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Engineering matter interactions using squeezed vacuum[1] SINA ZEYTINOGLU, Institute for Theoretical Physics, ETH Zurich, CH-8093 Zürich, Switzerland, ATAC IMAMOGLU, Institute of Quantum Electronics, ETH Zurich, CH-8093 Zürich, Switzerland, SEBASTIAN HUBER, Institute for Theoretical Physics, ETH Zurich, CH-8093 Zürich, Switzerland — Virtually all interactions that are relevant for atomic and condensed matter physics are mediated by the quantum fluctuations of the electromagnetic field vacuum. Consequently, controlling the latter can be used to engineer the strength and the range of inter-particle interactions. Recent experiments have used this premise to demonstrate novel quantum phases or entangling gates by embedding electric dipoles in photonic cavities or waveguides which modify the electromagnetic fluctuations. In this talk, we demonstrate theoretically that the enhanced fluctuations in the anti-squeezed quadrature of a squeezed vacuum state allows for engineering interactions between electric dipoles without the need for a photonic cavity or waveguide. Thus, the strength and range of the resulting dipole-dipole coupling can be engineered by dynamically changing the spatial profile of the squeezed vacuum in a travelling-wave geometry.

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