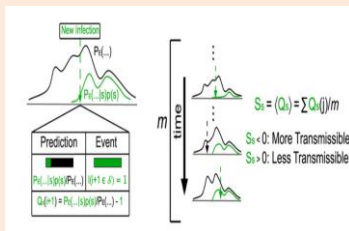


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COMPUTATIONAL BIOPHYSICS— EPIDEMIOLOGY AND STATISTICS



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Burghardt, K., Verzijl, C., Huang, J., Ingram, M., Song, B., & Hasne, M. (2016). Testing Modeling Assumptions in the West Africa Ebola Outbreak. *Scientific Reports*, 6, 34598-1-10.

Originating in West Africa, Ebola has spread to over 30000 people and claimed 11000 lives for over 2 years. Existing Ebola Virus Disease (EVD) models have assumed that Ebola is spread homogeneously. In contrast, the authors demonstrated that this assumption could not accurately estimate EVD. They discovered something that could not be assumed by traditional EVD models, which is that trends in human migration aided in anticipating the source of EVD and where it would subsequently go. They also found that EVD circulated at a more gradual pace, relative to other infectious diseases, such as H1N1. Greater population density was shown to negatively affect the initial propagation rate of EVD. Statistical testing was also employed to determine if EVD spread in an evenly distributed manner and it showed that varying strains of EVD spread in different ways. This model may be useful for planning vaccination strategies for all strains of EVD.

CONSTRUCTION AND BUILDING TECHNOLOGY— ROBOT-INCLUSIVE SPACES

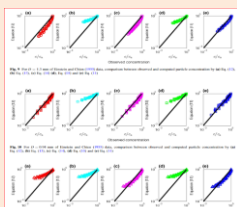


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Tan, N., Mohan, R., & Watanabe, A. (2016). Toward a framework for robot-inclusive environments. *Automation In Construction*, 69, 68-78.

A lack of methodical research on the robot relationship with its environment led to the study on how robots and their environment work in tandem to result in an intelligent living environment. This prompted the design of a scheme to connect a robot to its environment through a number of considerations such as robot-inclusiveness that determined how accommodating the robot's environment was towards it and rules to govern the design and evaluation of robots in different environments.

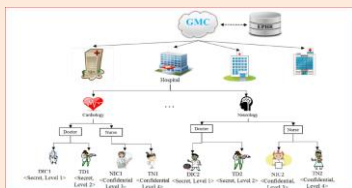
ENVIRONMENTAL SCIENCES— WATER RESOURCES



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Pal, D. & Ghoshal, K. (2016). Effect of particle concentration on sediment and turbulent diffusion coefficients in open-channel turbulent flow. *Environmental Earth Sciences*, 75(18), 1245.

How particle concentration affects turbulent flow parameters such as sediment and turbulent diffusion coefficients in open-channel turbulent flow has yet to be fully understood. A parameter, β , refers to the proportion of the sediment diffusion coefficient over the turbulent diffusion coefficient. The sediment diffusion coefficient was discovered to drop more markedly in contrast with turbulent diffusion coefficient in the presence of rising particle concentration. Discernible physical traits of β were mathematically indicated, which was verified through experiments.

HEALTH CARE SCIENCES & SERVICES—
MEDICAL INFORMATICS
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Gope, P. & Amin, R. (2016). A Novel Reference Security Model with the Situation Based Access Policy for Accessing EPHR Data. *Journal Of Medical Systems*, 40(11), 1-14.

A technique for access control is essential for electronic Patient Health Record (EPHR) systems that help patients in ensuring privacy while allowing healthcare professionals to see their medical records. The access control technique should, ideally, be able to deal with each potential situation effectively, such that security is not compromised. Yet in emergency situations, the circumvention of current access control techniques that limit patient data disclosure, frequently occurs. The authors suggested a framework by which EPHR information can be securely shared. A hierarchical chain of command to govern data flow, and an effective access control schema was implemented by them in a model.

