

Description of band structures



exfoliation

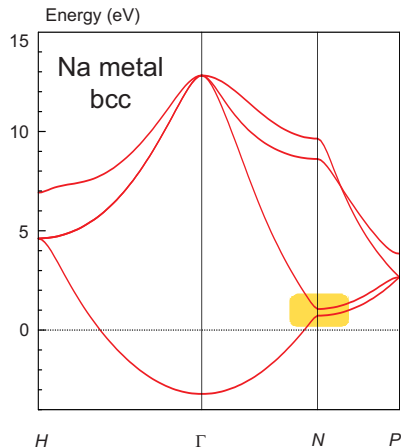
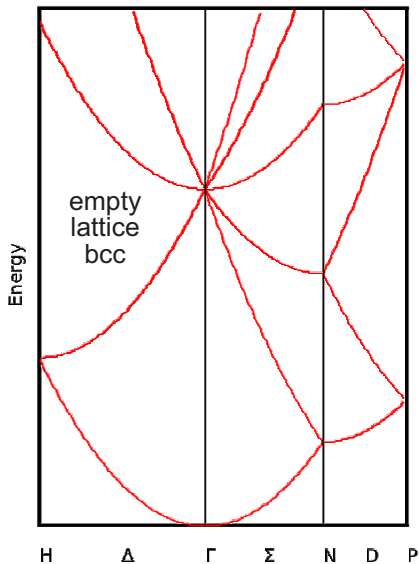


