

# Conductance features in point contact Andreev reflection spectra

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B J Hickey<sup>1,4</sup>**

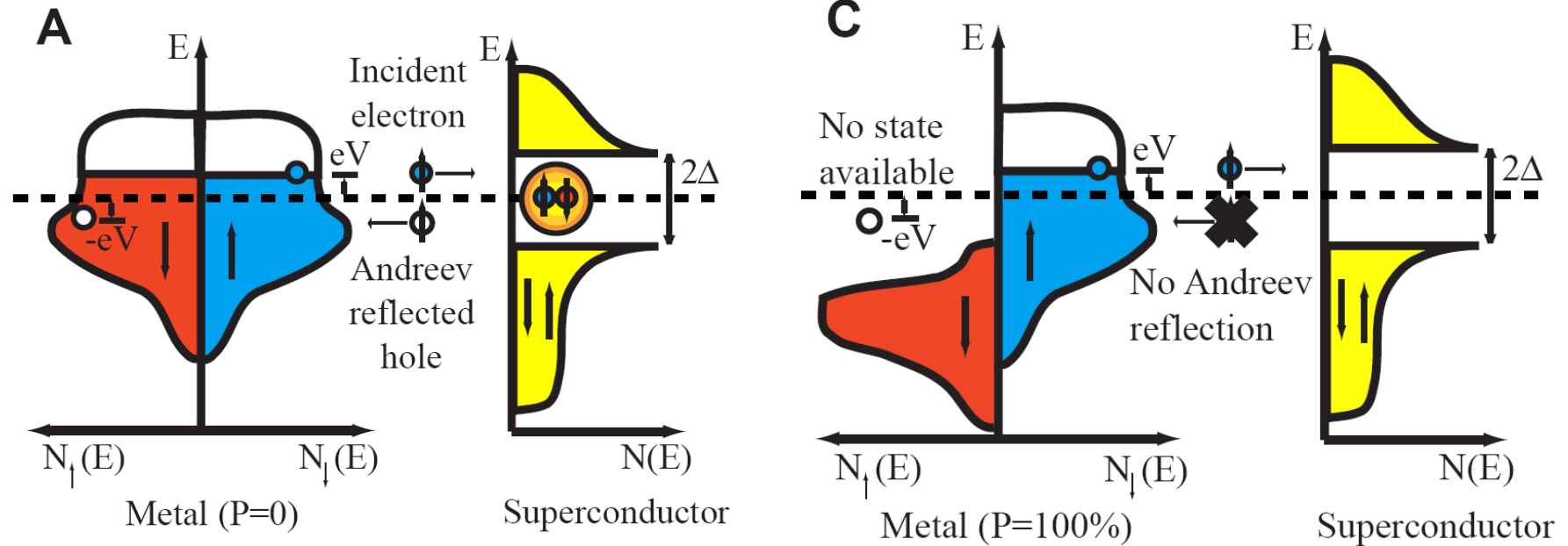
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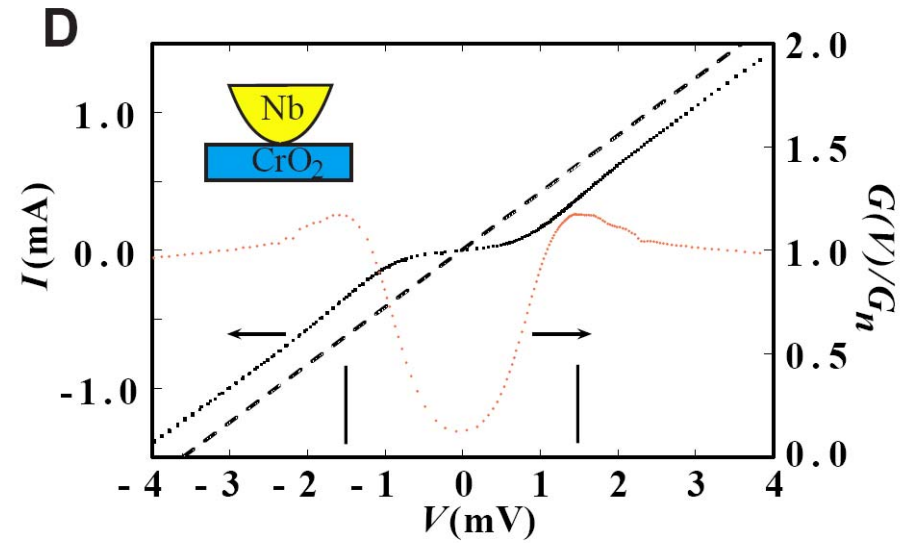
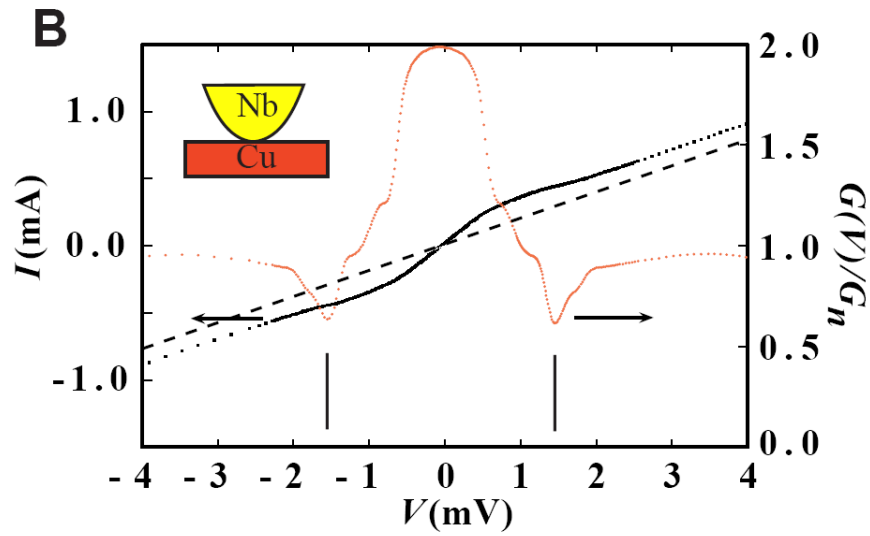
Literature discussion, June, 2nd 2010

