

Quantum walk hydrodynamics

Mohamed Hatifi,^{1,*} Giuseppe Di Molfetta,^{2,†} Fabrice Debbasch,^{3,‡} and Marc Brachet^{4,§}

¹*Aix Marseille Université, Institut Fresnel CNRS UMR 7249, 13013 Marseille, France*

²*Laboratoire d'Informatique Fondamentale, CaNa Research Group,
UMR7279 CNRS and Université Aix-Marseille, 163 Avenue de Luminy, 13288 Marseille France*

³*LERMA, UMR 8112, UPMC and Observatoire de Paris,
61 Avenue de l'Observatoire 75014 Paris, France*

⁴*Laboratoire de Physique Statistique, École Normale Supérieure,
PSL Research University; UPMC Univ Paris 06, Sorbonne Universités; Université Paris Diderot,
Sorbonne Paris-Cité; CNRS; 24 Rue Lhomond, 75005 Paris, France*

A simple Discrete-Time Quantum Walk on the line is revisited and given an hydrodynamic interpretation through a novel relativistic generalization of the Madelung transform. Numerical results are presented which show that suitable initial conditions indeed produce hydrodynamical shocks. An analytical computation of the asymptotic quantum shock structure is presented. The non-relativistic limit is explored.

Keywords: keyword1, keyword2, keyword3

* hatfi.mohamed@gmail.com
† gdimolfetta@gmail.com
‡ fabrice.debbasch@gmail.com
§ brachet@physique.ens.fr