Team creates new method to control quantum systems

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Dartmouth College researchers have discovered a method to design faster pulses, offering a new way to accurately control quantum systems.

The findings appear in the journal *Physical Review A*.

Quantum physics defines the rules that govern the realm of the ultra-small - the atomic and sub-atomic world—which explains the behavior of matter and its interactions. Scientists have been trying to exploit the seemingly strange properties of this quantum world to build practical devices, such as ultra-fast computers or ultra-precise quantum sensors. Building a practical device, however, requires accurately controlling your device to make it do what you want. This turns out to be challenging since quantum properties are very fragile.

"Ideally, you would like to come up with a method to control the device accurately even in the presence of uncertainties and errors," says co-author Chandrasekhar Ramanathan, an assistant professor of physics and astronomy.

One way to achieve this is through the use of adiabatic pulses, a class of amplitude- and frequency-modulated pulses that are used extensively to enable robust control of quantum operations. In quantum physics, an adiabatic process is one in which the configuration of a system is changed gradually enough so that the system is able to respond to the changes without being excited to higher energies. The drawback to using these adiabatic pulses is that they are typically very slow.

The Dartmouth team investigated a new class of faster adiabatic pulses that still retained the property of being insensitive to small errors.

"We came up with a systematic method to design fast adiabatic pulses, using only the controls that an experimenter may have available in the laboratory, thus offering a new way to accurately control quantum devices," Ramanathan says.

More information: Jonathan Vandermause et al, Superadiabatic control of quantum operations, *Physical Review A* (2016). DOI: 10.1103/PhysRevA.93.052329

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