

### **(Talk) Laser-written Waveguide Network as Optical Oracle**

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We implemented a laser-written “optical oracle” [1] chip to solve the famous travelling salesman classical graph theory problem of verifying the existence of a Hamiltonian path in a network. The glass waveguide chip consists of a unidirectional network with four cascaded directional couplers where each coupler plays the role of a node (town), also acting as a beam splitter to direct the light to other nodes. The various nodes are connected to each other by waveguides (roads). We interrogate the photonic network by injecting femtosecond optical pulses and resolving the pulse distribution in time from the optical oracle via optical cross-correlation. If the Hamiltonian solution exists, its delay will be equal to the sum of the travel times needed to visit all nodes of the network, which is made unique by design. This first demonstration of an integrated optical oracle in laser-written waveguides proves the prospect of implementing complex optical waveguide networks that are able to perform cognitive tasks, moving towards larger and scalable networks which may allow solving hard mathematical problems, optically.

[1] An optical fibre network oracle for NP-complete problems, K. Wu, J. García de Abajo, C. Soci, P.P. Shum, N.I. Zheludev, *Light: Science & Applications* 3, e147 (2014).