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Scientists from the Centre for Theoretical Physics of the Polish Academy of Sciences (CTP PAS) have developed a new tool for detecting quantum entanglement

A team of scientists from the Centre for Theoretical Physics of the Polish Academy of Sciences has developed an advanced method for detecting the most valuable form of quantum entanglement in many-particle systems. The results, published in the prestigious journal [Reports on Progress in Physics](), open new prospects for future quantum technologies.

Quantum entanglement – the key to the future

Quantum entanglement is one of the most fascinating phenomena in the quantum world-particles become correlated in a way that cannot be explained by classical physics. Particularly valuable is the so-called genuine multipartite entanglement, in which all particles in the system are simultaneously entangled with one another, rather than only in pairs

Prof. Remigiusz Augusiak, together with his team at the Centre for Theoretical Physics of the Polish Academy of Sciences – Jakub Szczepaniak and Dr. Owidiusz Makuta[1] – has developed new theoretical tools. The so-called entanglement witnesses make it possible to detect this special type of quantum correlations. Importantly, the method works not only for the simplest many-body systems composed of qubits, but also for more complex systems in which the subsystems have an arbitrary number of degrees of freedom.

The researchers have shown that their method is exceptionally robust to noise—the more complex the quantum particles, the better the method copes with noise and imperfections. This is a crucial property for practical applications, where quantum systems are inevitably exposed to environmental influence.

[1] Now at Instituut-Lorentz, Universiteit Leiden, PO Box 9506, 2300 RA Leiden, The Netherlands

From theory to applications

Detecting genuine multipartite entanglement has direct implications for future technologies. This form of entanglement is essential for instance for achieving the highest precision in quantum metrology and is of fundamental importance for the development of quantum computers and secure quantum communication.

The theoretical tools developed can be tested experimentally in a variety of systems—from cold atoms and ion traps to advanced photonic setups. This makes it likely that the discovery by the scientists at CFT PAN will have an impact on the development of practical quantum devices.

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