MATERIALS SCIENCE—
BLUE PHOSPHORENE OXIDE
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Zhu, L., Wang, S., Guan, S., Liu, Y., Zhang, T., Chen, G., & Yang, S. (2016). Blue Phosphorene Oxide: Strain-Tunable Quantum Phase Transitions and Novel 2D Emergent Fermions. *Nano Letters*, 16(10), 6548-6554.

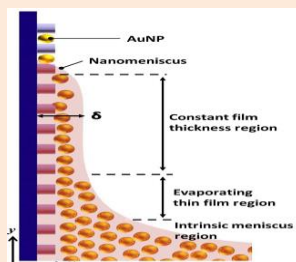
This article examines blue phosphorene oxide (BPO), a unique, two-dimensional (2D) material that has both up-and-coming fermions in its material structure and adjustable quantum phase changes. A semiconductor of small band gap possessing 3 bands of reduced energy was discovered to be the stable phase of BPO. The semiconductor to semi-metal change of state was initiated by application of medium strain. Documentation of up-and-coming fermions and adjustable quantum phase changes was carried out, along with other previously unfamiliar observations, using models. BPO could potentially be employed in nanoscale applications, such as optics and electronics.

MATERIALS SCIENCE—
DYNAMIC COVALENT NETWORK POLYMERS
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Yu, K., Shi, Q., Li, H., Jabour, J., Yang, H., & Dunn, M. et al. (2016). Interfacial welding of dynamic covalent network polymers. *Journal Of The Mechanics And Physics Of Solids*, 94, 1-17.

Dynamic covalent network polymers are a subset in the field of thermosetting polymers. They are capable of undergoing bond exchange reactions (BERs), during which their macromolecular chain network gets altered. Thus, contrary to traditional opinion, these state-of-the-art thermosetting polymers can vary their shape in response to external factors. Their surface welding in the presence of heat was analysed by a modelling scheme designed by the authors. This scheme consisted of four parameters that determined both modulus and fracture energy and bulk material tests could be employed to ascertain two of them. An interfacial fracture test could be used to verify the third parameter. Experimental results for both the elastic modulus and interfacial fracture energy of welded thermosetting polymers and the authors' modelling scheme were determined to be consistent with each other.

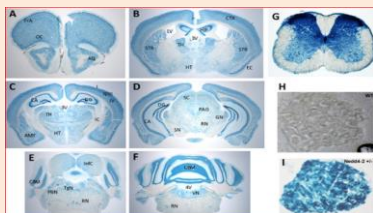
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MATERIALS SCIENCE—
NANOPARTICLES CLUSTERS

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Asbahi, M., Wang, F., Dong, Z., **Yang, J.**, & Chong, K. (2016). Directed self-assembly of sub-10 nm particle clusters using topographical templates. *Nanotechnology*, 27(42), 424001-1-6.

A technique that enables nanoparticles spread out throughout a liquid to be registered and then readjusted into predetermined sites upon a solid template is known as directed self-assembly of nanoparticles (DSA-n). Despite the growing popularity of DSA-n, it faces some hurdles, such as lack of repeatability of the patterns generated. This prompted the authors to use a new method that could keep the long-range molecular forces between nanoparticles in check and allow them to position nanoparticles accurately in each site. The authors were able to prove that, with their method, DSA-n was able to direct the self-assembly of nanoparticles in microarrays and it could also adjust how far apart nanoparticles were from each other at each site. This could be a precursor to designing nanostructures whose physical properties can be readily adjusted with high precision.

MOLECULAR NEURO SCIENCE—
NEUROTROPHIC FACTORS

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Yanpallewar, S., Wang, T., **Koh, D.**, Quarta, E., Fulgenzi, G., & Tessarollo, L. (2016). Nedd4-2 haploinsufficiency causes hyperactivity and increased sensitivity to inflammatory stimuli. *Scientific Reports*, 6, 32957-1-9.

