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Quantum Simulation of Quantum Field Theory with a Trapped Ion System[1] XIANG ZHANG, KUAN ZHANG, YANGCHAO SHEN, JINGNING ZHANG, MAN-HONG YUNG, KIHWAN KIM, Center for Quantum Information, IIIS, Tsinghua University, Beijing, P. R. China, JULEN SIMON, LUCAS LAMATA, ENRIQUE SOLANO, Department of Physical Chemistry, University of the Basque Country UPV/EHU, Bilbao, Spain, JORGE CASANOVA, Institut für Theoretische Physik, Universität Ulm, Ulm, Germany — We report on the experimental quantum simulation of interacting bosonic and fermionic quantum field modes with a trapped ion system [1]. We consider a basic model of only one fermion and one anti-fermion interacting through a bosonic field mode, which reveals interesting features such as self-interactions, particle creation and annihilation and non-perturbative regimes. We experimentally study these phenomena by manipulating the internal degrees of freedom of a multi-level single $^{171}Yb^{+}$ ion and its motional state, based on the proposal of Ref. [1]. Our experimental scheme is a scalable approach and can be extended beyond the limit of classical computation of quantum field theory when more fermions and bosons are included.

[1] J. Casanova, et al., Phys. Rev. Lett, 107, 260501 (2011)

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