Andreev reflection of fractional quantum Hall quasiparticles

Masayuki Hashisaka[2,3], Thibaut Jonckheere[1], Takafumi Akiho[2], Satoshi Sasaki[2], Jérôme Rech[1], Thierry Martin[1], and Koji Muraki[2]

[1]*Centre de Physique Théorique - CNRS, Campus de Luminy, case 907, 13009 Marseille, France*

[2]*NTT Basic Research Laboratories, NTT Corporation, 3-1 Morinosato-Wakamiya, Atsugi, Kanagawa 243-0198, Japan*

[3]*JST, PRESTO, 4-1-8 Honcho, Kawaguchi, Saitama 332-0012, Japan*

Electron correlation in a quantum many-body state appears as peculiar scattering behaviour at its boundary, symbolic of which is Andreev reflection at a metal-superconductor interface. Despite being fundamental in nature, dictated by the charge conservation law, however, the process has had no analogues outside the realm of superconductivity so far. Here, we report the observation of an Andreev-like process originating from a topological quantum many-body effect instead of superconductivity. A narrow junction between fractional and integer quantum Hall states shows a two-terminal conductance exceeding that of the constituent fractional state. This remarkable behaviour, while theoretically predicted more than two decades ago but not detected to date, can be interpreted as Andreev reflection of fractionally charged quasiparticles. The observed fractional quantum Hall Andreev reflection provides a fundamental picture that captures microscopic charge dynamics at the boundaries of topological quantum many-body states.[1]

[1] M. Hashisaka et al., Nature Communications 12, 2794 (2021)