Design of High Fidelity Quantum Waveguides via Shortcuts To Adiabaticity

Authors M. Odelli[1], A. Ruschhaupt[1]
[1] *UCC College, Cork.*
*119227230@umail.ucc.ie

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Quantum waveguides are one of the key components in the development of quantum technologies as they are crucial in the transmission of information. The progressive miniaturization of quantum chips requires the waveguides to follow certain paths and so they need to be bent in order to be accommodated onto the chip.

Often, waveguides are formed by two straight ends connected by a curved section. While the circular shape is the simplest choice, it generates wave reflection and in turn data loss. It is hence vital to find a protocol that helps designing the geometry of the curved section to ensure high transmission rates.

In this work [2] we implemented a procedure based on the "Shortcuts To Adiabaticity" approach as outlined in [1]: starting with a semi-classical argument, we imposed constraints on the trajectory of the particle, in order to inverse-engineer the geometry of the bent section with the aim of minimizing the excitation of the outcoming particle.

The obtained geometry served as the starting point to define the potential of the quantum system. We then simulated the time evolution of a wave function in said potential and compared it with a test wave function, obtaining very high fidelity for a variety of initial velocities.

REFERENCES

[1] François Impens, Romain Duboscq, and David Guéry-Odelin "Quantum Control beyond the Adiabatic Regime in 2D Curved Matter-Wave Guides" Physical Review Letter. **124**, 250403 (2020).
[2] Manuel Odelli, and Andreas Ruschhaupt, "In preparation" (2021).