The Electronic Bandstructure of Atomically Sharp Dopant Structures in Silicon

Justin W. Wells[+]

Center for Quantum Spintronics, Department of Physics, Norwegian University of Science and Technology, NO-7491 Trondheim, Norway

Recently, it has become possible to control the placement of dopants in silicon with atomic precision, and this has given rise to a plethora of atomic scale and quantum proto-devices [1-3]. In this talk, I will present our ongoing work on understanding the electronic bandstructure of these dopant profiles in silicon.

Angle Resolved Photo-Electron Spectroscopy (ARPES) is the method of choice for observing the bandstructure, however observing the bandstructure of buried structures is extremely challenging. We have demonstrated that it is nonetheless possible to use ARPES to measure the bandstructure of dopant structures which have been created several nm beneath the surface [4]. It is also possible to see electron-phonon and electron-impurity interactions [5], quantum confinement of both the valence band and conduction band [6] and more. I will present these findings together with an overview of the current in understanding and controlling the electronic structure of dopant assemblies in semiconductors.

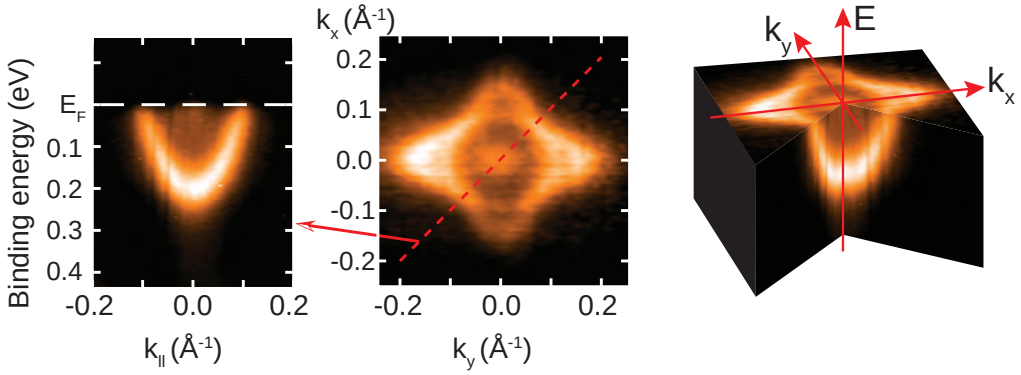

Figure: The measured electronic bandstructure of a 2D plane of dopants within a silicon host (so-called "delta-layer") located several nm beneath the sample surface.

[1] Weber *et al.,* Science 335, 64 (2012)
[2] Zwanenburg *et al.*, Rev. Mod. Phys. 85:961 (2013).
[3] Watson *et al.*, Nature 555, 633 EP (2018)
[4] Miwa *et al.*, Phys. Rev. Lett. 110:136801 (2013)
[5] Mazzola *et al.,* Appl. Phys. Lett. 104: 173108 (2014)
[6] Mazzola *et al.*, Phys. Rev. Lett. 120:046403 (2018)

[+] Author for correspondence: justin.wells@ntnu.no