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A chemical engineer is struck by the strange properties of 'patchy' colloids.

A recent paper about the behaviour of colloids makes an intriguing prediction — suggesting that they can adopt an 'empty' liquid state.

I study disordered states of matter, such as liquids and glasses. I find colloids interesting because they make phenomena such as crystal nucleation and the glass transition amenable to direct observation. Nanometre- or micrometre-sized particles suspended in liquids are wonderful model atoms. They arrange themselves in the same way that atoms and simple molecules do into solids, liquids or gases.

But controlling the interactions between colloidal particles provides a window into structural and thermodynamic behaviour beyond that found in atomic systems, as this recent theoretical paper shows (E. Bianchi *et al*. *Phys. Rev. Lett*. **97**, 168301; 2006).

It maps the phase diagrams of 'patchy' colloids. The particles in such colloids are decorated with sticky spots, which tend to bond them together. As the number of bonded neighbours per particle is reduced towards two, the phase diagrams predict liquid states with a vanishing packing fraction. This means the colloidal particles occupy a tiny fraction of the available space — but they still behave as a liquid that is distinct from the gas-like phase of still lower packing fraction.

The low-temperature behaviour of such 'empty' liquids is especially interesting. The calculations suggest that cooling the colloid can freeze in place the empty configuration to give a glassy state of arbitrarily low density.

These predictions have not been tested experimentally. But chemists have already developed techniques for making patchy particles, so the work of Bianchi et al. could guide experimentalists in their exploration of this fascinating form of matter.

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