seen in Fig. 1e,f, respectively, the resonant frequencies of the left and right cavities are both detuned from the laser line. Hence, few photons can enter to the left cavity and by extension to the right cavity. However, when $\theta < 0$, the resonant frequencies of both cavities overlap with pump light, producing a flood of pump photons in the left cavity. Within this narrow window of motion, photons dynamically tunnel from the left to the right cavity, producing a form of photon shuttling. This photon shuttling is observed as a burst of photons exiting the right cavity as the system self-oscillates.

In addition to these unusual physical behaviours, this see-saw system could form the basis for highly precise sensing technologies on a chip. With higher *Q*-factor optical resonators, the spatially extended coupling provided by such see-saw devices could also enable the observation of a host of new parametric and quantum interactions through nontrivial coupling between distinct cavity systems[17].

More generally, the steady march from individual optomechanical systems to coupled optomechanical ensembles provides many unique opportunities for new device physics and powerful optomechanical functionalities. For instance, the extended coherence provided by long-range excitations[7,9], ensembles of modes[9] and reservoir engineering[8] provides additional degrees of freedom with which single-phonon detection, coherent state transfer, entanglement and quantum state tomography can be accomplished. In the classical realm, extended coherence is the key to creating symmetry breaking, non-reciprocal systems, filtering, wide-band amplification, sensing, signal processing and memory. ❐

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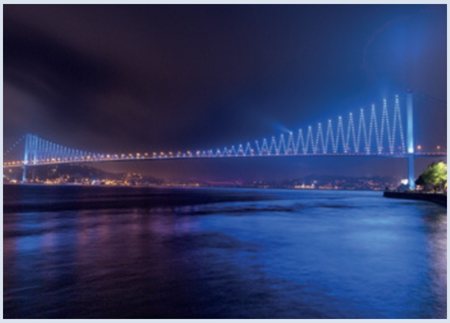
NOBEL PRIZE IN PHYSICS

Nitrides in the spotlight

In Istanbul there is a bridge that connects Europe to Asia. This symbol of merging cultures is called the Bosphorus Bridge and it opened in 1973. When it first opened, however, it did not look as glamorous as it does today — since 2007, it has been lit by thousands of light-emitting diodes (LEDs), which make up a sophisticated decorative illumination system (pictured). As well as the aesthetic improvement, this switch to LED-based lighting halved the energy consumption of the bridge's lighting.



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LEDs are efficient, low-power light sources that are now used in a range of applications, from flat-screen displays to urban illumination. They have revolutionized lighting applications because they achieve brighter emission at lower energy costs than incandescent or fluorescent bulbs. For comparison, LEDs can reach an efficiency of 300 lumen per watt, which is almost 20 times higher than incandescent bulbs. They also last much longer — 100 times more — than conventional light bulbs.

In LEDs, light is generated from electrically driven radiative recombination of electrons and holes, which occurs at the junction between positively and negatively doped semiconductors. Depending on the bandgap of the semiconductor materials, visible light with certain wavelengths is generated — the narrower the bandgap the longer the wavelength. For home or industrial lighting purposes, sources of white light can be obtained by combining LEDs that emit red, green and blue light. Alternatively, blue LEDs can be combined with phosphorescent materials that convert blue into red and green light, allowing the entire visible spectrum to be covered. While compound semiconductors based on Ga and P, which can emit red or green light, have been used for over 50 years to produce commercial LEDs, the development of blue LEDs proved to be significantly more difficult.

In the early days of LEDs, GaN was identified as a potential candidate for the emission of blue light, but challenges in the doping and growth of heterostructures based on this material prevented the development of blue LEDs for over 30 years. However, in the 1980s, Isamu Akasaki and Hiroshi Amano of Nagoya University, Japan, optimized the growth process to obtain high-quality GaN. They also made important observations on the properties of GaN doped with positive charges, which were later explained by Shuji Nakamura of the Nichia Chemical Corporation, opening the way for the fabrication of GaN-based heterostructures. By the early 1990s, both Akasaki's and Nakamura's teams had achieved blue light emission from GaN-based heterostructures.

These discoveries led to the development of white light sources that use only 10% of the energy that incandescent bulbs require. Considering the fraction of worldwide energy consumption that is attributable to lighting — about one fourth — the potential significance of these light sources is clear. In recognition of their importance, the Nobel Prize in Physics was this year awarded to Akasaki, Amano and Nakamura "for the invention of efficient blue light-emitting diodes which has enabled bright and energy-saving white light sources."

ELISA DE RANIERI