Fractional Interference in a Mach-Zehnder Interferometer

Hemanta Kumar Kundu[1], Sourav Biswas[1], Nissim Ofek[2], Vladimir Umansky[1] and Moty Heiblum[1]

[1]Department of Condensed Matter Physics, Braun Center of Sub-Micron Research

Weizmann Institute of Science, Israel

[2]Quantum Machines, Israel

(hemnata-kumar.kundu@weizmann.ac.il)

Interference of electrons and anyons in the quantum Hall regime have always been of fundamental interest. Such measurements allow studying the quantum statistics of quasiparticles. With recent observations of fractional interference in a Fabry-Perot interferometer[1], fractional interference was never observed in a Mach-Zehnder interferometer (MZI). The MZI is a true 'two-path' interferometer and is free of Coulomb interactions, responding solely to Aharonov-Bohm (AB) phase[2].

We report of an observation of AB interference of the outer-most edge mode ν=1/3 in bulk filling ν=2/5 in a MZI with path length 2 micron at ~10mK. While the maximum visibility of an integer mode (outer-most at ν=2) was ~91%, the fractional one was ~20%. With fairly transparent QPC's transmission of the ν=1/3 mode (t>0.5), the partitioned charge was found to be $e^*=e/3$. As expected, the flux period was Φ_0 – the flux quantum, similar to that of electrons[3] (due to the opaqueness of the internal ohmic contact to $e/3$ charges). We also observed peak visibility for MZI transmission of T~0.6 (away from T=0.5 for electrons) also agreeing with fractional interference.

1. Nakamura, J., et al., Nature Physics, 2019. **15**(6):p.563-569.
2. Ji, Y., et al., Nature, 2003. **422**(6930):p.415-8.
3. Law, K.T., et al., Physical Review B, 2006. **74**(4):p.045319.