Tim Verhagen

# Point contact Andreev reflection



# IV characteristics



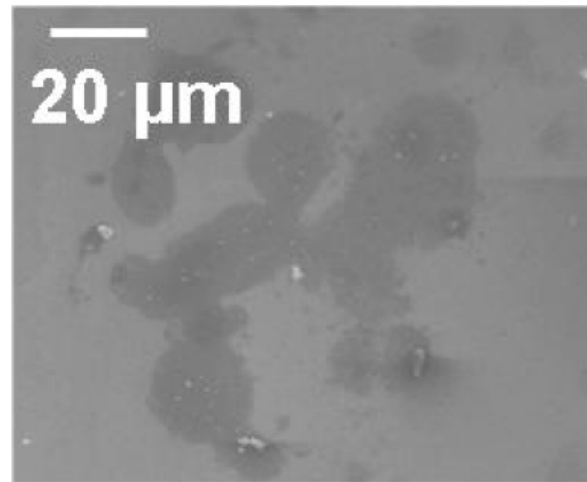
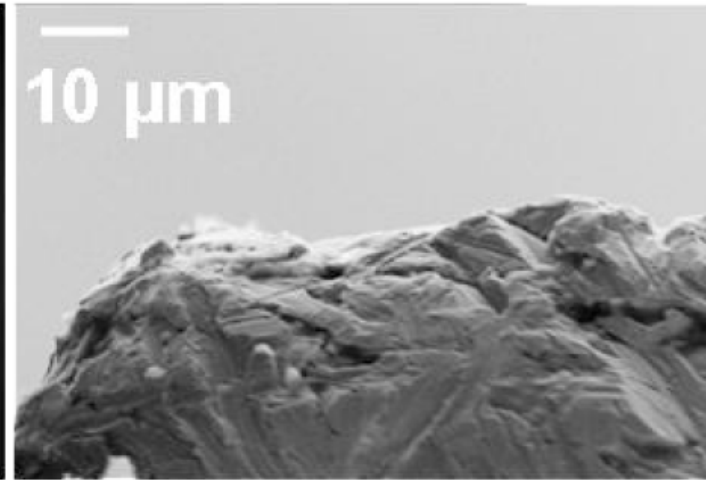
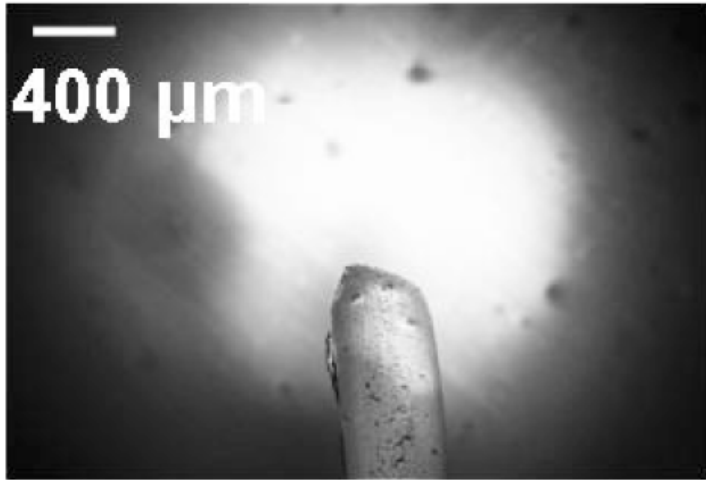
# (Modified) BTK model

$$\frac{G_i}{G_N} = -[1 + Z^2] \int [1 + A_i(\epsilon) - B_i(\epsilon)] \frac{f\left(\frac{\epsilon - eV}{\omega}\right)}{dV} d\epsilon$$

