

Was forscht Berndt eigentlich?

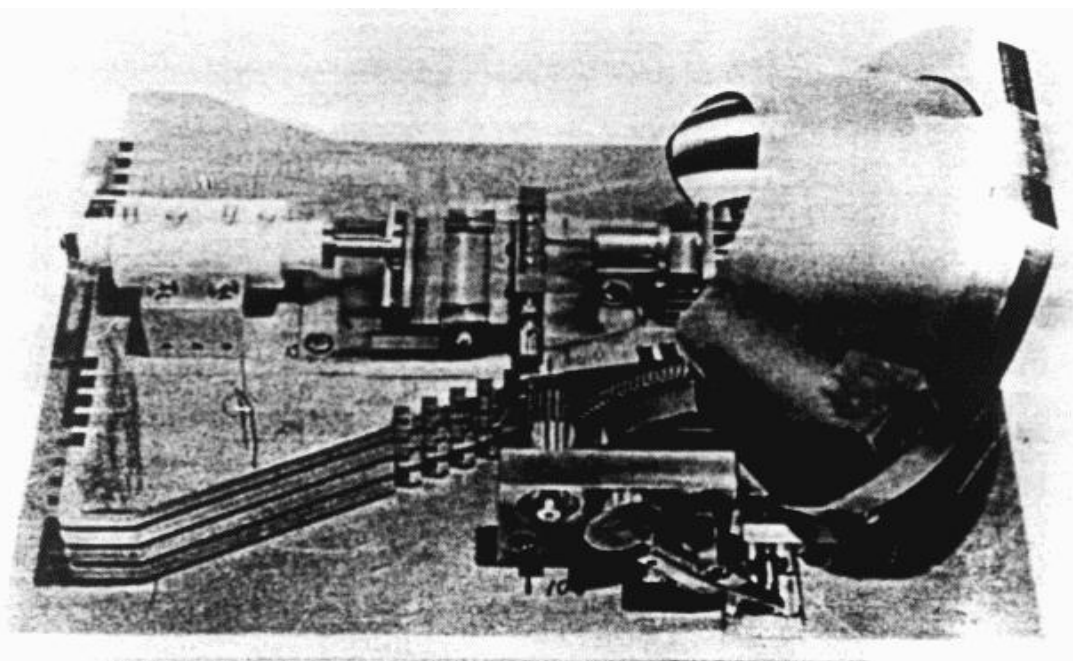
z. B.:

kleinste strombetriebene Lichtquelle der Welt

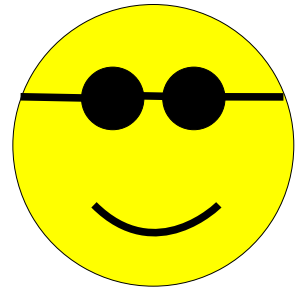
höchste optische Auflösung

Plasmonen – Quantentransport

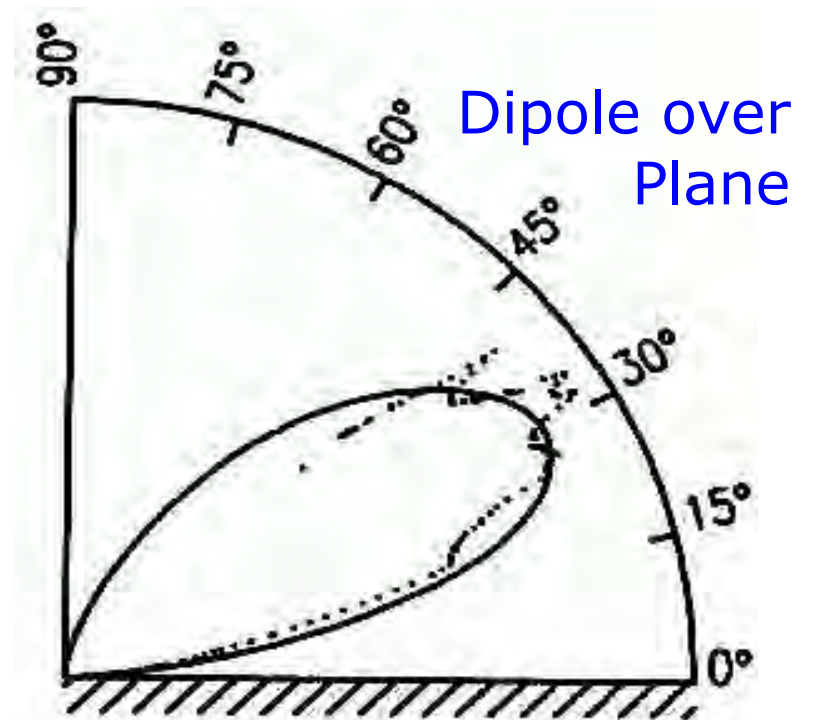
(Einzelatommagnetismus, Donatoren in ZnO, molekulare Schalter, intramolekularer Energietransfer, Elektrospraydeposition, Atomkraftmikroskopie ...)



