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Hybrid Entanglement for Optical Quantum Networks FÉLIX BUSSIÈRES, NICOLAS GODBOUT, Ecole Polytechnique de Montreal, WOLFGANG TITTEL, University of Calgary — A global optical quantum communication network will have to operate with different encodings of quantum information (QI) depending on the medium in which the photons are carried. Polarization qubits in the visible spectrum are well suited for free-space transmission due to the absence of birefringence in the air, whereas time-bin qubits at telecom wavelengths are more suited for optical fiber transmission due to their resistance to polarization mode dispersion. We present a scheme to generate hybrid photonic entanglement defined as entanglement between different encodings of QI using light. In this specific case we consider a time-bin photon at 1550 nm entangled with a polarization photon at 805 nm and we report on our progress towards creating such a source using parametric down-conversion in bulk crystals. We also show how to teleport a polarization qubit to a time-bin qubit using this type of entanglement. Finally, we discuss how this allows QI to be distributed over optical quantum networks interfacing free-space and optical fiber links hence increasing the versatility of such networks.

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