Observation of the scaling dimension of fractional quantum Hall anyons

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Résumé

Unconventional quasiparticles emerge from interacting electrons in the fractional quantum Hall regime (1). These quasiparticles differ from the electron-like excitations of Fermi liquids and integer quantum Hall effect in several ways: their charge is only a fraction of that of an electron, they are neither fermions nor bosons but obey different statistics ('anyons'), and they have different dynamics along chiral edges, controlled by the so-called scaling dimension. These exotic properties are challenging to observe unambiguously. Although the fractional charge of quasiparticles has been demonstrated since nearly three decades, the first convincing evidence of their anyonic quantum statistics has only recently been obtained and, so far, their scaling dimension remains elusive. Here (2) we obtained the scaling dimension of three different fractional quasiparticles, thereby experimentally establishing long-standing theoretical predictions. This was achieved by measuring the current fluctuations induced by tunneling quasiparticles, the scaling dimension being imprinted in the peculiar crossover between thermal noise at low voltage bias and shot noise at high bias (3). We have realized the same experiment with filling factors =1/3, 2/5, and 2/3 and the results consistently match the theory. This establishes a central property of fractional quantum Hall anyons, and demonstrates a powerful and complementary window into exotic quasiparticles.

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