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Record-scale entanglement of quantum fields for measurement-based quantum computing[1]

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Achieving scalability and eschewing decoherence are the two main challenges that stand in the way of the realization of a practical quantum computer in the laboratory. While the latter has been successfully addressed in trapped-ion and superconducting qubit platforms, significant progress on the former has been achieved with continuous-variable (CV) systems, all of them oscillators, in which qubits are replaced with "qumodes." Examples of qumodes are the resonant modes of an optical parametric oscillator. Recently, the simultaneous entanglement of 60 frequency qumodes was demonstrated by our group using a single OPO while the entanglement of one million qumodes (two at a time) was demonstrated by Akira Furusawa's group at the University of Tokyo. If this talk, I will present our recent proposal to combine these two concepts of entanglement in the frequency and time domains to build a bona fide quantum computing processor.

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