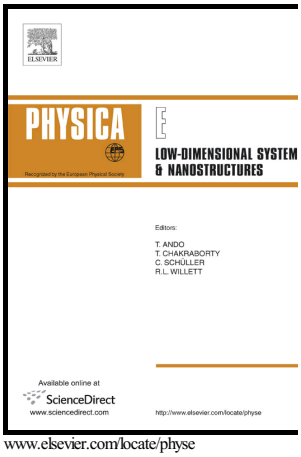
Transient dynamics of spin-polarized injection in helical Luttinger liquids

A. Calzona, M. Carrega, G. Dolcetto, M. Sassetti



www.elsevier.com/locate/physe

PII: S1386-9477(15)30175-2
DOI: http://dx.doi.org/10.1016/j.physe.2015.08.033
Reference: PHYSE12092

To appear in: *Physica E: Low-dimensional Systems and Nanostructures*

Received date: 26 June 2015
Revised date: 14 August 2015
Accepted date: 21 August 2015

Cite this article as: A. Calzona, M. Carrega, G. Dolcetto and M. Sassetti Transient dynamics of spin-polarized injection in helical Luttinger liquids *Physica E: Low-dimensional Systems and Nanostructures* http://dx.doi.org/10.1016/j.physe.2015.08.033

Transient dynamics of spin-polarized injection in helical Luttinger liquids

A. Calzona[a], M. Carrega[b], G. Dolcetto[b,*], M. Sassetti[a,b]

[a] *Dipartimento di Fisica, Università di Genova, Via Dodecaneso 33, 16146 Genova, Italy*
[b] *CNR-SPIN, Via Dodecaneso 33, 16146 Genova, Italy*

Abstract

We analyze the time evolution of spin-polarized electron wave packets injected into the edge states of a two-dimensional topological insulator. In the presence of electron interactions, the system is described as a helical Luttinger liquid and injected electrons fractionalize. However, because of the presence of metallic detectors, no evidences of fractionalization are encoded in dc measurements, and in this regime the system do not show deviations from its non-interacting behavior. Nevertheless, we show that the helical Luttinger liquid nature emerges in the transient dynamics, where signatures of charge/spin fractionalization can be clearly identified.

Keywords: Topological insulators, Luttinger liquids, transient dynamics

1. Introduction

The concept of single quasi-particle fails when applied to interacting electrons in one dimension. Indeed, the presence of two distinct Fermi points implies that the low energy excitations are represented by collective charge and spin density waves with bosonic nature [1, 2]. In the presence of electron interactions, a variety of peculiar quantum phenomena emerges. Among them, charge fractionalization represents one of the most striking signature [3, 4, 5, 6], being a manifestation of Luttinger liquid (LL) behavior [1, 7, 8]: an electron

*Corresponding author
Email address: giacomo.dolcetto@gmail.com (G. Dolcetto)