
Electron quantum optics in graphene

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Abstract

Electron quantum optics is a relatively new field of mesoscopic quantum physics that relies on the ballistic nature of electron transport in quantum conductors to develop experiments inspired by quantum optics. In this work using graphene, on-demand injection of a single electronic flying qubit state and its manipulation over the Bloch sphere is demonstrated for the first time. The flying qubit is a lone electron above the calm Fermi Sea generated by an engineered voltage pulse which propagates in quantum Hall edge channels of a high mobility monolayer graphene. A unique graphene Mach-Zehnder interferometer is used to realize Bloch sphere operations and the final state is read out statistically by shot noise measurements. This work addresses an important topic at the nexus of quantum information and quantum transport with a flavour of valleytronics in 2D material.

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