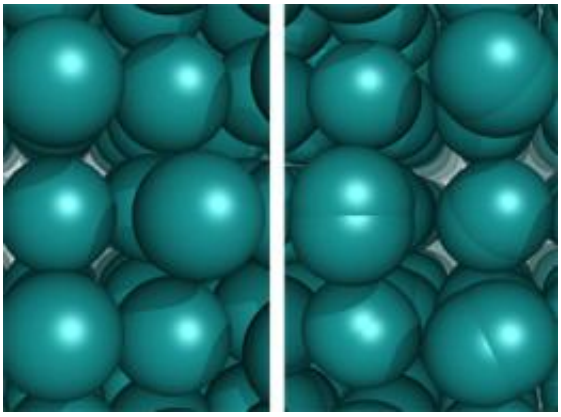
Tangling the microscopic ladder

December 17 2010



Atoms usually have one particle per point in a lattice (left). But simulations show conditions where crystals can have multiple particles per lattice point (right).

If a ladder had more than one rung at each step, it would look awkward and would be a bit dangerous to climb. Ladders in the microscopic world were thought to be similar in structure, having only one particle, or rung, in each step in the lattice of a crystal.

But theorists have conceived of structures where multiple particles could sit at one lattice site and have now simulated how these structures might form and behave for a range of temperatures, pressures and densities.

The result seems to defy the idea that repulsive forces typically keep particles apart. But “nature is not as simple as it appears,” says Patrick Charbonneau, a theorist jointly appointed in the chemistry and physics departments at Duke.

In simulations of cooled, compressed particles, he and his colleagues, Kai Zhang and Bianca Mladek, identified particles that began to mingle and overlap to occupy the same lattice site, rather than move away from each other.

Details of the work appear in the Dec. 10 issue of *Physical Review Letters*.

“We’re not sure how these overlaping particles would look in nature,” Charbonneau says. But confirmation of the theory could improve scientists’ understanding of exotic matter, like Bose-Einstein condensates and electron bubble crystals, or even the interactions among chain-like molecules, such as certain polymers and dendrimers.

Provided by Duke University