# Switching qubits with a terahertz source?

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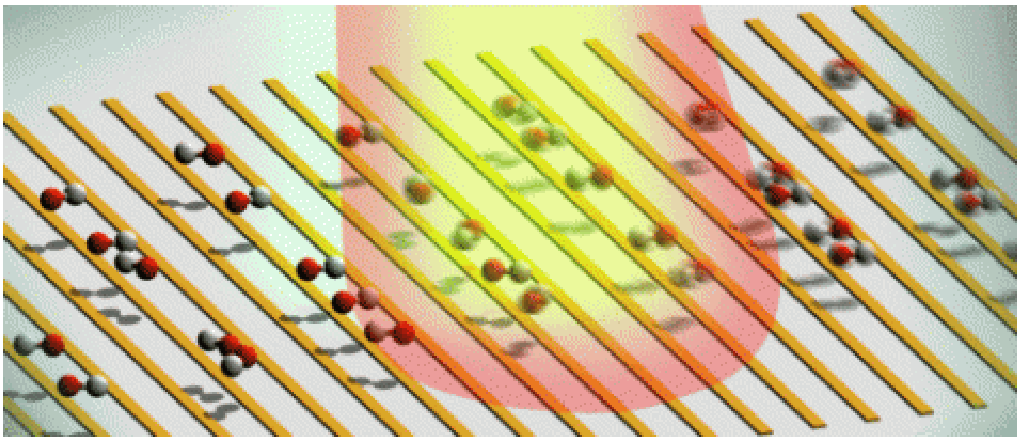

(PhysOrg.com) -- Rotational transitions induced in molecules on a chip could have important applications in quantum computing.

Scientists in Germany and the USA have been able to induce rotational transitions in molecules trapped at a close distance above a chip using a terahertz source. The new results, which are published in *ChemPhysChem*, could have interesting applications in quantum computing.

Polar molecules in selected quantum states can be guided, decelerated and trapped using electric fields created by microstructured electrodes on a chip. One of the possible applications of such molecules on a chip is their use in future quantum computers. However, to achieve this, researchers must be able to drive transitions from a certain quantum state to another one, that is, they should to be able "to switch a qubit (or quantum bit)". A transition between two rotational levels in a molecule is very well suited for this, and that is the reason why Gabriele Santambrogio and co-workers at the Fritz Haber Institute of the Max Planck Society in Berlin and Liam Duffy of the University of North Carolina at Greensboro decided to use a rather uncommon narrowband terahertz (THz) source to induce rotational transitions in laser-prepared metastable CO molecules. The researchers coupled the source to a chip setup that had been previously developed by them and studied the transitions between two quantum states in polar molecules trapped on the chip.

According to co-author Gerard Meijer, both the experimental approach and the results of this work are unique. The combination of laser-prepared molecules in a single rotational level, tunable narrow-band mm-wave radiation that can transfer the population to another rotational level, and state-selective detection of the molecules at a known delay and position, offers many interesting possibilities. With this approach, the research team has not only been able to trap the polar molecules on a chip but has also played further games with them—like inducing the rotational transitions. Meijer believes that these results could find important applications in quantum computing: "In the future, it is conceivable that compact THz sources are integrated on a chip, and that one can use this to switch between qubits in a routine fashion", he says.

**More information:** Gabriele Santambrogio, Driving Rotational Transitions in Molecules on a Chip, *ChemPhysChem* 2011, 12, No. 10, dx.doi.org/10.1002/cphc.201001007

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