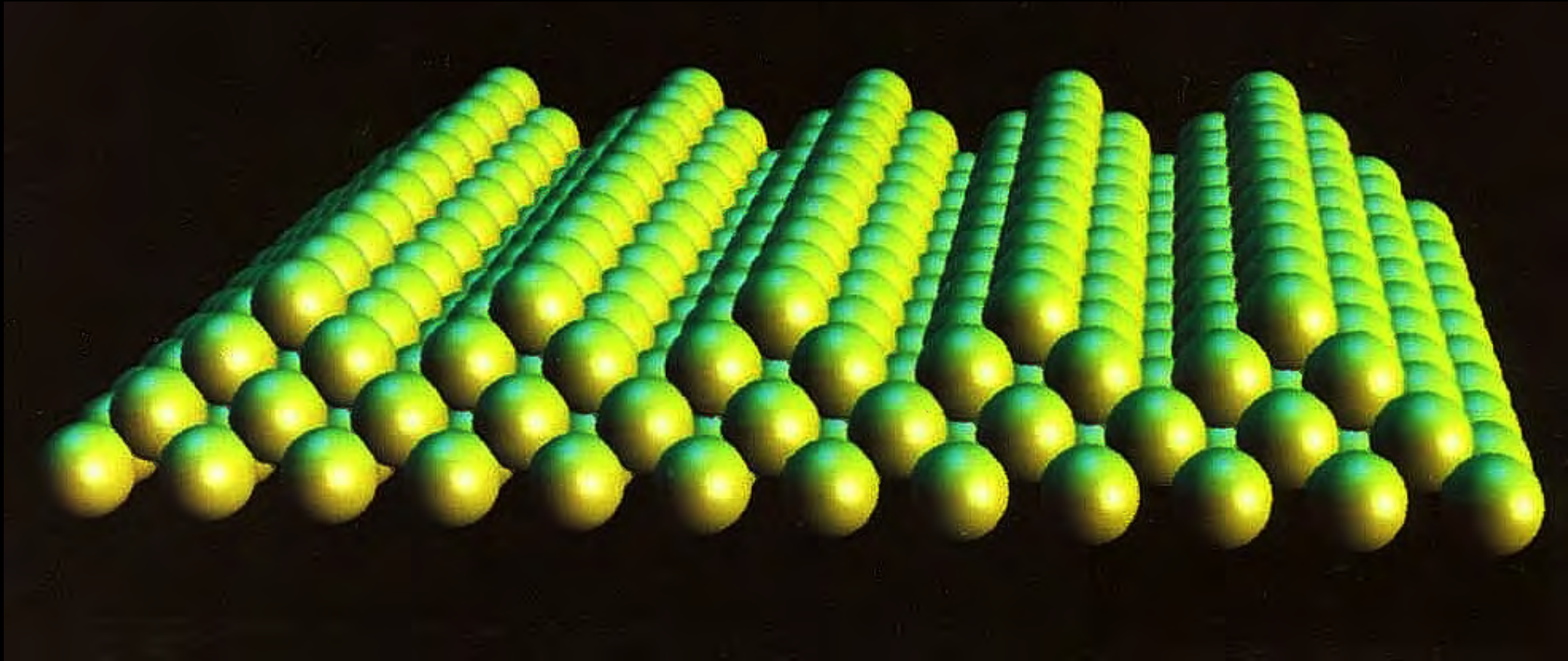
No Sun Glasses needed



J. Vac. Sci. Technol.
B **9**, 897 (1991)

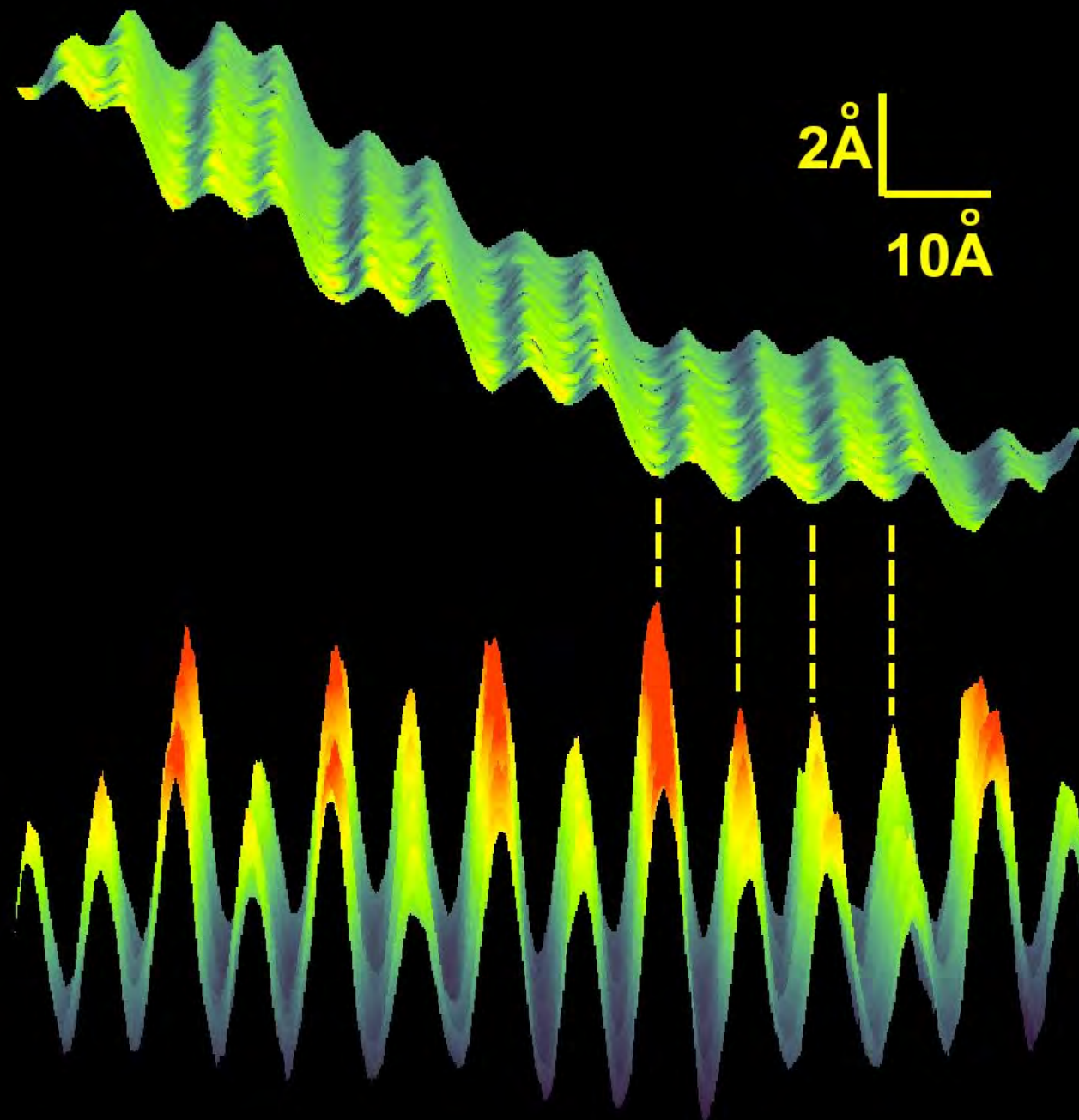


The Resolution Limit?



Au(110) 1x2: An Atomic Line Grating

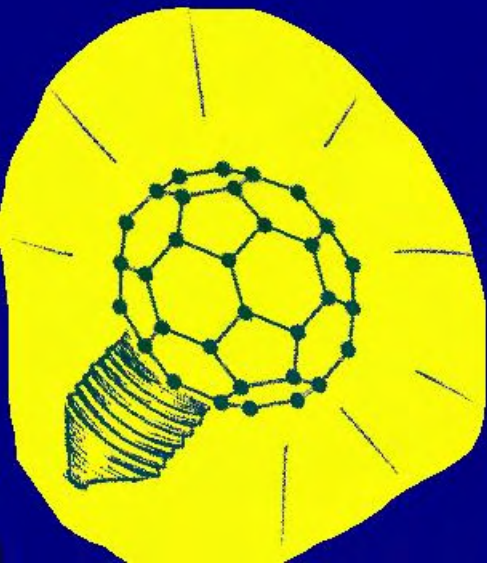
Au(110): 8 Å Gitter



'BUCKY BULBS'

Berndt et al., Science **262** (1993) 1425

1 nm



$$R = \rho \frac{A}{l}$$

Was passiert wenn l , A
atomare Größe haben?