Nedd4-2 is an ubiquitin protein ligase that controls the internalization and degradation of ion channels. Increased levels of epithelial sodium in rodent lungs and kidneys that caused the death of mice was found to occur with the removal of Nedd4-2 ligase. A mouse model of Nedd4-2 haploinsufficiency was then used to study if variations in Nedd4-2 expression influenced how the nervous system worked. The overstimulation of Nedd4-2 heterozygous mice was attributed to more rapid detection of stimuli by synapses which led to making them feel inflammatory pain more acutely.

PHYSICS—BLACK HOLE



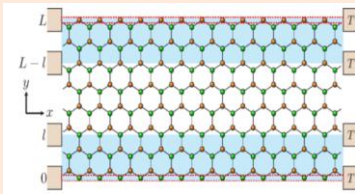
Image Source: Universe Today

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Zhukov, A., Bouffanais, R., Konobeeva, N., & Belonenko, M. (2016). Zitterbewegung near a Schwarzschild-type black hole. *Modern Physics Letters A*, 31(29), 1650168-1-7.

A rough analytic solution to the Dirac equation in the Schwarzschild geometry was suggested to study the Zitterbewegung (ZB) effect. An expression for the current density caused by the movement of a wave packet of electrons was derived. The intensity of dipole radiation surrounding the black hole was also determined. The authors' work has relevance in the field of astrophysics.

PHYSICS—CONDENSED MATTER

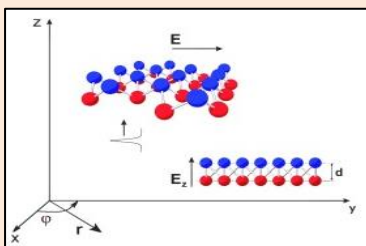


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Liu, D., Yu, Z., & Liu, Y. (2016). Pure spin current and perfect valley filter by designed separation of the chiral states in two-dimensional honeycomb lattices. *Physical Review B*, 94(15), 155112-1-6.

The functioning effectiveness of electronic devices can be enhanced through several binary degrees of freedom of electrons, according to studies on spintronics and valleytronics. One current research area is electronic device fabrication that allows for both power efficiency and differing degrees of freedom. Demonstration of an uncomplicated method that can spatially segregate all chiral states such that completely polarized currents, such as pure spin (valley) current can be produced and adjusted. Boundary disturbances such as faults, do not affect chiral states further from the boundaries. This makes it hard to utilize edge states. Thus, a technique that spatially segregates all the edge states of a quantum anomalous Hall (QAH) insulator with Chern number $|C|=2$ was developed by the authors. Two-dimensional honeycomb lattices are the basis for pure spin currents in this insulator. Accomplishing pure spin currents and perfect valley filters was done through accurate spin polarization of spatially segregated chiral states. The authors also discovered that inducing boundary potentials on the fringes of a sample's lattice structure could enable fabrication of a valley filter.

PHYSICS—GERMANENE

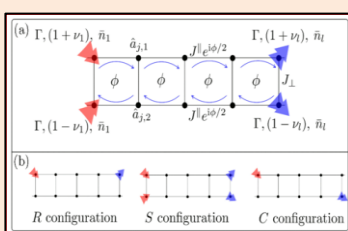


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Zhukov, A., Bouffanais, R., Konobeeva, N., & Belonenko, M. (2016). Peculiarities of the propagation of multidimensional extremely short optical pulses in germanene. *Physics Letters A*, 380(38), 3117-3120.

Germanene is a state-of-the-art two-dimensional material and its small size makes it attractive for use in fields of the micro- and nano-electronics. The band gap in the wave spectrum of germanene is relatively large and this is due to its markedly pronounced spin-orbit interaction, which exceeds that of graphene by 10000 times. This prompted the analysis on variations in the manner by which very short light waves pass through germanene. Some key findings are shared. Firstly, there was no decrease in the amplitude of the light waves passing through. Secondly, it was explained and proved how the spin-orbit interaction of germanene influenced the manner by which very short light waves passed through it. Thirdly, it was discovered that in the presence of non-linear wave excitation, very short light waves had two electric field oscillations that culminated in a tiny 'tail'. Germanene was therefore deemed as a good candidate for wave propagation optoelectronic applications.

