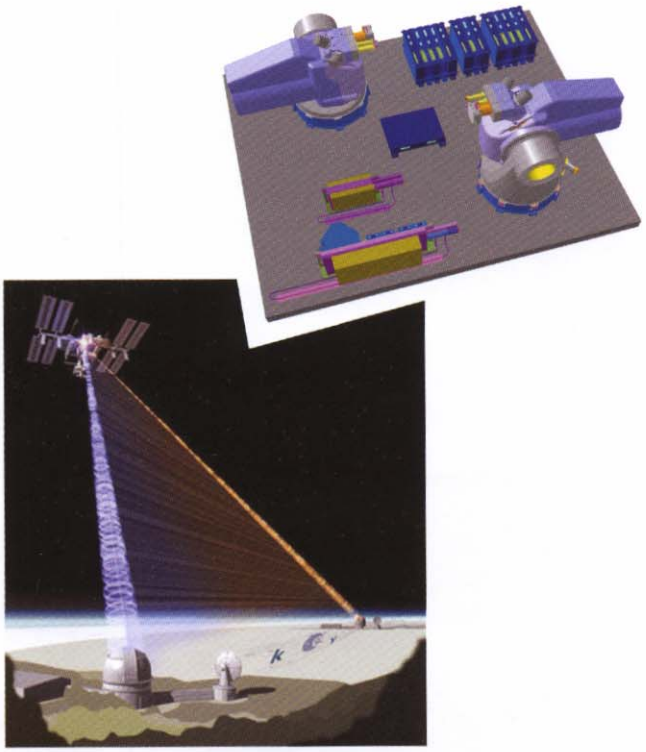
QUANTUM

Quantum Entanglement in Space Experiments



Quantum physics has changed our understanding of the fundamental principles of nature. Its predictions, although intriguing and counterintuitive in their philosophical consequences, have been verified extensively and have thus established quantum theory as the most successful theory of modern science. **Quantum entanglement** (Erwin Schroedinger 1935) is one fundamental feature of quantum physics. It describes the situation, in which separate particles have only joint but no individual properties, independent from the distance from each other. This counterintuitive behaviour has led to a series of fascinating experiments.

Besides its importance for fundamental physics, quantum entanglement has become a basic building block in the novel field of quantum information-processing. It is at the heart of **quantum cryptography**, the unconditional secure distribution of cryptographic keys and it is also a necessary ingredient in quantum communication applications such as quantum state teleportation and quantum computer.

We intend to place a source of entangled photons on a LEO (low earth orbit) platform such as the international Space Station (ISS). Global quantum key distribution can then be realized by combining separate quantum communication links to two (or more) ground stations, establishing an individual quantum key, when it passes over. When both keys are established, the system on the satellite has access to both separate keys. By sending a logical combination of the keys (e.g. bitwise XOR) to one of the ground stations, a symmetric unconditional secure key is established. Furthermore the two photons are each sent through telescopes towards two separate ground stations simultaneously at a distance of about 1400km from each other, where the photons will be received and finally measured. A world record in distance!

Satellite based distribution of quantum entanglement will eventually allow to establish a worldwide network for quantum communication and will help to prove the foundation on physics and the basic principles of a new upcoming technology.

Infobox

01.03.2006 – 30.06.2007

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