Stark shift of the atomic transition frequency caused by the driving field. This is achievable by using a nearly circularly polarized driving field, or, more generally, by applying an additional magnetic field. The amplification mechanism of QASER is governed by the difference combination parametric resonance that occurs when the drive-field frequency matches the frequency difference between two close, high-frequency normal modes of the coupled light–atom system. Such a superradiant resonance holds promise for the development of a new class of radiation sources that generate high-frequency coherent light by utilizing a low-frequency coherent source. *NH*

LASERS

Air laser insight

Phys. Rev. X **3,** 041009 (2013)

Lasing of optically excited molecular nitrogen ions, which occurs in so-called air lasers, has been studied by an international team of scientists. Haisu Zhang and co-workers have discovered that the stimulated emission of such a system contains periodic modulations in the time domain that are directly related to the coherent rotational wave packets of the molecular nitrogen ions. Indeed, the rotational wave packets of the molecules can be reconstructed in a single-shot manner from the frequency-resolved laser spectrum. The team says that this finding is important for two reasons: it provides new insights into the operation of such air lasers, which are currently not well understood, and it suggests that an air laser is a promising tool for remote characterization and reconstruction of rotational wave packets produced in the atmosphere during the free propagation of intense femtosecond laser pulses. *OG*

LASERS

Ultraviolet nanorod lasers

Appl. Phys. Lett. **103,** 191102 (2013)

Miniature metal-clad semiconductor pillars are very promising for realizing nanoscale lasers for use in chip-scale photonic integrated circuits. However, such nanolasers almost invariably have to be operated at cryogenic temperatures because of their high optical losses and low quality factors. Now, researchers in Taiwan have developed an ultraviolet (~365 nm) aluminium-clad GaN nanorod laser that operates at room temperature with a low threshold power density of 5.2 mJ cm^{-2}. They achieved this by incorporating an additional wet-chemical etching step with potassium hydroxide during the fabrication of the nanolaser. This step created nanorods with very smooth and vertically straight sidewalls that are truly perpendicular to the substrate. The alignment of the nanorods is especially important as finite-element simulations indicate that the quality factor of the lasers will drop by nearly a third when the sidewall angle is reduced from 90° to 89°. The high-quality-factor plasmon lasing modes were characterized by both experiments and simulations. *SP*

LASER SURGERY

Treating flies

Proc. Natl Acad. Sci. USA **110,** 18374–18379 (2013)

Microscopy and neurophysiology studies of live animals generally require time-consuming preparation procedures involving complex surgery. Such manual procedures require high dexterity and can introduce unwanted variability into experiments. Now, researchers at Stanford University in the USA have developed a largely automated laser surgical technique that can reduce processing time by a factor of about four for surgery on a single fly (even greater reductions are possible by processing a batch of flies). The researchers use a 193-nm excimer laser to create observation windows with diameters in the range 12–350 μm in the heads of fruit flies. The scientists claim that the surgery does not disrupt the complex behaviours of the flies and that it permits fluorescence brain imaging of alert flies for durations of up to 18 h — over four times longer than that for manual dissection. The laser surgery can also be used for other species, as demonstrated by the creation of microsurgical openings in nematodes, ants and the mouse cranium. *SP*

SINGLE-PHOTON SOURCES

Electrical drive

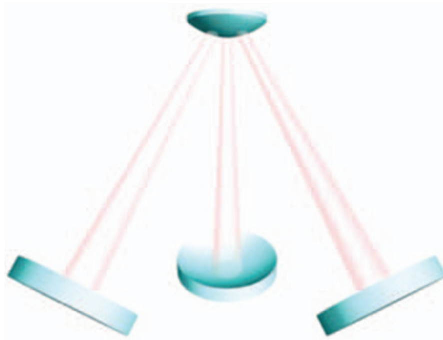
Appl. Phys. Lett. **103,** 162108 (2013)

Quantum dots are potentially an attractive source of single photons for applications in quantum information processing, because, unlike diamond–nitrogen vacancy centres and trapped ions, they can be controlled electrically and are amenable to on-chip integration. Although electrically driven resonant-injection quantum dots have been reported before, single-photon emission has not been demonstrated previously. Now, Michael Conterio and co-workers from Toshiba Research Europe and the University of Cambridge in the UK have observed just that. Their single-photon sources are p-i-n devices grown by molecular beam epitaxy. A layer of self-assembled quantum dots is grown inside a 30 nm intrinsic region of GaAs. Tuning the applied bias to induce resonant tunnelling in the dots allows the team to selectively measure the emission from a single dot in the ensemble, without using spectral filtering. A coherence time of 110 ± 2 ps was measured, corresponding to a linewidth of 20 ± 0.4 μeV, which is nearly an order of magnitude smaller than that previously achieved in resonant electrical injection devices. *RW*

OPTOMECHANICS

Mirror levitation

Phys. Rev. Lett. **111,** 183001 (2013)



Controlling optomechanical interactions at the quantum level is challenging. The main barrier to reaching the quantum regime is thermal coupling to the surrounding environment. If a system can be effectively isolated, it will be free from thermal fluctuations. Now, Giovanni Guccione and co-workers from the Australian National University and Tianjin University, China, propose the use of a tripod-shaped optical cavity that enables a mirror to be optically levitated by radiation pressure associated with the intra-cavity fields. Calculations suggest that if the levitated mirror is made of fused silica with a mass of 0.3 mg, a diameter of 2 mm, and a reflectivity of 99.998%, a total power of 3 W in the three cavity beams and a cavity finesse of 1,000 will provide a sufficiently large force to suspend the mirror. The levitation region was estimated to be 30 nm wide in the horizontal directions, and 1 nm high in the vertical direction. The researchers say that the approach provides a useful platform for not only studying quantum and classical optomechanics but also performing gravitational field sensing and quantum state generation. *NH*

Written by Oliver Graydon, Noriaki Horiuchi, David Pile, Simon Pleasants and Rachel Won.