Ladungsquantisierung und elektrischer Strom
oder:

The noise is the signal

Rolf Landauer, Nature **392**, 658 (1998)

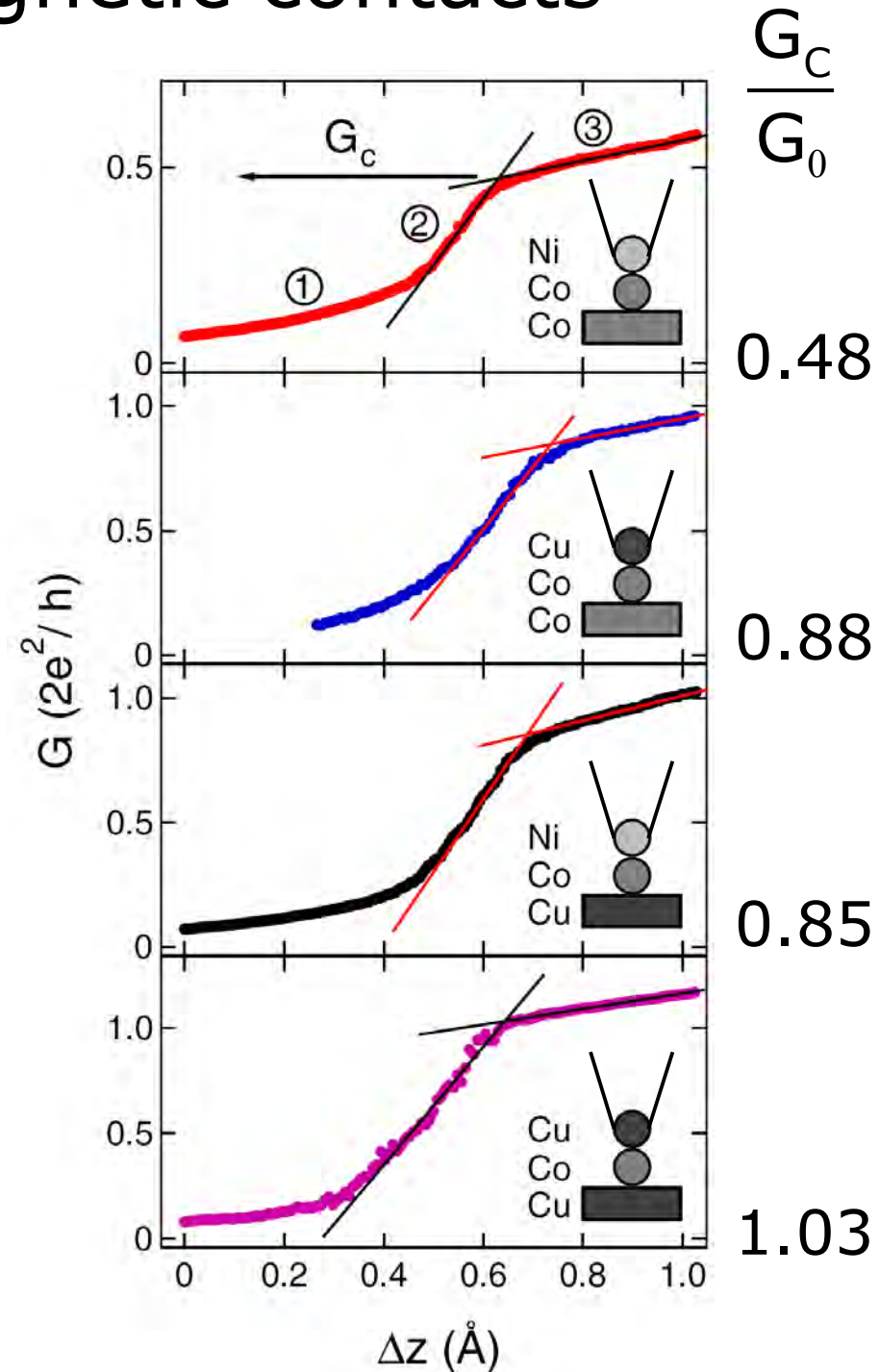
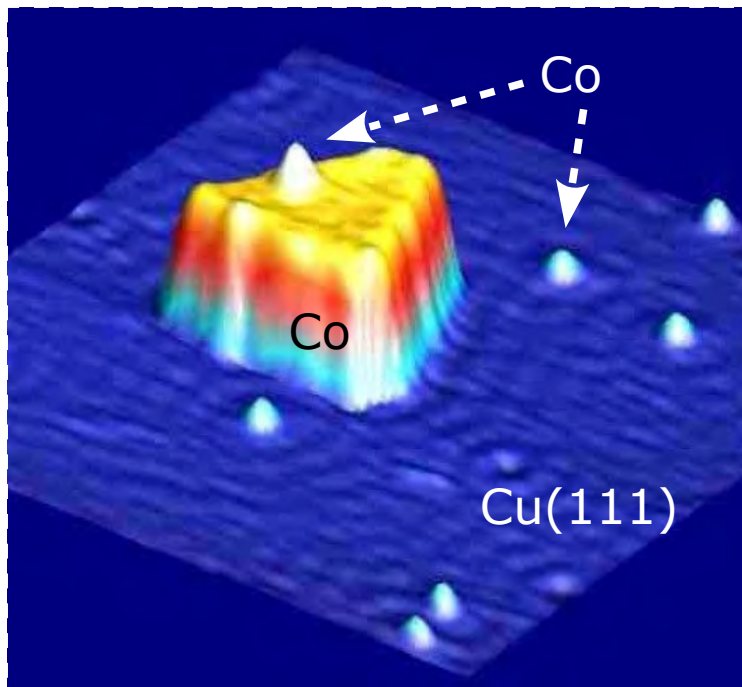
Conductance of magnetic contacts

$$G_0 = 2 e^2/h$$

100% spin polarized transport channel

with $G_c = 1/2 G_0$?