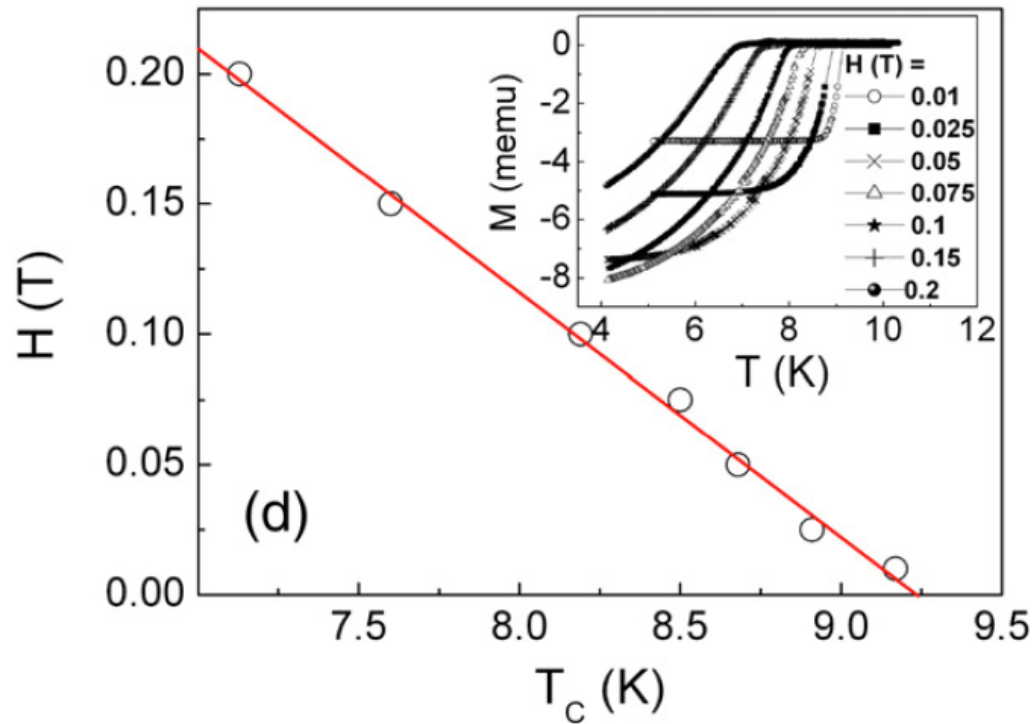
$$G = [1 - P]G_u(\Delta, Z, \omega) + PG_p(\Delta, Z, \omega)$$

↓  
kbT (4.2K ~ 0.362meV)

# Nb Tip



# VSM Nb Tip



Q: Do you really measure only the tip, or the whole wire?

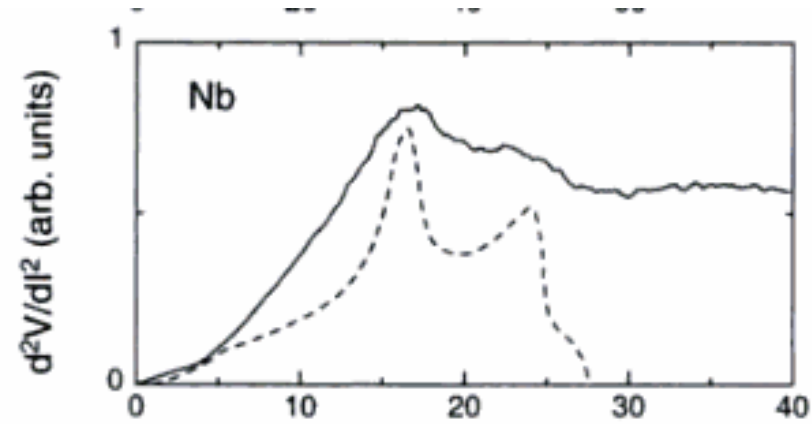
$$\Delta_{\text{Nb}} = 1.42 \text{ meV}$$

