Aharonov-Bohm interference of fractionalized electron-spin excitations

Masayuki Hashisaka

Institute for Solid State Physics, The University of Tokyo, Kashiwa, Chiba, Japan

Tomonaga-Luttinger liquid nature of copropagating spin-up and spin-down quantum Hall edge channels splits an electron excitation into fast and slow excitations. Previous works identified the fractionalization process by injecting a spin-up or spin-down excitation into one of the copropagating channels and measured the resultant multiple excitations [1]. On the other hand, this work studies the fractionalization of a spin-up and spin-down superposition state prepared in the interacting channels [2,3]. We measured the interference of the fractionalized excitations in a Mach-Zehnder interferometer (MZI) employing interacting copropagating channels as the interference paths [Fig. 1]. The observed interference visibility oscillates as a function of the voltage bias applied between the channels, showing the "lobe structure," which indicates the signature of the second-order interference in the one-way MZI. The lobe structure manifests the phase evolutions of the fractionalized excitations different from each other, reflecting the difference between their speeds.

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[1] M. Hashisaka, *et al*., *Nat. Phys.* **13**, 559 (2017).
[2] T. Shimizu, E. Iyoda, M. Hashisaka *et al*., in preparation.
[3] E. Iyoda, T. Shimizu, and M. Hashisaka, in preparation.

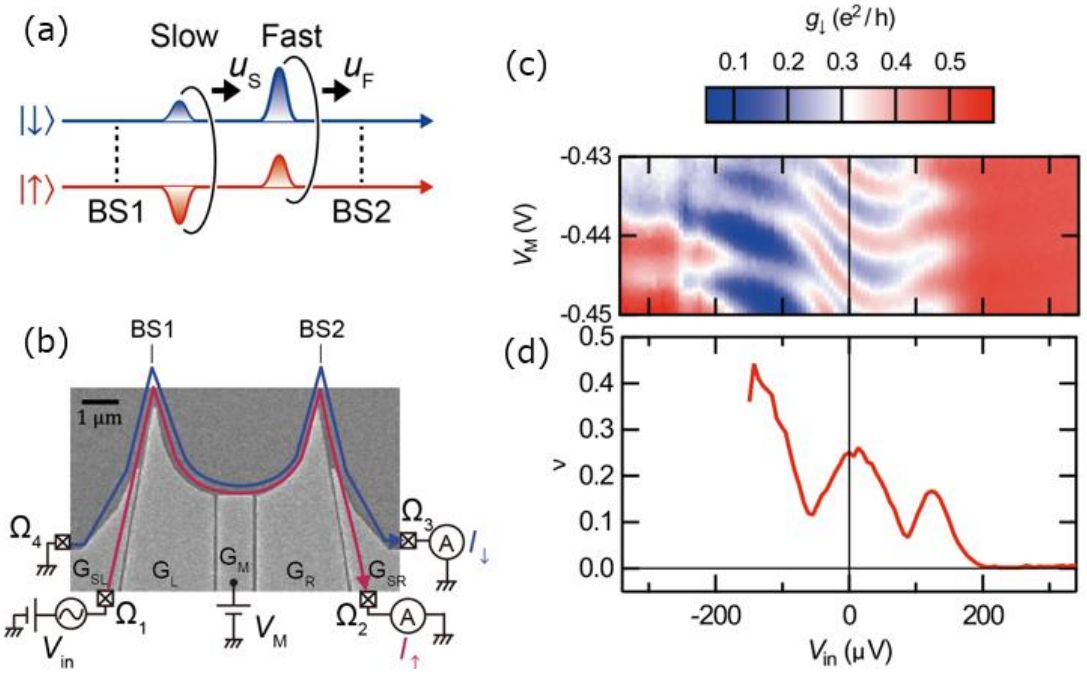

Fig. 1 (a) Schematic and (b) scanning electron micrograph of our MZI employing spin-up and spin-down channels as interference paths. (c) Interference pattern and (d) its visibility as a function of the voltage bias applied between the interference paths.