Néel et al., PRL **102**, 086805 (2009)



Shot Noise as a Probe of Spin-Polarized Transport

Shot noise spectral density S

Schottky's result:

Poisson noise

$$S_p = 2e \langle I \rangle = e V \frac{1}{2} G_0 \sum \tau_{j,\sigma}$$

Quantum transport (Lesovik):

Sub-poissonian noise

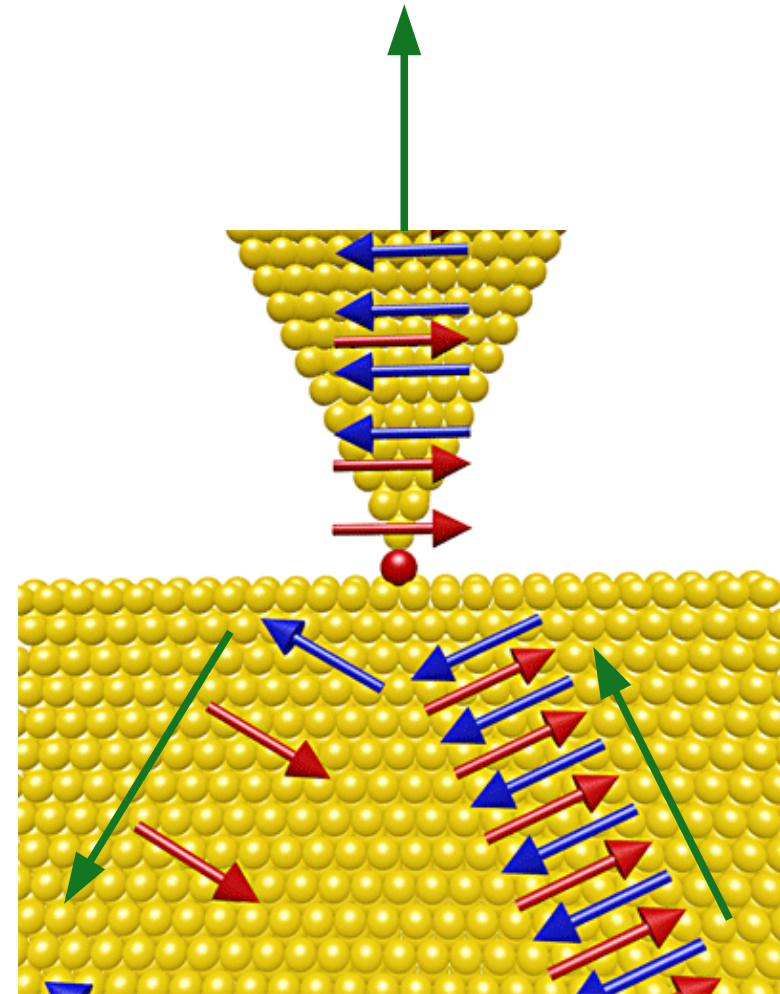
$$S = e V \frac{1}{2} G_0 \sum \tau_{j,\sigma} (1 - \tau_{j,\sigma})$$

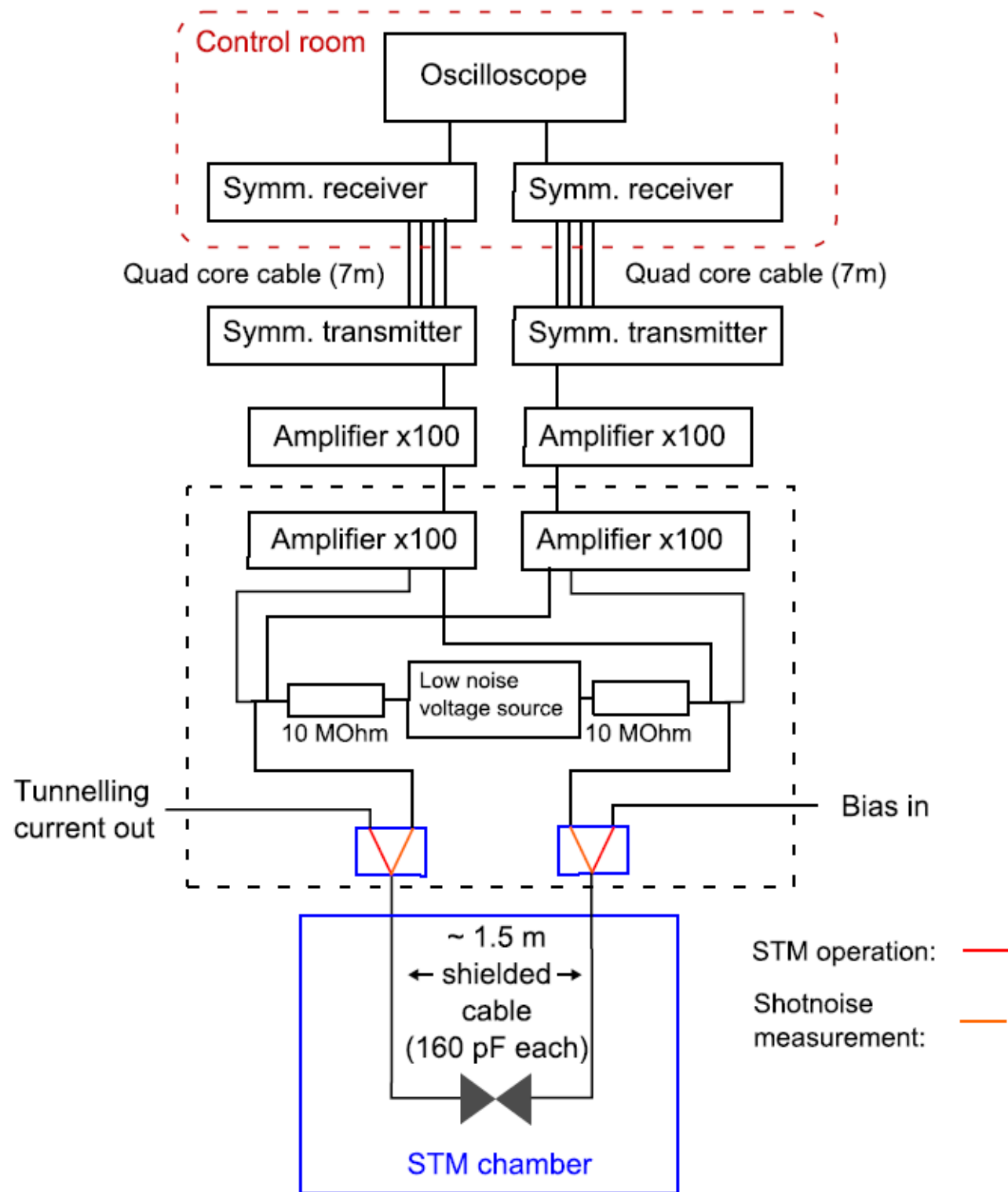
Noise reduction:

Fano Factor

$$F = S / S_p = \sum \tau_{j,\sigma} (1 - \tau_{j,\sigma}) / \sum \tau_{j,\sigma}$$

