The pump beam was used to generate signal and idler beams — each with a wavelength of 1,536 nm — through parametric down-conversion in a periodically poled $KTiOPO_4$ waveguide, and a reference beam was converted into pseudothermal light by employing a rotating speckle disk. The idler beam was used to herald two-photon states, and the signal beam and pseudothermal light were mixed and sent to an avalanche photodiode. The feasibility of the technique is demonstrated by reconstructing single-photon, thermal and two-photon states. Another powerful feature of the scheme is its robustness with respect to the noise and deviation affecting the measurement set-up. *NH*

ISOLATORS

Power up

Opt. Express **22,** 23226–23230 (2014)

Faraday isolators — magneto-optic devices that act as a one-way valve for light — are highly useful components for controlling the flow of light within photonic systems. Usually such devices are small and designed for use with the low-power laser light encountered in applications such as optical communications. Now, two researchers from the Institute of Applied Physics of the Russian Academy of Sciences and Nizhny Novgorod State University in Russia report a version that is compatible with powers on the order of kilowatts. The isolator is based on a 6-mm-diameter, 7-mm-long cylindrically shaped crystal of a magneto-optic material called TSAG (terbium scandium aluminium garnet). The TSAG material was chosen because it offers a high Verdet constant and the possibility of growing large-aperture single crystals with good optical quality. Initial prototypes offer an isolation ratio of 30 dB for a laser power of 500 W at a wavelength of 1,076 nm. The team say that following improvements in the growth of the crystals to reduce their optical absorption it should be possible to scale the devices to operate with laser powers in excess of 1 kW. *OG*

QUANTUM EMITTERS

Efficient collection

Optica **1,** 203–208 (2014)

One of the main components of any quantum network is a source of single photons emitted in a deterministic way. However, a serious obstacle to hurdle is the collection of such photons, which can be emitted in any direction within a 4π solid angle. Xiao-Liu Chu and co-workers from the Universities of Erlangen and Potsdam in Germany and the Los Alamos National Laboratory in the USA now claim to have solved the problem. The team built a planar, metallo-dielectric antenna that directs the photons with an efficiency exceeding 99% — just as theoretically predicted. In their experimental configuration, a sapphire cover glass is coated with two polymer layers of PMMA/PVA, which contain light-emitting quantum dots with a CdSe core within a CdS shell. A movable metallic mirror is then positioned in free space a small distance above the planar structure. Investigation of the angular emission pattern from the structure when it is optically excited with the gold mirror at various distances from the quantum dots revealed that part of the emission was reflected at the mirror interface and then interfered with the emission direct from the dot. The resulting fluorescence emission patterns were heavily modulated, with a 10% larger intensity when the mirror was in place. The team says that the result is an important building block towards the development of an ultrabright single-photon source that can deterministically deliver several tens of millions of photons per second. *MM*

GRAPHENE

Nanophotonic switching cell

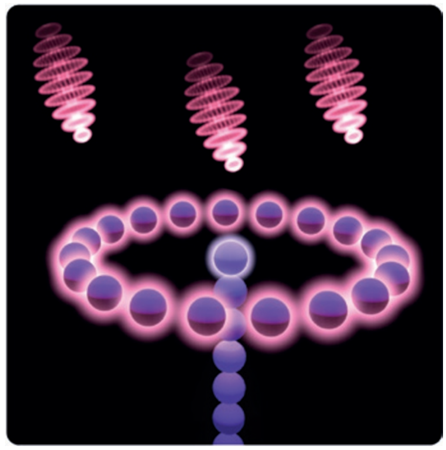
J. Opt. **16,** 105005 (2014)

Almir Wirth Lima and Antonio Sérgio Bezerra Sombra at the University of Ceará in Brazil have theoretically proposed a scheme for realizing a nanophotonic switching cell that takes advantage of the unique electronic properties of graphene. It is well known that the transportation of electrons in graphene sheets is governed by the Dirac equation and that they propagate as if they were massless. Furthermore, the Dirac-cone-shaped dispersion characteristics of graphene can be modified using an externally applied voltage. The authors build on these two properties to design a switching cell that operates in the infrared and terahertz frequency ranges. The device comprises a directional coupler and two graphene nanoribbons that are used as waveguides. They are separated vertically and embedded in a boron nitride substrate — a material chosen due to its low impact on the properties of graphene. When optical power is fed into one of the two ports, bar operation (in which power exits from the opposite end of the same waveguide) or cross operation (power exits from the adjacent waveguide) of the cell is determined by the value of the graphene nanoribbon's dielectric constant. The externally applied voltage changes the chemical potential, allowing the dielectric constant to be fine-tuned to the desired value. *MM*

QUANTUM PHYSICS

Superabsorption

Nature Commun. **5,** 4705 (2014)



NPG

Superradiance refers to the collective emission of light from a group of N two-level systems at a rate that is proportional to N^2, which is significantly higher than the rate predicted by classical physics. Although enhanced emission rates are closely linked to enhanced absorption rates due to time-reversal symmetry, the latter are much less likely to occur. Now, an international team from universities in the UK, Singapore and Australia have realized a number of analytical and numerical calculations to identify the conditions under which absorption dominates emission. The model system is a ring structure of N two-level systems, whose transition rates must be engineered so that the entire system's ladder of Dicke states can be considered as an effective two-level model. Enhancement of the transition rates at the effective central 'good' frequency is possible by engineering the spectral density or the occupation number of the modes. In fact, a large detuning between adjacent Dicke transitions can prove extremely useful for this purpose. As the authors propose such a scheme for applications in energy harvesting, they focus on defining an irreversible trapping process to extract only the photons at the good frequency. They also show that the system can be reset using a chirped laser pulse. The results can potentially be transposed in other systems that range from molecules to quantum dots, with interesting applications in optical or microwave sensing, solar cells and wireless power transfer. *MM*

Written by Oliver Graydon, Noriaki Horiuchi and Maria Maragkou.