Artificial graphene as a designer Dirac material

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Recent advances in creating *graphene-like systems from the two-dimensional electron gas* are leading to a new science of "designer Dirac materials" [1]. Artificial graphene can be created either by positioning molecules on a metal surface [2] or by arranging quantum dots in an adjustable honeycomb lattice (see Fig. 1 and Refs. [3, 4]). As our ability to control the quality of artificial graphene samples improves, so grows the need for an accurate theory of its electronic properties, including the effects of electron-electron interactions. Here we determine those effects on the band structure and on the emergence of Dirac points [4], and discuss future investigations and challenges in this exciting new field [5].

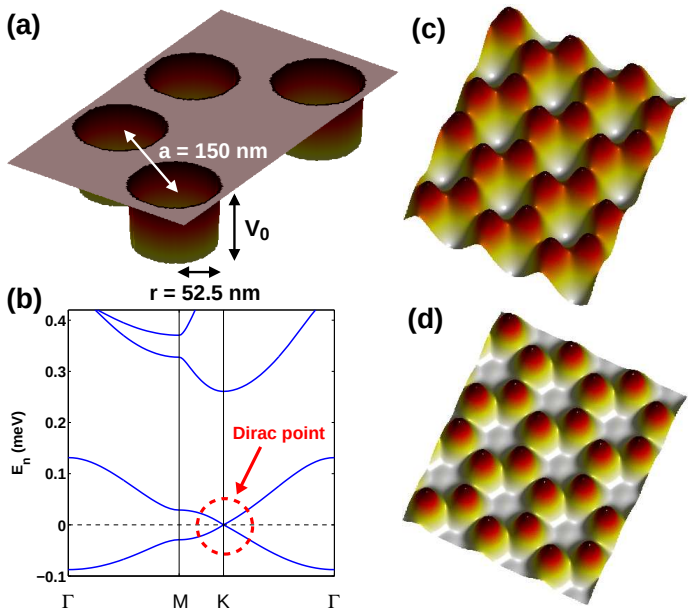

Figure 1: (a) Piece of the model potential for artificial graphene with tunable parameters. (b) Band structure exhibiting a Dirac point at the Fermi level. (c-d) Electron density without (c) and with (d) electron-electron interactions [4].

[1] Nature **483**, Issue 7389 (2012): Cover picture; News & Views by J. Simon and M. Greiner, p. 282; Letters by K. K. Gomes *et al.*, p. 306 (Ref. [2]) and Tarruell *et al.*, p. 302.
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[3] See A. Singha *et al.*, Science **332**, 1176 (2011) and references therein.
[4] E. Räsänen, C. A. Rozzi, S. Pittalis, and G. Vignale, Phys. Rev. Lett. **108**, 246803 (2012).
[5] E. Räsänen *et al.*, to be published (2013).