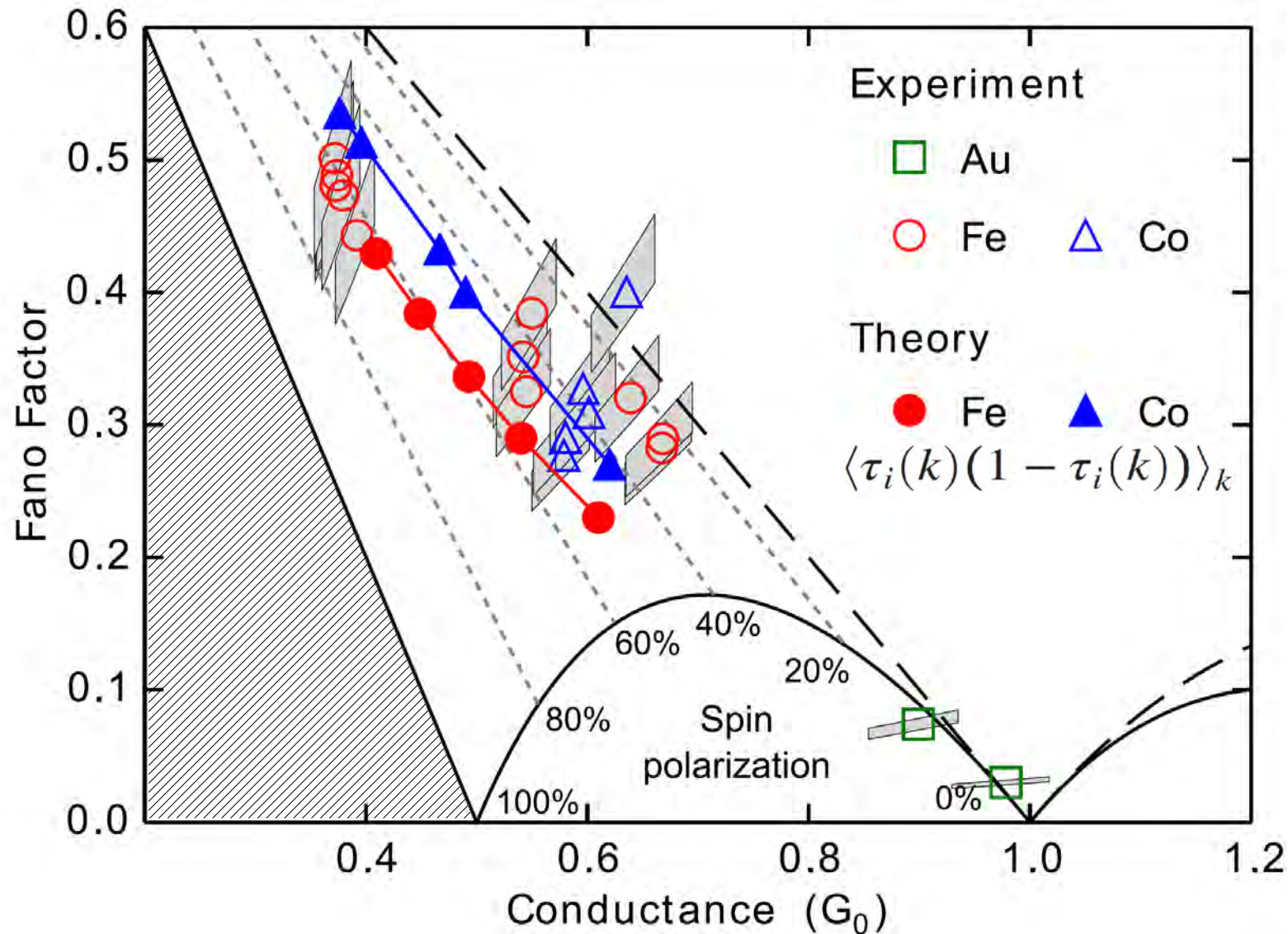
... depends on spin σ





Shot noise from single atoms on Au(111), Au tip, 4.5 K

Burtzlauff, Weismann, Brandbyge, Berndt, Phys. Rev. Lett. **114**, 016602 (2015)



Editors'

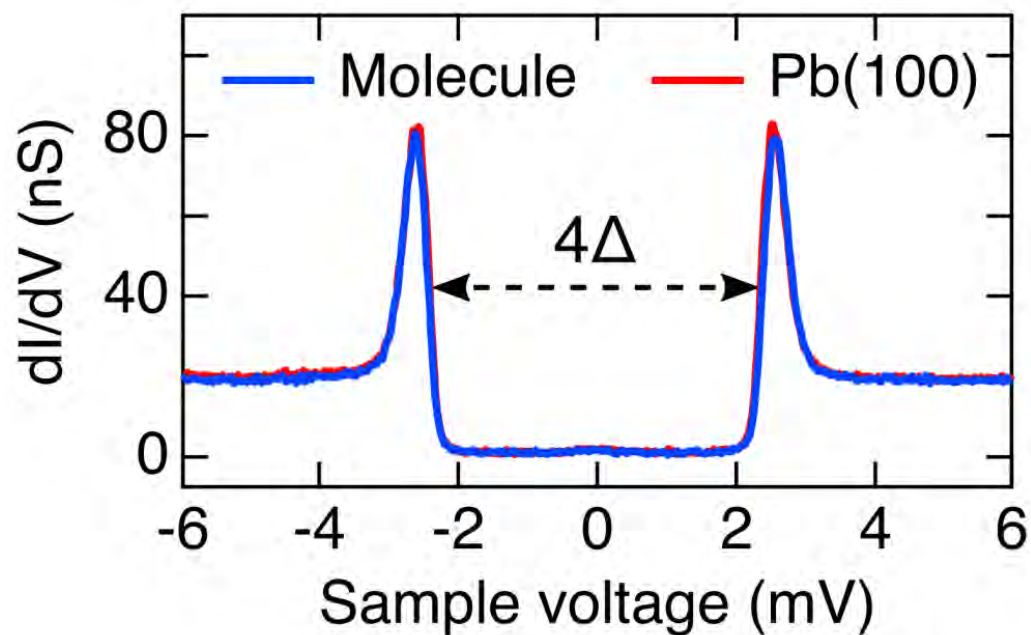
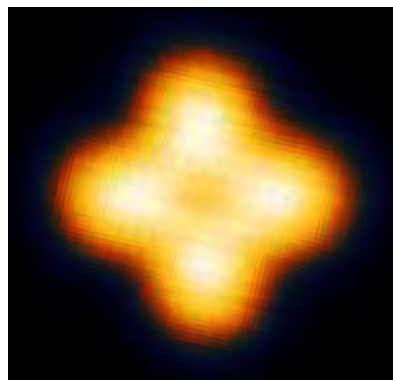
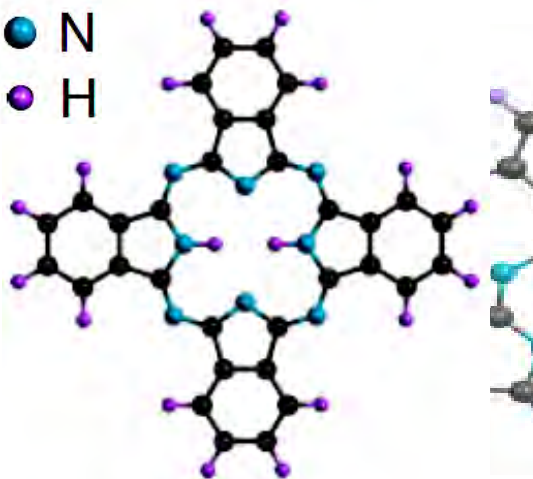
Suggestion

