Quantum Properties of Distributed Systems

Results in Brief

Beyond bits

The prospect of nature being coherently controlled and manipulated at the quantum level has been both a powerful stimulus and an intriguing challenge faced by the QUPRODIS project.

DIGITAL ECONOMY

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Information processing is currently implemented using quantities such as charges, voltages or currents in electronic devices which operate on the basics of classical physics. More specifically, conventional computers perform calculations on fundamental pieces of information called bits, which can take the values of 0 or 1. On the other hand, quantum information processing promises to employ the laws of quantum physics.

A number of technologies are under investigation for their suitability to implement a quantum computer that uses quantum bits, representing both values of 0 and 1 at the same time. Research on quantum information processing needs therefore to be highly interdisciplinary and coordinated efforts led to the creation of a diverse consortium made up of the 15 QUPRODIS project partners.

For a quantum computer, basic gate operations will be provided by logical operations

on individual quantum bits and controlled coherent interactions between two quantum bits. As a fully theoretical project, QUPRODIS focused on information processing and transmission by controllable and distributed systems (atoms and molecules), exploiting quantum mechanical operations and new quantum algorithms.

From the beginning of the project, new ideas emerged in connection with quantum coherence and entanglement, although theoretical work may be far ahead of experimental realisation of these ideas. Secret correlations are already an important resource in classical cryptography, where sender and receiver hold identical code books whose contents are only known to them. Entanglement, as a novel form of such secret correlations, will be a key resource in communication scenarios between distant laboratories.

The transfer of concepts from quantum information theory to other fields of theoretical physics such as condensed matter physics or quantum field theory has also proved fruitful. Research work done within the QUPRODIS project was undoubtedly at the-state-of-art in several theoretical fields, providing a benchmark for possible future applications.

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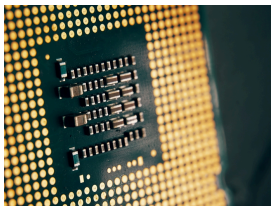
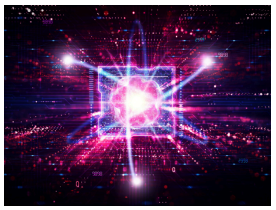
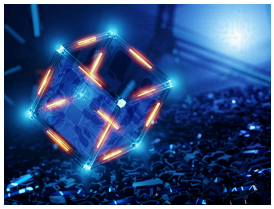


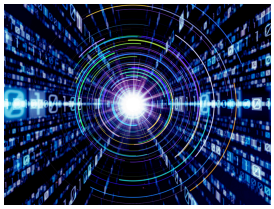
Silicon technology for large-scale quantum processors



A breakthrough for long-distance quantum communication



Entangling trapped ions over 200 metres apart



Paving the way for secure quantum communication networks

Project Information

QUPRODIS

Grant agreement ID: IST-2001-38877

Project website

Project closed

Start date
1 January 2003

End date
28 February 2006

Funded under
Programme for research, technological development and demonstration on a "User-friendly information society, 1998-2002"

Total cost
€ 255 800,00

EU contribution
€ 245 000,00

Coordinated by
UNIVERSITAET POTSDAM
Germany

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RESEARCH*EU MAGAZINE

Results Supplement No. 009

NO 9 NOVEMBER 2008

Last update: 8 September 2008

Permalink: https://cordis.europa.eu/article/id/84384-beyond-bits