$$\lambda = 19 \text{ nm}$$

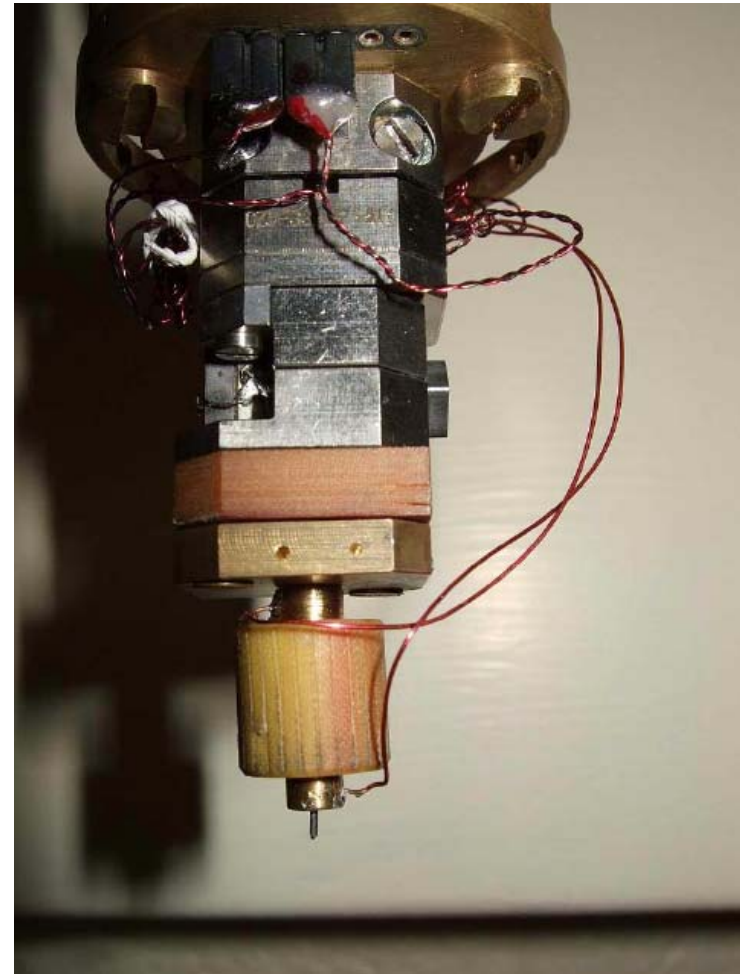
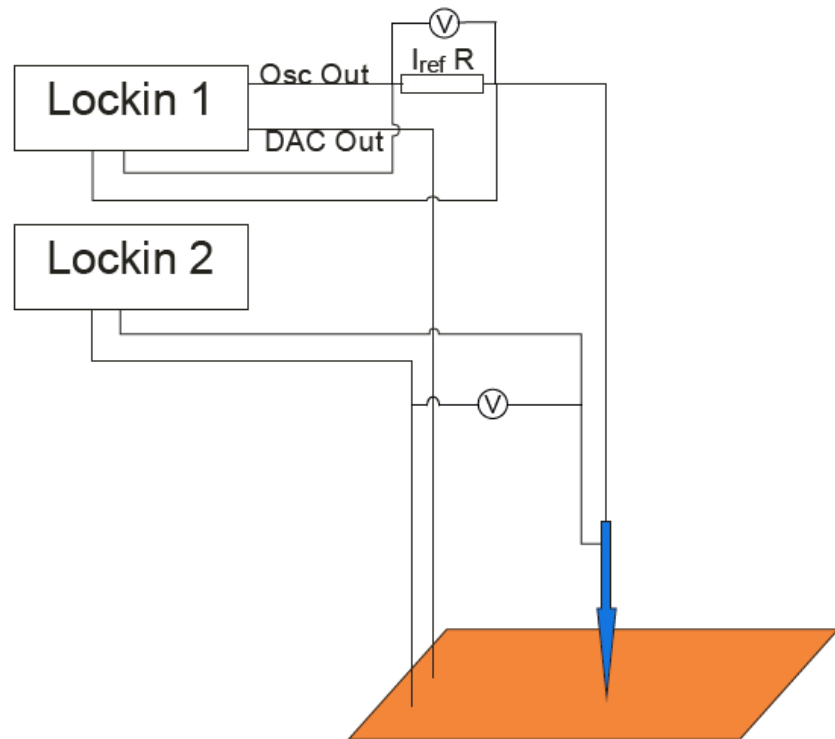
$$\rho = 6.1 \mu\Omega\text{cm}$$

