vanmaekelbergh, the Netherlands
- A Laubereau, Germany
- M Lewenstein, Spain

Cover images

- Schematic representation of the quorum ignition process in a neuronal network, adapted from Elvira Barbera, Francesca Brini and Giovanna Valenti 2012 EPL 98 54004; artistic impression by Frédérique Swist.
- Conformal diagram of a spacetime describing creation of a bubble universe, adapted from K Sugimura, D Yamauchi and M Sasaki 2012 EPL 100 29004; artistic impression by Frédérique Swist.
- Two-qubit Bell-diagonal states ordering with quantum discord, adapted from M Okrasa and Z Walczak 2012 EPL 98 40003; artistic impression by Frédérique Swist.
- Ternary plot for neutrino mixing visualization, adapted from C Zachos 2012 EPL 99 11001; artistic impression by Frédérique Swist.
EPL’s publishing partners

EPL is published under the scientific policy and control of the European Physical Society by EDP Sciences, IOP Publishing and SIF for a partnership of 17 European physical societies (the EPL Association):

The European Physical Society
The French Physical Society
The Italian Physical Society
Institute of Physics (UK)
The Austrian Physical Society
The German Physical Society
The Hungarian Physical Society
Institute “Ruder Boskovic”
The Netherlands Physical Society
The Portuguese Physical Society

Pool of Scandinavian Physical Societies:
• Danish Physical Society
• Finnish Physical Society
• Icelandic Physical Society
• Norwegian Physical Society
• Swedish Physical Society
The Swiss Physical Society
The Turkish Physical Society

Associate members
Institute “Josef Stefan”
Spanish Royal Society of Physics

Publishing partners

Editorial Office
European Physical Society
6, rue des Frères Lumière
F-68200 Mulhouse
CEDEX
France

Staff Editor:
Frédéric Burr

Editorial Assistants:
Uriel Megnassan, Jérold Robert and Kevin Desse

Società Italiana di Fisica
via Saragozza 12
40123 Bologna
Italy

Production Editor:
Barbara Ancarani and Elena Barontini

EDP Sciences
17 avenue du Hoggar
PA de Courtaboeuf,
BP 112
91944 Les Ulis Cedex A
France

Production Editor:
Catherine Brassac

IOP Publishing
Temple Circus
Temple Way
Bristol BS1 6HG, UK

Executive Editor:
Graeme Watt
Product Manager:
Emma Watkins
Marketing Executive:
Gemma Hougham
Production Specialist:
Christopher Bromley

epljournal.org/highlights-2013
International Year of Light 2015

It is an absolute pleasure to announce that the United Nations [UN] General Assembly formally proclaimed the year 2015 as the International Year of Light and Light-based Technologies [IYL2015]

You can read our official press release on the EPS website (www.epsnews.eu). This is the official green light that will allow the EPS and our many international partners to accelerate towards a fantastic year of activities throughout 2015.

The UN General Assembly declares only a very small number of International Years, and it does so to raise international awareness of issues that both resonate with the public and which are at the same time of critical importance for the future. What this means in practice is that the UN has entrusted to the EPS and our partners, with UNESCO as lead agency, the responsibility to implement a yearlong programme of activities to promote the importance of light science and technologies to the world.

It is therefore absolutely essential for us all to realise that an International Year is not business as usual! It is not even “enhanced” business as usual! In particular, 2015 is not just about planning activities and actions by physicists for physicists. And it is also not just about 2015. Rather, for the next two years and more as we plan, implement and follow up, we have an unprecedented opportunity to engage with new audiences and communities to explain why the science of light and its many applications is so important. Light and its applications span all areas of physics and science, and all of us can play a major role.

Of course there will be many exciting and high-profile scientific seminars during 2015, but if all we do is plan and organise events amongst ourselves, we will miss the unique opportunity to raise awareness of the importance of fundamental science to the broader public, to policymakers and to research funders. We often complain that our science is not sufficiently supported, and we now have a chance to do something about it. We absolutely have to make the most of 2015, and this will require real commitment from us all.

But in a sense of course, we have already started. Indeed, having the IYL2015 resolution passed at the UN General Assembly is already a very significant achievement. The applications of optics and photonics as solutions to global problems were extensively debated in the various consultative phases at UNESCO and the UN General Assembly, and there are probably hundreds of diplomats and politicians worldwide who are now aware of the importance of these areas of science. Indeed, it is worth noting that it was at the consultative stage in New York where the Member States of the UN themselves modified the title of the International Year to explicitly stress the technological applications of science to meeting UN priorities.

Throughout the year, there will be regular monthly updates in a dedicated column in e-EPS, and we will be providing guidelines for national organisation and many ideas for activities. But while EPS and other societies will be coordinating international activities, the real strength of International Years lies in the local actions run by the local scientific community. And organizing locally is up to you! On the EPS website, there is a presentation and prospectus to download, so please begin now and plan some local meetings in the next few weeks in your own university and department to brainstorm immediately. And please let your national physical society know what you are doing, as national coordination will also be important.

Let’s not delay one minute longer. Start making plans, pick up the phone, send e-mails, tweet (@IYL2015) or post or whatever you like, just organize and get to work! We have an absolutely remarkable time ahead of us.

John Dudley
EPS President

This press release is adapted from e-EPS newsletter page at www.epsnews.eu/2014/01/editorial-iyl2015/ in January 2014.
We would like to thank all of our authors, referees, board members, partners and supporters across the world for their vital contribution to the work and progress of EPL.