# Electron transport in nano-porous graphene: from Talbot interference to quantum confinement

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A major experimental breakthrough was recently achieved where nano-porous graphene (NPG), consisting of linked graphene nanoribbons (GNR), was synthesized with unprecedented sample sizes and quality using molecular precursors and bottom-up assembly [1]. Two essential questions are: (i) do the quasi-1D GNR transport channels interfere with each other and (ii) can the electronic currents be directed and controlled within such 2D covalent network. By using multiscale [2] atomistic transport simulations, we demonstrate that electrons injected into the reported NPG structure spread over a number of GNRs **(Figure 1)**, giving rise to a Talbot interference pattern, in analogy to light within optical wave-guide arrays [3]. Furthermore, we demonstrate that chemical engineering of the GNR connections in the NPG allows confinement of currents within individual channels for more than 100nm [4]. Our design is based on well-known quantum interference principles [5] and recent experiments support its potential realization [6]. Overall, we predict that Talbot interference and sub-nm confinement of electrons in NPG or other similar materials may open up new opportunities for future quantum computing and carbon-based nano-circuitry applications.

## References

[1] Moreno et al, Science 360, 199 (2018)
[2] Calogero et al, submitted; arXiv:1812.08054
[3] Calogero et al, Nano Lett. 19, 1 (2019) 576
[4] Calogero et al, submitted
[5] Tsuji et al, Proc. Nat. Acad. Sci. 11 (2016) E413
[6] Shekhirev et al, ACS Nano, 12 (2018) 8662

## Figures

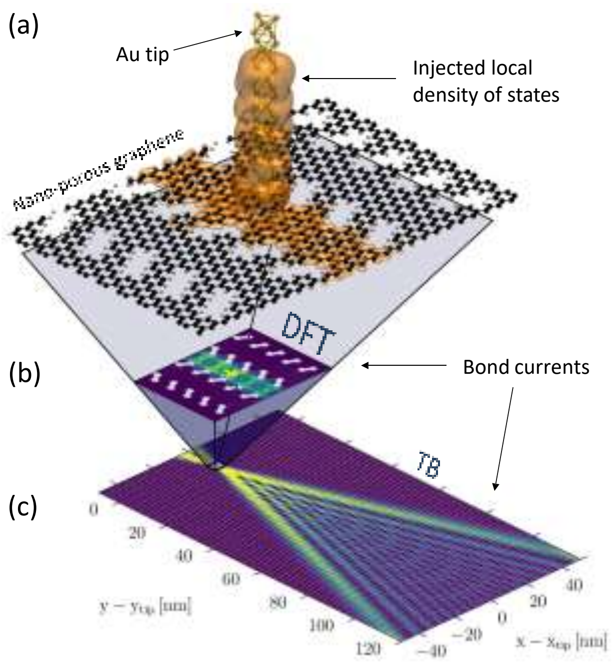


**Figure 1:** (a) Local density of states and (b) bond-currents injected by a metal tip in contact to NPG. (c) Bond-currents in a larger tight-binding model of NPG, exhibiting Talbot interference. Figure adapted from [3].