$$d_{\text{Sharvin}} \sim 10 \text{ nm}$$

# And the phonon peaks?

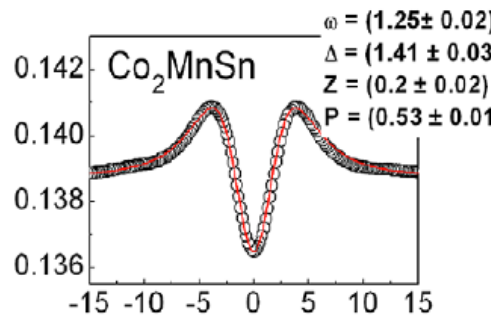
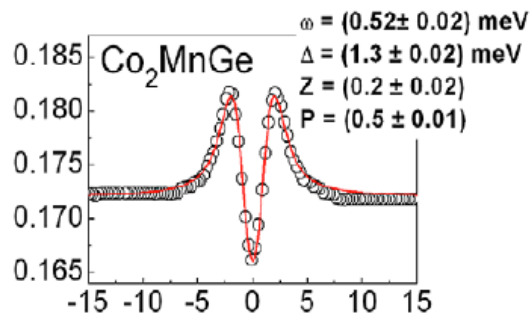
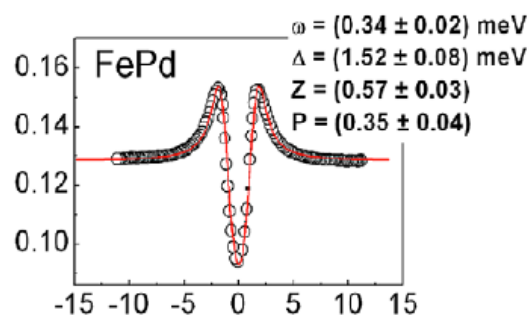
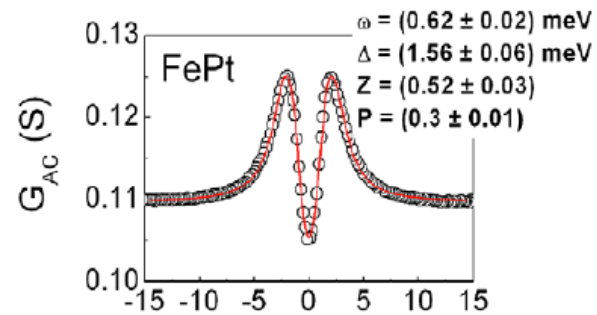
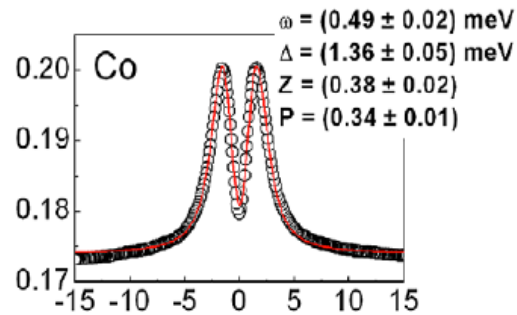
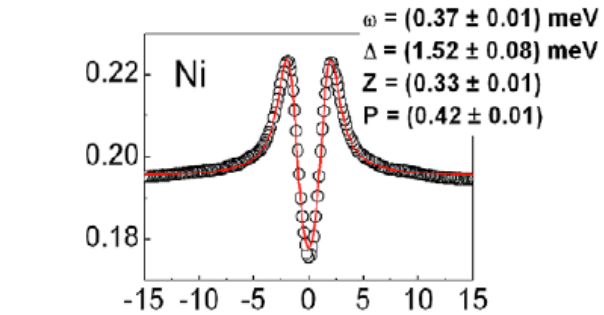


# Measurement setup

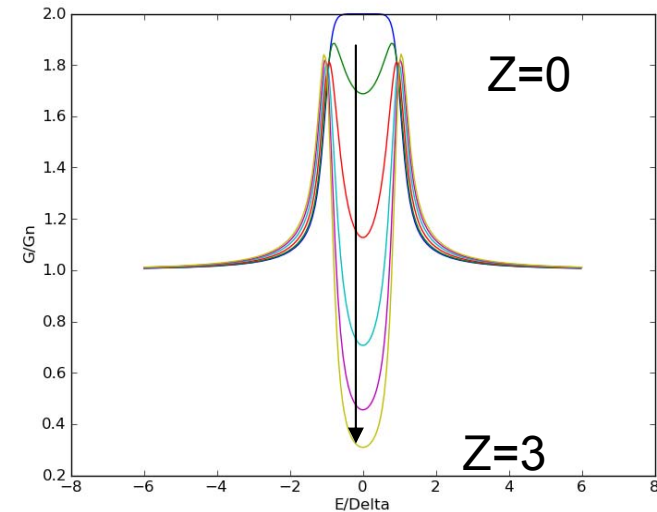
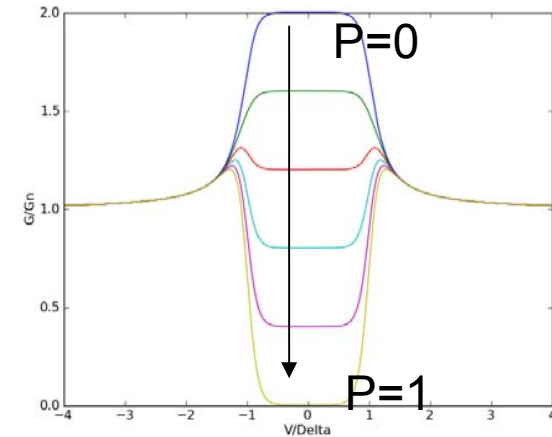




