Effect of parasitic capacitances on Bloch oscillations measured via dual Shapiro steps

Lisa Arndt (RWTH Aachen)

Host: Johannes Fink

Measurement of Bloch oscillations in a single Josephson junction in the phase slip regime is a crucial element of metrology that links the current to the frequency standard. Bloch oscillations can be measured by applying a periodic drive to a DC-biased Josephson junction. Phase-locking between the two oscillations then gives rise to dual Shapiro steps. Unlike the normal Shapiro steps, a measurement of these dual Shapiro steps is impeded by parasitic capacitances. These parasitic capacitances can be screened by an on-chip superinductance. However, as the system is constantly driven, the energy has to be dissipated. To that end, we propose to add an additional large off-chip resistance. We investigate the resulting system by a set of analytical and numerical methods. We show that even in the presence of parasitic capacitances, it is possible to observe Bloch oscillations with realistic system parameters. In particular, we show that the leading effect of the parasitic capacitance is a reduction of the critical voltage of the phase slip junction by a factor of \(\exp(-10kO/Z)\) where \(Z\) is the characteristic impedance formed by the parasitic capacitance and the superinductance.