Abstract Submitted
for the DAMOP20 Meeting of
The American Physical Society

Information transfer by quantum matter wave modulation[1]
ALEXANDER STIBOR, Lawrence Berkeley National Laboratory, ROBIN RÖPKE, NICOLE KERKER, University of Tübingen — Classical communication techniques by electromagnetic wave modulation and secure quantum communication schemes with photons revolutionized our modern society. Here, we demonstrate a fundamentally new information transfer scheme based on the quantum matter wave nature of electrons. It allows a signal transmission by a non-trivial quantum modulation of electron wave packets. The data is encoded in a biprism electron interferometer with a rather simple element, the Wien filter. It introduces a longitudinal shift of the separated wave packets that leads to a change in the fringe contrast without changing the beam position, total intensity or phase. We transmitted a message by binary encoding the information in the interference. The readout on the receiver side is done by a dynamic contrast measurement. Our scheme has no analog in light optics. It relies on the Aharonov-Bohm effect for charged matter waves and can therefore not be performed with photons. We discuss the high level of transmission security and demonstrate it by introducing a semiconducting plate close to the separated beam paths. It is equivalent to an eavesdropper attack which immediately destroys the interference pattern due to decoherence and stops the transmission.

[1]This work was supported by the Deutsche Forschungsgemeinschaft (no. STI 615/3), the Vector Foundation and the Office of Science of the U.S. Department of Energy (no. DE-AC02-05CH11231).

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Date submitted: 03 Feb 2020 Electronic form version 1.4