On computer-designed quantum experiments

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Designing experimental setups for high-dimensional multipartite entangled states is a notoriously difficult feat. For that reason, we have developed the computer algorithm Melvin which is able to find new experimental implementations for the creation and manipulation of complex quantum states [1]. The discovered experiments extensively use unfamiliar and asymmetric techniques which are challenging to understand intuitively. Melvin autonomously learns from solutions for simpler systems, which significantly speeds up the discovery rate of more complex experiments. Several of the computer-designed experiments have already been successfully implemented in our laboratories [2-4].

By analysing Melvin's experimental proposal for an unexpectedly high-dimensional quantum state, we discovered a novel technique which allows for very well controlled generation of entanglement based on a technique introduced by the group of Leonard Mandel in 1991 [5]. Surprisingly, this technique only uses elements which were available already for 25 years, but it has been discovered only now by a computer algorithm. This shows that computer designed quantum experiments can be inspirations for new techniques [6].

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