graphene

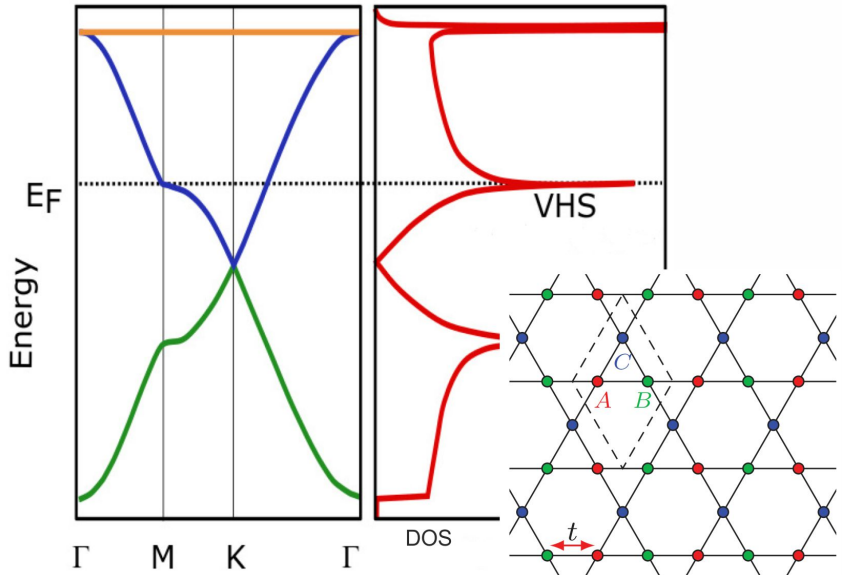


Andre Geim

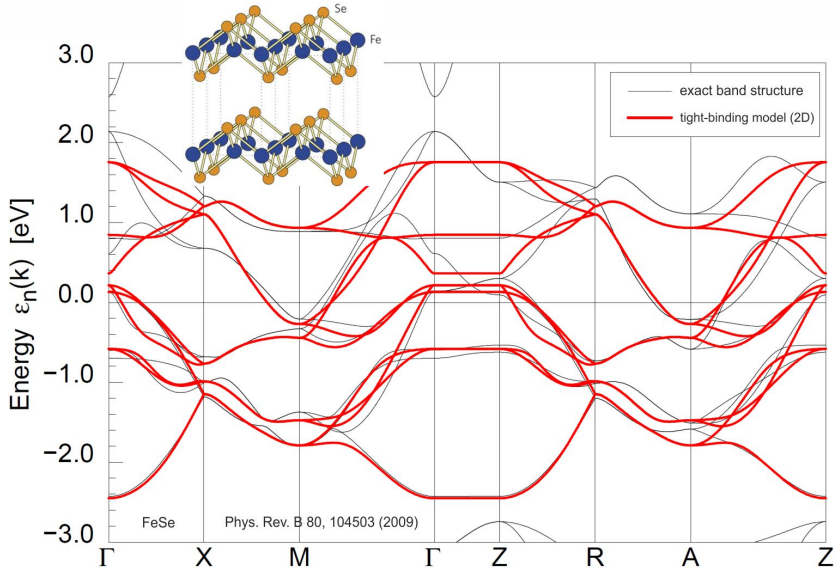


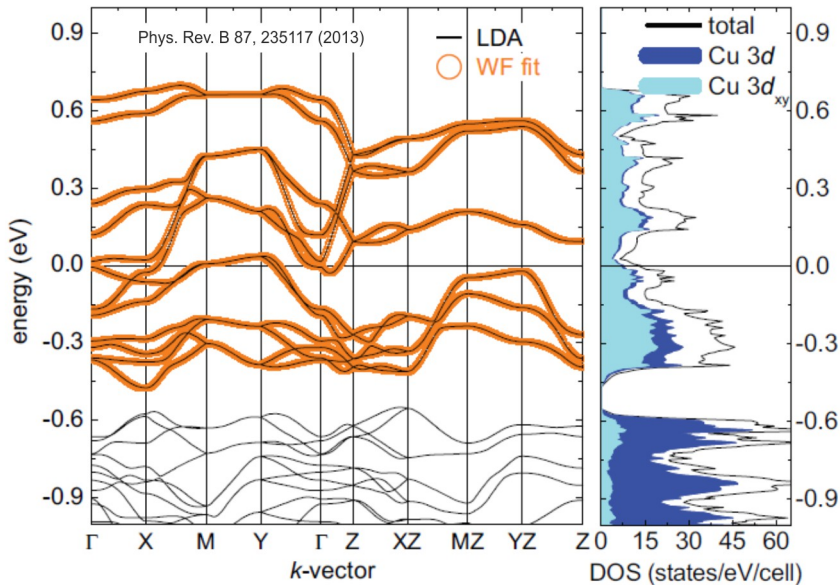


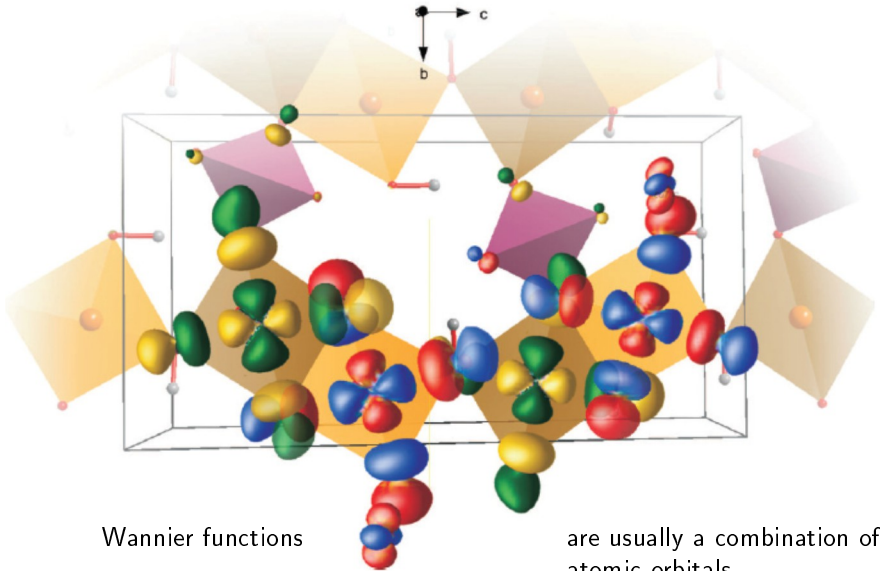
Reconstruct the band structure



Analyze the band structure







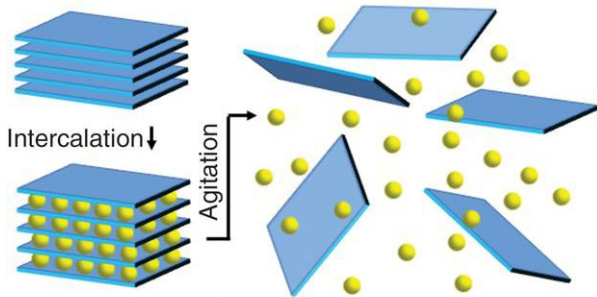
Wannier functions

are usually a combination of atomic orbitals

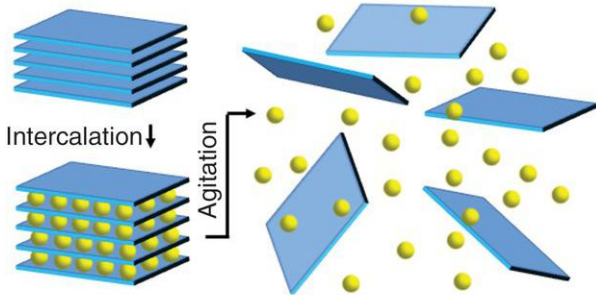


Experimental technique

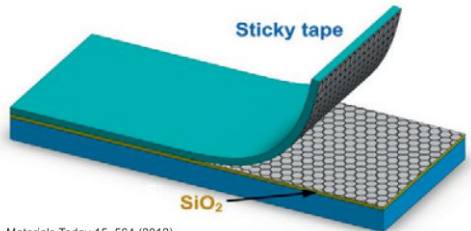
exfoliation



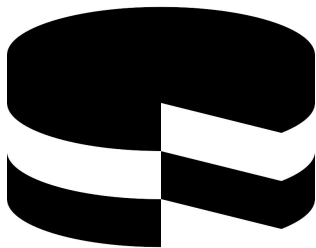