# Optimal spectra

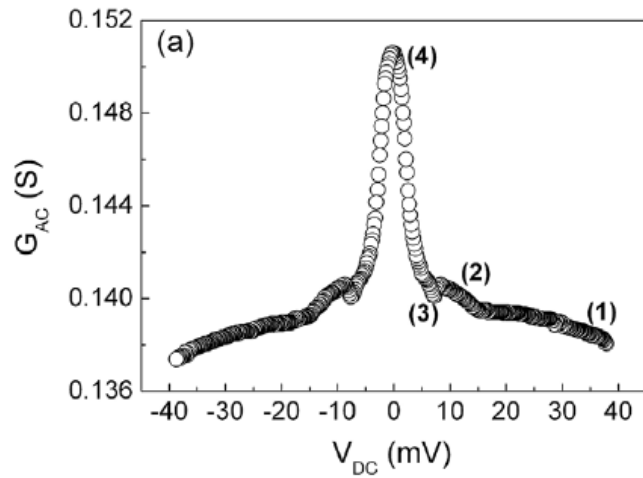


$V_{DC} \text{ (mV)}$

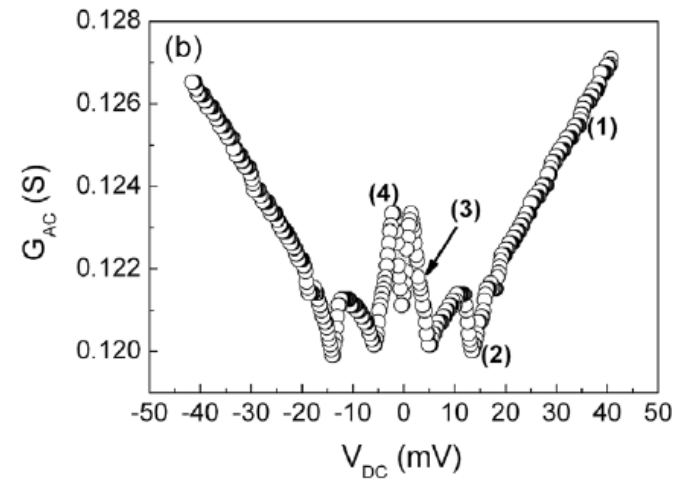


$T = 1.5\text{K}, \text{ gap} = 1.5\text{meV}$

# Conductance features



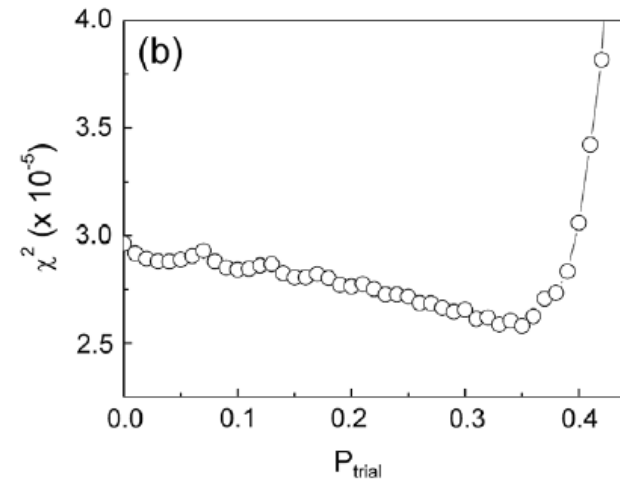
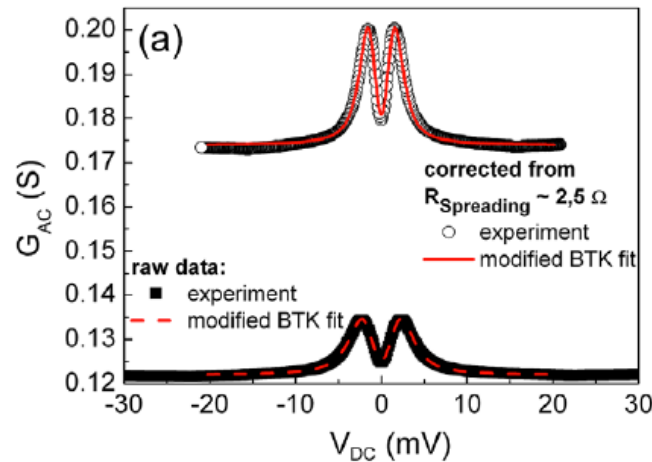
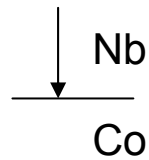
Nb  
↓  
Ni



Nb  
↓  
Au|Co<sub>2</sub>MnGe|V

# Spreading resistance

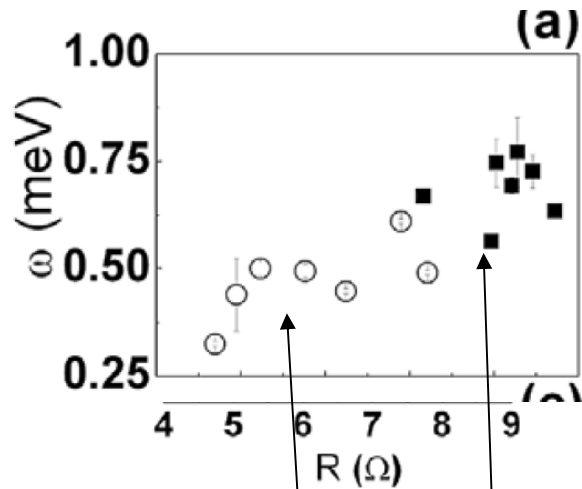
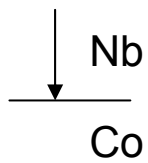
$$R_{pc} \sim R_{film}$$



position relative to the two electrode contacts to the nm. in this case the spreading resistance was estimated by rescaling the fitted gap from the raw data to the one that we have previously measured (section 2):  $\Delta_{Nb} G_{Corrected} = \Delta_{raw} G_{raw}$  and  $(1/G_{raw}) = (1/G_{Corrected} + R_{Spreading})$ , with  $G_{raw}$  the value of the raw conductance for  $eV = \Delta_{raw}$ . The red solid line

