as required for quantum information processing. Another benefit of ion crystals is their long trapping time, which is on the order of hours[6], compared with seconds for neutral-atom traps.

The collective interaction of an ion crystal and a cavity field is attractive not only for reaching the strong-coupling regime. By making use of the magnetic sublevel structure of the ions, the system of Herskind *et al.*[6] may be turned into an almost ideal quantum memory for photons. Using an external control beam coupled to a transition involving the same upper level as the cavity but a different lower state, any superposition of photon states can be mapped to a corresponding superposition of collective atomic states[9]. Preliminary measurements[6] gave coherence times on the order of milliseconds, already four orders of magnitude longer than the photon decay time in the cavity. Based on their cooperativity, the authors expect a transfer fidelity of more than 90%.

The collective coupling strength can be further improved; by surrounding the calcium-40 ions with ions of a heavier isotope, a strictly periodic structure of the central ion crystal can be obtained, so that all ions couple maximally to the standing wave in the cavity. The second ion-species could also provide continuous cooling of the crystal. Such bi-crystals have already been produced in the same lab where the work of Herskind *et al.*[6] was carried out, giving them a unique set of tools to realize an efficient and long-term quantum memory for photons. ❐

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INFORMATION TRANSMISSION

Gone up in flames

An early way of signalling information across large distances, without needing a messenger, was through the use of beacons. Centuries before the advent of electric telegraphy, fires placed at exposed points would form successive stations of a relay to warn, for example, of enemy troops approaching. (Pictured is an illustration from Alexis Belloc's 1888 book *La Télégraphie Historique* showing ancient Greek warriors using smoke signals to communicate.) Even today, suggest Samuel Thomas and colleagues, combustion-based systems for information transmission might have something to offer (*Proc. Natl Acad. Sci. USA* **106,** 9147–9150; 2009).

Instead of piles of wood, Thomas *et al.* use flammable nitrocellulose strips on which information is encoded in the form of dots containing different alkali-metal salts. Once such an 'infofuse' is ignited, it emits a series of light pulses — at a rate of 5–20 Hz — as the flame front makes its way down the strip. Burning nitrocellulose produces hardly any smoke that would obstruct the view of the embers, and the emitted light pulses can be conveniently detected using either a colour camera or a spectrometer placed a couple of metres away from the burning fuse.

In their proof-of-principle demonstration, Thomas *et al.* encode an alphabet of 40 characters into pairs of pulses, each of which can have one or several colours, depending on whether the emission comes from lithium, rubidium and/or caesium. The spectra of these alkali metals consist of sharp, non-overlapping lines, making them suitable for encoding information. Parameters such as signal intensity, pulse duration and pulse spacing offer further degrees of freedom to play with.

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So where could 'infochemistry' — as Thomas *et al.* dub this combination of information technology and chemistry — lead? They point out that infofuses are lightweight, self-powered and do not directly require electronics (the message transmitted in their first experiments was "LOOK MUM NO ELECTRICITY"). But ultimately, as these systems can interact chemically with their environment, the most interesting applications might be in the field of sensing, where the approach could be used both to detect and process chemical inputs, and to transmit the results.

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