Au: consistent with PRL **82**, 1526 (1999)

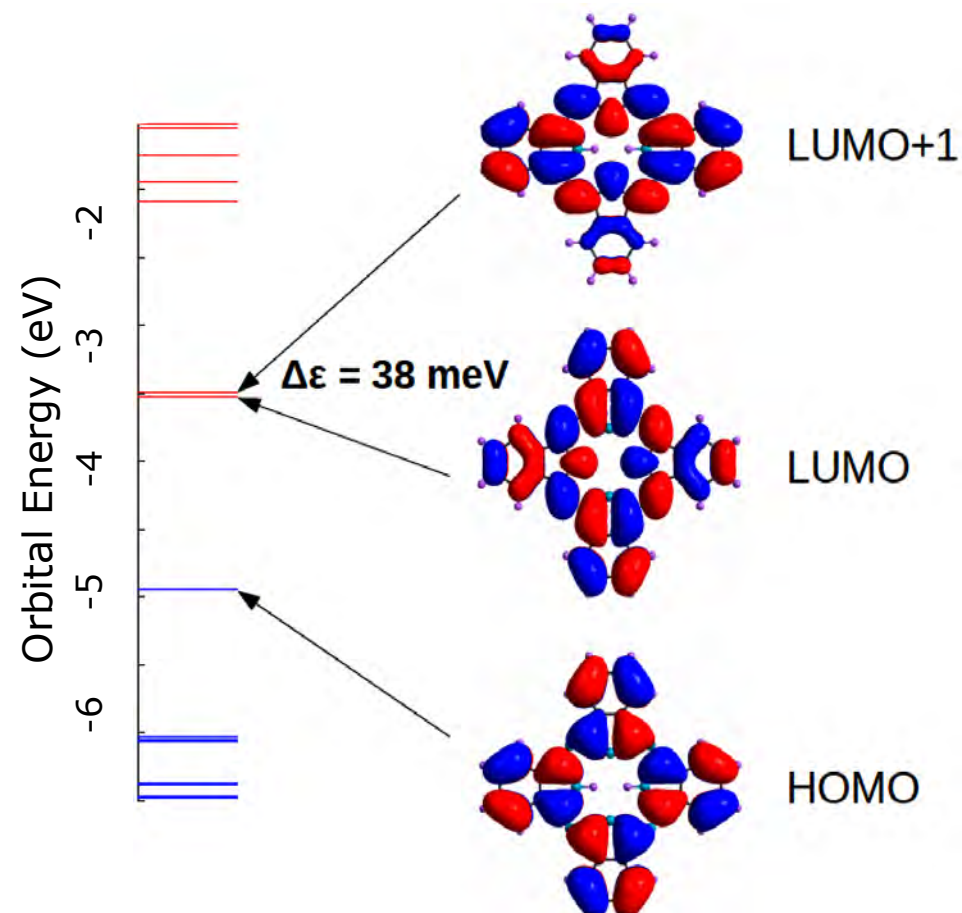
Fe, Co: single channel (Au is a filter!), spin polarized transmission

H₂Pc on Pb(100): a wee bit boring ?

