Abstract Submitted
for the MAR14 Meeting of
The American Physical Society

Universal entanglement crossover of coupled quantum wires[1] ROMAIN VASSEUR, Lawrence Berkeley Natl Lab and UC Berkeley, JESPER JACOBSEN, LPTENS, HUBERT SALEUR, IPhT CEA Saclay and USC — We consider the entanglement between two one-dimensional quantum wires (Luttinger Liquids) coupled by tunneling through a quantum impurity. The physics of the system involves a crossover between weak and strong coupling regimes characterized by an energy scale T_B, and methods of conformal field theory therefore cannot be applied. The evolution of the entanglement in this crossover has led to many numerical studies, but has remained little understood, analytically or even qualitatively. This is, in part, due to the fact that the entanglement in this case is non-perturbative in the tunneling amplitude. We argue that the correct universal scaling form of the entanglement entropy S (for an arbitrary interval containing the impurity) is $\partial S/\partial \ln L = f(LT_B)$. In the special case where the coupling to the impurity can be refermionized, we show how the universal function $f(LT_B)$ can be obtained analytically using recent results on form factors of twist fields and a defect massless-scattering formalism. Our results are carefully checked against numerical simulations.

[1]This work was supported by the the French ANR (ANR Projet 2010 Blanc SIMI 4 : DIME), the US DOE (grant number DE-FG03-01ER45908), the Quantum Materials program of LBNL (RV) and the Institut Universitaire de France (JLJ).

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Date submitted: 04 Nov 2013

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