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Quantum information for relativistic and quantum physics

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Quantum information has shaped physics and science in the past decades.
On the one hand, quantum information studies the theoretical aspects of information theory when quantum systems are employed.
On the other, quantum information promises technological revolutions far beyond our current capabilities. These include quantum computers, quantum communications and quantum cryptography.
Regardless of the approach considered, quantum information is well described and characterized by quantum mechanics. Experiments have been so far successfully explained by quantum physics alone. However, they are now reaching regimes where relativity cannot be ignored. A completely novel approach needs to be taken in order to give correct predictions at the overlap of relativity and quantum science; these will provide us with better ways to characterize our future technologies, our theory and, ultimately, our ability to test the fundamental laws of nature.

We present recent advances in the field of relativistic quantum information. We focus our attention on theoretical aspects and predictions of possible experiments that can test the role of paradigmatic quantum information resources, such as entanglement, in phenomena that occur at the overlap of relativity and quantum physics. In particular we focus on a recently proposed gravitational wave antenna based on micrometer-size Bose Einstein Condensates.
We then discuss the role of the information theoretical aspects of the proposal, such as optimisation of, and ultimate bounds on, measurements, which are paramount for the success of the technology.
We conclude with an overlook on future directions and applications.

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