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Experimental demonstration of decoherence-free one-way quantum information processing ROBERT PREVEDEL, Faculty of Physics, University of Vienna, MARK S. TAME, The Queen's University, Belfast, ANDRÉ STEFANOV, IQOQI, Austrian Academy of Science, MAURO PATERNOSTRO, MYUNGSHIK KIM, The Queens University, Belfast, ANTON ZEILINGER, Faculty of Physics, University of Vienna and IQOQI, Austrian Academy of Science —
In recent years, one-way quantum computing has become an exciting alternative to existing proposals for quantum computers. In this specific model, coherent quantum information processing (QIP) is accomplished via a sequence of single-qubit measurements applied to an entangled resource known as cluster state. However, there has so far been no experimental realization of noise-resilient quantum computation in the one-way model. Here we report the experimental demonstration of a one-way quantum processor reliably operating under the effects of decoherence. Information is protected by a properly designed decoherence-free subspace in which the cluster states reside. We demonstrate our scheme in an all-optical setup by encoding the information into the polarization states of four photons. A one-way information-transfer protocol is performed with the photons exposed to severe symmetric phase damping noise. Remarkable protection of information is accomplished, delivering nearly ideal computational outcomes.

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