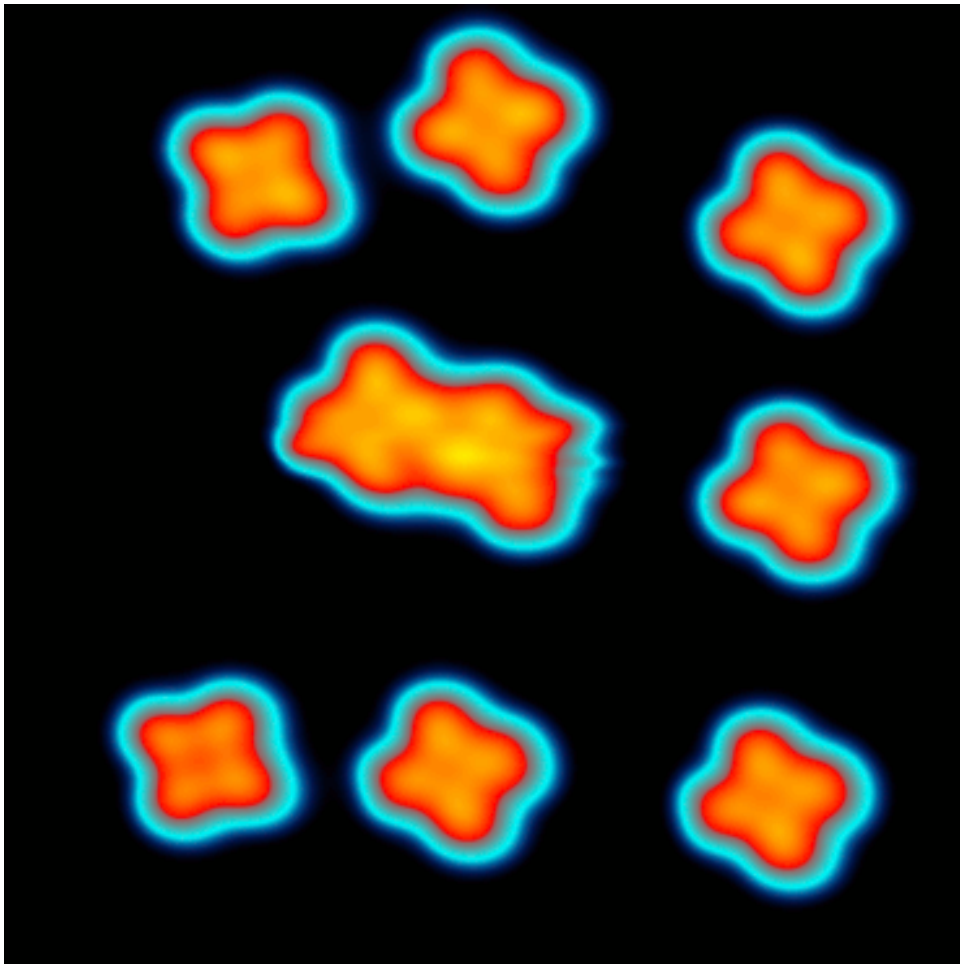
● C
● N
● H



2.3 K, Pb tip

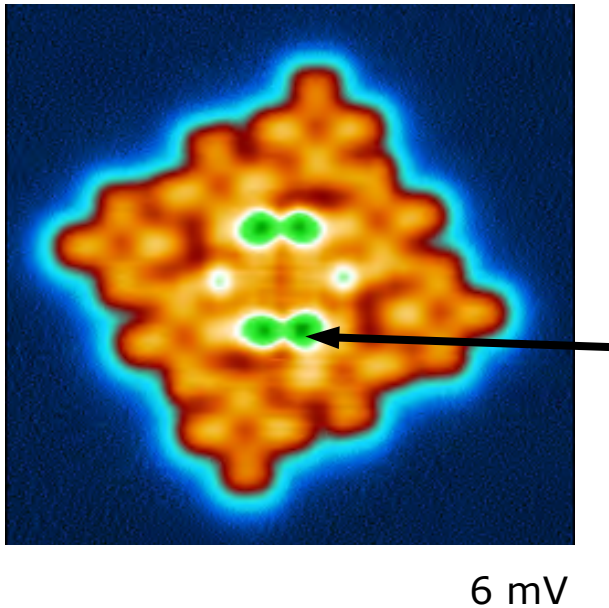


Building Supramolecules

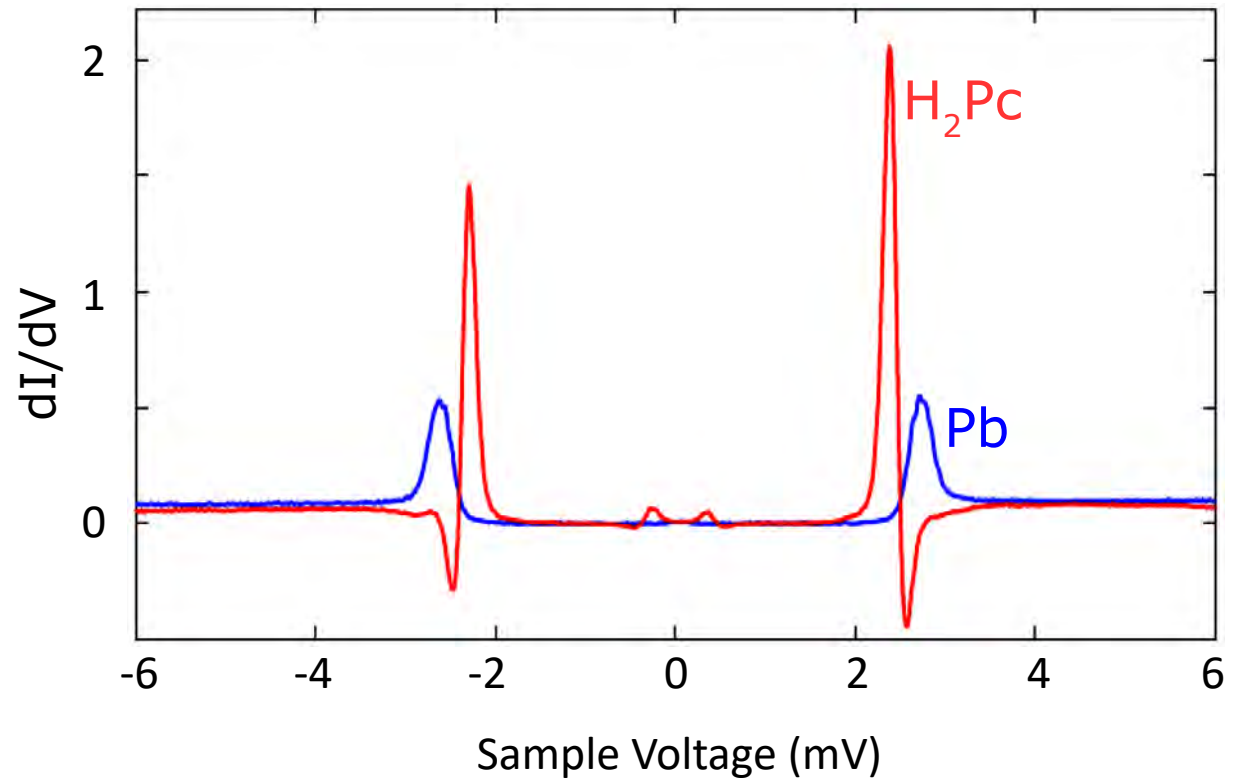


Low-bias data

6 mV Topograph



Conductance spectra

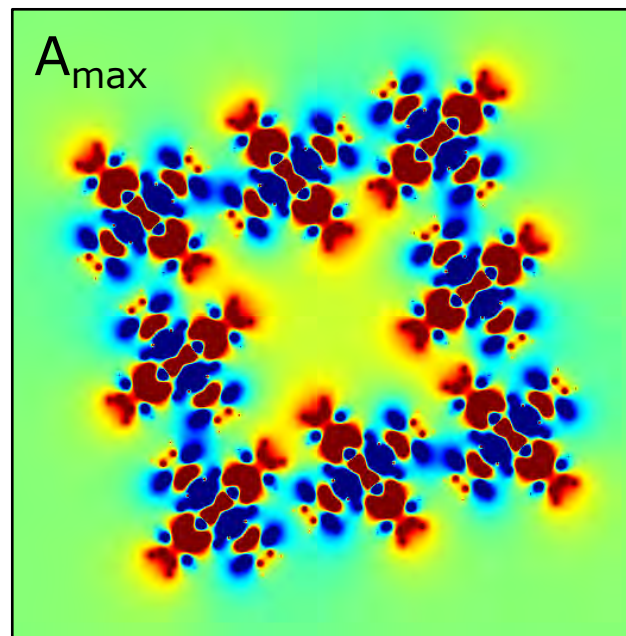
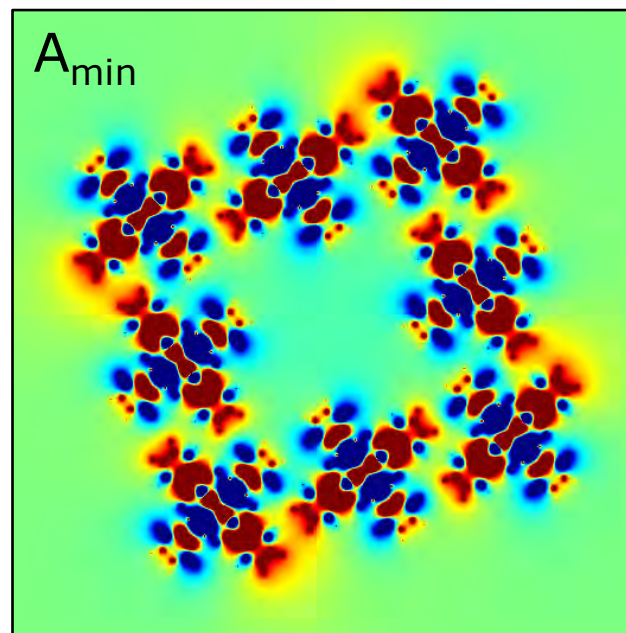
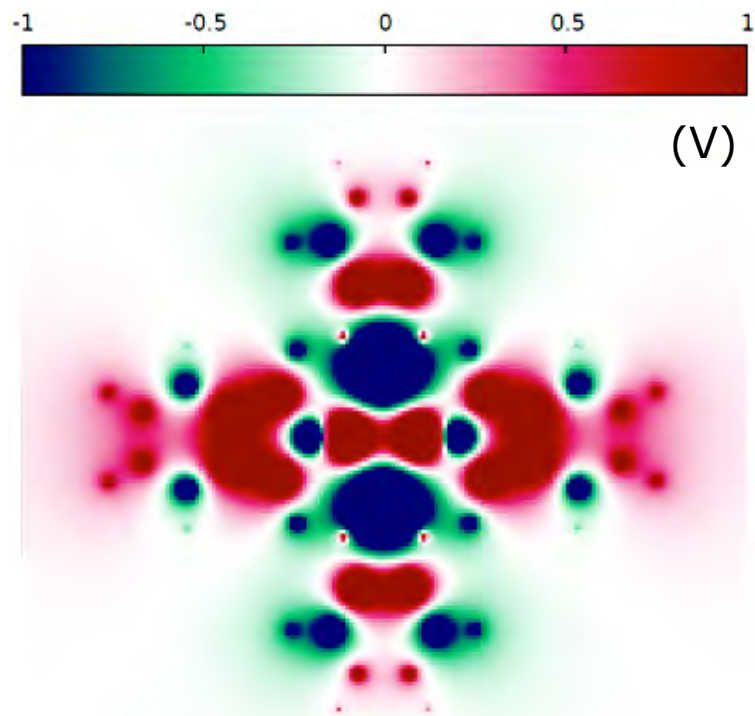