Science 340, 1420 (2013)



Science 340, 1420 (2013)



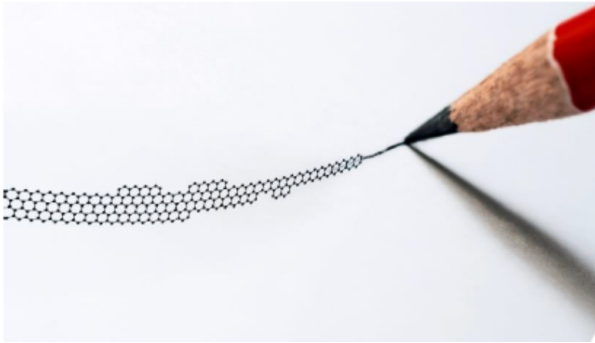
Materials Today 15, 564 (2012)



Material

graphene

Key features of graphene

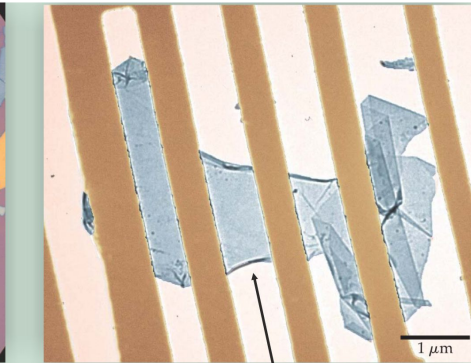
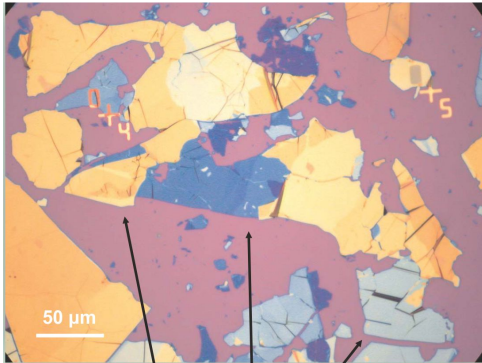


- easily obtained by exfoliation
discovery – 2004, Nobel prize in physics – 2010 (Geim and Novoselov)
- very light (0.77 mg/m^2)
- nearly transparent for visible light
- highly conducting
- very strong (resistant to breaking) but flexible (can be folded) at the same time

How to spot graphene?

