ENTOMOLOGY

To catch a bee

Many organisms rely on other species to transport them from one spot to another — particularly in harsh environments where such meagre resources as there are tend to occur in clumps. As Leslie S. Saul-Gershenz and Jocelyn G. Millar report (*Proc. Natl Acad. Sci. USA* doi:10.1073/pnas.0603901103; 2006), one species of the blister beetle *Meloe franciscanus* is a particularly innovative passenger: it can hail its taxi ride.

This blister beetle lives in the deserts of the southwestern United States. It feeds and lays its eggs under a plant that also provides nectar for the beetles' host and transporter species, a solitary bee of the species *Habropoda pallida*. Larvae of the beetle cooperatively form a spherical mass on the plant (right image), and simply hitch a ride when a male bee intent on mating with a female makes contact (left image). When the infested male copulates with a real female, the larvae are transferred and carried to the bee's nest. There they set up camp, and complete their development into adults nourished by the pollen and nectar stores of the nest and by the bee's egg.

Saul-Gershenz and Millar set out to test what lures the bees to make contact with the larvae in the first place. They found that visual models of the larval aggregations held no interest for the bees — but if the models were scented with an organic extract from either the larvae or the female bee's head, the bees found them just as enticing as real larvae.

Comparison of chemical profiles of the larval and bee extracts identified two alkene molecules common to the larvae and female bees that were not present in the males. And this heady blend of alkenes did indeed attract the male bees. It seems the beetle larvae have evolved a way to exploit the bee's sexual communication system as a means of calling a cab.

Helen Dell

Quantum electromechanics is still an emerging field. In experiments with nanomechanical devices, making the transition from the classical realm to the quantum world means that the random thermal fluctuations must be frozen out, allowing the so-called zero-point motion to come to the fore. This is achieved by cooling the devices to such low temperatures that the occupation of the fundamental vibrational energy modes is suppressed. But it is precisely in this cryogenic regime that thermal contact between these modes and the outside world falls precipitously[9], making it increasingly difficult to cool a device into the quantum regime.

An unexpected consequence of the latest work[3] may help in this matter. Naik and colleagues show that orchestrating a strong coupling between the cooled SSET and the nanomechanical resonator actually chills the latter. In other words, the very act of observing can make an observed object colder. Closer analysis shows that this surprising effect is formally analogous to the phenomenon of 'optical' trapping and cooling of atoms by laser light[10–12]. Both effects rely on back-action from an ensemble of discrete particles — whether correlated electrons or laser photons. These particles interact resonantly at a rate that depends on the motion of the observed object (the nanoresonator or atoms to be cooled).

In both cases, the back-action forces are engineered to damp, rather than excite, the object's motion. The overall effect is that the fluctuating interactions with the object provide it with a 'thermal bath', at a temperature lower than ambient, into which its energy can be absorbed. The puddle of barely moving atoms that resulted from optical cooling and trapping earned the name 'optical molasses'. In recognition of the inspiration drawn from that work, which won the 1997 Nobel physics prize, the authors call their effect 'Cooper-pair molasses'. From here, further advances along these lines will engender even deeper penetration into the strange realm of quantum electromechanics, which lies at the junction between the classical and quantum worlds. ■

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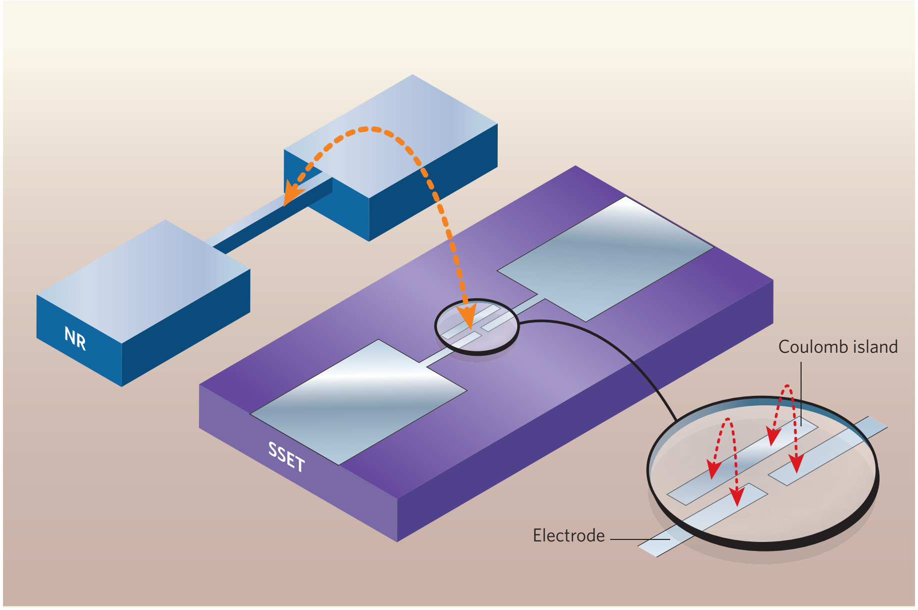

Figure 1 | Cooper-pair molasses in action. Naik and colleagues' experimental set-up[3] consists of a nanomechanical resonator (NR) comprising a suspended, doubly clamped, nanometre-scale beam electrostatically coupled (orange arrow) to a superconducting single-electron transistor (SSET). Back-action arises from the intrinsic charge fluctuations during the operation of the device. These fluctuations are due to discrete quantum-mechanical tunnelling events of quasiparticles or Cooper pairs (red arrows) between the electrodes and an isolated, conducting 'Coulomb island'.

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