TRAPPING

A marriage of atoms and ions

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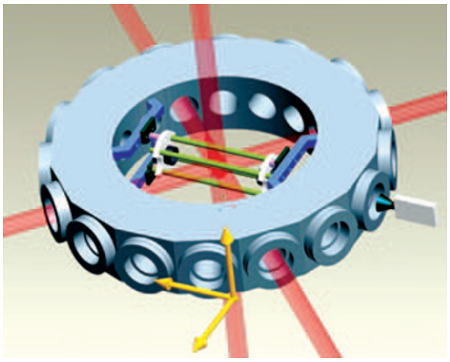

Scientists from the Raman Research Institute in India and the Johannes Gutenberg University in Germany have unveiled a device that can simultaneously trap both ions and cold atoms. The apparatus combines a linear radiofrequency Paul trap for ions with a six-laser-beam magneto-optical trap for atoms. Spatial overlap between the traps allows the investigation of ion–atom interactions at low temperatures. The researchers cooled the atoms by laser Doppler cooling using light from an amplified home-made external-cavity diode laser. They tested their design with ^{85}Rb atoms and ^{85}Rb^{+} ions, which were made by using two-photon ionization to strip electrons from ^{85}Rb atoms. The researchers say that the scheme also lends itself to any species that can be laser-cooled in a vapour cell, and that experiments with multiple species may even be possible. *OG*

SENSORS

Photon counting

Appl. Phys. Lett. **99,** 201110 (2011)

Distributed temperature sensing can be useful for monitoring structures such as buildings and pipelines. Michael Tanner and colleagues from Heriot-Watt University in the UK and the National Institute of Standards and Technology (NIST) in Colorado, USA, have now built a distributed fibre Raman sensor that can simultaneously measure absolute temperature at over 100 1.2-cm-spaced positions along a single-mode optical fibre. Although distributed fibre sensors have been around for a while, the researchers claim that previous research focused on using multimode fibres and avalanche photodiodes, which limited detection wavelengths to around 800–900 nm. In contrast, this latest work uses pulses of 1,550 nm light and measures the single-photon level Raman backscattered signal using superconducting nanowire single-photon detectors. The researchers used a time-of-flight approach to determine the temperature profile along the fibre. They recorded temperature measurements at various positions along the fibre with an uncertainty of less than 3 K over a period of 1 minute. They hope that a 1-km-range distributed sensor will be possible in the near future. *DP*

QUANTUM OPTICS

Coherent photon conversion

Nature **478,** 360–363 (2011)

Entangled photons are key elements of quantum information processing and communications technology such as quantum key distribution. Unfortunately, current schemes for achieving entangled photon generation are inefficient because of the probabilistic processes involved. Now, Nathan Langford and co-workers from Austria, UK, Canada and Japan have proposed a deterministic process called coherent photon conversion that could be more suitable for practical applications. The key principle of coherent photon conversion is the use of classically pumped nonlinearities to induce coherent oscillations between different multi-excitation states. The resulting approach offers a new way to generate and process quantum states for quantum information processing tasks such as multiphoton entanglement and the realization of optically switched quantum circuits. The researchers demonstrated their approach by using a four-colour nonlinear process in a standard commercial, polarization-maintaining photonic crystal fibre with a 532 nm pulsed laser and a 710 nm diode laser. *NH*

SOLITONS

Passive Kerr observation

New J. Phys. **13,** 113026 (2011)

Scientists in France claim to have observed the first experimental evidence of dissipative solitons in a one-dimensional Fabry–Pérot passive Kerr cavity. Eric Louvergneaux and co-workers from the University of Lille filled a Fabry–Pérot cavity comprising two 81%-reflective parallel mirrors with a 50-μm-thick layer of E7 liquid crystal. When pumping the cavity with a 532 nm beam from a frequency-doubled Nd^{3+}:YVO_4 laser, they observed two regimes of operation: a modulational instability regime and a bistability regime. In the bistability regime, the researchers observed the existence of either three independent solitons or a complex soliton comprising two locked solitons. Although this experiment was limited to the creation of one-dimensional solitons, the scientists are confident that their approach can easily be extended to two dimensions and are now working on making this a reality. *OG*

OPTICAL ISOLATORS

Single-photon performance

Phys. Rev. Lett. **107,** 173902 (2011)

Unwanted feedback caused by reflections between optical components can have a deleterious effect on quantum optical devices. Avoiding feedback requires the use of optical diodes, also known as isolators, which support the propagation of photons in one direction while prohibiting propagation

SOLAR CELLS

Fano-enhanced performance

Phys. Rev. A **84,** 053818 (2011)

Quantum coherence between competing energy-level pathways is known to help optimize photosynthesis and enable phenomena such as lasing without inversion. Researchers from Texas A&M University and Princeton University in the USA have now suggested that quantum coherence could also be used to enhance the performance of solar cells. One idea is to split degenerate excited energy levels by exploiting tunnelling between two adjacent quantum dots. The two split energy levels (known as an energy level doublet) both couple to the conduction state. Fano interference between the two pathways minimizes unwanted radiative transitions and helps to maximize the generated photocurrent. An alternative approach is to create an energy level doublet from two lower-energy levels and use Fano interference to enhance the absorption of solar energy. Theoretical analysis of this scheme suggests that the photocurrent and peak power of a photovoltaic cell employing fully coherent Fano interference could be improved by up to 50%. The researchers also suggest the possibility to engineer the cell such that the Fano interference is robust against environmental decoherence. The challenge now is for the research community to realize such a cell in practice. *OG*