optical microscope

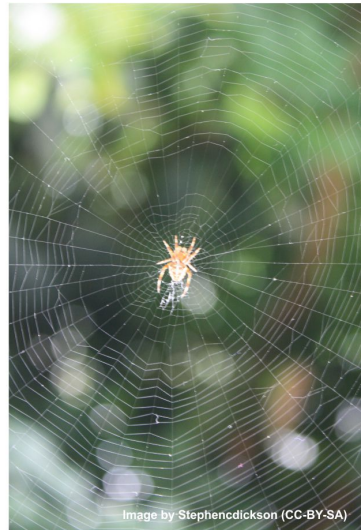
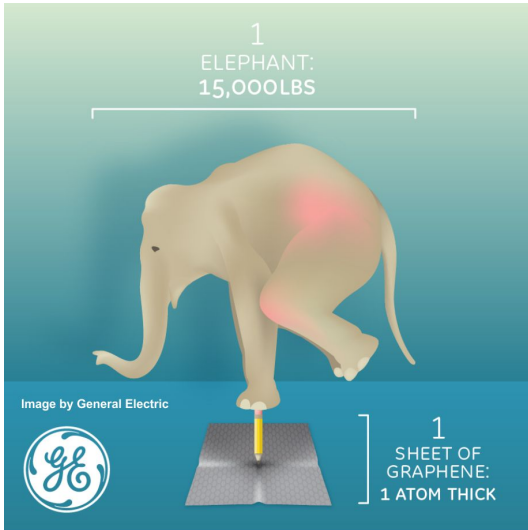
electron microscope



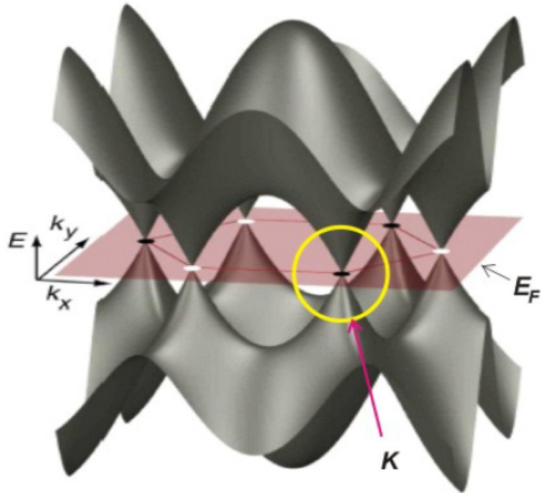
graphene flakes
with different thickness

one-atom-thick graphene layer
hangs on Au wires

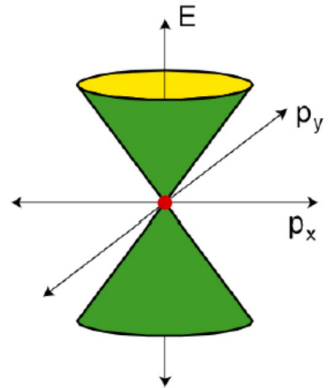
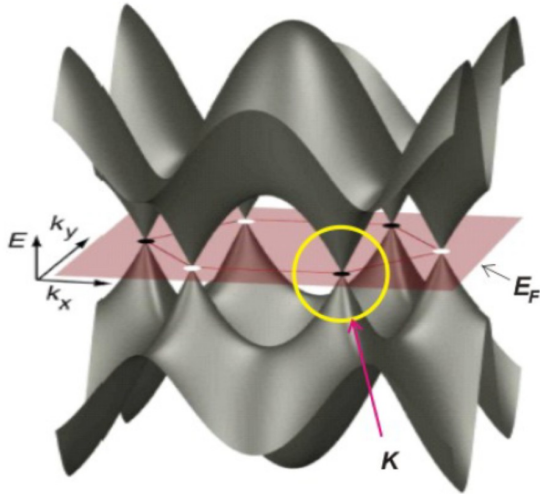
Physics Today 60(8), 35 (2007)



What would it take
to pierce a sheet of graphene?

