معهد قطر لبحوث البيئة والطاقة
Qatar Environment & Energy Research Institute
جامعة حمد بن خليفة
HAMAD BIN KHALIFA UNIVERSITY

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Press Release: Electric Circuits Go Beyond Expected Limits

Researchers from the Qatar Environment and Energy Research Institute (QEERI) – a national research institute of Hamad Bin Khalifa University – the National Institute of Information and Communications Technology (NICT) of Japan, and the Nippon Telegraph and Telephone Corporation (NTT) have discovered new states of interaction between atoms and light. This discovery was published this week, on October 10, in the high-impact journal Nature Physics.

The indispensable technologies in modern life such as a time system measured by an atomic clock and a secure and energy-efficient communications system are based on the fundamental science of the interaction between light and matter. The absorption and emission of light from any device is explained based on the interaction of light and atoms. A fundamental question is "How strong can the interaction of light and an atom be?" This question has not been answered in spite of years of research.

Understanding the interactions between atoms and light is important to QEERI's research and development of new solar cells materials. In addition, this discovery may contribute to the development of quantum technologies in areas such as quantum communication, quantum simulation and computation, or quantum metrology.

Previously, Dr. Sahel Ashhab, QEERI Senior Scientist, performed theoretical investigations and identified desirable conditions for achieving this new state using superconducting circuits. Recently, his collaborators at NICT carried out experiments using devices fabricated jointly at the facilities of NICT and NTT. "Well-designed circuits can really go beyond what many people thought were unsurpassable limits" commented Dr. Ashhab, who provided the theoretical basis and interpretation of the experiments.

Dr. Ashhab explained that "for technological applications, sometimes you want the strongest interactions possible. You want fast absorption and emission of light. Naturally there are limits to how strong this interaction can be, but now with artificial systems, we are able to design extremely strong interactions. Forty years ago it was predicted theoretically that if you increase the strength of this interaction beyond a certain point, the atoms would form a new state, an unusual molecular state in which the atoms would bind with the photons. Scientists have since debated if this was really possible under realistic conditions. This work has answered the question. We have been able to design an electric circuit in which the circuit interacts with light in an extreme manner, creating the predicted molecular state."

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About NICT

As Japan's sole National Research and Development Agency specializing in the field of information and communications technology, the National Institute of Information and Communications Technology (NICT) is charged with promoting the ICT sector as well as research and development in ICT, which drives economic growth and creates an affluent, safe and secure society. For more information, please visit http://www.nict.go.jp/en/index.html

About NTT

Nippon Telegraph and Telephone Co. (NTT) carries out basic research and development activities at three laboratory groups in a wide range of fields, including some of the most advanced ICT research in the world. In the interest of creating a "new world of communication brought about by sharing of contextualized knowledge" in a "broadband and ubiquitous society", NTT is undertaking R&D to create new communication services and to foster foundational technologies that will realize communication networks to support these services. Moreover, NTT is also actively engaging in research on cutting-edge and basic technologies that look to the next decade. For more information, please visit http://www.ntt.co.jp/RD/e/organization/lab.html

About QEERI

The Qatar Environment and Energy Research Institute (QEERI) is part of Hamad Bin Khalifa University. As a mission-driven national research institute, QEERI plays a leading role addressing the national Energy and Water Security Grand Challenges through Research and Development (R&D). Aligned with the Qatar National Vision 2030's strategy of transforming the State into a diverse and sustainable knowledge-based economy, QEERI's water R&D program is developing innovative technologies in water desalination and treatment; water quality and reuse; aquifer recharge; and climate change and atmospheric science. QEERI's energy R&D focuses on Solar Photovoltaics (PV), energy storage and smart grids. For more information, please visit http://www.qeeri.org.qa/