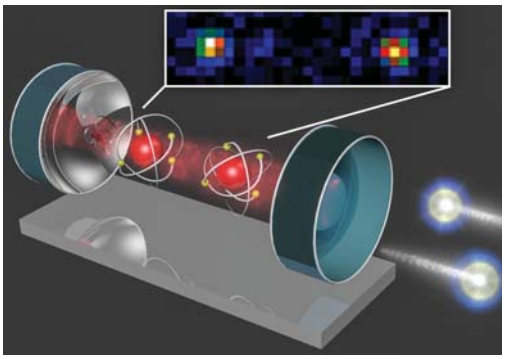
CARVING OUT ENTANGLEMENT

Physicists usually build entanglement from the ground up, by forcing multiple atoms, ions, or photons into close contact. Now, following up on a 2003 proposal by Anders Sørensen and Klaus Mølmer, researchers at the Max Planck Institute of Quantum Optics in Germany have sculpted their way to entanglement by removing undesired components of the wavefunction that describes two atoms.

Stephan Welte and colleagues loaded a pair of rubidium atoms into a 0.5-mm-long cavity and optically pumped both atoms into a given state—for example, spin down. A laser pulse then rotated the atoms, creating a superposition of up and down states in each atom but still no special relationship between the atoms. To initiate entanglement, the researchers injected linearly polarized photons to bounce around the cavity. (In the illustration here, photons are shown in blue and atoms in red; the inset is of a fluorescence image from a trial.) A measured shift in one photon's polarization indicated that it had encountered an atom in the up state; a second photon's polarization shift signaled a brush with an atom in the down state. The photon interventions served to chip away the down–down and up–up components from the wavefunction of the atomic pair. Left behind were wavefunction states in which the rubidium atoms could not be described separately—the atoms were maximally entangled.



Because the wavefunction-carving technique relies on photons rather than interatomic forces, it should work even if the atoms are spaced far apart in a large cavity. Researchers also should be able to entangle two qubits in a larger ensemble of atoms. Welte and his colleagues hope to demonstrate that the technique could be useful in quantum repeaters, which could preserve and relay the entanglement between qubits spaced hundreds of kilometers apart. (S. Welte et al., *Phys. Rev. Lett.* **118**, 210503, 2017.) —AG

BLACK CARBON IN ANTARCTICA

Snow-covered surfaces in Antarctica are among the cleanest and most reflective on Earth. Yet even on the remote continent, light-absorbing particles from fossil-fuel emissions embed themselves in snow and reduce the amount of solar radiation reflected back to space. Humans' contribution to snow–albedo feedback is a key component in climate models, but it remains poorly constrained because many current remote sensing systems and algorithms only roughly estimate the physical characteristics of exposed snow.

Now scientists led by Kimberly Casey of NASA's Cryospheric Sciences Laboratory and the US Geological Survey's Land Remote Sensing Program have directly measured the composition and spectral response of Antarctic snow, which let them better determine the effect of pollution on snow radiative energy balance. At seven sites around the Amundsen–Scott South Pole Station during the southern summer of 2014–15, Casey and her team measured surface reflectance with a portable spectrometer that detects solar radiation from visible to shortwave IR. The researchers determined grain sizes and element concentrations in collected snow samples using analytical chemistry, microscopy, and spectroscopy techniques. The data show that high concentrations of trace elements and black carbon result in radiative forcing up to 70 W/m^2, nearly two orders of magnitude above that of clean snow.

Casey and coworkers found that even snow that appears as white as its surroundings to the naked eye (see photo) can be significantly less reflective than truly pure snow. By the time particles have collected on snow and ice at visibly noticeable levels, their radiation effect has likely reduced the albedo by at least 25%. Casey hopes the new results demonstrate the importance of quantifying pollutant impacts on snow albedo reduction and improving climate models' accounting of how blackened snow affects reflectance. (K. A. Casey et al., *J. Geophys. Res. Atm.*, in press, doi: 10.1002/2016JD026418.) —RB

SHEPHERDING DNA WITH LIGHT AND ENTROPY

To analyze single molecules, including DNA, scientists need to manipulate and transport them through fluidic pathways. Using entropic nanoconfinement, they can pin DNA and other nano-sized species near constrictions in fluidic channels. To drive transport, researchers also exploit plasmons, electron oscillations in metals that resonate when excited by light. Localized heat from light-induced plasmon excitations produces thermal gradients and fluid motion that propel molecules forward. However, combining nanoconfinement with plasmonic transport has been a challenge. Nanoconfinement demands fluid channels that are less than the radius of gyration of the desired molecule—for many DNA molecules, that's about 0.5 μm—whereas plasmonic flow-based transport requires channel heights greater than 1 μm.

Now Anders Kristensen at the Technical University of Denmark and colleagues have succeeded in joining the two techniques. Their demonstration of directed DNA transport opens the door for light-controlled manipulation of biopolymers in readily available microscope systems. The trick was embedding metallic V-shaped grooves in the nanofluidic channel. The tapered design of the grooves brings multiple length scales, and thus both mechanisms, into play: Large trapping potentials confine molecules, while plasmon-induced thermal gradients shuttle them along. The improved approach, with its impressive control and flexibility, prevents clumping and photodamage of biomolecules and enables propulsion of DNA. The researchers are looking to use their apparatus to perform site-specific chemical analysis of DNA and other biomolecules. (C. L. C. Smith et al., *ACS Nano* **11**, 4553, 2017.) —KS PT