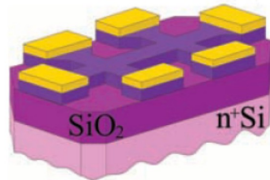
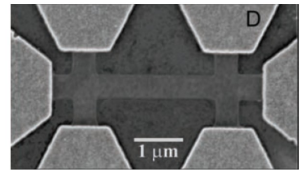
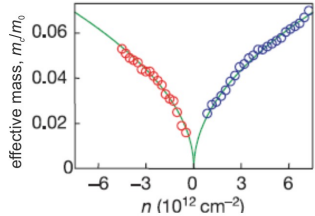
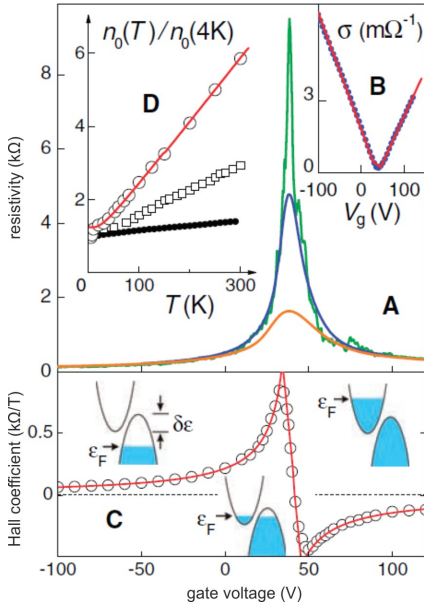


Graphene is an archetype semi-metal

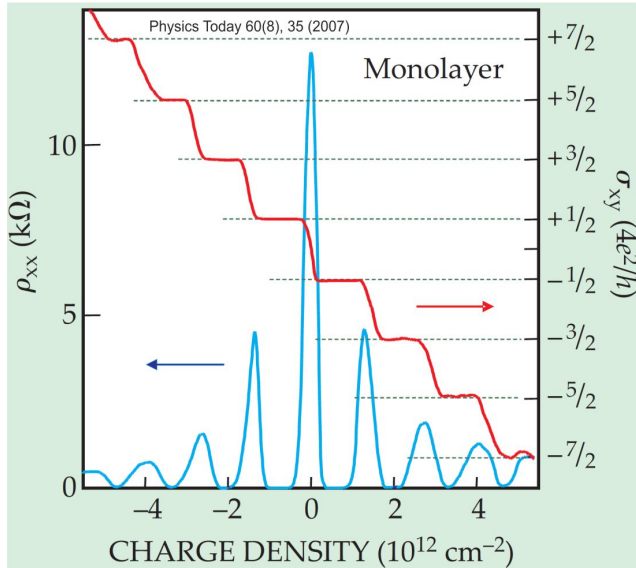


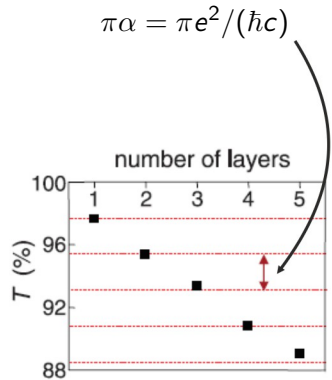
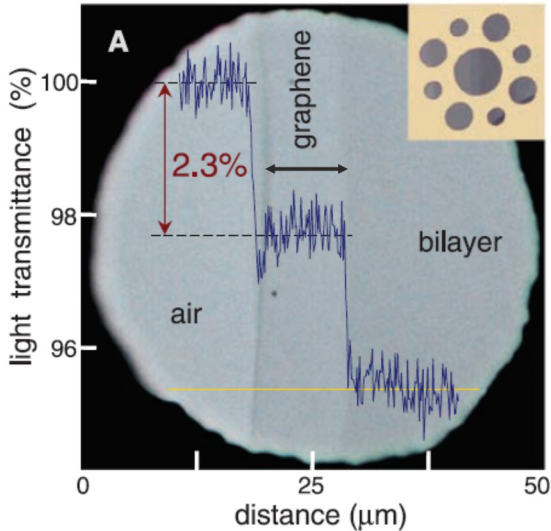
Dirac cone

Graphene is an archetype semi-metal with linear bands around ϵ_F



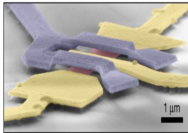
Science 306, 666 (2004)
 Nature 438, 197 (2005)





Science 320, 1308 (2008)

Physics Colloquium



Tuesday, January 23, 2024 at 16:30

Thomas Weitz

Georg-August-University Göttingen



**Quantum phases in flat-band van-der-Waals systems:
making, controlling and measuring by quantum transport**



Person

Andre Geim



Andre Geim
(born 1958)

