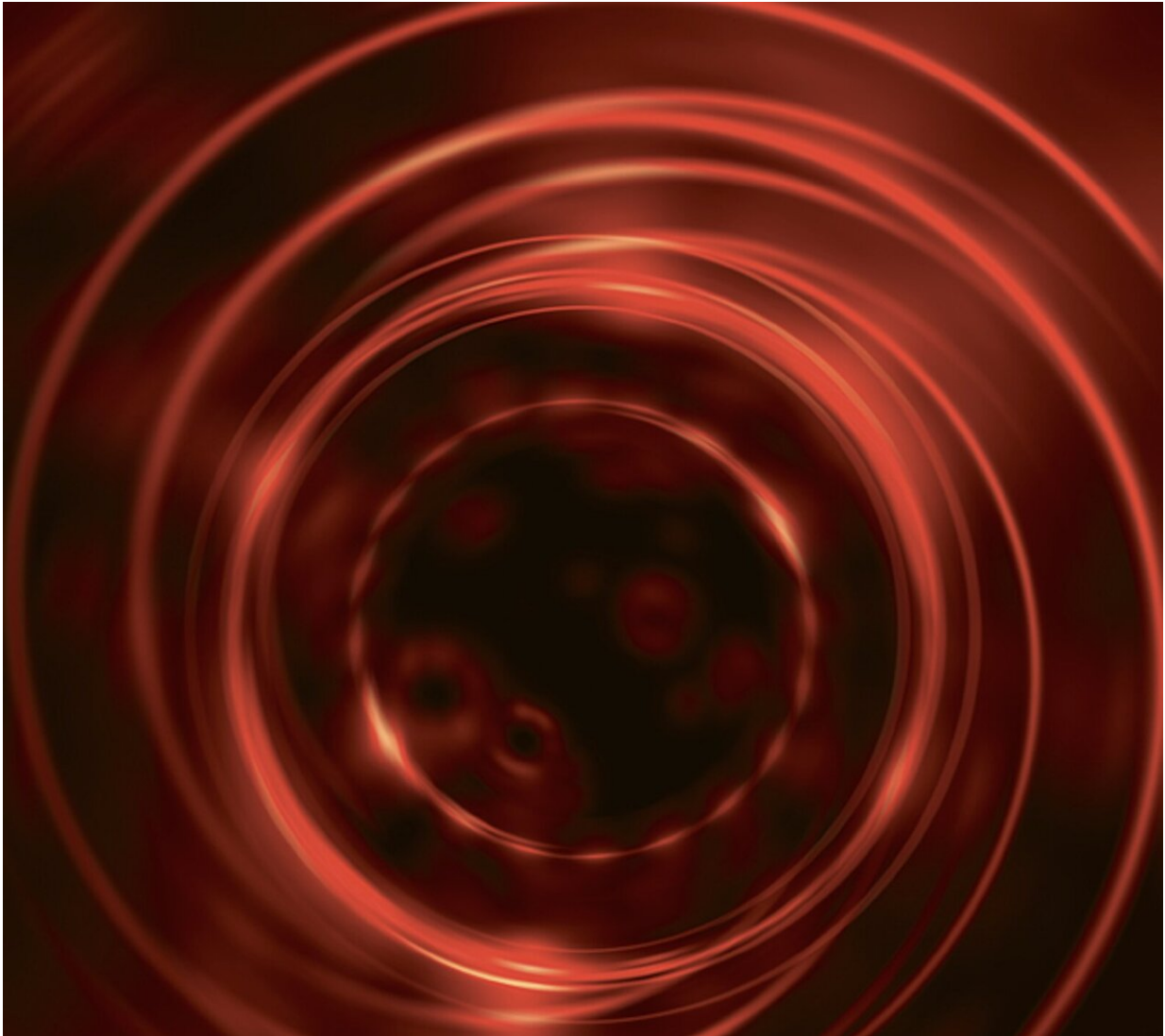


# Computing with spins of light

January 21 2020, by Simon Davies

---



Credit: fisher4/123rf

A laser system that generates spinning light particles could lead to the strong kind of computational power needed to solve complex biological problems. The system, which improves on previous ones, is described in the journal *Quantum Science and Technology*.

Some problems are too large and complex for even modern-day computers to solve. The [traveling salesman problem](#) is a typical example. This problem asks: Given a list of cities and distances between each pair, what is the shortest possible route that visits each [city](#) and returns to the city of origin? As the number of cities to visit increases, the possible number of routes to choose from becomes exponentially higher, taking more and more time to solve. A modern computer would take one billion years to solve a 60-city problem.

To try to solve [complex problems](#) faster, physicists are turning to spin systems, which are simplified models that describe the interactions between particles in a material. In the "XY model" of a spin system, particles form vortex-like patterns around multiple focal points. Imagine several drains in a large bathtub, with unidirectional flows of water going down each drain. Complex problems that involve directional data can be simulated by creating a physical system that emulates this XY model.

This sort of system could be used, for example, to predict the angles between bonds within a protein, determining how it is folded, for drug discovery and synthesis. It could significantly reduce the time needed to conduct complex probabilistic computing.

Physicist Yutaka Takeda of the Tokyo University of Science and colleagues in Japan improved an experimental set up that emulates the XY model. Their design features a [laser system](#) that generates pulses of [light particles](#) within a one-kilometer-long optical fiber cavity. The pulses are generated using a "nondegenerate optical parametric oscillator network," which ultimately generates 5,000 spins, i.e. flows of [light](#)

particles going down 5,000 different drains, within the cavity. It enables long simulations over several minutes within a stable system. This improves on previous oscillators that produced only 100 spins and simulation times that were limited to several tens of milliseconds.

The team demonstrated the spinning light particles within the optical fiber cavity accurately correspond to an XY [model](#).

"We hope that our work will motivate research in computation with physical systems and in algorithms that involve continuous and directional data," the researchers conclude.

**More information:** Y Takeda et al. Boltzmann sampling for an XY model using a non-degenerate optical parametric oscillator network, *Quantum Science and Technology* (2017). [DOI: 10.1088/2058-9565/aa923b](#)

Provided by Institute of Physics

Citation: Computing with spins of light (2020, January 21) retrieved 20 April 2024 from <https://phys.org/news/2020-01-computing-with-spins-of-light.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.