Nagamanasa *et al.* showed that details of their experiment matched other predictions of RFOT. For example, particles with large displacements occur in localized groups, and the shape of these groups becomes more compact as the glass transition is approached.

Ideas of a subtle structural length scale in amorphous materials are more general than the RFOT theory[1,12]. Nonetheless, the experimental work of Nagamanasa *et al.*[2] confirms the existence of the point-to-set length scale, and thus provides important experimental evidence supporting the RFOT ideas. Ultimately, the combination of the simulations and experiments reveals crucial relations between amorphous structure and dynamics — suggesting that amorphous structure may not be quite as amorphous as we thought. ❐

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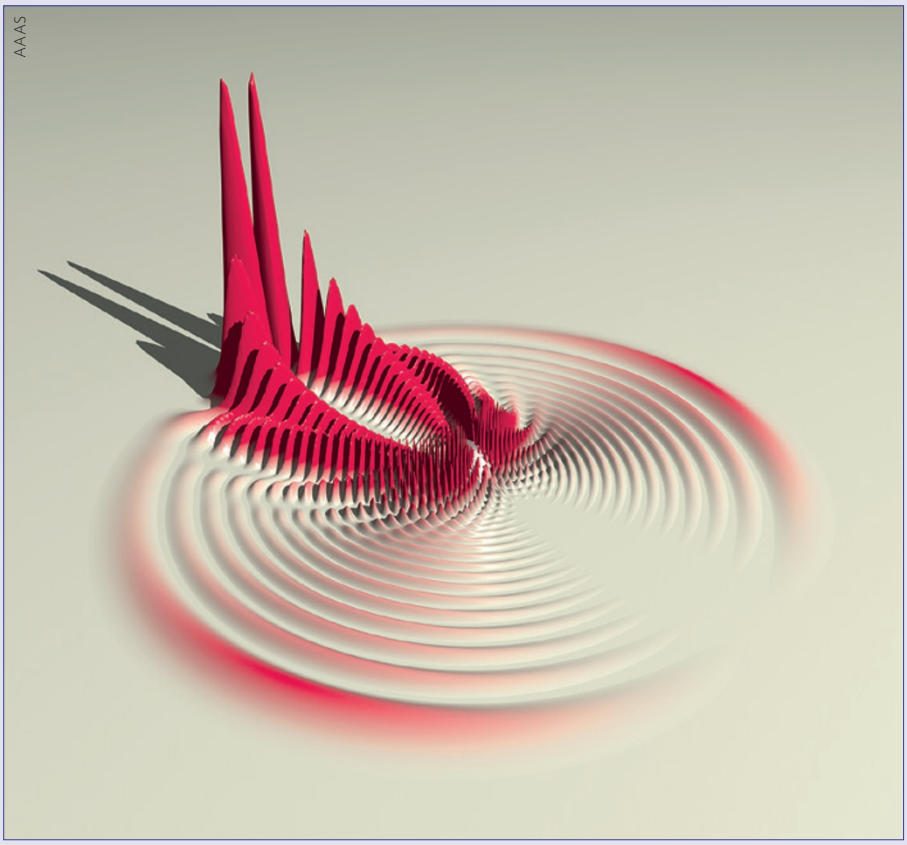
MOLECULAR PHYSICS

Tiny giant

Behold this little beast: a trilobite Rydberg dimer (pictured). These exotic trilobite molecules — named for the resemblance between their electron probability distributions and fossilized ancient marine creatures — are unusual in many ways. Theoretically predicted by Chris Greene and co-workers more than a decade ago (*Phys. Rev. Lett.* **85,** 2458–2461; 2000), they are ultra-long-range molecular Rydberg states. These are highly excited states with very large principal quantum numbers and high orbital angular momenta coupled to a ground-state atom of the same species. Due to the strong localization of the electron clouds, these dimers are expected to possess huge permanent electric dipole moments, of the order of thousands of debye. And this is quite surprising given that homonuclear molecules are symmetric and therefore should not have a dipole moment in the first place.



Greene *et al.* predicted that trilobite Rydberg molecules could be produced in Bose–Einstein condensates, and the obvious experimental target has been rubidium. But Donald Booth and colleagues have now shown that caesium atoms, due to peculiarities in their low orbital angular momentum energy states, can be bound in a hybrid molecule with a mixture of high and low orbital angular momentum states, yielding permanent electric dipole moments of thousands of debye (*Science* **348,** 99–102; 2015). To put this into perspective, the dipole moment of water is 1.85 debye and even very polar molecules like sodium chloride have dipole moments of 9 debye.

The caesium dimer observed by Booth *et al.* has a bond length of around 100 nanometres. This is huge — stretching the very definition of a chemical bond. In comparison, the diameter of a C_{60} fullerene is about 1 nanometre, with its carbon bonds measuring roughly 1 ångström. Still, this may not come as such a surprise if we recall that the orbits of Rydberg electrons can be as large as 8 micrometres: comparable — or even larger — than the Bose–Einstein condensate they are part of.

One can readily envisage applications for these trilobite Rydberg dimers, ranging from ultracold chemistry to the study of strongly correlated many-body physics. But irrespective of whether these will materialize or not, creating these molecules adds a new creature to the ultracold atom menagerie of exotic states.

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