- 1982: diploma in physics, Moscow Institute of Physics and Technology
- 1987: PhD in Physics, Chernogolovka (Russia)
- 1994–2000: associate professor at Nijmegen (Netherlands)
- since 2001: full professor at Manchester, UK
- 2000: Ig Nobel prize (diamagnetic levitation)
- 2004: discovery of graphene
- 2010: Nobel prize in physics (graphene)



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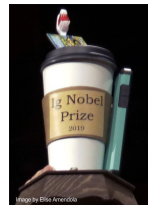
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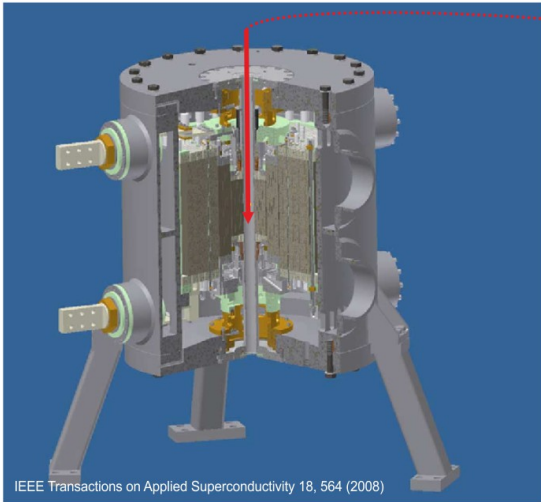
Ig Nobel prize:

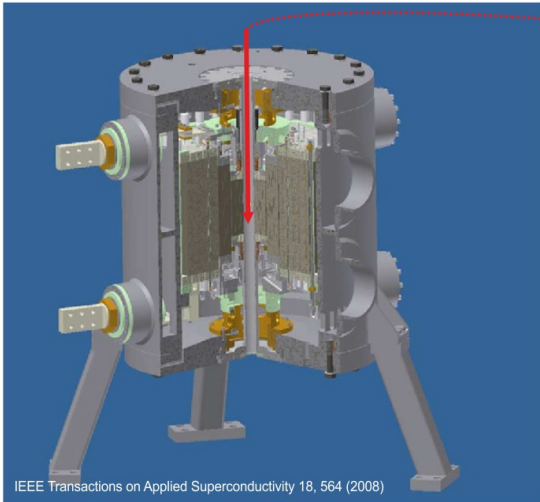
“honor achievements that first make people laugh, and then make them think”

2001 Prize in Physics: to Dr. Len Fisher for calculating the optimal way to dunk a biscuit



Levitating frog







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Physica B 294–295 (2001) 736–739

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Detection of earth rotation with a diamagnetically levitating gyroscope

A.K. Geim*, H.A.M.S. ter Tisha

High Field Magnet Laboratory, University of Nijmegen, Toernooiveld 1, 6525 ED Nijmegen, The Netherlands



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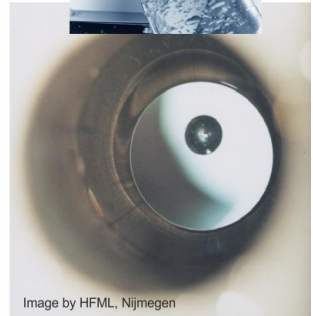
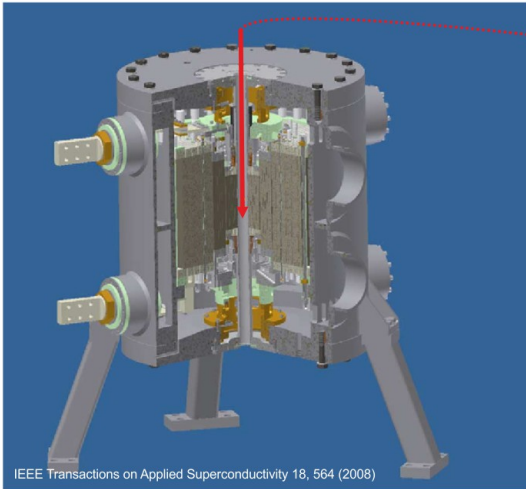
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“...added as co-author
for his assistance with the project”





“Search, not re-search!” (A. Geim)

Scotch tape experiments



Image by Peter O'Connor (CC-BY-SA)

“What those guys did not realize was that throwing away the Scotch tape they were throwing away the Nobel Prize as well”