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The dynamical Casimir effect generates entanglement[1] SIMONE FELICETTI, MIKEL SANZ, LUCAS LAMATA, GUILLERMO ROMERO, University of the Basque Country UPV/EHU, Apartado 644, E-48080 Bilbao, Spain, GÖRAN JOHANSSON, PER DELSING, Microtechnology and Nanoscience, Chalmers University of Technology, S-41296 Gothenburg, Sweden, ENRIQUE SOLANO, University of the Basque Country UPV/EHU, Apartado 644, E-48080 Bilbao, Spain and IKERBASQUE, Basque Foundation for Science — The existence of vacuum fluctuations, i.e., the presence of virtual particles in empty space, represents one of the most distinctive results of quantum mechanics. It is also known, under the name of dynamical Casimir effect, that fast-oscillating boundary conditions can generate real excitations out of the vacuum fluctuations. Long-awaited, the first experimental demonstration of this phenomenon has been realized only recently, in the framework of superconducting circuits [C. M. Wilson *et al.* Nature 479, 376-379 (2011)]. In this contribution, we will discuss novel theoretical results, showing that the dynamical Casimir effect can be exploited to generate bipartite and multipartite entanglement among qubits. We will also present a superconducting circuit design which can feasibly implement the model considered with current technology. Our scheme is composed of a SQUID device side-coupled to two transmission line resonators, each one interacting with a superconducting qubit. Such proposal can be straightforwardly generalized to the multipartite case, and it can be scaled up to build strongly correlated cavity lattices for quantum simulation and quantum computation.

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