# Towards Flying qubits with SAW driven single electrons & single electron voltage pulses

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In this talk we will present recent experiments aiming at the coherent manipulation of single flying electrons driven by surface acoustic waves. For this purpose we employ a tunnel-coupled wire, which was shown to work as a beam splitter for ballistic electrons [1], and integrate it with on-demand single electron transfer circuits [2,3]. We demonstrate single-electron transfer over 20 µm with extremely high efficiency (> 99%). Controlling the energy detuning of the tunnel-coupled wire allows for partitioning of a single flying electron into the two paths with an arbitrary probability hence allowing the realization of a directional coupler for a single flying electron.
In the second part of the talk we will show how similar experiments can be realized by injecting single electrons using Lorentzian voltage pulses [4]. In addition we perform time resolved measurements of the propagating voltage pulses. We show that even for a single particle excitation (Leviton), the voltage pulse propagates much faster than the Fermi velocity due to electron-electron interactions.

References:

[1] M. Yamamoto et al., Nature Nanotech. **7**, 247 (2012).
[2] S. Hermelin et al., *Nature* **477**, 435 (2011).
[3] R. P. G. McNeil et al., *Nature* **477**, 439 (2011).
[4] J. Dubois et al., *Nature* **502**, 659 (2013).