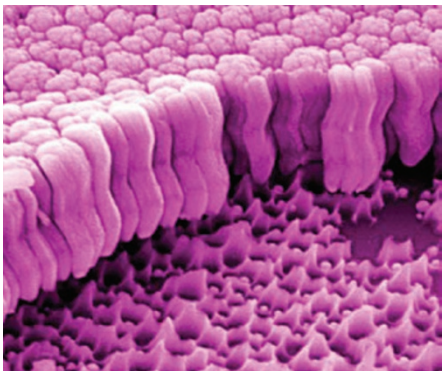
METALLIC GLASSES

## Tunable nanostructures

*Nature Commun.* **6,** 7043 (2015)



NATURE PUBLISHING GROUP

Metallic glasses are attractive materials for use in small-scale devices, including microelectromechanical systems. Perhaps the biggest advantage they offer is the lack of large constituent building blocks (such as grains in polycrystalline materials), resulting in the small-scale limit for the size of a part not being constrained. However, fabricating metallic glass nano-architectures is problematic, and the range of suitable material compositions for existing approaches is limited. Yanhui Liu *et al.* have now demonstrated a deposition-based approach for synthesizing high-aspect-ratio metallic glass nanostructures, where the substrate is rotated between different element-specific sputtering guns. By varying deposition rate from each target, and rotation speed of the substrate, nanostructures within a wide composition range can be achieved. Additionally, it is possible to fabricate hybrid nanostructures, in which the composition in a single structure changes, and to control feature geometry. Developing new processing routes for metallic glasses at the nanoscale may broaden the scope for utilizing their unique properties at the small scale. *JP*

ORGANIC PHOTOVOLTAICS

## Equilibrium at the interface

*Adv. Energy Mater.* http://doi.org/f266gm (2015)

The realization of organic solar cells with high efficiency also hinges on an improved understanding of the processes that link charge transfer states, which correspond to electrons and holes photogenerated in an organic heterojunction and interacting at the donor/acceptor interface, with free charge carrier states. A model developed by Timothy Burke and colleagues now shows that the population of charges in the charge transfer states is in equilibrium with free carriers. This condition allows the researchers to formulate an equation that correlates the open-circuit voltage of the photovoltaic device with several parameters, such as the average energy, lifetime and number of the charge transfer states as well as the interfacial disorder and the extension of the mixed region between the donor and the acceptor, that can be extracted by direct characterization of the materials and the device. Thus, the model helps explain the relatively low open-circuit voltage experimentally observed in organic solar cells and suggests guidelines to improve it. *LM*

QUANTUM PHYSICS

## Indistinguishable atoms

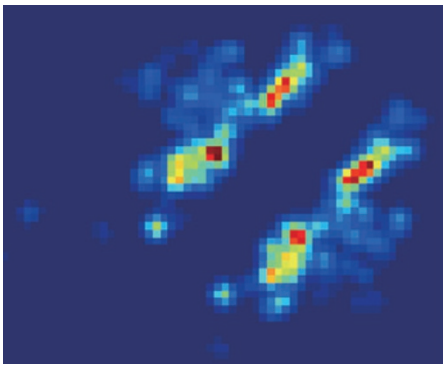
*Nature* **520,** 66–68 (2015)

In 1987, C. K. Hong, Z. Y. Ou and L. Mandel experimentally demonstrated that two photons arriving at a beamsplitter from two different sides are bound to exit together if they are indistinguishable, that is, with identical spectral, spatial and polarization properties. In their two-photon interference scheme, the two detectors monitoring the two exit ports of the beamsplitter recorded zero coincidences for zero time delay between them, the so-called Hong–Ou–Mandel (HOM) dip. This is a purely quantum effect that has been extensively investigated with photons. Raphaël Lopes and colleagues now report similar observations using freely propagating twin beams of metastable $^4$He atoms. They observe a HOM dip approaching 0.33, well below the value of 0.5, which represents the limit for classical correlations for single distinguishable particles. Indistinguishability is considered a key property for the implementation of quantum information systems; these results open up the possibility to study quantum physics using massive particles, which, contrary to photons, can interact with each other. *MM*

SINGLE-MOLECULE TRACKING

## Fretted diffusion

*Nature Commun.* **6,** 6992 (2015)



NATURE PUBLISHING GROUP

When it comes to measuring the nanoscale real-time dynamics of single biomolecules non-invasively, the sensitivity of single-molecule fluorescence resonance energy transfer (smFRET) is hard to beat. However, low photon count rates as well as photobleaching and photoblinking issues have limited the technique's temporal resolution to ~10 ms. Protein diffusion and conformational dynamics are, however, typically faster. Now, Nam Ki Lee and colleagues demonstrate that the dynamics of a single biomolecule in a buffer solution can be measured by smFRET for tens of milliseconds at submillisecond timescales by simply tethering the molecule to a freely diffusing liposome (through biotin–NeutrAvidin interactions) and using a photoprotection buffer. With this technique, the researchers resolved the ~5-ms diffusional rate of a single protein on single-stranded DNA and the faster 1,500 $s^{-1}$ conformational transition rate of a Holliday junction (a branched nucleic-acid structure). Compared with alternative smFRET approaches, the liposome-tethering variant needs a basic microscopy set-up, and does not require the immobilization of the sample on a glass slide or a high concentration of FRET samples. *PP*

FERROMAGNETISM

## Ultrafast tunability

*Nature Commun.* **6,** 6724 (2015)

Modifying the magnetization of materials by means of ultrashort laser pulses has proved to be faster, by several orders of magnitude, than other approaches based on the application of magnetic fields or spin-polarized current pulses. Although laser excitations typically produce an attenuation of the magnetization due to heating, in some materials they can cause transitory enhancements owing to strong coupling among spin, charge, and orbital angular moment. Masakazu Matsubara and colleagues now demonstrate that the magnetization can be increased or decreased in materials with a low density of carriers in the conduction band and with a high density of magnetic moments, by controlling the density of resonantly photoexcited carriers. Using this approach, they show changes of 10% in the magnetization strength within 3 ps in low-doped $Eu_{1-x}Gd_xO$. Besides providing insights into the non-equilibrium photoinduced magnetization dynamics, this result may constitute a step towards ultrafast optically controlled ferromagnetic devices. *DC*

*Written by David Ciudad, Maria Maragkou, Luigi Martiradonna, Pep Pàmies and John Plummer.*