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Quantum Technology: An Emerging Technology for Intrinsic Secure Communication

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ABSTRACT

Quantum communication represents a cutting-edge technological advancement designated to revolutionize secure communications. By applying the principles of quantum mechanics, this technology offers unprecedented levels of security, addressing vulnerabilities inherent to the classical communication systems. Unlike classical encryption methods that may become vulnerable to advances in computational power and quantum computing, quantum encryption remains secure due to its reliance on the principles of quantum mechanics.

At the core of quantum communication lies the concept of quantum entanglement. Quantum entanglement involves particles becoming interlinked such that the state of one particle is strongly correlated to the state of the other, regardless of the distance separating them. This phenomenon enables the creation of highly secure communication channels.

Quantum Key Distribution (QKD), the most mature application of quantum communication, utilizes the properties of quantum mechanics to generate encryption keys that are virtually immune to eavesdropping. Any attempt to intercept the communication alters the quantum state of the particles, thereby alerting the legitimate communicators to the presence of an intruder.

This work introduces the concept of quantum communications, representing a transformative leap forward in secure communications technology. We will describe the research progress and practical implementations by our group, demonstrating its potential to become an integral component of global communication networks and ensure the highest levels of security for future communications.

BIO

Dr. Paulo Sérgio de Brito André was born in 1971. He received a bachelor's degree in physics engineering in 1996, a Ph.D. in Physics in 2002, and the Agregação title (habilitation) in 2011 from the Universidade de Aveiro, Portugal. Currently, he is a Full Professor in the Department of Electrical and Computer Engineering at Instituto Superior Técnico (IST), University of Lisbon. He is also a senior researcher and the director of the Lisbon branch of the Instituto de Telecomunicações. Since 2019, he has served as the vice director of the Department of Electronics Engineering and a member of the Scientific Council of IST, University of Lisbon.

He has published approximately 300 papers in journals, 600 conference communications, and 20 books or book chapters, with over 8,500 citations and an h-index of 51 according to Google Scholar. He also holds 10 patents. His current research interests include the study and simulation of photonic and optoelectronic components and systems for telecommunications, sensing, and energy applications, in both classical and quantum regimes. Paulo André is a senior member of the Institute of Electrical and Electronics Engineers (IEEE).