A photograph of D-Wave's 1000+ qubit computer chip under development. CfA scientists and their colleagues have proposed a new way to use photons of light instead of silicon chips as qubits, opening the door to new technologies. Credit: Google

Quantum mechanics incorporates some very non-intuitive properties of matter. Quantum superposition, for example, allows an atom to be
simultaneously in two different states with its spin axis pointed both up
and down, or combinations in between. A computer that uses quantum
mechanical manipulation of atoms or particles therefore has many more
possible options than a conventional one that works with "zeros" and
"ones" and has only two choices, called bits. A quantum computer's
memory uses instead what are called quantum bits - qubits - and each
qubit can be in a superposition of these two states. As a result,
theoretical physicists estimate a quantum computer with only about one
hundred of these qubits could in principle exceed the computing power
of the powerful current classical computers. Building a quantum
computer is therefore one of the main technological goals in modern
physics and astrophysics.

CfA physicist Hannes Pichler, of the CfA's Institute for Theoretical
Atomic, Molecular and Optical Physics (ITAMP), and three colleagues
have proposed a new way to build a quantum computer using just a
single atom. Light quanta (photons) can be used as information carriers
and act as qubits, but to use them in a quantum computer they must
interact with each other.

Under normal conditions, however, light does not interact with itself and
so the challenge is to create correlations between them. The key idea of
their new paper is to allow light photons from an atom to interact with
their own mirror image reflections. Photons that the atom emits are
reflected by the mirror and can interact again with the atom but with a
very slight time delay. That delay, the scientists show, results in the
combined waveform of the photons being so complex that in principle
any quantum computation can be achieved by simply measuring the
emitted photons.

The theoretical discovery is not only a conceptual breakthrough in
quantum optics and information, it opens the door to new technology. In
particular, the proposed single atom setup is appealing since it minimizes
the resources needed and relies only on elements that have already been demonstrated in state-of-the-art experiments.


Provided by Harvard-Smithsonian Center for Astrophysics

Citation: A new kind of quantum computer (2017, November 6) retrieved 9 July 2023 from https://phys.org/news/2017-11-kind-quantum.html

This document is subject to copyright. Apart from any fair dealing for the purpose of private study or research, no part may be reproduced without the written permission. The content is provided for information purposes only.