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Quantum motor would run with kick

Scientists propose a way to put two ultracold atoms to work

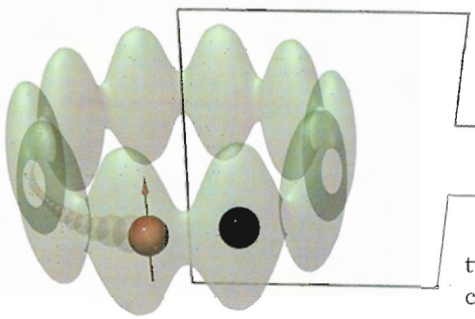
By Laura Sanders

Physicists have proposed a way to get their quantum motor running. An electric motor could be built from just two atoms held in a ring by lasers, a theoretical study published online June 8 in *Physical Review Letters* contends.

The proposal "might be hard to implement, but it has the core of a good idea," comments Ian Spielman of the Joint Quantum Institute in College Park, Md.

Electric motors, like the ones in fans, convert electric current into mechanical motion, such as spinning blades. "The idea of a quantum motor is exactly the same as a mechanical motor," says study coauthor Alexey Ponomarev of the University of Augsburg in Germany. "You have an electromagnetic force that launches it."

Because of the inherent weirdness in the quantum world, an electromagnetic force would set a quantum motor rotating counterclockwise and clockwise at the same time, resulting in no net movement. The theory put forth by Ponomarev and his Augsburg colleagues Sergey Denisov and Peter Hänggi suggests a way to get around this problem and build a quantum system with net movement, which could ultimately be harnessed to do work.



A proposed quantum motor that may one day do work would be made up of a carrier atom (brown with an arrow) and a starter atom (blue) trapped in a ring.

In the proposal, two ultracold atoms are held in a 100-micrometer-wide ring made up of confined spaces created by lasers. Researchers apply a magnetic field to the ring. One of the atoms, the carrier, is electrically charged, feels the magnetic flux and moves — but yields no net motion. An uncharged atom called the starter provides a kick to the carrier atom once the two are nestled in the same well of the laser ring, like two eggs in the same compartment of a carton. This kick causes the carrier atom to have net motion, Ponomarev says.

Next, the researchers introduced a gravity-like force into their equations to see if the motor could perform work against the force. The team found that, under certain conditions, the atoms in the motor would have net motion against the force, akin to water flowing uphill.

Experimentalists will have some challenges to overcome before a quantum motor can be built, Ponomarev says, and possible applications are still unclear. "How can you use it in real life? It's not so obvious," he says.