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Local quanta, unitarity inequivalence and vacuum entanglement

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Creation and annihilation operators adding or subtracting well-defined amounts of energy and momentum to the field canonically describe particles, the elementary excitations of the fields, in QFT. These operators create quanta completely delocalized in space, at odds with the idea of particles as minute subdivisions of matter of finite mass and tiny size. In this talk, I will show how QFT owns the tools to describe localized quanta using the appropriate operators. Fock Space operators in unitarily inequivalent representations describe both subatomic units, those with sharply defined momentum and energy on the one side, and those well localized in space-time on the other. This gives rise to explanations for a multitude of different properties, from the absence of local number operators in the standard formulation to the absence of local projectors for the vacuum state as the raison d'etre for vacuum entanglement.

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