PHYSICS—QUANTUM SYSTEMS



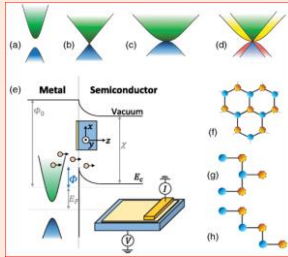
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Guo, C. & Poletti, D. (2016). Geometry of system-bath coupling and gauge fields in bosonic ladders: Manipulating currents and driving phase transitions. *Physical Review A*, 94(3), 033610-1-7.

Boundary systems, which are a subset of quantum systems, were studied by the authors. Particular attention was paid to the instance where the ends of a chain of particles were linked to two different baths, culminating in a flow within the system. Analysis of the coupling orientation between the system and baths was carried out by taking into account a dissipative boundary-driven ladder in the presence of a gauge field. Depending on the coupling orientation, it was evident that the attributes of the boundary system varied. This study is a precursor to developing methods that oversee transport properties in quantum systems.

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PHYSICS, APPLIED—GRAPHENE

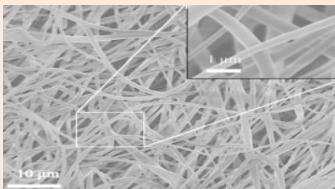


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Ang, Y. & Ang, L. (2016). Current-Temperature Scaling for a Schottky Interface with Nonparabolic Energy Dispersion. *Physical Review Applied*, 6(3), 034013-1-10.

To enable heterostructures hinged upon nanomaterials to be employed in devices, their unconventional physical properties must be transcribed. In this article, special attention was paid to the Schottky interface, one heterostructure that is the metal-semiconductor interface. Three transport mechanisms explain how current is moved over a Schottky interface. Schottky transport in graphene and in a semiconductor with small band gap was analysed and clear types of unique scaling affinities were evident in the Schottky transport current. To gain a clearer comprehension of the physics of Schottky devices hinged on materials with nonparabolic energy dispersions, the authors emphasize the need to use an accurate scaling affinity.

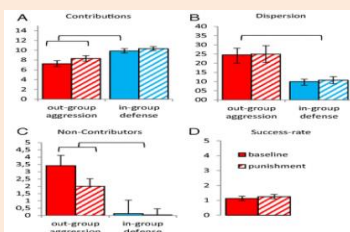
POLYMER SCIENCE—ADHESIVES



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Sahay, R., Baji, A., Ranganath, A., & Anand Ganesh, V. (2016). Durable adhesives based on electrospun poly(vinylidene fluoride) fibers. *Journal Of Applied Polymer Science*, 134(2), 44393-1-7.

Adhesives generally employ the concept of force of attraction between two different surfaces. Adhesives that are responsive to pressure are commonly used, yet they can usually only be used once. Thus, new adhesives that can be reused must be designed. How adhesion occurs in nature is an ongoing area of research. In this article, particular attention is paid to the design and subsequently evaluation of a poly(vinylidene fluoride) (PVDF) fibrous membrane. Electrospinning was employed in designing the fibers. Strong adhesive ability was found to be the result of many points of contact with the surface. Shear and adhesive performance of the fibrous membrane were assessed. From this, it was confirmed that the fibrous membrane provided good adhesion and was reusable.