Yu-Shiba-Rusinov state in the superconducting gap

→ Evidence of localized spin

Electrostatic potentials

Single molecule



Superposition of 8

Quadrupoles ($\rightarrow$ tautomers) lower potential at central molecule

Caveat: Gas phase result; surface electrons add screening $\rightarrow$ reduced magnitude

Wie (sollte) Intensität von Strom abhängen?

Elektron entspricht δ -Strompuls

δ -Strompuls hat weißes Spektrum

$$\delta(t) = \frac{1}{2\pi} \int_{-\infty}^{+\infty} \exp(i\omega t) d\omega$$

regt u. a. Resonanz an ("lokales Plasmon")

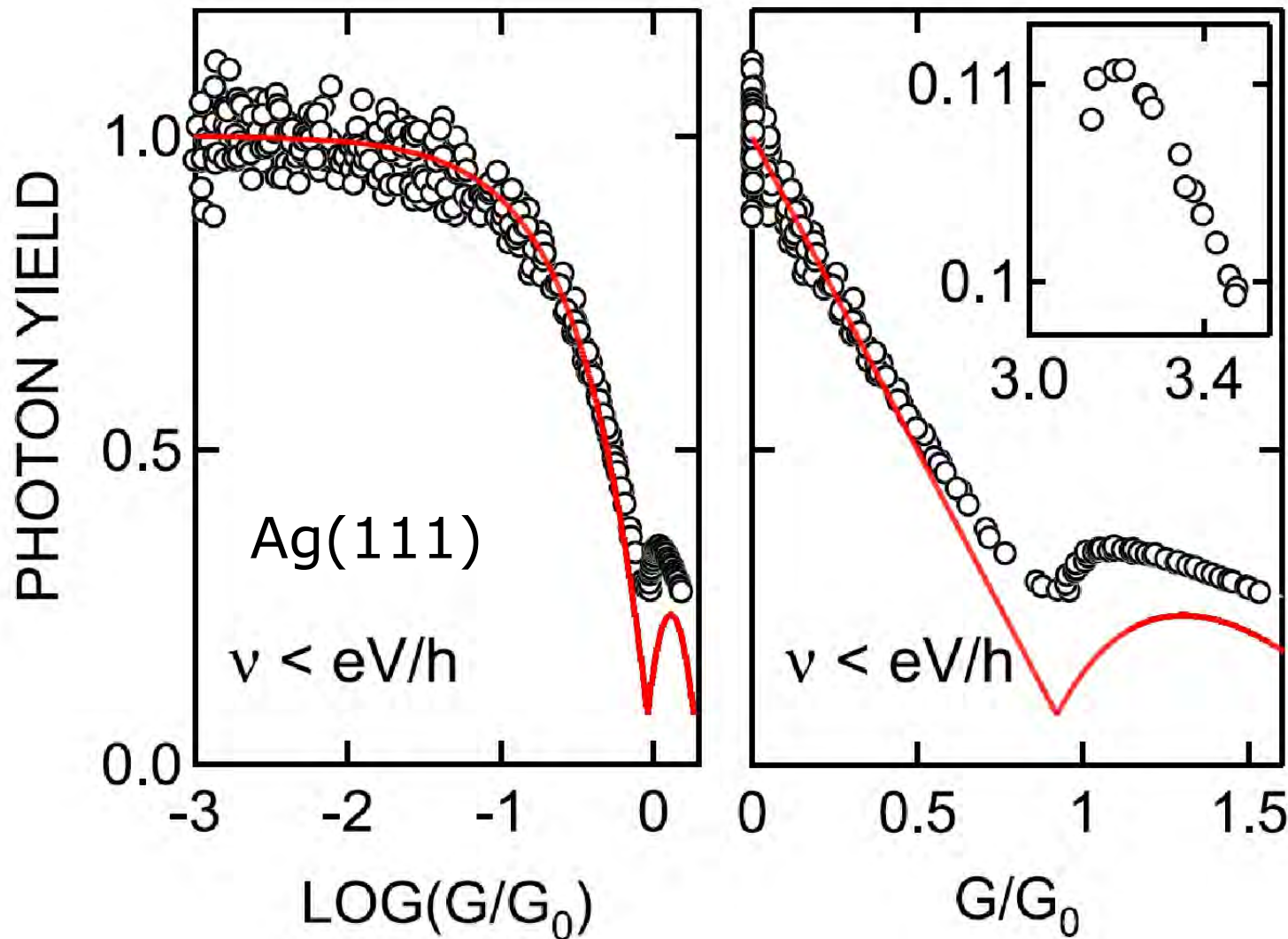
strahlt Photon ab

Stromstärke $I \sim$ Elektronen pro Zeitintervall

Intensität $\sim I$

also: Intensität/ I = Ausbeute = const.

Comparison of Fano factor & photon yield



Leitwert
Conductance
 $G = 1/R$

$T \sim 2000 \text{ K} ?$

Optical probe of quantum shot noise
at a single atom contact



Schneider,
Schull,
Berndt,

PRL 105, 026601 ('10)

Editors' Suggestion