The fun way to manipulate atoms

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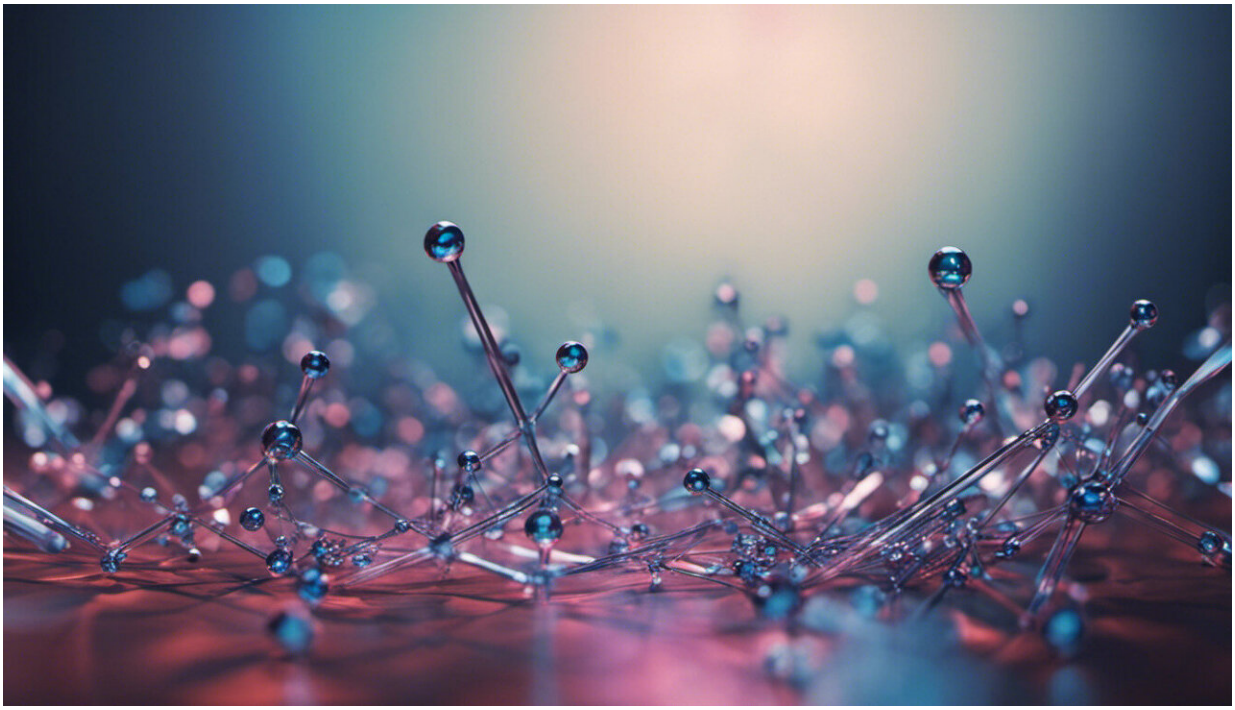

Credit: AI-generated image (disclaimer)

With their potential to perform calculations far beyond the reach of conventional supercomputers, machines harnessing certain quantum physics phenomena are expected to change the way the world solves complex problems. They will help scientists develop more efficient solar cells and more effective drugs, and even have an impact on artificial intelligence. This is because unlike today's computers that work by manipulating binary bits existing in one of two states, a 0 or a 1,

quantum computers use qubits, or quantum bits. These represent a state of an atom or elementary particle (such as the spin) with an ability to store multiple values at once, a phenomenon known as superposition.

Such systems involve the notion of quantum entanglement—what Albert Einstein once called spooky action at a distance. They can't be described independently of each other, regardless of how far apart they are. Thanks to this entanglement property, individual qubits could be linked to each other in such a way that they can possess information about the rest of the register. This allows quantum computers to process data simultaneously versus sequentially, running algorithms in record time. However, it's a real challenge to generate entanglement and manage qubits.

Enter the EU-funded RYSQ project that has made great strides in improving scientists' understanding of many-body quantum systems. The project ended in 2018, but a team of scientists, game developers, designers and visual artists based at project partner Aarhus University have recently developed a fun way of teaching the dynamics involved in complex systems. The team believes its game and simulator called Rydbergator could be beneficial for the field of quantum computing.

How does it work?

The game focuses on atoms that interact with each other at a large distance. As can be seen on the team's website, the game makes use of Danish physicist Niels Bohr's model of the atom where electrons inside the atoms are jumping between different states. These are known as the ground state and the excited state. The ground state refers to the energy level an electron normally occupies. If it's given extra energy, for example, if it absorbs a photon or a packet of light, or collides with a nearby atom or particle, an electron can become excited.

The same website states: "The model accounts for spectroscopic investigations by the Swedish scientist Johannes Rydberg, and in particular, it reveals that electrons can orbit the atomic nucleus at a large distance, much like the outer planets in the solar system. Such orbits are referred to as Rydberg states, with the atomic electron placed on an orbit that is far from the ionic core." When that happens, even electrons in other atoms far away are affected in their motion, and this results in complex patterns of ground and excited state atoms in large atomic ensembles.

The three-year Rydberg Quantum Simulators (RYSQ) project was set up to capitalize on the versatility of Rydberg atoms in order to address a variety of quantum simulations. A video presents the game's features and invites the viewer to explore the game and simulate the excitation of atoms into Rydberg states.

More information: RYSQ project website: qurope.eu/projects/rysq

Provided by CORDIS

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