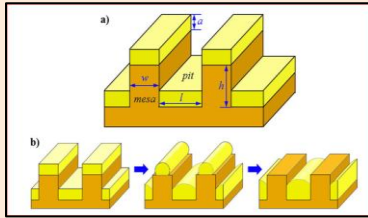
PSYCHOLOGY AND COGNITIVE SCIENCES—
COLLECTIVE ACTION

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De Dreu, C., Gross, J., Méder, Z., Giffin, M., Prochazkova, E., Krikeb, J., & Columbus, S. (2016). In-group defense, out-group aggression, and coordination failures in intergroup conflict. *Proceedings Of The National Academy Of Sciences*, 113(38), 10524-10529.

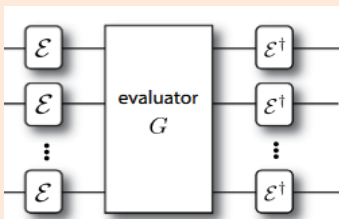
Intergroup conflict is one of the most common phenomena in the history of the human race but to understand how groups organize themselves into effective collective action is a complex process. The distinctions between contributions geared towards out-group aggression and those geared towards in-group defense were analyzed. Due to its relative difficulty in coordination, out-group aggression was found to be less fruitful than in-group defense. This accounts for why attempts to aggress an out-group could be less convincing relative to attempts to guard the in-group. In addition, it was observed that to effectively control intergroup conflict, it is useful to undermine the logistics of contribution to in-group defense and at the same time the dynamics of out-group aggression such as leadership, communication, and infrastructure.

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SCIENCE AND TECHNOLOGY—
NANOSCALE MATERIALS
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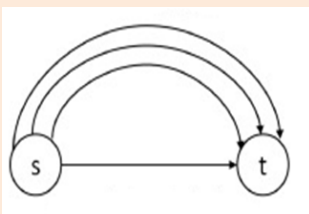
Lu, L. X., Wang, Y. M., Srinivasan, B. M., Asbahi, M., Yang, J. K. W., & Zhang, Y. W. (2016). Nanostructure Formation by controlled dewetting on patterned substrates: A combined theoretical, modeling and experimental study. *Scientific Reports*, 6, 18.

Nanostructures whose size and locality may be varied can be created by a process known as solid state dewetting (SSD). A study on such created nanostructures was carried out, to determine their stability. Various factors, including the substrate surface pattern, depth of the film and wetting angle had to be carefully monitored for their optimal growth. The correlation between different nanostructure morphologies and the factors mentioned was shown by phase diagrams. Both the phase field simulations and the experimental results for the combined gold and silicon film substrate system were found to be compatible with one another. The framework for the widespread employing of SSD for nanostructure design was therefore provided by the phase field simulations.

SCIENCE AND TECHNOLOGY—
QUANTUM INFORMATION
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Tan, S., Kettlewell, J., Ouyang, Y., Chen, L., & Fitzsimons, J. (2016). A quantum approach to homomorphic encryption. *Scientific Reports*, 6, 33467-1-8.

A private-key quantum encryption technique which allowed a wide range of quantum computation on encrypted data was introduced. The quantum data was encoded on specific bosons in specific spatial modes, and the quantum computations were rearrangements of the bosons to become unrelated to their origins. The authors' encoding had good security that could conceal a constant fraction of encrypted data and this fraction could be varied.

TRANSPORTATION SCIENCE AND TECHNOLOGY—
TRAFFIC EQUILIBRIUM MODELS
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Damla Ahipaşaoğlu, S., Arıkan, U., & Natarajan, K. (2016). On the flexibility of using marginal distribution choice models in traffic equilibrium. *Transportation Research Part B*, 91, 130-158.

A new traffic equilibrium model based on the stochastic user equilibrium (SUE) model and the marginal distribution model (MDM), the MDM-SUE model, was developed for transportation system analysis. It employs a MDM as its route choice model where the joint distribution is not defined and the marginal distributions of the path utilities are stated. This MDM-SUE model was found to be adaptable as it enabled different user preferences together with enabling different distributions to be inputted into it. It could be applied to both small and large traffic networks.