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Engineering Quantum Coherence In The Integer Quantum Hall Regime

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Rare are the cases where quantum coherence can simply be monitored with a knob. The reason for this lies in the fact that the coherence is generally limited by the coupling of the studied quantum system to the environment, and that this coupling is not so simple to control. The Integer quantum Hall regime at filling factor two offers a particular configuration where the environment can be engineered. In this regime, where a high magnetic field is applied perpendicularly to a two dimensional electron gas, the transport occurs through one dimensional chiral channels localized on the edge of the electron gas: the edge states. The number of these channels is determined by the filling factor which is the number of electron per quantum of flux. The recent theoretical proposals to use these edge sates for quantum information experiments has renewed the interest of the community for precise investigations of quantum coherence and energy relaxation in these edge states. At filling factor two, there is only two edge states such that the direct environment of one edge state is the other one. RecentIy we have shown that the coherence in one edge state is limited by the thermal charge noise in the other one (its environment) [1,2]. Even more recently, it has been shown that energy exchanges between the two edge states occur and that it can be frozen by localizing one edge state on small closed loops. Taking advantage of this finding we have designed a new Mach-Zehnder interferometer were we added additional gates to control the trajectory of the inner edge state, while measuring quantum interferences on the outer one. This gives us an unprecedented way to control the coherence in the IQH regime. Our measurements show that one can increase the coherence by a factor two, in perfect agreement with the the RPA approach developped in ref. [2] ,and that the finite bias visibility is also modified. This work gives a new very promising tool for near future quantum electronic experiments using edge states [5].

Fig. 1: *Logo SFP Bordeaux-2011*

Références

[1] P. Roulleau et al., Phys. Rev. Lett. **100**, 126802 (2008).

[2] P. Roulleau et al., Phys. Rev. Lett. **101**, 186803 (2008).

[3] C. Altimiras et al., Phys. Rev. Lett. **105**, 226804 (2010)

[4] H. le Sueur et al., Phys. Rev. Lett. **105**, 056803 (2010)

[5] P-A Huynh et al., to be published

Je souhaite concourir au prix ń affiche ż (ou ń présentation orale ż) et je déclare être un(e) chercheur(se) non-permanent ayant soutenu ma thèse après le 31 Juillet 2009 (ou nŠayant pas encore soutenu ma thèse).