Physicists develop technology to transform information from microwaves to optical light

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Physicists at the University of Alberta have developed technology that can translate data from microwaves to optical light—an advance that has promising applications in the next generation of super-fast quantum computers and secure fiber-optic telecommunications.

"Many quantum computer technologies work in the microwave regime,

while many quantum communications channels, such as fiber and satellite, work with optical light," explained Lindsay LeBlanc, who holds the Canada Research Chair in Ultracold Gasses for Quantum Simulation. "We hope that this platform can be used in the future to transduce quantum signals between these two regimes."

The new technology works by introducing a strong interaction between microwave radiation and atomic gas. The microwaves are then modulated with an audio signal, encoding information into the microwave. This modulation is passed through the gas atoms, which are then probed with optical light to encode the signal into the light.

"This transfer of information from the microwave domain to the optical domain is the key result," said LeBlanc. "The wavelengths of these two carrier signals differ by a factor of 50,000. It is not easy to transduce the signal between these regimes, but this transfer proves this is possible."

LeBlanc and researchers in her lab, including graduate student Andrei Tretiakov and undergraduate student Timothy Lee, worked closely with physicist John P. Davis and his research group, including graduate student Clinton Potts, to develop the technology.

LeBlanc and Davis are part of Quanta, an NSERC CREATE program designed to train graduate students in emerging quantum technologies.

"This idea arose by having talks and meeting within the Quanta group—and it turned out to work as well or better than we first expected," said LeBlanc.

"This sort of discovery-led research can be very fruitful, and lead us to new possibilities."

The study, "Atomic Microwave-to-Optical Signal Transduction via

Magnetic-Field Coupling in a Resonant Microwave Cavity," was published in *Applied Physics Letters*.

More information: A. Tretiakov et al. Atomic microwave-to-optical signal transduction via magnetic-field coupling in a resonant microwave cavity, *Applied Physics Letters* (2020). DOI: 10.1063/1.5144616

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