BTK model proposed in [4, 8]. The fitting parameters were  $\omega = (0.69 \pm 0.02)$  meV,  $\Delta = (1.83 \pm 0.02)$  meV,  $Z = (0.31 \pm 0.01)$ , and  $P = (0.41 \pm 0.01)$ . The red solid line is a fit to the corrected data. The fitting parameters were  $\omega = (0.49 \pm 0.02)$  meV,  $\Delta = (1.36 \pm 0.05)$  meV,  $Z = (0.38 \pm 0.02)$ , and  $P = (0.35 \pm 0.01)$ .

# Influence spreading resistance



Broadening due to thermal and a-thermal processes

- quasi-particle lifetime

- interface scattering ←

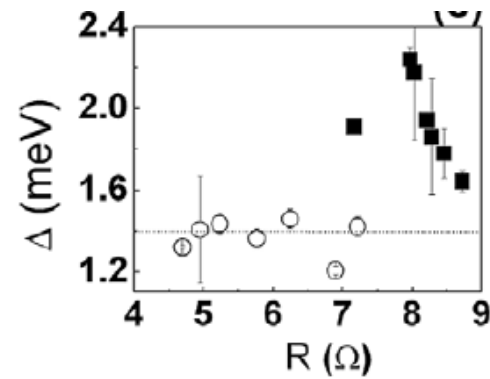
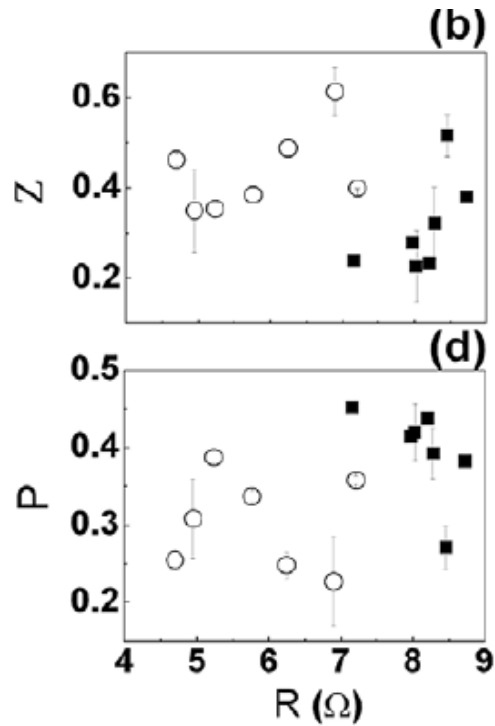
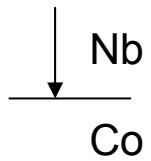
- deficiencies BTK

Contact resistance

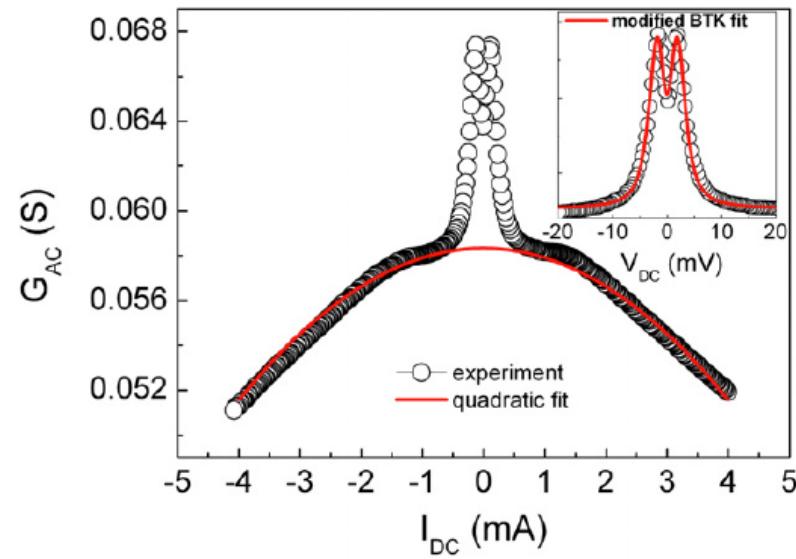
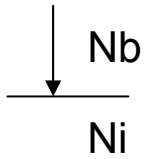
Raw data

Corrected data

# Influence spreading resistance



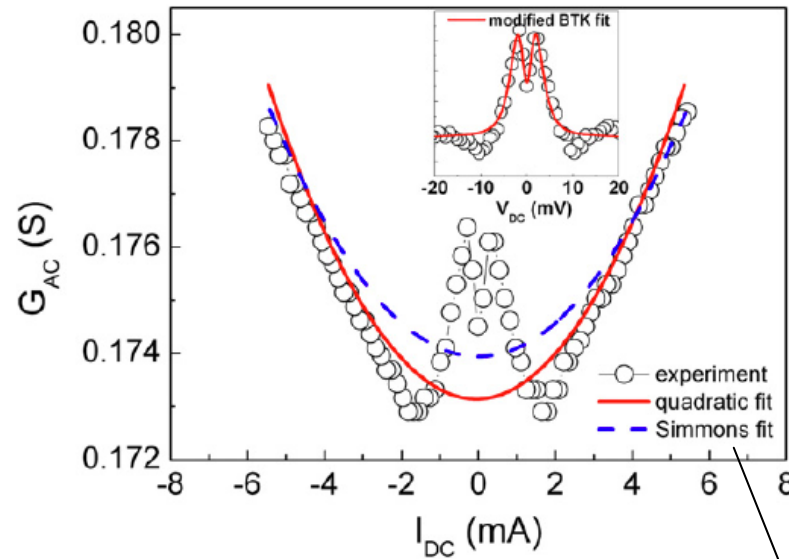
# Joule heating



$$P \propto \frac{1}{R_{pc}}$$
$$P \propto R_{film}$$

# Tunnel barriers

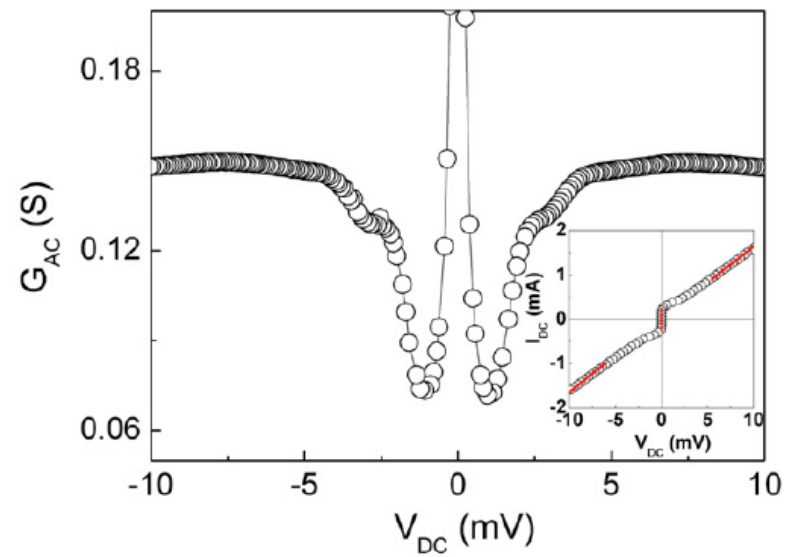
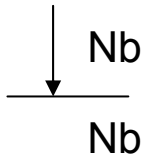
Nb  
↓  
Au|Co<sub>2</sub>MnGe|V



Oxidation of tip with  
NbO<sub>x</sub>/Nb<sub>2</sub>O<sub>5</sub>

in a set of implausible parameters: a barrier thickness of  $(2 \pm 3)$  nm, a barrier height of  $(0.1 \pm 3)$  meV and a contact area of  $(9.06 \pm 0.04) \times 10^{-8}$  m<sup>2</sup>.

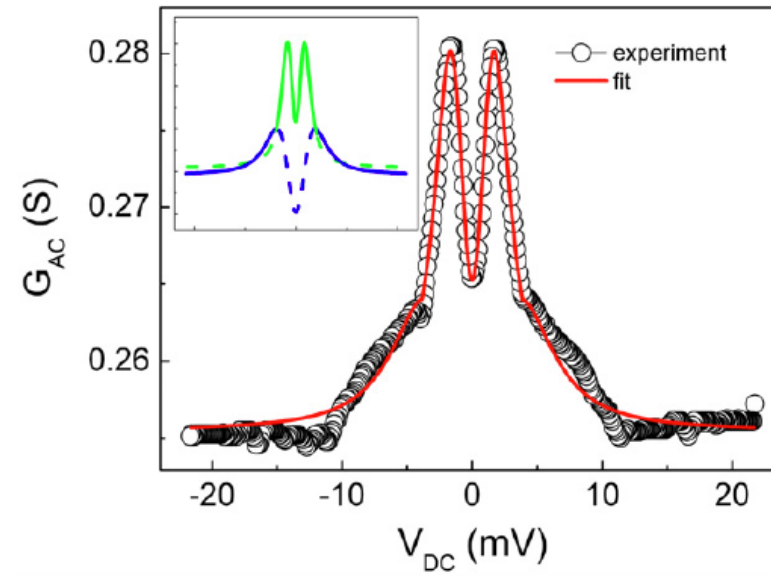
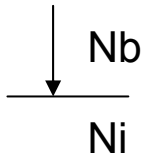
# Critical current



literature. They were ascribed to the finite resistance of the superconductor above the critical current when the contact is no longer in the ballistic limit. More detailed information on



# Multiple contacts



# Conclusion

- Lot of unwanted features in a pcs
- Possible explanations